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Contents

Corrigenda

★ **Corrigendum to Commission Recommendation (EU) 2021/2279 of 15 December 2021 on the use of the Environmental Footprint methods to measure and communicate the life cycle environmental performance of products and organisations** (OJ L 471, 30.12.2021) 1

EN

Acts whose titles are printed in light type are those relating to day-to-day management of agricultural matters, and are generally valid for a limited period.

The titles of all other acts are printed in bold type and preceded by an asterisk.

CORRIGENDA

Corrigendum to Commission Recommendation (EU) 2021/2279 of 15 December 2021 on the use of the Environmental Footprint methods to measure and communicate the life cycle environmental performance of products and organisations

(Official Journal of the European Union L 471 of 30 December 2021)

On page 1, the text of Commission Recommendation (EU) 2021/2279 is replaced as follows:

COMMISSION RECOMMENDATION (EU) 2021/2279

of 15 December 2021

on the use of the Environmental Footprint methods to measure and communicate the life cycle environmental performance of products and organisations

THE EUROPEAN COMMISSION,

Having regard to the Treaty on the Functioning of the European Union, and in particular Articles 191 and 292 thereof,

Whereas:

(1) Reliable and correct measurement and information on the environmental performance of products and organisations is an essential element in the environmental decision-making of a wide range of actors.

(2) The Product Environmental Footprint and Organisation Environmental Footprint methods (hereafter 'Environmental Footprint methods') enable companies to measure and communicate their environmental performance and thereby compete on the market based on reliable environmental information. They contain detailed instructions on how to model and calculate the environmental impacts of products and organisations. The Environmental Footprint methods build on existing, internationally accepted practices, indicators and rules.

(3) In 2013, the Commission adopted Commission Recommendation 2013/179/EU ([1]) to promote the use of common methods to measure and communicate the life cycle environmental performance of products and organisations. It recommends their use to Member States, companies, private organisations and the financial community, and contains two annexes establishing the proposed methods.

(4) The Commission established a framework for developing further the Environmental Footprint methods with the participation of a wide range of stakeholders, including industry, and particularly SMEs, through a pilot phase.

(5) In the pilot phase running from 2013 to 2018, the development of product-specific rules (Product Environmental Footprint Category Rules, PEFCRs) and sector-specific rules (Organisation Environmental Footprint Sector Rules, OEFSRs) was tested with the active participation of stakeholders, resulting in the finalisation of 19 PEFCRs and 2 OEFSRs.

(6) The Environmental Footprint methods were also updated on several technical aspects, such as: (1) application of the materiality principle ('*act where it matters*'); (2) the definition of a benchmark corresponding to the Environmental Footprint profile of the average production the market, also called representative product / organisation; (3) agreements on the modelling of key aspects concerning climate change, electricity, transport, infrastructure & equipment, packaging, end-of-life and agriculture; (4) inclusion of normalisation and weighting; (5) guidelines on how to include biodiversity as additional environmental information; (6) improvement of some impact assessment methods, with particular attention to the toxicity-related methods (human toxicity – cancer effects; human toxicity – non-cancer effects; eco-toxicity freshwater, water use, land use, resources and particulate matter); (7) defining characterisation factors based on REACH data; (8) and a guide on Environmental Footprint compliant datasets.

(7) The results of the pilot phase were presented in the 2019 Commission Staff Working Document on 'Sustainable Products in a Circular Economy – Towards an EU Product Policy Framework contribution to the Circular Economy' ([2]). The same staff working document also indicated possible uses of the Environmental Footprint methods in policy development at EU level. Since 2019, and following a call of interest addressed to industry, the Commission continued the development of new Product Environmental Footprint Category Rules.

([1]) Commission Recommendation 2013/179/EU of 9 April 2013 on the use of common methods to measure and communicate the life cycle environmental performance of products and organisations (OJ L 124, 4.5.2013, p. 1).

([2]) SWD(2019) 91final.

(8) The Council Conclusions of October 2019 ([3]) welcomed the piloting of the EU Environmental Footprint methodology and all initiatives to support the communication of environmental impacts based on the Environmental Footprint pilot.

(9) The European Green Deal ([4]) aims to mobilise industries for a clean and circular economy and underlines that to enable buyers to make more sustainable decisions and reduce the risk of 'green washing', reliable, comparable and verifiable information is needed.

(10) In its Communication 'A new Circular Economy Action Plan – For a cleaner and more competitive Europe' ([5]), the Commission highlighted that companies should substantiate their environmental claims using Product and Organisation Environmental Footprint methods and committed to test the integration of these methods in the EU Ecolabel.

(11) The Communication on a 'New Consumer Agenda – Strengthening consumer resilience for sustainable recovery' ([6]) indicates that to stimulate more voluntary corporate action, the Commission plans to work with economic operators to encourage their voluntary pledges to disclose to consumers the company's environmental footprint, improve their sustainability and reduce the impact on the environment.

(12) The Council Conclusions of December 2020 noted that the Product Environmental Footprint method has the potential of being one underlying methodology for various product policy tools in the EU and the framework for sustainable products, taking also other suitable methodologies into account.

(13) The use of the Environmental Footprint methods is already foreseen in the context of EU policies and legislation such as the Taxonomy Regulation ([7]), the Sustainable Batteries Initiative ([8]) and the Green Consumption Pledge ([9]).

(14) In the light of these developments, Commission Recommendation 2013/179/EU should be updated to integrate the technical developments of the pilot phase, in particular the development of category and sector rules, and therefore provide a sound basis for further policy development and implementation. It should facilitate companies to calculate their environmental performance based on reliable, verifiable and comparable information, and for other actors (public administrations, NGOs, business partners, for example) to have access to such information. It should also enhance the development of an EU Environmental Footprint database.

(15) SMEs might lack the expertise and resources to address the requests for life cycle environmental performance information. Therefore, support to SMEs should be provided not only by the Commission, but also by Member States and industrial associations.

(16) As new, internationally agreed approaches emerge, the Environmental Footprint methods are expected to be updated to integrate new indicators or modelling rules. These aspects are discussed in the Commission expert group on the Environmental Footprint Technical Advisory Board. Impacts related to biodiversity are for instance currently being considered.

(17) As announced in the new Circular Economy Action Plan, the Commission will explore the development of a regulatory framework for certification of carbon removals based on robust and transparent carbon accounting to monitor and verify the authenticity of carbon removals. This framework will be developed in mutual synergy and consistency with the environmental footprint method and when necessary be reflected in future updates of this Recommendation.

([3]) https://www.consilium.europa.eu/media/40928/st12791-en19.pdf
([4]) COM(2019) 640 final.
([5]) COM(2020) 98 final.
([6]) COM(2020) 696 final.
([7]) Regulation (EU) 2020/852 of the European Parliament and of the Council of 18 June 2020 on the establishment of a framework to facilitate sustainable investment, and amending Regulation (EU) 2019/2088 (OJ L 198, 22.6.2020, p. 13).
([8]) COM(2020) 798 final.
([9]) https://ec.europa.eu/info/sites/default/files/working_document_for_the_green_consumption_pledges_0.pdf

(18) While this recommendation focuses on environmental impacts, in the global context concerns related to economic and social impacts, including of labour practices, play an increasingly important role. The Commission will continue to closely follow these developments as well as methods of analysing environmental, social and economic supply chain impacts of products consumed in the EU that have effects along the supply chain in third countries.

(19) This Recommendation should replace the Commission Recommendation 2013/179/EU,

HAS ADOPTED THIS RECOMMENDATION:

1. **PURPOSE AND SCOPE**

1.1. This Recommendation promotes the use of the Environmental Footprint methods in relevant policies and schemes related to the measurement and/or communication of the life cycle environmental performance of all kinds of products, including both goods and services, and of organisations.

1.2. This Recommendation is addressed to Member States and to private and public organisations that measure or intend to measure the life cycle environmental performance of their product or of their organisation, and/or communicate or intend to communicate life cycle environmental performance information to any private, public and civil society stakeholder in the EU.

1.3. This Recommendation does not apply to the implementation of EU mandatory legislation that foresees a specific methodology for the calculation of the life cycle environmental performance of products or organisations. This Recommendation may however be referred to by EU legislation or policy as a method for the calculation of the life cycle environmental performance of products or organisations.

2. **DEFINITIONS**

For the purposes of this Recommendation, the following definitions apply:

(a) Product Environmental Footprint (hereinafter 'PEF') method: general method to measure and communicate the potential life cycle environmental impact of a product as laid down in Annex I.

(b) Organisation Environmental Footprint (hereinafter 'OEF') method: general method to measure and communicate the potential life cycle environmental impact of an organisation as laid down in Annex III.

(c) Product Environmental Footprint: result of a Product Environmental Footprint study based on the Product Environmental Footprint method.

(d) Organisation Environmental Footprint: result of an Organisation Environmental Footprint study based on the Organisation Environmental Footprint method.

(e) Product Environmental Footprint Category Rules (hereinafter '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. If a PEFCR exists, this should be used for calculating the environmental footprint of a product belonging to that product category.

(f) Organisation Environmental Footprint Sector Rules (hereinafter 'OEFSRs'): Sector-specific, life-cycle-based rules that complement general methodological guidance for OEF studies by providing further specification at the level of a specific sector. If an OEFSR exists, this should be used for calculating the environmental footprint of an organisation belonging to the sector.

(g) Life cycle environmental performance: quantified measurement of the potential environmental impacts taking all relevant life cycle stages of a product or organisation into account, from a supply chain perspective.

(h) Communication of life cycle environmental performance: any disclosure of life cycle environmental performance information, including to business partners, investors, public bodies or consumers.

(i) Organisation: a company, corporation, firm, enterprise, authority or institution, or part or combination thereof, whether incorporated or not, public or private, that has its own functions and administrations.

(j) Scheme: for-profit or not-for-profit initiative taken by private companies or an association thereof, by a public-private partnership, by governmental or by non-governmental organisations that requires the measurement or communication of life cycle environmental performance.

(k) Industrial association: organisation representing private companies that are members of the organisation or private companies belonging to a sector at local, regional national or international level.

(l) Financial community: all actors providing financial services (including financial advice), including banks, investors and insurance companies.

3. USE OF THE PEF AND OEF METHODS IN MEMBER STATES' POLICIES

Member States should:

3.1. Use the PEF method or the OEF method and related PEFCRs and OEFSRs in voluntary policies involving the measurement or communication of the life cycle environmental performance of products or organisations, as appropriate while ensuring that such policies do not create obstacles to the free movement of goods in the EU.

3.2. Consider life cycle environmental performance information or claims based on the use of the PEF method or the OEF method and related PEFCRs and OEFSRs as valid in relevant national schemes involving the measurement or communication of the life cycle environmental performance of products or organisations.

3.3. Make efforts to increase the availability of high quality life cycle data by setting up actions to develop, review and make available national databases and contributing to populating existing public databases, based on requirements for Environmental Footprint compliant datasets. Coherence between the different databases should be ensured between themselves..

3.4. Contribute to Commission efforts in the area of availability of high quality of EF compliant datasets.

3.5. Provide assistance and tools for SMEs to help them measure, improve and communicate the life cycle environmental performance of their products or organisation based on the PEF or the OEF method, on PEFCRs and OEFSRs. In doing so, authorities should avoid to duplicate existing tools, where these are fit for purpose.

3.6. Encourage the use of the OEF method and related OEFSRs, where applicable, for measuring or communicating the life cycle environmental performance of public organisations.

3.7. Promote and support the use of PEF and OEF methods at international level, including in multilateral forums or in relation to schemes on the measurement or communication of life cycle environmental performance. In doing so, authorities should consider providing assistance and tools to SMEs in EU partner countries for the measurement and improvement of the life-cycle environmental performance of any intermediate goods or semi-finished products they produce.

4. USE OF THE PEF AND OEF METHODS BY COMPANIES AND OTHER PRIVATE ORGANISATIONS

Companies and other private organisations deciding to measure or communicate the life cycle environmental performance of their products or organisation should:

4.1. Use the PEF method and the OEF method and related PEFCRs and OEFSRs for the measurement or communication of the life cycle environmental performance of their products or organisation.

4.2. Contribute to the review of public databases and populate these with high quality life cycle data in line with requirements on Environmental Footprint compliant datasets. Contribute to Commission efforts in the area of availability of high quality of EF compliant datasets.

4.3. Consider providing support to companies in their supply chains, especially SME, to provide information based on PEF and OEF or PEFCRs and OEFSRs and to improve their organisations' and their products' life cycle environmental performance.

Industrial associations should:

4.4. Promote the use of the PEF method and the OEF method and related PEFCRs and OEFSRs among their membership.

4.5. Contribute to the review of public databases and populate these with high quality life cycle data in line with the requirements on Environmental Footprint compliant datasets. Contribute to Commission efforts in the area of availability of high quality of EF compliant datasets.

4.6. Provide simplified calculation tools and expertise to help SME members calculate the life cycle environmental performance of their products or organisation based on the PEF method or the OEF method and related PEFCRs and OEFSRs.

4.7. Promote and support the use of PEF and OEF methods at international level, including in multilateral forums or in relation to schemes on the measurement or communication of life cycle environmental performance.

5. USE OF THE PEF AND OEF METHODS AND RELATED PEFCRS AND OEFSRS IN SCHEMES RELATED TO THE MEASUREMENT OR COMMUNICATION OF LIFE CYCLE ENVIRONMENTAL PERFORMANCE

5.1 Schemes related to the measurement or communication of life cycle environmental performance should use the PEF method and the OEF method and related PEFCRs/OEFSRs as a reference method for the measurement or communication of the life cycle environmental performance of products and organisations.

6. USE OF THE PEF AND OEF METHODS AND RELATED PEFCRS/OEFSRS BY THE FINANCIAL COMMUNITY

Members of the financial community should, if appropriate:

6.1. Promote the use of life cycle environmental performance information calculated on the basis of the PEF method or the OEF method and related PEFCRs and OEFSRs in the assessment of financial risk related to life cycle environmental performance.

6.2. Promote the use of information based on OEF studies in their assessment of performance levels for the environmental component of sustainability indices.

6.3. Promote and support the use of PEF and OEF methods at international level, including in multilateral forums or in relation to schemes on the measurement or communication of life cycle environmental performance.

7. VERIFICATION

7.1. If PEF and OEF studies are disclosed to third parties, the studies should be verified according to the requirements of the PEF and OEF methods and any specific indications in PEFCRs and OEFSRs.

8. REPORTING ON THE IMPLEMENTATION OF THE RECOMMENDATION

8.1. Member States are invited to inform the Commission of actions taken in light of this Recommendation on a yearly basis. The first provision of information should be transmitted one year after the adoption of this Recommendation. Information transmitted should include:

(a) how the PEF method and the OEF method and related PEFCRs/OEFSRs are used in policy initiative(s);

(b) number of products and organisations covered by the initiative;

(c) incentives related to life cycle environmental performance;

(d) initiatives related to the development of high quality life cycle data;

(e) assistance provided to SMEs in the provision of life cycle environmental information and in improving their life cycle environmental performance;

(f) eventual problems or bottlenecks identified with the use of the methods.

9. REPEALING OF PREVIOUS RECOMMENDATION

Commission Recommendation 2013/179/EU is hereby repealed. References to the repealed Recommendation shall be construed as references to the present Recommendation.

Done at Brussels, 15 December 2021.

For the Commission
Virginijus SINKEVIČIUS
Member of the Commission

ANNEX I

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Abbreviations

ADEME	Agence de l'Environnement et de la Maîtrise de l'Energie
AF	allocation factor
AR	allocation ratio
B2B	business to business
B2C	business to consumer
BoC	bill of components
BoM	bill of materials
BP	best practice
BSI	British Standards Institution
CF	characterization factor
CFCs	chlorofluorocarbons
CFF	Circular Footprint Formula
CPA	Classification of Products by Activity
DC	distribution centre
DMI	dry matter intake
DNM	Data Needs Matrix
DQR	Data Quality Rating
EC	European Commission
EF	environmental footprint
EI	environmental impact
EMAS	Eco-Management and Audit Scheme
EMS	Environmental Management Systems
EoL	end of life
EPD	Environmental Product Declaration
FU	functional unit
GE	gross energy intake
GHG	greenhouse gas

GR	geographical representativeness
GRI	Global Reporting Initiative
GWP	global warming potential
ILCD	International Reference Life Cycle Data System
ILCD-EL	International Reference Life Cycle Data System – Entry Level
IPCC	Intergovernmental Panel on Climate Change
ISIC	international standard industrial classification
ISO	International Organisation for Standardisation
IUCN	International Union for Conservation of Nature and Natural Resources
JRC	Joint Research Centre
LCA	life cycle assessment
LCDN	Life Cycle Data Network
LCI	life cycle inventory
LCIA	life cycle impact assessment
LCT	life cycle thinking
LT	lifetime
NACE	Nomenclature Générale des Activités Economiques dans les Communautés Européennes
NDA	non-disclosure agreement
NGO	non-governmental organisation
NMVOC	non-methane volatile compounds
OEFSR	organization environmental footprint sectorial rules
P	precision
PAS	publicly available specification
PCR	product category rules
PEF	product environmental footprint
PEFCR	product environmental footprint category rules
PEF-RP	PEF study of the representative product
RF	reference flow
RP	representative product
SB	system boundary
SMRS	sustainability measurement & reporting system
SS	supporting study
TeR	technological representativeness
TiR	time representativeness
TS	Technical Secretariat
UNEP	United Nations Environment Programme
UUID	Universally Unique Identifier
WBCSD	World Business Council for Sustainable Development
WRI	World Resources Institute

Terminology: shall, should, may

This Annex I uses precise terminology to indicate the requirements, the recommendations and options that companies may choose.

The term "**shall**" indicates what is required for a PEF study to be compliant with this method.

The term "**should**" indicates a recommendation rather than a requirement. Any deviation from a "should" recommendation must be justified by the party conducting the study and made transparent.

The term "**may**" indicates an option that is permissible

Definitions

Activity data - information which is associated with processes while modelling Life Cycle Inventories (LCI). The aggregated LCI results of the process chains, which 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.

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.

Synonym of 'non-elementary flow'.

Acidification – EF impact category that addresses impacts due to acidifying substances in the environment. Emissions of NO_x, NH_3 and SO_x lead to releases of hydrogen ions (H^+) when the gases are mineralised. The protons contribute to the acidification of soils and water when they are released in areas where the buffering capacity is low, resulting in forest decline and lake acidification.

Additional environmental information – environmental information outside the EF impact categories that is calculated and communicated alongside PEF results.

Additional technical information – non-environmental information that is calculated and communicated alongside PEF results.

Aggregated dataset - complete or partial life cycle of a product system that – next to the elementary flows (and possibly not relevant amounts of waste flows and radioactive wastes) – itemises only the product(s) of the process as reference flow(s) in the input/output list, but no other goods or services.

Aggregated datasets are also called 'LCI results' datasets. The aggregated dataset may have been aggregated horizontally and/or vertically.

Allocation – an approach to solving multi-functionality problems. It refers to 'partitioning the input or output flows of a process or a product system between the product system under study and one or more other product systems'.

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

Attributional – process-based modelling intended to provide a static representation of average conditions, excluding market-mediated effects.

Average Data – production-weighted average of specific data.

Background processes – refers to those processes in the product life cycle for which no direct access to information is possible. For example, most of the upstream life-cycle processes and generally all processes further downstream will be considered part of the background processes.

Benchmark – a standard or point of reference against which any comparison may 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.

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

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 the product in scope of the PEF study. In some sectors it is equivalent to the bill of components.

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.

Characterisation – calculation of the magnitude of the contribution of each classified input/output to their respective EF impact categories, and aggregation of contributions within each category.

This requires a linear multiplication of the inventory data with characterisation factors for each substance and EF impact category of concern. For example, with respect to the EF impact category 'climate change', the reference substance is CO_2 and the reference unit is kg CO_2-equivalents.

Characterisation factor – factor derived from a characterisation model which is applied to convert an assigned life cycle inventory result to the common unit of the EF impact category indicator.

Classification – assigning the material/energy inputs and outputs tabulated in the life cycle inventory to EF impact categories, according to each substance's potential to contribute to each of the EF impact categories considered.

Climate change – EF impact category considering all inputs and outputs that result in greenhouse gas (GHG) emissions. The consequences include increased average global temperatures and sudden regional climatic changes.

Co-function - any of two or more functions resulting from the same unit process or product system.

Commissioner of the EF study - organisation (or group of organisations), such as a commercial company or non-profit organisation, that finances the EF study in accordance with the PEF method and the relevant PEFCR, if available.

Company-specific data – refers to directly measured or collected data from one or more facilities (site-specific data) that are representative for the activities of the company (company is used as synonym of organisation). It is synonymous to 'primary data'. To determine the level of representativeness a sampling procedure may be applied.

Company-specific dataset – refers to a dataset (disaggregated or aggregated) compiled with company-specific data. In most cases the activity data is company-specific while the underlying sub-processes are datasets derived from background databases.

Comparative assertion – an environmental claim regarding the superiority or equivalence of one product versus a competing product that performs the same function (including the benchmark of the product category).

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.

Consumer – an individual member of the general public purchasing or using goods, property or services for private purposes.

Co-product – any of two or more products resulting from the same unit process or product system.

Cradle to gate – a partial product supply chain, from the extraction of raw materials (cradle) up to the manufacturer's 'gate'. The distribution, storage, use stage and end of life stages of the supply chain are omitted.

Cradle to grave – a product's life cycle that includes raw material extraction, processing, distribution, storage, use, and disposal or recycling stages. All relevant inputs and outputs are considered for all of the stages of the life cycle.

Critical review – process intended to ensure consistency between a PEFCR and the principles and requirements of the PEF method.

Data quality – characteristics of data that relate to their ability to satisfy stated requirements. Data quality covers various aspects, such as technological, geographical and time-related representativeness, as well as completeness and precision of the inventory data.

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.

Delayed emissions – emissions that are released over time, e.g. through long use or final disposal stages, versus a single emission at time t.

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

Direct land use change (dLUC) – the transformation from one land use type into another, which takes place in a unique land area and does not lead to a change in another system.

Directly attributable – refers to a process, activity or impact occurring within the defined system boundary.

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

Downstream – occurring along a product supply chain after the point of referral.

Ecotoxicity, freshwater – EF impact category that addresses the toxic impacts on an ecosystem, which damage individual species and change the structure and function of the ecosystem. Ecotoxicity is a result of a variety of different toxicological mechanisms caused by the release of substances with a direct effect on the health of the ecosystem.

EF communication vehicles – all the possible ways that may be used to communicate the results of the EF study to the stakeholders (e.g. labels, environmental product declarations, green claims, websites, infographics, etc.).

EF-compliant dataset – dataset developed in compliance with the EF requirements, regularly updated by DG JRC ([2]).

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

Elementary flows – in the life cycle inventory, elementary flows include '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'.

Elementary flows include, for example, resources taken from nature or emissions into air, water, soil that are directly linked to the characterisation factors of the EF impact categories.

Environmental aspect – element of an organisation's activities or products or services that interacts or can interact with the environment.

Environmental footprint (EF) impact assessment – phase of the PEF analysis aimed at understanding and evaluating the magnitude and significance of the potential environmental impacts for a product system throughout the life cycle of the product. The impact assessment methods provide impact characterisation factors for elementary flows, to aggregate the impact so as to obtain a limited number of midpoint indicators.

Environmental footprint (EF) impact assessment method – protocol for converting life cycle inventory data into quantitative contributions to an environmental impact of concern.

([2]) https://eplca.jrc.ec.europa.eu/permalink/Guide_EF_DATA.pdf
([3]) https://ec.europa.eu/energy/intelligent/projects/en/projects/e-track-ii

Environmental footprint (EF) impact category – class of resource use or environmental impact to which the life cycle inventory data are related.

Environmental footprint (EF) impact category indicator – quantifiable representation of an EF impact category.

Environmental impact – any change to the environment, whether adverse or beneficial, that wholly or partially results from an organisation's activities, products or services.

Environmental mechanism – system of physical, chemical and biological processes for a given EF impact category linking the life cycle inventory results to EF category indicators.

Eutrophication – EF impact category related to nutrients (mainly nitrogen and phosphorus) from sewage outfalls and fertilised farmland that accelerate the growth of algae and other vegetation in water.

The degradation of organic material consumes oxygen, resulting in oxygen deficiency and, in some cases, fish death. Eutrophication translates the quantity of substances emitted into a common measure, expressed as the oxygen required for the degradation of dead biomass.

To assess the impacts due to eutrophication, three EF impact categories are used: eutrophication, terrestrial; eutrophication, freshwater; eutrophication, marine.

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

Extrapolated data – data from a given process that is used to represent a similar process for which data is not available, on the assumption that it is reasonably representative.

Flow diagram – schematic representation of the flows occurring during one or more process stages within the life cycle of the product being assessed.

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

Foreground processes – those processes in the product life cycle for which direct access to information is available. For example, the producer's site and other processes operated by the producer or its contractors (e.g. goods transport, head-office services, etc.).

Functional unit – defines the qualitative and quantitative aspects of the function(s) and/or service(s) provided by the product being evaluated. The functional unit definition answers the questions 'what?', 'how much?', 'how well?', and 'for how long?'.

Gate to gate – a partial product supply chain that includes only the processes carried out on a product within a specific organisation or site.

Gate to grave – a partial product supply chain that includes only the distribution, storage, use, and disposal or recycling stages.

Global warming potential (GWP) – An index measuring the radiative forcing of a unit mass of a given substance accumulated over a chosen time horizon. It is expressed in terms of a reference substance (for example, CO_2-equivalent units) and specified time horizon (e.g. GWP 20, GWP 100, GWP 500 – for 20, 100 and 500 years respectively).

By combining information on both radiative forcing (the energy flux caused by emission of the substance) and on the time it remains in the atmosphere, GWP gives a measure of a substance's capacity to influence the global average surface-air temperature and therefore subsequently influence various climate parameters and their effects, such as storm frequency and intensity, rainfall intensity and frequency of flooding, etc.

Horizontal averaging – the action of aggregating multiple unit process datasets or aggregated process datasets in which each provides the same reference flow, to create a new process dataset.

Human toxicity – cancer – EF impact category that accounts for adverse health effects on human beings caused by the intake of toxic substances through inhalation of air, food/water ingestion, penetration through the skin – insofar as they are related to cancer.

Human toxicity - non cancer – EF impact category that accounts for the adverse health effects on human beings caused by the intake of toxic substances through inhalation of air, food/water ingestion, penetration through the skin – insofar as they are related to non-cancer effects that are not caused by particulate matter/respiratory inorganics or ionising radiation.

Independent external expert – competent person, not employed in a full-time or part-time role by the commissioner of the EF study or the user of the EF method, and not involved in defining the scope or conducting the EF study.

Indirect land use change (iLUC) – this occurs when a demand for a certain land use leads to changes, outside the system boundary, i.e. in other land use types. These indirect effects may be mainly assessed by means of economic modelling of the demand for land or by modelling the relocation of activities on a global scale.

Input flows – product, material or energy flow that enters a unit process. Products and materials include raw materials, intermediate products and co-products.

Intermediate product – output form of a unit process that in turn is input to other unit processes which require further transformation within the system. An intermediate product is a product that requires further processing before it is saleable to the final consumer.

Ionising radiation, human health – EF impact category that accounts for the adverse health effects on human health caused by radioactive releases.

Land use – EF impact category related to use (occupation) and conversion (transformation) of land area by activities such as agriculture, forestry, roads, housing, mining, etc.

Land occupation considers the effects of the land use, the amount of area involved and the duration of its occupation (changes in soil quality multiplied by area and duration). Land transformation considers the extent of changes in land properties and the area affected (changes in soil quality multiplied by the area).

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

Life cycle – consecutive and interlinked stages of a product system, from raw material acquisition or generation from natural resources to final disposal.

Life cycle approach – takes into consideration the spectrum of resource flows and environmental interventions associated with a product from a supply-chain perspective, including all stages from raw material acquisition through processing, distribution, use, and end of life processes, and all relevant related environmental impacts (instead of focusing on a single issue).

Life cycle assessment (LCA) – compilation and evaluation of the inputs, outputs and the potential environmental impacts of a product system throughout its life cycle.

Life cycle impact assessment (LCIA) – phase of life cycle assessment that aims to understand and evaluate the magnitude and significance of the potential environmental impacts for a system throughout the life cycle.

The LCIA methods used provide impact characterisation factors for elementary flows to aggregate the impact, to obtain a limited number of midpoint and/or damage indicators.

Life cycle inventory (LCI) - the combined set of exchanges of elementary, waste and product flows in a LCI dataset.

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

Loading rate – ratio of actual load to the full load or capacity (e.g. mass or volume) that a vehicle carries per trip.

Material-specific – a generic aspect of a material. For example, the recycling rate of polyethylene terephthalate (PET).

Multi-functionality – if a process or facility provides more than one function, i.e. it delivers several goods and/or services ('co-products'), then it is 'multifunctional'. In these situations, all inputs and emissions linked to the process will be partitioned between the product of interest and the other co-products, according to clearly stated procedures.

Non-elementary (or complex) flows – in the life cycle inventory, non-elementary flows include all the inputs (e.g. electricity, materials, transport processes) and outputs (e.g. waste, by-products) in a system that need further modelling efforts to be transformed into elementary flows.

Synonym of 'activity data'.

Normalisation – after the characterisation step, normalisation is the step in which the life cycle impact assessment results are divided by normalisation factors that represent the overall inventory of a reference unit (e.g. a whole country or an average citizen).

Normalised life cycle impact assessment results express the relative shares of the impacts of the analysed system, in terms of the total contributions to each impact category per reference unit.

Displaying the normalised life cycle impact assessment results for the different impact topics next to each other shows which impact categories are affected most and least by the analysed system.

Normalised life cycle impact assessment results reflect only the contribution of the analysed system to the total impact potential, not the severity/relevance of the respective total impact. Normalised results are dimensionless, but not additive.

Organisation Environmental Footprint Sectorial Rules (OEFSRs) - sector specific, life-cycle based rules that complement general methodological guidance for OEF studies by providing further specification at the level of a specific sector.

OEFSRs help to shift the focus of the OEF 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 OEF method. Only the OEFSRs developed by or in cooperation with the European Commission, or adopted by the European Commission or as EU acts are recognised as in line with this method.

Output flows – product, material or energy flow that leaves a unit process. Products and materials include raw materials, intermediate products, co-products and releases. Output flows are also considered to cover elementary flows.

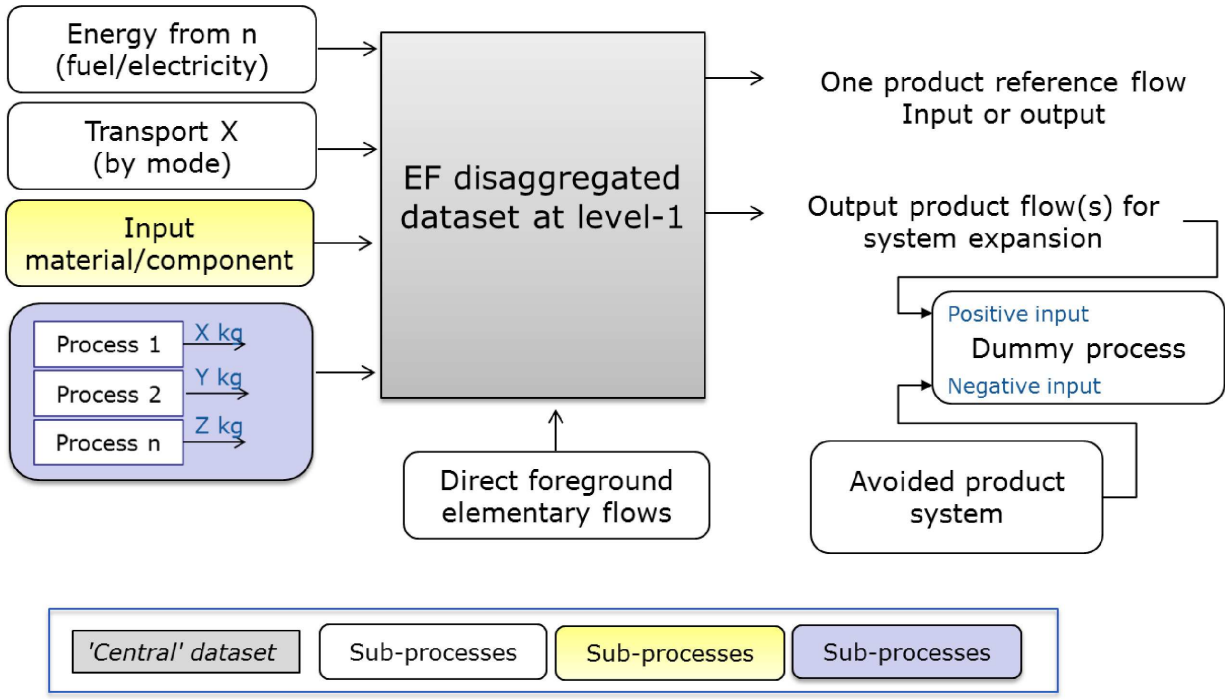
Ozone depletion – EF impact category that accounts for the degradation of stratospheric ozone due to emissions of ozone-depleting substances, for example long-lived chlorine and bromine containing gases (e.g. chlorofluorocarbons (CFCs), hydrochlorofluorocarbons (HCFCs), halons).

Partially disaggregated dataset - a dataset with an LCI that contains elementary flows and activity data, and that yields a complete aggregated LCI data set when combined with its complementing underlying datasets.

Partially disaggregated dataset at level-1 - a partially disaggregated dataset at level-1 contains elementary flows and activity data for one level down in the supply chain, while all complementing underlying datasets are in their aggregated form.

Figure 1

Example of dataset partially disaggregated at Level-1



Particulate matter – EF impact category that accounts for the adverse effects on human health caused by emissions of particulate matter (PM) and its precursors (NO_x, SO_x, NH_3).

PEFCR supporting study – PEF study based on 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 report.

PEF report – Document that summarises the results of the PEF study.

PEF study of the representative product (PEF-RP) – PEF study carried out on the representative product(s) and intended to identify the most relevant life cycle stages, processes, elementary flows, impact categories and any other major requirements needed for to define the benchmark for the product category/ sub-categories in scope of the PEFCR.

PEF study – term used to identify all the actions needed to calculate the PEF results. It includes the modelling, data collection and analysis of the results. PEF study results are the basis for drafting PEF reports.

Photochemical ozone formation – EF impact category that accounts for the formation of ozone at the ground level of the troposphere caused by photochemical oxidation of volatile organic compounds (VOCs) and carbon monoxide (CO) in the presence of nitrogen oxides (NO_x) and sunlight.

High concentrations of ground-level tropospheric ozone damage vegetation, human respiratory tracts and manmade materials, by reacting with organic materials.

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

Primary data – data from specific processes within the supply chain of the user of the PEF method or user of 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 user of the PEF method or user of the PEFCR.

In this method, primary data is a synonym of 'company-specific data' or 'supply chain specific data'.

Product – any good or service.

Product category – group of products (or services) that can fulfil equivalent functions.

Product category rules (PCRs) – set of specific rules, requirements and guidelines for developing Type III environmental declarations for one or more product categories.

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 for a specific product category.

PEFCRs help to shift the focus of the PEF study towards those aspects and parameters that matter most, and hence increase the relevance, reproducibility and consistency of the results by reducing costs, compared to a study based on the comprehensive requirements of the PEF method.

Only PEFCRs developed by or in cooperation with the European Commission, or adopted by the Commission or as EU acts, are recognised as being in line with this method.

Product flow – products entering from or leaving to another product system.

Product system – collection of unit processes with elementary and product flows, performing one or more defined functions, which model the life cycle of a product.

Raw material – primary or secondary material used to produce a product.

Reference flow – measure of the outputs from processes in a given product system required to fulfil the function expressed by the functional unit.

Refurbishment – the process of restoring components to a functional and/or satisfactory state compared 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.

Releases – emissions to air and discharges to water and soil.

Representative product (model) – this may be a real or virtual (non-existing) product. The virtual product should be calculated based on average European market sales-weighted characteristics for all existing technologies/materials covered by the product category or sub-category.

Other weighting sets may be used, if justified – for example weighted average based on mass (ton of material) or weighted average based on product units (pieces).

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 of which the sample is a subset.

Resource use, fossil – EF impact category that addresses the use of non-renewable fossil natural resources (e.g. natural gas, coal, oil).

Resource use, minerals and metals – EF impact category that addresses the use of non-renewable abiotic natural resources (minerals and metals).

Review – procedure intended to ensure that the process of developing or revising a PEFCR has been carried out in accordance with the requirements provided in the PEF method and part A of Annex II.

Review report - a documentation of the review process that includes the review statement, all relevant information about the review process, the detailed comments from the reviewer(s) and the corresponding responses, and the outcome. The document shall carry the electronic or handwritten signature of the reviewer (or the lead reviewer, if a reviewer panel is involved)

Review panel – team of experts (reviewers) who will review the PEFCR

Reviewer – independent external expert conducting the review of the PEFCR and possibly taking part in a reviewer panel.

Sample – 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 – data that is not from a specific process within the supply-chain of the company performing a PEF study.

This refers to data that is not directly collected, measured or estimated by the company, but rather sourced from a third party LCI database or other sources.

Secondary data includes industry average data (e.g., from published production data, government statistics and industry associations), literature studies, engineering studies and patents) and may also be based on financial data, and contain proxy and other generic data.

Primary data that go through a horizontal aggregation step are considered to be secondary data.

Sensitivity analysis – systematic procedures for estimating the effects of the choices made regarding methods and data on the results of a PEF study.

Site-specific data – directly measured or collected data from one facility (production site).

A synonym of 'primary data'.

Single overall score – sum of the weighted EF results of all environmental impact categories.

Specific data – directly measured or collected data representative of activities at a specific facility or set of facilities.

A synonym of 'primary data'.

Subdivision – subdividing involves disaggregating multifunctional processes or facilities to isolate the input flows directly associated with each process or facility output. The process is investigated to see whether it may be subdivided. Where subdivision is possible, inventory data should be collected only for those unit processes directly attributable to the products/services of concern.

Sub-population – 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.

A synonym of 'stratum'.

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

Sub-sample - a sample of a sub-population.

Supply chain – all of the upstream and downstream activities associated with the operations of the user of the PEF method, including the use of sold products by consumers and the end-of-life treatment of sold products after consumer use.

Supply chain-specific – refers to a specific aspect of a company's specific supply chain. For example, the recycled content of aluminium produced by a specific company.

System boundary – definition of aspects included or excluded from the study. For example, for a 'cradle-to-grave' EF analysis, the system boundary includes all activities ranging from the extraction of raw materials, through processing, distribution, storage and use, to the disposal or recycling stages.

System boundary diagram – graphic representation of the system boundary defined for the PEF study.

Temporary carbon storage – this happens when a product reduces the greenhouse gases in the atmosphere or creates negative emissions, by removing and storing carbon for a limited amount of time.

Type III environmental declaration – an environmental declaration providing quantified environmental data using predetermined parameters and, where relevant, additional environmental information.

Uncertainty analysis – procedure for assessing uncertainty in the results of a PEF study due to data variability and choice-related uncertainty.

Unit process – smallest element considered in the LCI for which input and output data are quantified.

Unit process, black box – process chain or plant-level unit process. This covers horizontally averaged unit processes across different sites. Also covers multi-functional unit processes where the different co-products undergo different processing steps within the black box, hence causing allocation problems for this dataset ([4]).

Unit process, single operation - unit operation type unit process that cannot be further subdivided. Covers multi-functional processes of the unit operation type ([5]).

Upstream – occurring along the supply chain of purchased goods/ services prior to entering the system boundary.

User of the PEFCR – stakeholder producing a PEF study based on a PEFCR.

User of the PEF method – stakeholder producing a PEF study based on the PEF method.

User of the PEF results – stakeholder using the PEF results for any internal or external purpose.

Validation – confirmation – by the environmental footprint verifier – that the information and data in the PEF study, PEF report and communication vehicles are reliable, credible and correct.

Validation statement – conclusive document aggregating the conclusions from the verifiers or the verification team regarding the EF study. This document is mandatory and shall carry the electronic or handwritten signature of the verifier or (where a verification panel is involved) the lead verifier.

Verification – conformity assessment process carried out by an environmental footprint verifier to demonstrate whether the PEF study has been carried out in compliance with Annex I

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 may be confidential. The document shall carry the electronic or handwritten signature of the verifier or (where a verification panel is involved) the lead verifier.

Verification team – team of verifiers who will verify the EF study, EF report and EF communication vehicles.

Verifier – independent external expert performing a verification of the EF study and possibly taking part in a verification team.

Vertical aggregation – technical or engineering-based aggregation refers to vertical aggregation of unit processes that are directly linked within a single facility or process train. Vertical aggregation involves combining unit process datasets (or aggregated process datasets) together, linked by a flow.

([4]) More details can be found in the Guide for EF-compliant datasets at https://eplca.jrc.ec.europa.eu/permalink/Guide_EF_DATA.pdf.
([5]) More details can be found in the Guide for EF-compliant datasets at https://eplca.jrc.ec.europa.eu/permalink/Guide_EF_DATA.pdf.

Waste – substances or objects which the holder intends (or is required) to dispose of.

Water use – EF impact category that represents the relative available water remaining per area in a watershed, after demand from humans and aquatic ecosystems has been met. It assesses the potential for water deprivation, to either humans or ecosystems, based on the assumption that the less water remaining available per area, the more likely it is that another user will be deprived.

Weighting – a step that supports the interpretation and communication of the analysis results. PEF results are multiplied by a set of weighting factors (in %), which reflect the perceived relative importance of the impact categories considered. Weighted EF results may be directly compared across impact categories, and also summed across impact categories to obtain a single overall score.

Relationship to other methods and standards

Each requirement specified in the PEF method was developed taking into consideration the recommendations of similar, widely recognised product environmental accounting methods and guidance documents.

Specifically, the methodological guides considered were:

ISO standards, in particular:

(a) EN ISO 14040:2006 Environmental management — Life cycle assessment — Principles and framework;

(b) EN ISO 14044:2006 Environmental management — Life cycle assessment — Requirements and guidelines;

(c) EN ISO 14067:2018 Greenhouse gases — Carbon footprint of products — Requirements and guidelines for quantification;

(d) ISO 14046:2014 Environmental management — Water footprint — Principles, requirements and guidelines;

(e) EN ISO 14020:2001 Environmental labels and declarations — General principles;

(f) EN ISO 14021:2016 Environmental labels and declarations — Self-declared environmental claims (Type II environmental labelling)

(g) EN ISO 14025:2010 Environmental labels and declarations – Type III environmental declarations – Principles and procedures;

(h) ISO 14050:2020 Environmental management — vocabulary

(i) CEN ISO/TS 14071:2016Environmental management — Life cycle assessment — Critical review processes and reviewer competencies: Additional requirements and guidelines to EN ISO 14044:2006

(j) ISO 17024:2012 Conformity assessment – General requirements for bodies operating certification of persons.

(k) PEF Guide, Annex to Commission Recommendation 2013/179/EU on the use of common methods to measure and communicate the life cycle environmental performance of products and organisations (April 2013);

(l) ILCD (International Reference Life Cycle Data System) Handbook ([6]) developed by EC Joint Research Centre;

(m) Ecological Footprint Standards ([7]);

(n) Greenhouse Gas Protocol - Product Life Cycle Accounting and Reporting Standard ([8]) (World Resources Institute - WRI/ World Business Council for Sustainable Development - WBCSD);

(o) BP X30-323-0:2015 General principles for an environmental communication on mass market products (Agence de la transition écologique, ADEME) ([9]);

([6]) Available online at http://eplca.jrc.ec.europa.eu/?page_id=86
([7]) Global Footprint Network Standards Committee (2009) Ecological Footprint Standards 2009.
([8]) WRI/WBCSD 2011, Greenhouse Gas Protocol – Product Life Cycle Accounting and Reporting Standard.
([9]) Withdrawn on May 2016.

(p) PAS 2050:2011 Specification for the assessment of the life cycle greenhouse gas emissions of goods and services (British Standards Institution - BSI);

(q) ENVIFOOD Protocol ([10]).

(r) FAO:2016. Environmental performance of animal feeds supply chains: Guidelines for assessment. LEAP Partnership.

A detailed description of most of the analysed methods and the outcome of the analysis is available in 'Analysis of Existing Environmental Footprint methodologies for Products and Organisations: Recommendations, Rationale, and Alignment' ([11]).

1. Product Environmental Footprint Category Rules (PEFCRs)

The primary objective of a PEFCR is to fix a consistent and specific set of rules for calculating the relevant environmental information of products belonging to the product category in scope. An important objective is to focus on what matters most for a specific product category, to make PEF studies easier, faster and less costly.

An equally important objective is to enable comparisons and comparative assertions in all cases where this is feasible, relevant and appropriate. Comparisons and comparative assertions are allowed only if PEF studies are conducted in compliance with a PEFCR. All PEF studies shall be conducted in compliance with a PEFCR, if a PEFCR is available for the product in scope.

Requirements for developing PEFCRs are specified in part A of Annex II. A PEFCR may further specify requirements made in the PEF method and add new requirements, if the PEF method leaves more than one choice. The objective is to ensure that PEFCRs are developed according to the PEF method and that they provide the specifications needed to achieve the comparability, increased reproducibility, consistency, relevance, focus and efficiency of PEF studies.

PEFCRs should, as far as possible, and recognising the different application contexts, be compliant with existing relevant international product category rules (PCR). If other PCRs are available from other schemes, these are to be listed and evaluated. They may be used as a basis for developing a PEFCR, in line with the requirements provided in Annex II.

1.1. *Approach and examples for potential applications*

The rules provided in the PEF method enable practitioners to conduct PEF studies that are more reproducible, consistent, robust, verifiable and comparable. The results of PEF studies are the basis for the provision of EF information and they may be used in a diverse number of potential fields of application.

Applications of PEF studies without an existing PEFCR for the product(s) in scope will include:

1) In-house applications

   a) optimising processes along the life cycle of a product,

   b) supporting environmental management,

   c) identifying environmental hotspots,

   d) supporting product design that minimises environmental impacts along the life cycle,

   e) environmental performance improvement and tracking,

2) External applications: (e.g. business to business (B2B), business to consumer (B2C)):

   a) applying or complying with policies referring to the PEF,

   b) responding to customers and consumers demands,

([10]) ENVIFOOD Protocol, Environmental Assessment of Food and Drink Protocol, European Food Sustainable Consumption and Production Round Table (SCP RT), Working Group 1, Brussels, Belgium

([11]) European Commission - Joint Research Centre - Institute for Environment and Sustainability (2011b). Analysis of Existing Environmental Footprint methodologies for Products and Organisations: Recommendations, Rationale, and Alignment. EC – IES - JRC, Ispra, November 2011.

c) marketing,

d) co-operation along supply chains to optimise the product along the life cycle,

e) participating in 3rd party schemes related to environmental claims or giving visibility to products that calculate and communicate their life cycle environmental performance.

Applications of PEF studies performed in compliance with an existing PEFCR for the product in scope, in addition to those listed above, will include:

— Comparisons and comparative assertions (i.e. claims of overall superiority or equivalence for the environmental performance of one product compared to another (based on EN ISO 14040:2006)) based on PEF studies,

— Comparison and comparative assertions against the benchmark of the product category, followed by a grading of other products according to their performance versus the benchmark,

— Identifying significant environmental impacts common to a product group,

— Reputational schemes giving visibility to products that calculate their life cycle environmental performance,

— Green procurement (public and corporate).

2. General considerations for Product Environmental Footprint (PEF) studies

2.1. *How to use this method*

This method provides the rules necessary to conduct a PEF study and is presented in a sequential manner, in the order of the methodological steps that shall be completed when calculating a PEF.

Where appropriate, sections begin with a general description of the methodological step, along with an overview of necessary considerations and supporting examples.

When additional requirements for creating PEFCRs are specified, these are available in Annex II.

2.2. *Principles for Product Environmental Footprint studies*

To perform a PEF study the following two requirements shall be met:

i) The bill of material (BoM) shall be specific of the product in scope,

ii) The modelling of the manufacturing processes shall be based on company-specific data (e.g. energy needed to assemble the materials/components of the product in scope).

Note: For companies producing more than one product, the activity data used (including the BoM) shall be specific to the product in scope of the study.

To produce reliable, reproducible, and verifiable PEF studies, a core suite of analytical principles shall be adhered to. These principles provide overarching guidance on how to apply the PEF method. They shall be considered with respect to each phase of PEF studies, from defining the goal and the scope, through data collection, impact assessment, reporting and verification of study outcomes.

Users of this method shall observe the following principles in conducting a PEF study:

(1) Relevance

All methods used and data collected for the purpose of quantifying the PEF shall be as relevant to the study as possible.

(2) Completeness

Quantification of the PEF shall include all environmentally relevant material/energy flows and other environmental interventions as required for adherence to the defined system boundary, the data requirements, and the impact assessment methods employed.

(3) Consistency

Strict conformity to this method shall be observed in all steps of the PEF study, to ensure internal consistency and comparability.

(4) Accuracy

All reasonable effort shall be taken to reduce uncertainties in product system modelling and the reporting of results.

(5) Transparency

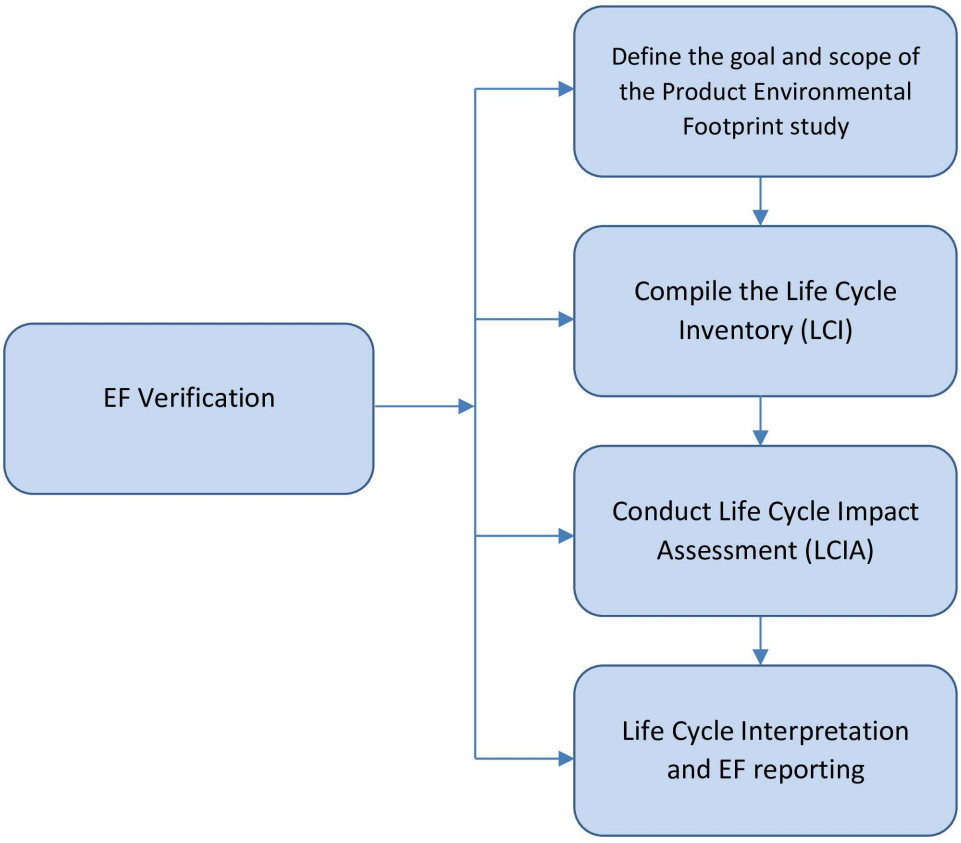
PEF information shall be disclosed in such a way as to provide intended users with the necessary basis for decision-making, and for stakeholders to assess its robustness and reliability.

2.3. *Phases of a Product Environmental Footprint study*

A number of phases shall be completed in carrying out a PEF study in line with this method - i.e. goal definition, scope definition, life cycle inventory (LCI), life cycle impact assessment (LCIA), interpretation of PEF results and PEF reporting – see Figure 2.

Figure 2

Phases of a Product Environmental Footprint study



In the goal definition phase, the aims of the study are defined, namely the intended application, the reasons for carrying out the study and the intended audience. In the scope definition phase, the main methodological choices are made, for example the exact definition of the functional unit, identifying the system boundary, selecting additional environmental and technical information, and the main assumptions and limitations.

The LCI phase involves the data collection procedure and the calculation procedure for quantifying of inputs and outputs of the studied system. Inputs and outputs concern energy, raw material and other physical inputs, products and co-products and waste, and emissions to air/water/soil. Data collected concern foreground processes and background processes. Data are put in relationship to the process units and functional unit. The LCI is an iterative process. In fact, as data are collected and more is learned about the system, new data requirements or limitations may be identified that require a change in the data collection procedures so the goals of the study will still be met.

In the impact assessment phase, LCI results are associated with environmental impact categories and indicators. This is done through LCIA methods, which first classify emissions into impact categories and then characterise them as common units (e.g. CO_2 and CH_4 emissions are both expressed in CO_2 equivalent emissions by using their global warming potential). Examples of impact categories are climate change, acidification or resource use.

In the interpretation phase, results from LCI and LCIA are interpreted in accordance with the stated goal and scope. In this phase, most relevant impact categories, life cycle stages, processes and elementary flows are identified. Conclusions and recommendations can be drawn, based on the analytical results. It also includes the reporting step designed to summarise the results of the PEF study in the PEF report.

Finally, during the verification phase a conformity assessment process is carried out, to check whether the PEF study has been carried out in compliance with the present PEF method. The verification is mandatory whenever the PEF study, or part of the information in it, is used for any type of external communication.

3. Defining the goal(s) and scope of the Product Environmental Footprint study

3.1. *Goal definition*

Goal definition is the first step of a PEF study, and sets the overall context for the study. The purpose of clearly defining goals is to ensure that the aims, methods, results and intended applications are aligned, and that a shared vision is in place to guide participants in the study.

The decision to use the PEF method implies that some aspects of the goal definition will be decided a priori, due to the specific requirements provided by the PEF method.

In defining goals, it is important to identify the intended applications and the degree of analytical depth and rigour of the study. This shall be reflected in the defined study limitations (scope definition phase).

The goal definition for a PEF study shall include:

1. Intended application(s);
2. Reasons for carrying out the study and decision context;
3. Target audience;
4. Commissioner of the study;
5. Identity of the verifier.

Table 1

Example of goal definition - Product Environmental Footprint of a T-shirt

Aspects	Detail
Intended application(s):	Provide product information to customer
Reasons for carrying out the study and decision context:	Respond to a request from a customer
Target audience:	External technical audience, business-to-business.

Verifier:	Independent external verifier, Mr Y
Commissioner of the study:	G company limited

3.2. *Scope definition*

The scope of the PEF study describes in detail the system to be evaluated and the technical specifications.

The scope definition shall be in line with the defined goals of the study and shall include (see subsequent sections for a more detailed description):

1. Functional unit and reference flow;
2. System boundary;
3. EF impact categories ([12]);
4. Additional information to be included;
5. Assumptions/limitations.

3.2.1 Functional unit and reference flow

The functional unit (FU) is the quantified performance of a product system, to be used as a reference unit. The functional unit qualitatively and quantitatively describes the function(s) and duration of the product in scope.

The reference flow is the amount of products needed to provide the defined function. All other input and output flows in the analysis quantitatively relate to it. The number of products needed to fulfil the lifetime of the product should always be rounded up, unless there is a valid reason for not doing this. The reference flow may be expressed in direct relation to the FU or in a more product-oriented way.

Users of the PEF method shall define the FU and the reference flow for the PEF study. They shall also describe which aspects of the product are not covered by the FU and justify why (e.g., because they are not quantifiable or intrinsically subjective).

The FU for a PEF study shall be defined according to the following aspects:

i) The function(s)/service(s) provided: '**what**';

ii) The extent of the function or service: '**how much**';

iii) The expected level of quality: '**how well**';

iv) The duration/life time of the product: '**how long**';

If shelf-life (indicated for example as 'best before date' or 'use by date') is provided on the packaging (e.g. number of months) of food products, then food losses at storage, retail, and consumer stages shall be quantified. If the type of packaging affects the shelf-life, it shall be taken into account. This is relevant for the 'how long' aspect of the FU.

If applicable standards exist, they shall be used and cited in the PEF study when defining the FU. The International System of Units (SI), commonly known as the metric system, shall always be used.

Example 1

Define the FU of decorative paint: the functional unit is to protect and decorate 1 m^2 of substrate for 50 years at a specified quality level (minimum 98% opacity).

What: Provide decoration and protection of a substrate,

How much: coverage of 1 m^2 of substrate,

How well: with a minimum 98% opacity

([12]) The term "EF impact category" will be used throughout this method in place of the term "impact category" that is used in EN ISO 14044:2006.

How long: for 50 years (life time of the building)

Reference flow: amount of product needed to fulfil the defined function, to be measured in kg of paint.

Example 2

Define the FU and reference flow for the PEF of pet food.

What: To serve the recommended daily intake in kilocalories of metabolisable energy (kcal ME) ('daily ration') of prepared pet food to a cat or dog

How much: Daily ration

How well: To meet the daily caloric and nutritional requirements of an average cat or dog (where average refers to the pet's weight: 4 kg for a cat and 15 kg for a dog)

How long: 1 day of serving prepared pet food to a cat or dog.

Reference flow: amount of product needed to fulfil the defined function, to be measured in grams (g) per day.

For intermediate products, the FU is more difficult to define as it may often fulfil multiple functions and the whole life cycle of the product is not known. Therefore, a declared unit should be applied, for example, mass (kilograms) or volume (cubic meters). In this case, the reference flow may correspond to the FU.

3.2.2. System boundary

The system boundary defines which parts of the product life cycle and which associated life cycle stages and processes belong to the analysed system (i.e. are required for carrying out its function as defined by the FU), except for those processes excluded based on the cut-off rule (see section 4.6.4). The reason for and potential significance of any exclusion shall be justified and documented.

The system boundary shall be defined following a general supply-chain logic, including all stages from raw material acquisition and pre-processing, production of the main product, product distribution and storage, use stage and end of life treatment of the product (if appropriate, see section 4.2). The co-products, by-products and waste streams of at least the foreground system shall be clearly identified.

System boundary diagram

A system boundary diagram (or flow diagram) is a schematic representation of the analysed system. It shall clearly indicate the activities or processes that are included and those that are excluded from the analysis. The user of the PEF method shall highlight where company-specific data were used.

The activity and/or process names in the system diagram and in the PEF report shall be aligned. The system diagram shall be included in the scope definition and included in the PEF report.

3.2.3. Environmental Footprint impact categories

The purpose of LCIA is to group and aggregate the collected LCI data according to the respective contributions to each EF impact category. The selection of EF impact categories covers a broad range of relevant environmental issues related to the product supply chain of interest, following the general completeness requirements for PEF studies.

EF impact categories ([13]) refer to specific categories of impacts considered in a PEF study and they constitute the EF impact assessment method. Characterisation models are used to quantify the environmental mechanism between the LCI (i.e. inputs (e.g. resources) and emissions associated with the product life cycle) and the category indicator of each EF impact category.

([13]) The term "EF impact category" is used throughout the PEF method in place of the term "impact category" used in EN ISO 14044:2006.

Table 2 provides a default list of EF impact categories and related assessment methods. For a PEF study, all EF impact categories shall be applied, without exclusion. The full list of CFs that shall be used is provided within the EF reference package ([14])

Table 2

EF impact categories with respective impact category indicators and characterisation models.

EF impact category	Impact category indicator	Unit	Characterisation model	Robust-ness
Climate change, total ([1])	Global warming potential (GWP100)	kg $CO_{2\ eq}$	Bern model - Global warming potentials (GWP) over a 100-year time horizon (based on IPCC 2013)	I
Ozone depletion	Ozone depletion potential (ODP)	kg CFC-11 $_{eq}$	EDIP model based on the ODPs of the World Meteorological Organisation (WMO) over an infinite time horizon (WMO 2014 + integrations)	I
Human toxicity, cancer	Comparative toxic unit for humans (CTU_h)	CTUh	based on USEtox2.1 model (Fantke et al. 2017), adapted as in Saouter et al., 2018	III
Human toxicity, non-cancer	Comparative toxic unit for humans (CTU_h)	CTUh	based on USEtox2.1 model (Fantke et al. 2017), adapted as in Saouter et al., 2018	III
Particulate matter	Impact on human health	Disease incidence	PM model (Fantke et al., 2016 in UNEP 2016)	I
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)	II
Photochemical ozone formation, human health	Tropospheric ozone concentration increase	kg NMVOC $_{eq}$	LOTOS-EUROS model (Van Zelm et al, 2008) as applied in ReCiPe 2008	II
Acidification	Accumulated exceedance (AE)	mol H^+ $_{eq}$	Accumulated exceedance (Seppälä et al. 2006, Posch et al, 2008)	II
Eutrophication, terrestrial	Accumulated exceedance (AE)	mol N $_{eq}$	Accumulated exceedance (Seppälä et al. 2006, Posch et al, 2008)	II
Eutrophication, freshwater	Fraction of nutrients reaching freshwater end compartment (P)	kg P $_{eq}$	EUTREND model (Struijs et al, 2009) as applied in ReCiPe	II
Eutrophication, marine	Fraction of nutrients reaching marine end compartment (N)	kg N $_{eq}$	EUTREND model (Struijs et al, 2009) as applied in ReCiPe	II

([14]) The EF reference package includes all information to perform the LCIA phase (in ILCD format). It includes reference items such as elementary flows, flow properties, unit groups, impact assessment methods etc. and is available at https://eplca.jrc.ec.europa.eu/LCDN/developerEF.xhtml

Ecotoxicity, freshwater	Comparative toxic unit for ecosystems (CTU_e)	CTUe	based on USEtox2.1 model (Fantke et al. 2017), adapted as in Saouter et al., 2018	III
Land use [2]	Soil quality index [3]	Dimension-less (pt)	Soil quality index based on LANCA model (De Laurentiis et al. 2019) and on the LANCA CF version 2.5 (Horn and Maier, 2018)	III
Water use	User deprivation potential (deprivation-weighted water consumption)	m^3 water eq of deprived water	Available WAter REmaining (AWARE) model (Boulay et al., 2018; UNEP 2016)	III
Resource use, minerals and metals	Abiotic resource depletion (ADP ultimate reserves)	kg Sb_{eq}	van Oers et al., 2002 as in CML 2002 method, v.4.8	III
Resource use, fossils	Abiotic resource depletion – fossil fuels (ADP-fossil) [4]	MJ	van Oers et al., 2002 as in CML 2002 method, v.4.8	III

[1] The indicator "Climate Change, total" is a combination of three sub-indicators: Climate change –Change fossil; Climate change –Change biogenic; Climate change – land use and land use change. The sub-indicators are further described in section 4.4.10 of Annex I. The sub-categories 'Climate change –fossil', 'Climate change – biogenic' and 'Climate change - land use and land use change' shall be reported separately, if they show a contribution of more than 5% each to the total score of climate change.

[2] Refers to occupation and transformation

[3] This index is the result of the aggregation, performed by JRC, of 4 indicators (biotic production, erosion resistance, mechanical filtration and groundwater replenishment) provided by the LANCA model for assessing impacts due to land use, as reported in De Laurentiis et al, 2019.

[4] In the EF flow list, and for the current recommendation, Uranium is included in the list of energy carriers, and it is measured in MJ.

Further information on impact assessment calculations is provided in section 5 of this Annex.

3.2.4. Additional information to be included in the PEF

Relevant potential environmental impacts of a product may go beyond the EF impact categories. It is important to report them, whenever feasible, as additional environmental information.

Similarly, relevant technical aspects and/or physical properties of the product in scope may need to be taken into account. These aspects shall be reported as additional technical information.

3.2.4.1. *Additional environmental information*

Additional environmental information shall be:

(a) In compliance with relevant legislation, for instance the Unfair Commercial Practices Directive (UCPD) [15] and related guidance;

(b) Relevant to the particular product or product category;

[15] The UCPD and related guidance is available at https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=LEGISSUM%3Al32011

(c) Additional to the EF impact categories: additional environmental information shall not reflect the same or similar EF impact categories, shall not substitute the characterisation models of the EF impact categories and shall not report results of new |characterisation factors (CFs) added to EF impact categories.

The supporting models for this additional information shall be clearly referenced and documented together with the corresponding indicators. For example, biodiversity impacts due to land use changes may occur in association with a specific site or activity. This may require the application of additional impact categories that are not included among the EF impact categories, or even additional qualitative descriptions, where impacts may not be linked to the product supply chain in a quantitative manner. Such additional methods should be viewed as complementary to the EF impact categories.

Additional environmental information shall only be related to environmental aspects. Information and instructions, e.g. product safety sheets that are not related to the environmental performance of the product, shall not be part of additional environmental information.

Additional environmental information may include:

(a) Information on local/site-specific impacts;

(b) Offsets;

(c) Environmental indicators or product responsibility indicators (e.g. as per the Global Reporting Initiative (GRI));

(d) For gate-to-gate assessments, number of IUCN (International Union for Conservation of Nature and Natural Resources) Red List species and national conservation list species with habitats in areas affected by operations, by level of extinction risk;

(e) Description of significant impacts of activities, products, and services on biodiversity in protected areas and in areas of high biodiversity value outside protected areas;

(f) Noise impacts;

(g) Other environmental information considered relevant within the scope of the PEF study.

Biodiversity

The PEF method does not include any impact category named 'biodiversity', as currently there is no international consensus on an LCIA method capturing that impact. However, the PEF method includes at least eight impact categories that have an effect on biodiversity (i.e., climate change, eutrophication (aquatic freshwater), eutrophication (aquatic marine), eutrophication (terrestrial), acidification, water use, land use, ecotoxicity freshwater).

Considering the high relevance of biodiversity for many product groups, each PEF study shall explain whether biodiversity is relevant for the product in scope. If that is the case, the user of the PEF method shall include biodiversity indicators under additional environmental information.

The following options may be used to cover biodiversity:

(a) expressing the (avoided) impact on biodiversity as the percentage of material that comes from ecosystems that have been managed to maintain or enhance conditions for biodiversity, as demonstrated by regular monitoring and reporting of biodiversity levels and gains or losses (e.g. less than 15% loss of species richness due to disturbance – though the PEF studies may set their own loss level, if they can make a convincing case for it and not in contradiction to a relevant existing PEFCR).

The assessment should refer to materials that end up in the final products and to materials that have been used during the production process. For example, charcoal that is used in steel production processes, or soy that is used to feed cows that produce dairy etc.

(b) To report, additionally, the percentage of such materials for which no chain of custody or traceability information can be found.

(c) To use a certification system as a proxy. The user of the PEF method should determine which certification schemes provide sufficient evidence for ensuring biodiversity maintenance and describe the criteria used.

The user of the PEF method may choose other, relevant indicators to cover the impacts of the product on biodiversity. The PEF study shall motivate the choice and describe the chosen methodology.

3.2.4.2. *Additional technical information*

Additional technical information may include (non-exhaustive list):

(a) Bill of materials data;

(b) Reversible disassembly, ease of assembly, reparability and other circular economy-related information;

(c) Information on the use of hazardous substances;

(d) Information on the disposal of hazardous/non-hazardous waste;

(e) Information on energy consumption;

(f) Technical parameters, such as the use of: renewable versus non-renewable energy; renewable versus non-renewable fuels; secondary materials; fresh water resources;

(g) Total weight of waste by type and disposal method;

(h) Weight of transported, imported, exported, or treated waste deemed hazardous under the terms of the Basel Convention ([16]) Annexes I, II, III, and VIII, and percentage of transported waste shipped internationally;

(i) Information and data related to the functional unit and technical performance of the product.

(j) Information on biodegradability and compostability;

When the product in scope is an intermediate product, additional technical information shall include:

(a) The biogenic carbon content at factory gate (physical content and allocated content);

(b) Recycled content (R_1);

(c) Results with application-specific A-values of the circular footprint formula (CFF), if relevant.

3.2.5. Assumptions/ limitations

In PEF studies, several limitations on carrying out the analysis may arise and therefore assumptions need to be made. All limitations (e.g. data gaps) and assumptions shall be transparently reported.

4. **Life cycle inventory**

An inventory of all material, energy and waste inputs and outputs and emissions into air, water and soil for the product supply chain shall be compiled as a basis for modelling the PEF.

Detailed data requirements and quality requirements are described in section 4.6.

The life cycle inventory (LCI) shall adopt the following classification of flows included:

1) elementary flows;

2) non-elementary (or complex) flows (e.g. product or waste flows).

([16]) OJ L 39, 16.2.1993, p. 3–22

Within the PEF study, all non-elementary flows in the LCI shall be modelled up to the level of elementary flows, apart from the product flow for the product in scope. For example, waste flows shall not only be included in the study as kg of household waste or hazardous waste, but shall be modelled up to the stage of emissions into water, air and soil, from the treatment of the solid waste. The LCI modelling is therefore only complete when all non-elementary flows are expressed as elementary flows. Therefore, the LCI dataset of the PEF study shall contain only elementary flows, apart from the product flow for the product in scope.

4.1. *Screening step*

An initial screening of the LCI – the 'screening step' – may be performed because it helps focus data collection activities and data quality priorities. A screening step shall include the LCIA phase and result in further, iterative refinements to the life cycle model for the product in scope, as more information becomes available. Within a screening step, no cut-off is allowed and readily available primary or secondary data may be used, fulfilling the data quality requirements to the extent possible (as defined in section 4.6). Once the screening is performed, the initial scope settings may be refined.

4.2. *Life cycle stages*

As a minimum, the default life cycle stages in a PEF study shall be:

1) raw material acquisition and pre-processing (including production of parts and components);

2) manufacturing (production of the main product);

3) distribution (product distribution and storage);

4) use;

5) end of life (including product recovery or recycling).

If a different name is used for any of these default stages, the user shall specify which default stage it corresponds to.

If there is valid need to do so, the user of the PEF method may decide to split or add life cycle stages. The reason(s) for doing this shall be set out in the PEF report. For example, the life cycle stage 'Raw material acquisition and pre-processing' may be split into 'Raw material acquisition', 'pre-processing', and 'raw materials supplier transport'.

For intermediate products, the following life cycle stages shall be excluded:

1) distribution (justified exceptions are allowed);

2) use;

3) end of life (including product, recovery / recycling)

4.2.1. Raw material acquisition and pre-processing

This life cycle stage starts when resources are extracted from nature, and ends when product components enter (through the gate of) the product's production facility. Examples of processes that may occur in this stage include:

1) mining and extraction of resources;

2) pre-processing of all material inputs to the product in scope, including recyclable materials;

3) agricultural and forestry activities;

4) transportation within and between extraction and pre-processing facilities, and to the production facility.

Packaging production shall be modelled as part of the 'Raw material acquisition and pre-processing' life cycle stage.

4.2.2. Manufacturing

The production stage begins when the product components enter the production site, and ends when the finished product leaves the production facility. Examples of production-related activities include:

1) chemical processing;

2) manufacturing;

3) transport of semi-finished products between manufacturing processes;

4) assembly of material components.

The waste of products used during manufacturing shall be included in the modelling for the manufacturing stage. The circular footprint formula (section 4.4.8) shall be applied to such waste.

4.2.3. Distribution

Products are distributed to users and may be stored at various points along the supply chain. The distribution stage includes transport from factory gate to warehouse/retail, storage at warehouse/retail and transport from warehouse/retail to consumer home.

Examples of processes to include:

1) energy inputs for warehouse lighting and heating;

2) use of refrigerants in warehouses and transport vehicles;

3) fuel use by vehicles;

4) roads and trucks.

Waste from products used during distribution and storage shall be included in the modelling. The circular footprint formula (section 4.4.8) shall be applied to such waste, and the results taken into consideration under the distribution stage.

Default loss rates per type of product during distribution and at the consumer are provided in part F of Annex II and shall be used if no specific information is available. Allocation rules on energy consumption at storage are presented in section 4.4.5. For transport, see section 4.4.3.

4.2.4. Use

The use stage describes how the product is expected to be used by the end user (e.g. the consumer). This stage starts the moment the end user uses the product until it leaves its place of use and enters the end of life (EoL) stage (e.g., recycling or final treatment).

The use stage includes all activities and products that are needed for proper use of the product (i.e. to ensure it performs its original function throughout its lifetime). Waste generated by using the product, such as food waste and its primary packaging or the product itself once no longer functional, is excluded from the use stage and shall be part of the EoL stage of the product.

Some examples include: the provision of tap water when cooking pasta; the manufacturing and distribution of, and waste from, materials needed for maintenance, repair or refurbishment (e.g. spare parts needed to repair the product, coolant production and waste management due to losses). The EoL of coffee capsules, residues for coffee making and packaging of ground coffee belong to the end of life stage.

In some cases, some products are needed for a proper use of the product in scope and they are used in a way that they become physically integrated: in this case, the waste treatment of these products belongs to the EoL of the product in scope. For example, when the product in scope is a detergent, the treatment of the wastewater following the use of the detergent belongs to the end of life stage.

The use scenario also needs to reflect whether or not the use of the analysed products might lead to changes in the systems in which they are used.

The following sources of technical information on the use scenario may be taken into account:

1) Market surveys or other market data;

2) Published international standards that specify guidance and requirements for developing scenarios for the use stage and scenarios for (i.e. estimation of) the service life of the product;

3) Published national guidelines for the development of scenarios for the use stage and scenarios for (i.e. estimation of) the service life of the product;

4) Published industry guidelines for developing scenarios for the use stage and scenarios for (i.e. estimation of) the service life of the product.

The manufacturer's recommended method to be applied in the use stage (e.g. cooking in an oven at a specified temperature for a specified time) should be used to provide a basis for determining the use stage of a product. The actual usage pattern may, however, differ from those recommended and should be used if this information is available and documented.

Default loss rates per type of product during distribution and at consumer are provided in part F of Annex II and shall be used if no specific information is available.

The following processes are excluded from the use stage:

1) If a product is reused (see also section 4.4.9.2), the processes needed to collect the product and make it ready for the new use cycle are excluded (e.g. the impacts from collection and cleaning reusable bottles). These processes are included in the EoL stage, if the product is reused as a product with different specifications (see section 4.4.9 for further details). If the product lifetime is extended to that of a product with original product specifications (providing the same function), these processes shall be included in the FU and reference flow.

2) Transport from retail to consumer home shall be excluded from the use stage and shall instead be included in the distribution stage.

3) The transport to EoL shall be excluded from the use stage and instead be included in the end of life stage.

Waste from products used during the use stage shall be included in the modelling for the use stage. The circular footprint formula (section 4.4.8) shall be applied to such waste.

The PEF report shall document the methods and assumptions used for this stage. All relevant assumptions for the use stage shall be documented.

Technical specifications for modelling the use stage are available in Section 4.4.7.

4.2.5. End of life (including product recovery and recycling)

The end of life stage begins when the product in scope and its packaging is discarded by the user and ends when the product in scope is returned to nature as a waste product or enters another product's life cycle (i.e. as a recycled input). In general this includes the waste from the product in scope, such as food waste and primary packaging.

Waste generated during the manufacturing, distribution, retail, use stage or after use shall be included in the life cycle of the product and modelled at the life cycle stage where it occurs.

The end of life stage shall be modelled using the circular footprint formula and requirements provided in section 4.4.8. The user of the PEF method shall include all EoL processes applicable to the product in scope. Examples of processes to be covered in this life cycle stage include:

1) Collection and transport of the product in scope and its packaging to end of life treatment facilities;

2) Dismantling of components;

3) Shredding and sorting;

4) Wastewater from products used, dissolved in or with water (e.g. detergents, shower gels, etc.);

5) Conversion into recycled material;

6) Composting or other organic-waste treatment methods;

7) Incineration and disposal of bottom ash;

8) Landfilling and landfill operation and maintenance.

For intermediate products, the EoL of the product in scope shall be excluded.

4.3. *Nomenclature for the life cycle inventory*

LCI data shall be compliant with EF requirements:

— For all elementary flows, the nomenclature shall be aligned with the most recent version of the EF reference package available on the EF developer's page ([17]).

— For the process datasets and product flow, the nomenclature shall be compliant with the 'ILCD Handbook – Nomenclature and other conventions' ([18]) .

4.4. *Modelling requirements*

This section provides detailed guidance and requirements on how to model specific life cycle stages, processes and other aspects of the product life cycle, to compile the LCI. Covered aspects include:

(a) agricultural production;

(b) electricity use;

(c) transport and logistics;

(d) capital goods (infrastructure and equipment);

(e) storage at distribution centre or retail;

(f) sampling procedure;

(g) use stage;

(h) end of life modelling;

(i) extended product lifetime;

(j) packaging;

(k) GHG emissions and removals;

(l) offsets;

(m) handling multi-functional processes;

(n) data collection requirements and quality requirements;

(o) cut-off.

4.4.1. Agricultural production

4.4.1.1. *Handling multi-functional processes*

The rules described in the LEAP Guideline shall be followed ([19]).

4.4.1.2. *Crop type specific and country, region or climate specific data*

Crop type specific and country/region/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, shall be used.

([17]) https://eplca.jrc.ec.europa.eu/LCDN/developerEF.xhtml
([18]) http://eplca.jrc.ec.europa.eu/repository/EF
([19]) Environmental performance of animal feed supply chains (pages 36-43), FAO 2016, available at http://www.fao.org/partnerships/leap/publications/en/

4.4.1.3. *Averaging data*

Cultivation data shall be collected over a period of time sufficient to provide an average assessment of the LCI associated with the inputs and outputs for crop growing that will offset fluctuations due to seasonal differences. This shall be undertaken as described in the LEAP guidelines, set out below:

(a) 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, etc.). 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 or plants grown in greenhouses shall be considered to be annual crops/ plants, unless the growth cycle is significantly less than a year and another crop is grown consecutively within that year. Tomatoes, peppers and other crops, which are grown and harvested over a longer period through the year, are considered to be annual crops.

(b) For perennial plants (including entire plants and edible portions of perennial plants), a steady state situation (i.e. where all development stages are proportionally represented in the studied time period) shall be assumed and a three-year period shall be used to estimate the inputs and outputs.

(c) Where the different stages in the growth cycle may be of differing durations, 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 corrections shall be explained and recorded in the PEF report. The LCI of perennial plants and crops shall not be undertaken until the production system actually yields output.

(d) For crops that are grown and harvested in less than one year (e.g. lettuce 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 may best be done by first gathering annual data and calculating the LCI per year and then determining the three-year average.

4.4.1.4. *Pesticides*

Pesticide emissions shall be modelled as specific active ingredients. The USEtox life cycle impact assessment method has a built-in multimedia fate model which simulates the fate of the pesticides, starting from the different emission compartments. Therefore, default emission fractions to environmental emission compartments are needed in the LCI modelling. The pesticides applied to the field shall be modelled as 90% emitted to the agricultural soil compartment, 9% emitted to air and 1% emitted to water (based on expert judgement, due to current limitations). More specific data may be used if available.

4.4.1.5. *Fertilisers*

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

(a) NH_3, to air (from the use of N-fertiliser);

(b) N_2O, to air (direct and indirect) (from the use of N-fertiliser);

(c) CO_2, to air (from the use of lime, urea and urea-compounds);

(d) NO_3, to water unspecified (leaching from the use of N-fertiliser);

(e) PO_4, to water unspecified or freshwater (leaching and run-off of soluble phosphate from the use of P-fertiliser);

(f) P, to water unspecified or freshwater (soil particles containing phosphorous, from the use of P-fertiliser).

The impact assessment model for freshwater eutrophication starts (i) when P leaves the agricultural field (run off) or (ii) from the application of manure or fertiliser on the agricultural field.

Within LCI modelling, the agricultural field (soil) is often seen as belonging to the technosphere and thus included in the LCI model. This aligns with approach (i), where the impact assessment model starts after run-off, i.e. when P leaves the agricultural field. Therefore, within the EF context, the LCI 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 to 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 and included in the CF for soil.

The impact assessment marine eutrophication starts after N leaves the field (soil). Therefore, N emissions to soil shall not be modelled. The amount of emissions ending up in the different air and water compartments per amount of fertilisers applied to the field shall be modelled within the LCI.

N emissions shall be calculated from nitrogen applications by the farmer to the field and excluding external sources (e.g. rain deposition). The number of emissions factors is fixed in the EF context by following a simplified approach. For N-fertilisers, the Tier 1 emissions factors of Table 2-4 of IPCC (2006) shall be used, as reproduced in Table 3, except when better data is available. If better data is available, a more comprehensive nitrogen field model may be used in the PEF study, provided (i) it covers at least the emissions requested above, (ii) N is balanced in inputs and outputs and (iii) it is described in a transparent way.

Table 3

Tier 1 emissions factors of IPCC (2006) (modified)

Note that these values shall not be used to compare different types of synthetic fertiliser.

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**

FracGASF: fraction of synthetic fertiliser N applied to soils that volatilises as NH_3 and NO_x. FracLEACH: fraction of synthetic fertiliser and manure lost to leaching and runoff as NO3-

The above nitrogen field model has limitations – so a PEF study which has agricultural modelling in scope may test the following alternative approach and report the results in an Annex to the PEF report.

The N-balance is calculated using the parameters in Table 4 and the formula below. The total NO_3^-N emission to water is considered a variable and its total inventory shall be calculated as:

'Total NO3-N emission to water' = 'NO_3^- base loss' + 'additional NO_3^-N emissions to water', with

'Additional NO3-N emissions to water' = 'N input with all fertilisers' + 'N_2 fixation by crop' – 'N-removal with the harvest' – 'NH_3 emissions to air' – 'N_2O emissions to air' – 'N_2 emissions to air' -'NO_3^- base loss'.

If, in certain low-input schemes, the value for 'additional NO_3-N emissions to water' becomes negative, the value shall be set to '0'. Moreover, in such cases the absolute value of the calculated 'additional NO_3-N emissions to water' is to be inventoried as additional N-fertiliser input into the system, using the same combination of N-fertilisers as employed for the analysed crop.

This last step serves to avoid fertility-depletion schemes by capturing the N-depletion by the analysed crop that is assumed to lead to the need for additional fertiliser later on and to keep the same soil fertility level.

Table 4

Alternative approach to nitrogen modelling

Emission	Compartment	Value to be applied
NO_3^- base loss (synthetic fertiliser and manure)	Water	kg NO_3^-= kg N*FracLEACH = 1*0.1*(62/14) = 0.44 kg NO_3^-/ kg N applied
N_2O (synthetic fertiliser and manure; direct and indirect)	Air	0.022 kg N_2O/ kg N fertiliser applied
NH_3 - Urea (synthetic fertiliser)	Air	kg NH_3= kg N * FracGASF= 1*0.15* (17/14)= 0.18 kg NH_3/ kg N fertiliser applied
NH_3 - Ammonium nitrate (synthetic fertiliser)	Air	kg NH_3= kg N * FracGASF= 1*0.1* (17/14)= 0.12 kg NH_3/ kg N fertiliser applied
NH_3 - others (synthetic fertiliser)	Air	kg NH_3= kg N * FracGASF= 1*0.02* (17/14)= 0.024 kg NH_3/ kg N fertiliser 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
N_2-fixation by crop		For crops with symbiotic N_2-fixation: the fixed amount is assumed to be identical to the N-content in the harvested crop
N_2	Air	0.09 kg N_2 / kg N applied

4.4.1.6. *Heavy metal emissions*

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.

Two different modelling approaches are allowed:

(a) The final fate of the heavy metal elementary flows is 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 grown 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.

(b) The final fate (emission compartment) of the heavy metal elementary flows is considered within the system boundary: the inventory does account for the final emissions (release) of the heavy metals in the environment and therefore shall also account for the uptake of heavy metals by the crop.

For example, heavy metals in agricultural crops grown for feed will mainly end up in the animal digestion and used as manure back on the field where the metals are released in the environment and their impacts are captured by the impact assessment methods. Therefore, the inventory of the agricultural stage shall account for the uptake of heavy metals by the crop. A limited amount ends up in the animal, which may be neglected for simplification.

4.4.1.7. *Rice cultivation*

Methane emissions from rice cultivation shall be included, based on the calculation rules in section 5.5. of IPCC (2006)

4.4.1.8. *Peat soils*

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

4.4.1.9. *Other activities*

If applicable, the following activities shall be included in agricultural modelling, unless they are allowed to be excluded, based on the cut-off criteria:

(a) input of seed material (kg/ha),

(b) input of peat to soil (kg/ha + C/N ratio),

(c) input of lime (kg $CaCO_3$/ha, type),

(d) machine use (hours, type) (to be included if there is high level of mechanisation),

(e) input N from crop residues that stay on the field or are burned (kg residue + N content/ha). Including emissions from residue burning, drying and storage of products.

Unless it is clearly documented that operations are carried out manually, field operations shall be accounted for through total fuel consumption or through inputs of specific machinery, transports to/ from the field, energy for irrigation, or similar.

4.4.2. Electricity use

Electricity used from the grid shall be modelled as precisely as possible giving preference to supplier-specific data. If (part of) the electricity is renewable, it is important that no double counting occurs. Therefore, the supplier shall guarantee that the electricity supplied to the organisation to produce the product is effectively generated using renewable sources and is not available anymore for other consumers.

4.4.2.1. *General guidelines*

The following section introduces two types of electricity mixes: (i) the consumption grid mix which reflects the total electricity mix transferred over a defined grid including green claimed or tracked electricity, and (ii) the residual grid mix, consumption mix (also named residual consumption mix), which characterizes the unclaimed, untracked or publicly shared electricity only.

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

(a) Supplier-specific electricity product ([20]) shall be used if, for a country, there is a 100% tracking system in place, or if :

  (i) available, and

  (ii) the set of minimum criteria to ensure the contractual instruments are reliable is met.

(b) The supplier-specific total electricity mix shall be used if:

  (i) available, and

  (ii) the set of minimum criteria to ensure the contractual instruments are reliable is met.

(c) The 'country-specific residual grid mix, consumption mix' shall be used. Country-specific means the country in which the life cycle stage or activity occurs. This may be an EU or non-EU country. The residual grid mix prevents double counting with the use of supplier-specific electricity mixes in (a) and (b).

(d) As a last option, the average EU residual grid mix, consumption mix (EU+EFTA), or region representative residual grid mix, consumption mix, shall be used.

([20]) See EN ISO 14067:2018

The environmental integrity of the use of supplier-specific electricity mix depends on ensuring that contractual instruments (for tracking) are **reliable and unique**. Without this, the PEF lacks the accuracy and consistency needed to drive product/corporate electricity procurement decisions and accurate consideration of the supplier-specific mix by buyers of electricity. 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.

4.4.2.2. *Set of minimum criteria to ensure contractual instruments from suppliers*

A supplier-specific electricity product/mix may only be used if the user of the PEF method ensures that the contractual instrument meets the criteria specified below. If contractual instruments do not meet the criteria, then the country-specific residual electricity consumption-mix shall be used in the modelling.

The list of criteria below is based on the criteria of the 'GHG Protocol Scope 2 Guidance – An amendment to the GHG Protocol Corporate Standard' (Mary Sotos, World Resource Institute) ([21]). A contractual instrument used for electricity modelling shall meet the following criteria.

Criterion 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 (obtained, acquired or withdrawn) on behalf of its customers. Electricity from facilities for which the attributes have been sold off (via contracts or certificates) shall be characterised as having the environmental attributes of the country residual consumption mix where the facility is located.

Criterion 2 – be a unique claim

Be the only instrument that carries 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 handled automatically through other disclosure registries, systems, or mechanisms).

Criterion 3 – be as close as possible to the period to which the contractual instrument is applied

Table 5

Minimum criteria to ensure contractual instruments from suppliers – guidance to fulfil criteria

Criterion 1	**CONVEY ENVIRONMENTAL ATTRIBUTES AND GIVE EXPLANATION ABOUT THE CALCULATION METHOD** Convey the energy type mix (or other related environmental attributes) associated with the unit of electricity produced. Explain the calculation method used to determine this mix.
Context	Each programme or policy will establish their own eligibility criteria and the attributes to be conveyed. These criteria specify energy resource type and certain energy generation facility characteristics, such as type of technology, facility age, or facility location (but differ from one programme/policy to another). These attributes specify the energy resource type and sometimes some energy generation facility characteristics.

([21]) https://ghgprotocol.org/sites/default/files/standards/Scope%202%20Guidance_Final_Sept26.pdf

Conditions for satisfying the criterion	1. Convey the energy mix: if there is no energy type mix specified in the contractual instruments, ask your supplier to provide you with this information or other environmental attributes (e.g. GHG emission rate). If the supplier does not respond, use the 'country-specific residual grid mix, consumption mix'. If the supplier responds, go to step 2).
	2. Explain the calculation method used: ask your supplier to provide details of the calculation method to ensure that they follow the above principle. If your supplier does not provide this information, apply the supplier-specific electricity mix, include the information received and document that it was not possible to check for double counting.
Criterion 2	**UNIQUE CLAIMS** Be the only instrument that carries the environmental attribute claim associated with that quantity of electricity generation. 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 handled automatically through other disclosure registries, systems, or mechanisms).
Context	Certificates generally serve four main purposes: (i) supplier disclosure, (ii) supplier quotas for the delivery or sales of specific energy sources, (iii) tax exemption, and (iv) voluntary consumer programmes. Each programme or policy will establish their own eligibility criteria. These criteria specify certain energy generation facility characteristics, such as type of technology, facility age, or facility location (but differ from one programme/policy to another one). Certificates shall come from facilities that meet these criteria to be eligible for use in that programme. In addition, individual country markets or policy-making bodies may carry out these different functions using a single certificate system or a multi-certificate system.
Conditions for satisfying the criterion	1. Is the plant located in a country with no tracking system? Information provided by the 'Association of issuing bodies' ([1]) should be used. If yes, use the 'country-specific residual grid mix, consumption mix'; If no, go to the second question. 2. Is the plant located in a country where consumption is partly untracked (> 95%)? If yes, use the 'country-specific residual grid mix, consumption mix' as the best data available to calculate the residual consumption mix; If no, go to the third question. 3. Is the plant located in a country with a single certificate system or a multi-certificate system? If the plant is located in a region/country with a single certificate system the unique claim criteria is met. Use energy type mix mentioned on the contractual instrument. If the plant is located in a region/country with a multi-certificate system, the unique claim is not ensured. Contact the country-specific issuing body (The European organisation which governs the European Energy Certificate System, http://www.aib-net.org) to find out whether you need to ask for more than one contractual instrument(s) in order to ensure there is no risk of double counting. If more than one contractual instrument is needed, request all contractual instruments from the supplier to avoid double counting;

	If it is not possible to avoid double counting, report this in the PEF study and use the 'country-specific residual grid mix, consumption mix'.
Criteria 3	**Be issued and redeemed as close as possible to the period of electricity consumption to which the contractual instrument is applied.**

([1]) European Residual Mix | AIB (aib-net.org)

4.4.2.3. *How to model 'country-specific residual grid mix, consumption mix'*

The user of the PEF method should identify suitable datasets for residual grid mix, consumption mix, each energy type, country and voltage.

If no suitable dataset is available, the following approach should 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 combine them with LCI datasets per energy type and country/region (e.g. LCI dataset for the production of 1MWh hydro energy in Switzerland).

1) Activity data related to non-EU country consumption mix per detailed energy type shall be determined based on:

   (a) domestic production mix per production technology;

   (b) import quantity and from which neighbouring countries;

   (c) transmission losses;

   (d) distribution losses;

   (e) type of fuel supply (share of resources used, by import and/or domestic supply).

   These data should be found in International Energy Agency (IEA) publications.

2) Available LCI datasets per fuel technology; the LCI datasets available are generally specific to a country or a region in terms of:

   (a) fuel supply (share of resources used, by import and/ or domestic supply);

   (b) energy carrier properties (e.g. element and energy contents);

   (c) technology standards of power plants regarding efficiency, firing technology, flue-gas desulphurisation, NOx removal and de-dusting.

4.4.2.4. *A single location with multiple products and more than one electricity mix*

This section describes how to proceed if only some of the electricity consumed is covered by a supplier-specific mix or on-site electricity generation and how to account for the electricity mix of products produced at the same location. In general, the subdivision of electricity supply used among multiple products is based on a physical relationship (e.g. number of pieces or kg of product). 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 comes from a specific supplier, a supplier-specific electricity mix shall be used for this amount. See Section 4.4.2.7 for on-site electricity use.

A specific type of electricity may be allocated to one specific product with the following conditions.

(a) If the production (and the related electricity consumption) of a product occurs in a separate site (building), the energy type that is physically related to this site may be used.

(b) If the production (and the related electricity consumption) of a product occurs in a space shared with specific energy metering or purchase records or electricity bills, the product-specific information (measure, record, bill) may be used.

(c) If all the products produced in the specific plant are supplied with a publically available PEF study, the company that wants to make the claim related to energy used 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.

4.4.2.5. *For multiple locations producing one product*

In case a product is produced in different locations or sold in different countries, the electricity mix shall reflect the ratios of production or ratios of sales between EU countries/regions. To determine the ratio, a physical unit shall be used (e.g. number of pieces or kg of product). For PEF studies where such data are not available, the average EU residual consumption mix (EU+EFTA), or region-representative residual mix, shall be used. The same general guidelines mentioned above shall be applied.

4.4.2.6. *Electricity use at the use stage*

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

4.4.2.7. *On-site electricity generation*

If on-site electricity production equals the site's electricity consumption, two situations apply:

(a) no contractual instruments have been sold to a third party: the user of the PEF method shall model its own electricity mix (combined with LCI datasets).

(b) contractual instruments have been sold to a third party: the user of the PEF method shall use 'country-specific residual grid mix, consumption mix' (combined with LCI datasets).

If the amount of electricity produced exceeds the amount consumed on-site within the defined system boundary and is sold to, e.g. the electricity grid, this system may be seen as a multi-functional situation. The system will provide two functions (e.g. product + electricity) and the following rules shall be followed.

(a) If possible, apply subdivision. This applies both to separate electricity productions or to a common electricity production where you may allocate, based on electricity amounts, the upstream and direct emissions to your own consumption and to the share you sell to a third party (e.g. if a company uses a windmill on its production site and exports 30% of the produced electricity, emissions related to 70% of produced electricity should be accounted for in the PEF study).

(b) If not possible, direct substitution shall be used. The country-specific residual consumption electricity mix shall be used as substitution ([22]). Subdivision is not considered possible when upstream impacts or direct emissions are closely related to the product itself.

4.4.3. Transport and logistics

The following parameters shall be taken into account when modelling transport activities.

(1) **Transport type:** the type of transport, e.g. by land (truck, rail, pipe), water (boat, ferry, barge), or air (airplane).

(2) **Vehicle type:** the type of vehicle by transport type.

(3) **Loading rate (=utilisation ratio; see next section)** ([23]): environmental impacts are directly linked to the actual loading rate, which therefore shall be considered. The loading rate affects the vehicle's fuel consumption.

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

([23]) The loading rate is the ratio of actual load to the full load/ capacity (e.g. mass or volume) that a vehicle carries per trip.

(4) **Number of empty returns:** the number of empty returns (i.e. the ratio of the distance travelled to collect the next load after unloading the product to the distance travelled to transport the product), when applicable and relevant, shall be taken into account. The kilometres travelled by the empty vehicle shall be allocated to the product. In default transport datasets this is often already taken into account in the default utilisation ratio.

(5) **Transport distance**: transport distances shall be documented, applying average transport distances specific to the context being considered.

Within the EF compliant datasets, the fuel production, the fuel consumption by the transport vehicle, the infrastructure needed and the amount of additional resources and tools needed for logistic operations (e.g. cranes and transporters) are included in the transport datasets.

4.4.3.1. *Allocation of impacts from transport – truck transport*

EF compliant datasets for truck transport are per tkm (tonne*km) expressing the environmental impact for 1 tonne (t) of product that is transported for 1km in a truck with a certain load. The transport payload (= maximum mass allowed) is indicated in the dataset. For example, a truck of 28-32 t has a payload of 22 t; the LCA dataset for 1 tkm (fully loaded) expresses the environmental impact for 1 t of product that is transported for 1km within a 22 t loaded truck. The transport emissions are allocated based on the transported product's mass and you get only a share of 1/22 of the truck's full emissions. When the load transported is lower than the maximum load capacity (e.g. 10 t), the environmental impact for 1 t of product is affected in two ways. First, the truck has less fuel consumption per total load transported and second, its environmental impact is allocated by the load transported (e.g., 1/10 t). When a full freight's mass is lower than the truck's load capacity (e.g. 10 t), the transport of the product may be considered volume limited. In this case, the environmental impact shall be calculated using the real mass loaded.

In EF compliant datasets, the transport payload should be modelled in a parameterised way through the utilisation ratio. The utilisation ratio affects (i) the truck's total fuel consumption and (ii) the allocation to impact per ton. The utilisation ratio is calculated as the kg real load divided by the kg payload and shall be adjusted when the dataset is used. In case the real load is 0 kg, a real load of 1 kg shall be used for the calculation. Empty return trips may be included in the utilisation ratio by taking into account the percentage of empty km driven. E.g., if the truck is fully loaded for delivery but half empty upon its return, the utilisation ratio is: 22 t real load / 22 t payload * 50% km + 11 t real load / 22 t payload * 50% km = 75%.

PEF studies shall specify the utilisation ratio to be used for each type of truck transport modelled and clearly indicate whether the utilisation ratio includes empty return trips. The following default utilisation ratios apply.

(a) If the load is mass-limited, a default utilisation ratio of 64% ([24]) shall be used, unless specific data is available. This default utilisation ratio includes empty return trips and thus shall not be modelled separately.

(b) Bulk transport (e.g., gravel transport from mining pit to concrete plant) shall be modelled with a default utilisation ratio of 50% (100% loaded outbound and 0% loaded inbound), unless specific data is available.

4.4.3.2. *Allocation of impacts from transport – van transport*

Vans are often used for home delivery, e.g. delivery of books and clothes or home delivery from retailers. For vans, the limiting factor is volume rather than mass. If no specific information is available to perform the PEF study, a lorry of <1.2 t with a default utilisation ratio of 50% shall be used. In case no dataset for a lorry of <1.2 t is available, a lorry of <7.5 t shall be used as approximation with a utilisation ratio of 20%. A lorry of <7.5 t with a payload of 3.3 t and a utilisation ratio of 20% has the same load as a van with payload of 1.2 t and utilisation ratio of 50%.

([24]) Eurostat 2015 indicates that 21% of the km truck transport is driven with an empty load and 79% is driven loaded (with an unknown load). In Germany only, the average truck load is 64%.

4.4.3.3. *Allocation of impacts from transport – consumer transport*

Allocation of the car impact shall be based on volume. The maximum volume to be considered for consumer transport is 0.2 m^3 (around 1/3 of a trunk of 0.6 m^3). For products larger than 0.2 m^3 the full car transport impact shall be considered. For products sold through supermarkets or shopping malls, the product volume (including packaging and empty spaces such as between fruits or bottles) shall be used to allocate the transport burdens between the products transported. The allocation factor shall be calculated as the volume of the product transported divided by 0.2 m^3. To simplify the modelling, all other types of consumer transport (like buying in specialised shops or using combined trips) shall be modelled as if sold through a supermarket.

4.4.3.4. *Default scenarios – from supplier to factory*

For suppliers located within Europe, if no specific data are available to perform the PEF study, then the default data provided below shall be used.

For packaging materials from manufacturing plants to filler plants (beside glass; values based on Eurostat 2015 ([25]), the following scenario shall be used:

(a) 230 km by truck (>32 t, EURO 4);

(b) 280 km by train (average freight train); and

(c) 360 km by ship (barge).

For transport of empty bottles, the following scenario shall be used:

(a) 350 km by truck (>32 t, EURO 4);

(b) 39 km by train (average freight train); and

(c) 87 km by ship (barge).

For all other products from supplier to factory (values based on Eurostat 2015 ([26]), the following scenario shall be used:

(a) 130 km by truck (>32 t, EURO 4);

(b) 240 km by train (average freight train); and

(c) 270 km by ship (barge).

For suppliers located outside of Europe, if no specific data are available to perform the PEF study, then the default data provided below shall be used:

(a) 1 000 km by truck (>32 t, EURO 4), for the sum of distances from harbour/airport to factory outside and inside Europe;

(b) 18 000 km by ship (transoceanic container) or 10 000 km by plane (cargo);

(c) if producers' country (origin) is known, the adequate distance for ship and airplane should be determined using specific calculators ([27]);

(d) in case it is not known whether the supplier is located within or outside Europe, transport shall be modelled as if the supplier was located outside of Europe.

4.4.3.5. *Default scenarios – from factory to final client*

The transport from factory to final client (including consumer transport) shall be included in the distribution stage of the PEF study. In case no specific information is available, the default scenario outlined below shall be used as a basis. The following values shall be determined by the user of the PEF method (specific information shall be used, unless it is unavailable):

— ratio between products sold through retail, distribution centre (DC) and directly to the final client;

([25]) Calculated as the mass weighted average of the goods categories 06, 08 and 10 using the Ramon goods classification for transport statistics after 2007. The category 'non-metallic mineral products' is excluded as they can double count with glass.

([26]) Calculated as the mass weighted average of the goods of all categories.

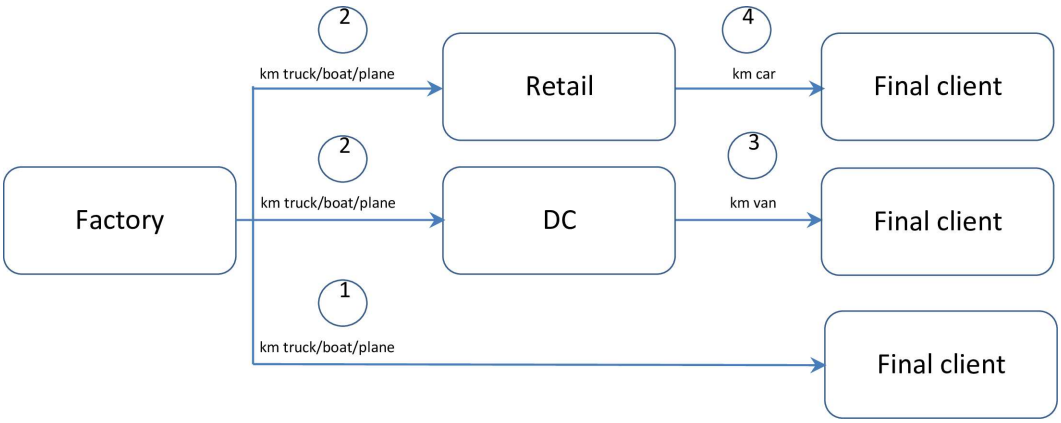
([27]) https://www.searates.com/services/distances-time/ or https://co2.myclimate.org/en/flight_calculators/new

— for factory to final client: ratio between local, intracontinental and international supply chains;

— for factory to retail: distribution between intracontinental and international supply chains.

Figure 3

Default transport scenario



The following is the default transport scenario from factory to client represented in Figure 3.

1. X% from factory to final client:

   X% local supply chain: 1 200 km by truck (>32 t, EURO 4)

   X% intracontinental supply chain: 3 500 km by truck (>32 t, EURO 4)

   X% international supply chain: 1 000 km by truck (>32 t, EURO 4) and 18 000 km by ship (transoceanic container). Note that for specific cases, plane or train may be used instead of ship.

2. X% from factory to retail/distribution centre (DC):

   X% local supply chain: 1 200 km by truck (>32 t, EURO 4)

   X% intracontinental supply chain: 3 500 km by truck (>32 t, EURO 4)

   X% international supply chain: 1 000 km truck (>32 t, EURO 4), and 18 000 km by ship (transoceanic container). Note that for specific cases, plane or train may be used instead of ship.

3. X% from DC to final client:

   100% local: 250 km round trip by van (lorry <7.5 t, EURO 3, utilisation ratio of 20%).

4. X% from retail to final client:

   62%: 5 km, by passenger car (average)

   5%: 5 km round trip, by van (lorry <7.5 t, EURO 3 with utilisation ratio of 20%)

   33%: no impact modelled.

For reusable products, the return transport from retail/DC to factory shall be modelled in addition to the transport needed to go to retail/ DC. The same transport distances as from product factory to final client shall be used (see above). However the truck utilisation ratio might be volume limited depending on the type of product.

Frozen or cooled products shall be transported in freezers or coolers.

4.4.3.6. *Default scenarios – from EoL collection to EoL treatment*

The transport from where products at their EoL are collected to where they are treated may already be included in the landfill, incineration and recycling LCA datasets.

However, there are some cases where additional default data may be needed in the PEF study. The following values shall be used in case no better data is available:

(a) consumer transport from home to sorting place: 1 km by passenger car;

(b) transport from collection place to methanisation: 100 km by truck (>32 t, EURO 4);

(c) transport from collection place to composting: 30 km by truck (lorry <7.5 t, EURO 3).

4.4.4. Capital goods – infrastructure and equipment

Capital goods (including infrastructure) and their EoL should be excluded, unless there is evidence from previous studies that they are relevant. If capital goods are included, the PEF report shall include a clear and extensive explanation on why they are relevant, reporting all assumptions made.

4.4.5. Storage at the distribution centre or retail

Storage activities consume energy and refrigerant gases. The following default data shall be used, unless better data is available.

Energy consumption at the distribution centre: the storage energy consumption is 30 kWh/m^2·year and 360 MJ bought (= burnt in boiler) or 10 Nm^3 natural gas/m^2·year (if you use the value per Nm^3, do not forget to consider emissions from combustion, not only the production of natural gas). For centres that contain cooling systems, the additional energy use for the chilled or frozen storage is 40 kWh/m^3·year (with an assumption of 2 m high for the fridges and freezers). For centres with both ambient and cooled storage: 20% of the DC's area is chilled or frozen. Note: the energy used for chilled or frozen storage is only the energy used to maintain the temperature.

Energy consumption at retail: General energy consumption of 300 kWh/m^2·year for the entire building surface shall be considered as the default. For retail specialised in non-food/non-beverage products, 150 kWh/m^2·year for the entire building surface shall be considered. For retail specialised in food/beverage products, 400 kWh/m^2·year for the entire building surface plus energy consumption for chilled and frozen storage of 1 900 kWh/m^2·year and 2 700 kWh/m^2·year respectively is to be considered (PERIFEM and ADEME, 2014).

Refrigerant gases consumption and leakages at DCs with cooling systems: gas content in fridges and freezers is 0.29 kg R404A per m^2 (Organization Environmental Footprint Sector Rules for retail sector, retail OEFSR ([28]). Annual leakage of 10% is considered (Palandre 2003). For the portion of refrigerant gases that remain in the equipment at end of life, 5% is emitted at end of life and the remaining fraction is treated as hazardous waste.

Only the portion of the emissions and resources emitted or used at storage systems shall be allocated to the product stored. This allocation shall be based on the space (in m^3) and time (in weeks) occupied by the product stored. For this, the total storage capacity of the system shall be known, and the product-specific volume and storage time shall be used to calculate the allocation factor (as the ratio between product-specific volume*time and storage capacity volume*time).

An average DC is assumed to store 60 000 m^3 of product, out of which 48 000 m^3 for ambient storage and 12 000 m^3 for chilled or frozen storage. For 52 weeks of storage, a default total storage capacity of 3 120 000 m^3 *weeks/year shall be assumed.

An average retail place is assumed to store 2 000 m^3 of products (assuming that 50% of the 2 000 m^2 building area is covered by shelves that are 2 m high) over 52 weeks, i.e. 104 000 m^3 * weeks/year.

([28]) The OEFSR of the retail sector (v 1.0) is available at http://ec.europa.eu/environment/eussd/smgp/pdf/OEFSR-Retail_15052018.pdf.

4.4.6. Sampling procedure

In some cases, the user of the PEF method needs a sampling procedure to limit the data collection to only a representative sample of plants, farms etc. The user of the PEF method shall (i) specify in the PEF report if sampling was applied, (ii) follow the requirements described in this section and (iii) indicate which approach was used.

Examples of cases when the sampling procedure may be needed are those where multiple production sites are involved in producing the same product. E.g. if the same raw material/input material comes from multiple sites or if the same process is outsourced to more than one subcontractor/supplier.

The representative sample shall be derived via a stratified sample, i.e. one that ensures that sub-populations (strata) of a given population are each adequately represented within the whole sample of a research study.

Using a stratified sample allows for more precision than a simple random sample, provided that the sub-populations have been chosen so that the items of the same sub-population are as similar as possible in terms of the characteristics of interest. In addition, a stratified sample guarantees better coverage of the population ([29]).

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

i. define the population;

ii. define homogeneous sub-populations (stratification);

iii. define the sub-samples at the sub-population level;

iv. define the sample for the population starting from the definition of sub-samples at the sub-population level.

4.4.6.1. *How to define homogeneous 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.

The following aspects need to be taken into consideration in identifying the sub-populations:

(a) geographical distribution of sites;

(b) technologies/ farming practices involved;

(c) production capacity of the companies/sites taken into consideration.

Additional aspects to be taken into consideration may be added.

The number of sub-populations shall be calculated as follows:

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

— 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 above formula 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 system in place).

Example 1

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

([29]) The researcher has control over the sub-populations that are included in the sample, whereas simple random sampling does not guarantee that sub-populations (strata) of a given population are each adequately represented within the final sample. However, one main disadvantage of stratified sampling is that it may be difficult to identify appropriate sub-populations for a population.

Out of 350 farmers located in the same region in Spain, all have more or less the same annual production and use the same harvesting techniques.

In this case:

g=1: all the farmers are located in the same country

t=1: all the farmers use the same harvesting techniques

c=1: the capacity of the companies is almost the same (i.e. they have the same annual production)

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

Only one sub-population may be identified as coinciding with the population.

Example 2

350 farmers are distributed across three different countries (100 in Spain, 200 in France and 50 in Germany). There are two different harvesting techniques used, and these 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 terms of annual production varies between 10 000 t and 100 000 t. According to expert judgement / relevant literature, it is estimated that farmers with an annual production lower than 50 000 t are completely different in terms of efficiency compared to the farmers with an annual production higher than 50 000 t. Two classes of companies are defined based on annual production: class 1, if production is lower than 50 000 t and class 2, if production is higher than 50 000 t. (Spain: 80 class 1, 20 class 2; France: 50 class 1, 150 class 2; Germany: 50 class 1).

Table **6** includes the details about the population.

Table 6

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 summarised in Table 7:

Table 7

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

4.4.6.2. *How to define sub-sample size at sub-population level*

Once the sub-populations have been identified, the sample size of each shall be calculated (the sub-sample size). Two alternative approaches are possible:

i. Based on the total production of the sub-population

The user of the PEF method shall identify the percentage of production that each sub-population will cover. It shall not be lower than 50%, expressed in the relevant unit. This percentage determines the sample size within the sub-population.

ii. 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

The chosen approach shall be specified in the PEF report. The same approach shall be used for all the sub-populations selected.

Example

Table 8

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

4.4.6.3. *How to define the sample for the population*

The representative sample of the population corresponds to the sum of the sub-samples at the sub-population level.

4.4.6.4. *What to do in case rounding is necessary*

If rounding is necessary, the general rule used in mathematics shall be applied:

(a) If the number you are rounding is followed by 5, 6, 7, 8, or 9, round the number up.

(b) If the number you are rounding is followed by 0, 1, 2, 3, or 4, round the number down.

4.4.7. Modelling requirements for the use stage

The use stage often involves multiple processes. A distinction shall be made between (i) product independent and (ii) product dependent processes.

(i) **Product independent processes** have no relationship with the way the product is designed or distributed. The impacts of the use stage process will remain the same for all products in this product (sub-)category even if the producer changes the product's characteristics. Therefore, they do not contribute to any form of differentiation between two products or might even hide the difference. Examples are: the use of glass for drinking wine (considering that the product does not determine a difference in glass use); frying time when using olive oil; energy use for boiling one litre of water used for preparing coffee made from bulk instant coffee; and the washing machine used for heavy laundry detergents (capital good).

(ii) **Product dependent processes** are directly or indirectly determined or influenced by the product design or are related to instructions for using the product. These processes depend on the product characteristics and therefore help differentiate two products. All instructions provided by the producer and directed towards the consumer (through labels, websites or other media) shall be considered product dependent. Examples of instructions are: indications on how long the food must be cooked, how much water must be used, or in the case of drinks, the recommended serving temperature and storage conditions. An example of a direct dependent process is the energy used by electrical equipment under normal conditions.

Product dependent processes shall be included in the system boundary of the PEF study. Product independent processes shall be excluded from the system boundary and qualitative information may be provided.

For final products, the LCIA results shall be reported for (i) the total life cycle and (ii) the total life cycle excluding the use stage.

4.4.7.1. *Main function approach or delta approach*

The modelling of the use stage may be done in different ways. Very often the related impacts and activities are modelled fully, e.g. the total electricity consumption when using a coffee machine, or the total cooking time and related gas consumption when boiling pasta. In these cases, the use stage processes for drinking coffee or eating pasta are related to the product's main function (referred to as 'main function approach').

In some cases, the use of one product may influence the environmental impact of another, as described in the following examples.

(a) A toner cartridge is not 'responsible' for the paper it prints on. But if a remanufactured toner cartridge works less efficiently and causes more paper loss compared to an original cartridge, the additional paper loss should be considered. In that case, the paper loss is a product-dependent process of the use stage of a remanufactured cartridge.

(b) The energy consumption during the use stage of the battery/charger system is not related to the amount of energy stored and released from the battery. It only refers to the energy loss in each loading cycle, which may be caused by the loading system or the internal losses in the battery.

In these cases, only the additional activities and processes should be allocated to the product (e.g. paper and energy for the remanufactured toner cartridge and battery respectively). The allocation method involves taking all associated products in the system (in this case paper and energy), and allocating the excess consumption of these associated products to the product which is considered responsible for this excess. This requires a reference amount of consumption to be set for each associated product (e.g. of energy and materials), which refers to the minimum consumption that is essential for providing the function. The consumption above this reference (the delta) will then be allocated to the product (referred to as 'Delta approach') ([30]).

This approach shall only be used to increase impacts and to account for additional consumption above the reference. To set the reference situation, the following shall be considered, if available:

(a) regulations applicable to the product in scope;

(b) standards or harmonised standards;

([30]) Specifications for drafting and revising product category rules (10.12.2014), ADEME.

(c) recommendations from manufacturers or manufacturers' organisations;

(d) use agreements established by consensus in sector-specific working groups.

The user of the PEF method can decide which approach is taken and shall describe the one applied in the PEF report (main function approach or delta approach).

4.4.7.2. *Modelling the use stage*

Part D of Annex II provides default data to be used to model use stage activities. If available, better data should be used, and shall be made transparent and justified in the PEF report.

4.4.8. Recycled content and end of life modelling

The recycled content and end of life shall be modelled using the circular footprint formula (CFF) at the life-cycle stage where the activity occurs. The following sections describe the formula and parameters to be used and how they shall be applied to final and intermediate products (Section 4.4.8.12).

4.4.8.1. *The circular footprint formula (CFF)*

The circular footprint formula is a combination of 'material + energy + disposal', i.e.:

Equation 3

The circular footprint formula (CFF)

Material

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

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

$$(1 - R_2 - R_3)E_D$$

Parameters of the CFF

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.
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:	the proportion of material in the input to the production that has been recycled from a previous system.
R_2:	the proportion of the material in the product that will be recycled (or reused) in a subsequent system. Therefore, R2 shall 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:	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 the collection, sorting and transportation processes.

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.

E_{ER}: specific emissions and resources consumed (per functional unit) arising from the energy recovery process (e.g. incineration with energy recovery, landfill with energy recovery, etc.).

$E_{SE,heat}$ 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 the disposal of waste material at the analysed product's EoL, 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 used for energy recovery.

Users of the PEF method shall report all the parameters used. Default values for some parameters (A, R_1, R_2, R_3 and Q_s/Q_p for packaging) are available in Part C of Annex II (see following sections for further details): users of the PEF method shall refer to the version of Part C of Annex II they are using ([31]).

4.4.8.2. *The A factor*

The A factor allocates burdens and credits from recycling and virgin material production between two life cycles (i.e. the one supplying and the one using recycled material) and it aims to reflect market realities.

An A factor equal to 1 would reflect a 100:0 approach (i.e. credits are given only to the recycled content), while an A factor equal to 0 would reflect a 0:100 approach (i.e. credits are given only to the recyclable materials at the EoL).

In PEF studies the A factor values shall be in the range **$0.2 \leq A \leq 0.8$**, to always capture both aspects of recycling (recycled content and recyclability at EoL).

The driver determining the values of the A factor is the analysis of the market situation. This means:

1) **A = 0.2** – low supply of recyclable materials and high demand: the formula focuses on recyclability at EoL;

2) **A = 0.8** – high supply of recyclable materials and low demand: the formula focuses on recycled content.

3) **A = 0.5** – equilibrium between supply and demand: the formula focuses both on recyclability at EoL and recycled content.

Default application-specific and material-specific A values are available in Part C of Annex II. The following procedure shall be applied (in hierarchical order) to select the value of A to be used in a PEF study:

1) check in Part C of Annex II the availability of an application-specific A value which fits the PEF study;

2) if an application-specific A value is not available, the material-specific A value in Part C of Annex II shall be used;

3) if a material-specific A value is not available, the user shall apply an A value of 0.5.

([31]) The European Commission periodically reviews and updates the list of values in the part C of the Annex II; users of the PEF method are invited to check and use the most updated values provided at http://eplca.jrc.ec.europa.eu/LCDN/developerEF.xhtml

4.4.8.3. *The B factor*

The B factor is used as an allocation factor of energy recovery processes. It applies both to burdens and credits. Credits refer to the amount of heat and electricity sold, not to the total energy produced, taking into account relevant variations over a 12-month period, e.g. for heat.

In PEF studies, the B value shall, by default, be equal to 0, unless another appropriate value is available in part C of Annex II.

To avoid double-counting between the current and the subsequent system in case of energy recovery, the subsequent system shall model its own energy use from energy recovery processes as primary energy (if the B value has been set at a value other than 0 in the upstream system, the user of the PEF method shall ensure that no double counting occurs).

4.4.8.4. *The point of substitution*

It is necessary to determine the point of substitution to apply the 'material' part of the formula. The point of substitution is to the point in the value chain where secondary materials substitute for primary materials.

The point of substitution should be identified in correspondence to the process where input flows come from 100% primary sources and 100% secondary sources (level 1 in Figure 4). In some cases, the point of substitution may be identified after some mixing of primary and secondary material flows has occurred (level 2 in Figure 4).

— **Point of substitution at level 1**: this corresponds to e.g. the point where metal scrap, glass cullet and pulp are added to the process.

— **Point of substitution at level 2**: this corresponds to e.g. the point where metal ingots, glass and paper are added to the process.

The point of substitution at this level may be applied only if the datasets used to model, e.g. E_{rec} and $E_{v,}$ take into account the real (average) flows regarding primary and secondary material. For example, if E_{rec} corresponds to the 'production of 1 t of secondary material' (see Figure 4) and it has an average input of 10% from primary raw materials, the amount of primary materials, together with their environmental burdens, shall be included in the E_{rec} dataset.

Figure 4

Point of substitution at level 1 and level 2

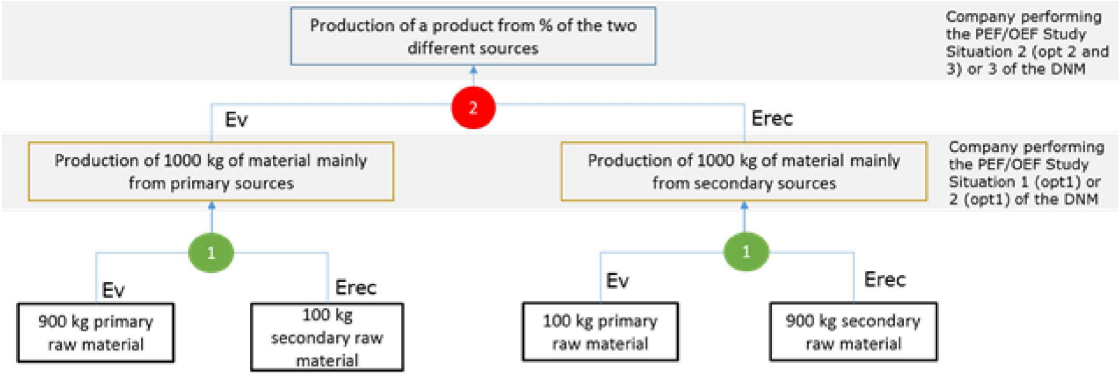
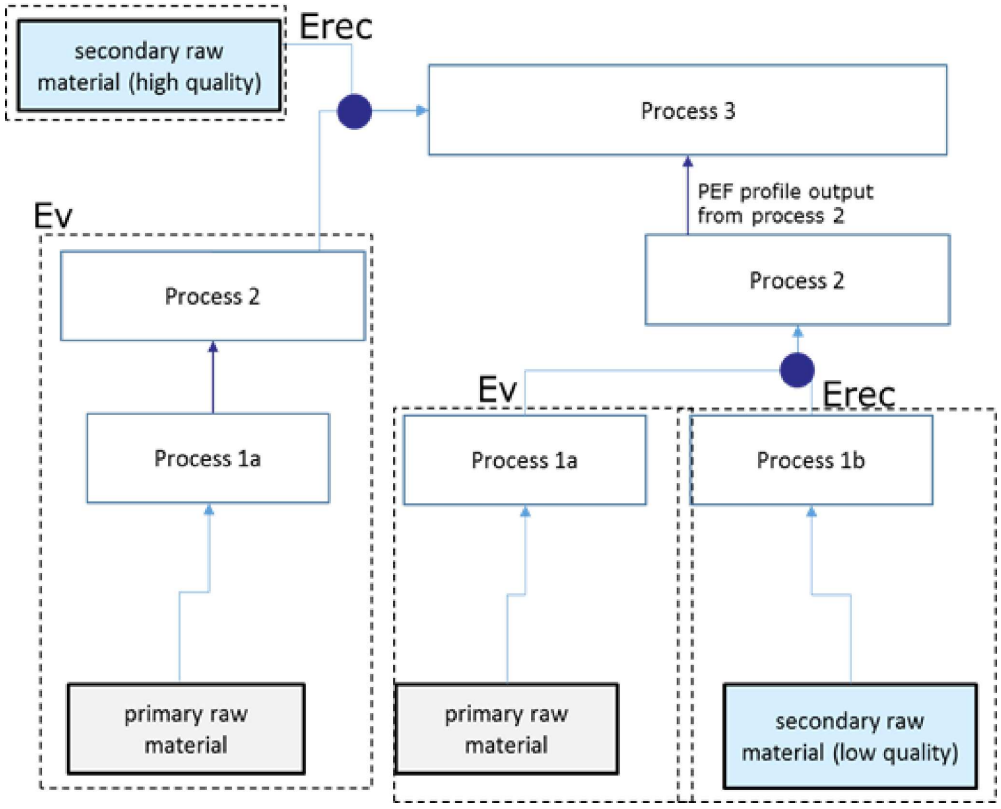


Figure 4 is a schematic representation of a generic situation (flows are 100% primary and 100% secondary). In practice, in some situations more than one point of substitution may be identified at different steps in the value chain, as represented in Figure 5, where e.g. scrap of two different qualities is processed at different steps.

Figure 5

Example of point of substitutions at different steps in the value chain.



4.4.8.5. *The quality ratios: Qsin/Qp and Qsout/Qp*

Two quality ratios are used in the CFF, to take into account the quality of both the ingoing and the outgoing recycled materials: Qsin/Qp and Qsout/Qp.

Two different cases are highlighted.

(a) **If Ev=E*v**, the two quality ratios are needed: Qs_{in}/Q_p associated to the recycled content, and Qs_{out}/Q_p associated to recyclability at EoL. The quality factors are there to capture the downcycling of a material compared to the original primary material and, in some cases, may capture the effect of multiple recycling loops.

(b) **If Ev≠E*v**, one quality ratio is needed: Qs_{in}/Q_p associated to the recycled content. In this case, E*v refers to the functional unit of the material substituted in a specific application. For example, plastic recycled to produce a bench modelled via substitution of cement shall also take into account the 'how much', 'how long' and 'how well'. Therefore, the E*v parameter indirectly integrates the Qs_{out}/Q_p parameter, and therefore the Qs_{out} and Qp parameters are not part of the CFF.

The quality ratios shall be determined at the point of substitution and per application or material.

The quantification of the quality ratios shall be based on the following.

(a) Economic aspects: i.e. price ratio of secondary compared to primary materials at the point of substitution. If the price of secondary materials is higher than that of primary ones, the quality ratios shall be set equal to 1.

(b) When economic aspects are less relevant than physical aspects, the latter may be used.

Packaging materials used by industry are often the same within different sectors and product groups: Part C of Annex II provides one worksheet with Qs_{in}/Q_p and Qs_{out}/Q_p values applicable to packaging materials. The company conducting a PEF study may use different values, which shall be made transparent and justified in the PEF report.

4.4.8.6. *Recycled content (R1)*

The R_1 values applied shall be company-specific or default secondary (application-specific), depending on the information available to the company conducting the PEF study. Default secondary (application-specific) R_1 values are available in Part C of Annex II. The following procedure shall be applied (in hierarchical order) to select the value of R_1 to be used in a PEF study.

(a) Company-specific values shall be used either when the process is run by the company conducting the PEF study or when the process is not run by the company conducting the PEF study but that company has access to (company-) specific information. (Situation 1 and Situation 2 of the Data Needs Matrix, see Section 4.6.5.4).

(b) In all other cases, the default secondary R_1 values of Part C of Annex II (application-specific) shall be applied.

(c) When no application-specific value is available in Part C of Annex II, R_1 shall be set to 0% (material-specific values based on supply market statistics are not accepted as a proxy and therefore shall not be used).

The applied R_1 values shall be subject to PEF study verification.

4.4.8.7. *Guidelines when using company-specific R1 values*

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

1) the supplier information (through e.g., statement of conformity or delivery note) shall be maintained during all the production and delivery stages at the converter;

2) once the material is delivered to the converter for producing the end products, the converter shall handle information through their regular administrative procedures;

3) the converter for producing the end products claiming recycled content shall demonstrate through its management system the percentage of recycled input material into the respective end product(s).

4) The latter demonstration shall be transferred upon request to the person using the end product. If a PEF profile is calculated and reported, this shall be stated as additional technical information of the PEF profile.

5) Industry- or company-owned traceability systems may be applied as long as they cover the general guidelines outlined above. If not, they shall be supplemented with the general guidelines above.

For the packaging industry, the following industry-specific guidelines are recommended.

1) For the container glass industry: the European Commission Regulation No 1179/2012. This Regulation requests a statement of conformity delivered by the cullet producer.

2) For the paper industry: the European Recovered Paper Identification System (CEPI – Confederation of European Paper Industries, 2008). This document prescribes rules and guidance on necessary information and steps, with a delivery note that shall be received by the mill operator.

3) For beverage cartons no recycled content is used so far. If needed, the same guidelines used for paper shall be used in this case as they are the most suitable (beverage cartons are covered by a recovered paper grade category under the European list of waste paper grades, EN643).

4) For the plastics industry: EN standard 15343:2007. This standard prescribes rules and guidelines on traceability. The supplier of the recyclate is requested to provide specific information.

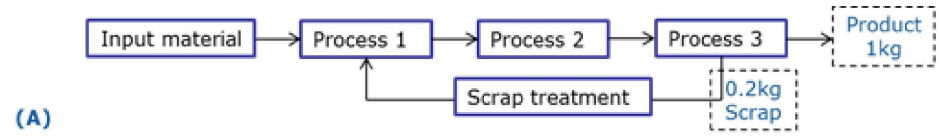
4.4.8.8. *Guidelines on how to deal with pre-consumer scrap*

When dealing with pre-consumer scrap, two options may be applied.

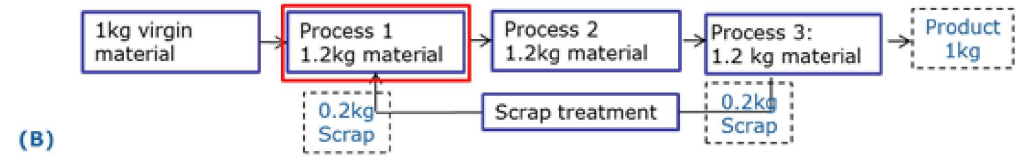
Option 1: the impacts to produce the input material that leads to the pre-consumer scrap in question shall be allocated to the product system that generated this scrap. Scrap is claimed as pre-consumer recycled content. Process boundaries and modelling requirements applying the CFF are shown in Figure 6.

Figure 6

Modelling option when pre-consumer scrap is claimed as pre-consumer recycled content



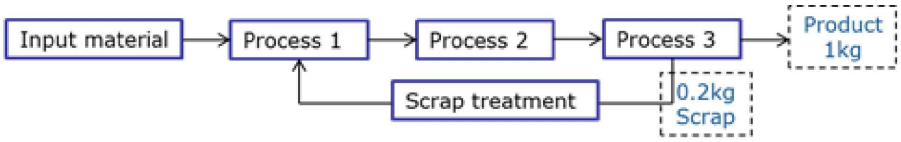
Option 1:
- **Process boundaries:** scrap treatment is a separate process. The input material for *process 1* is 1kg virgin material and 0.2kg recycled material (1.2kg input material).
- **Modelling CFF formula:** 0.2kg scrap can be claimed as pre-consumer recycled content, $R_{1Pre\text{-}consumer}$ = 17% (0.2/1.2), and should be included in the recycling rate.



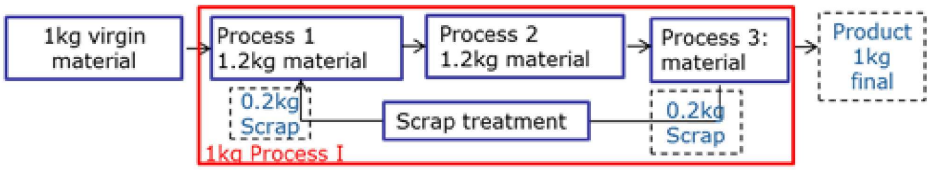
Option 2: Any material that circulates within a process chain or pool of process chains is excluded from being defined as recycled content and is not included in R_1. Scrap is not claimed as pre-consumer recycled content. Process boundaries and modelling requirements applying the CFF are shown in **Figure 7**.

Figure 7

Modelling option when pre-consumer scrap is not claimed as pre-consumer recycled content



Option 2:
- **Process boundaries:** scrap treatment is inside the process boundaries.
- **Modelling CFF formula:** 0.2kg scrap should NOT be claimed as pre-consumer material and excluded from the recycled content and recycling rate, $R_{1Pre\text{-}consumer}$ = 0%.

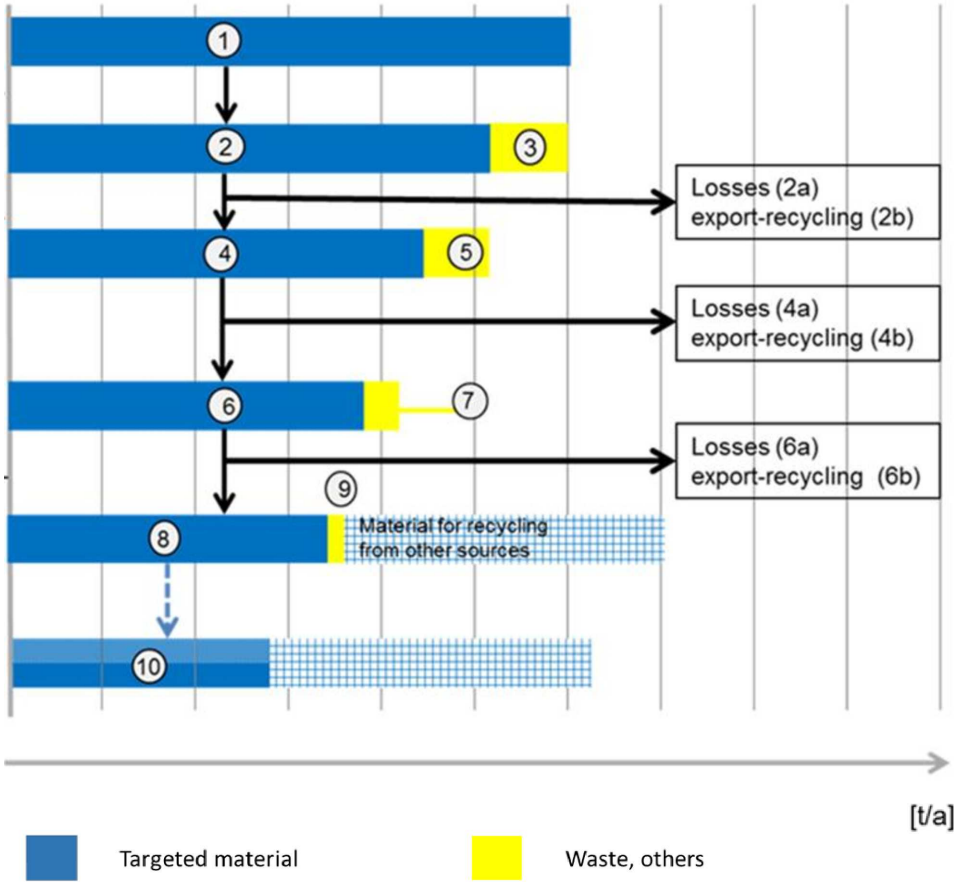


4.4.8.9. *Recycling output rate (R2)*

The R_2 parameter refers to the 'recycling output rate': Figure 8 provides a visual representation. Often, values are available for point 8 ([32]) in Figure 8, therefore such values shall be modified to match the actual output recycling rate (point 10) taking into account possible process losses. In Figure 8, the output recycling rate (R_2) corresponds to point 10.

Figure 8

Simplified collection recycling scheme of a material



A product's design and composition will determine whether if its material is actually suitable for recycling. Therefore, before selecting the appropriate R_2 value, an evaluation of the material's recyclability shall be made and the PEF study shall include a statement on the recyclability of the materials/products.

The statement on recyclability shall be provided together with an evaluation for recyclability that includes evidence for the following three criteria (as described by EN ISO 14021:2016, 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) Recycling facilities to accommodate the collected materials exist;

([32]) Statistical data gathered which corresponds to point 8 in Figure 8 may be used to calculate the recycling output rate. Point 8 corresponds to recycling targets calculated according to the general rule provided in Directive (EU) 2018/851 of 30 May 2018. In some cases, under strict conditions and by way of derogation from the general rule, data may be available at point 6 in Figure 8 and may be used to calculate the recycling output rate.

3) Evidence is available to show that the product for which recyclability is claimed is being collected and recycled. For PET bottles, the European PET Bottle Platform (EPBP) guidelines should be used (https://www.epbp.org/design-guidelines), while for generic plastics, the recyclability by design should be used (www.recoup.org).

If one criterion is not fulfilled, or the sector-specific recyclability guidelines indicate limited recyclability, an R_2 value of 0% shall be applied. Point (1) and (3) may be proven by recycling statistics, which should be country-specific derived from industry associations or national bodies. Approximation to evidence at point (3) may be provided by applying, for example, the design for evaluating recyclability outlined in EN 13430 Material recycling (Annexes A and B) or other sector-specific recyclability guidelines if available.

Default application-specific R_2 values are available in Part C of Annex II. The following procedure shall be followed to select the R_2 value to be used in a PEF study:

(a) Company-specific values shall be used when available, after recyclability has been evaluated.

(b) If no company-specific values are available and the criteria used for evaluating recyclability are fulfilled (see above), application-specific R_2 values shall be used selecting the appropriate value available in Part C of Annex II:

— 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.

Note that new R_2 values may be provided to the Commission to be implemented in Part C of Annex II. Newly proposed R_2 values (based on new statistics) shall be provided together with a study report indicating the sources and calculations, and reviewed by an external independent third party. The Commission will decide if the new values are acceptable and can be implemented in an updated version of Part C of Annex II. Once the new R_2 values are integrated into Part C of Annex II, they may be used by any PEF study.

The applied R_2 values shall be subject to verification.

4.4.8.10. *The R3 value*

The R_3 value is the proportion of the product's material that is used for energy recovery at EoL. The R_3 values applied shall be company-specific or default values taken from Part C of Annex II, depending on the information available to the company conducting the PEF study. The following procedure shall be applied (in hierarchical order) to select the R_3 value to be used in a PEF study.

(a) Company-specific values shall be used when the process is run by the company conducting the PEF study or when the process is not run by the company conducting the PEF study but that company has access to (company-)specific information (Situation 1 and Situation 2 of the DNM, see Section 4.6.5.4).

(b) In all other cases, the default secondary R_3 values of Part C of Annex II shall be applied.

(c) When no value is available in Part C of Annex II, new values can be used for R_3 (using statistics or other data sources) or shall be set to 0%.

The applied R_3 values shall be subject to verification.

4.4.8.11. *$E_{recycled}$ (E_{rec}) and $E_{recyclingEoL}$ (E_{recEoL})*

E_{rec} and E_{recEoL} are the specific emissions and resources consumed (per functional unit) arising from the recycling process of the recycled material and at EoL, respectively. The system boundary of E_{rec} and E_{recEoL} shall take into account all the emissions and resources consumed starting from collection up to the defined point of substitution.

If the point of substitution is identified at 'level 2' E_{rec} and E_{recEoL} shall be modelled using the real input flows. Therefore, if a portion of the input flows are from primary raw materials, it shall be included in the datasets used to model E_{rec} and E_{recEoL}.

In some cases, E_{rec} may correspond to E_{recEoL}, for example, in cases where close loops occur.

4.4.8.12. *E_{*v}*

E^*_v are the 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. When default E^*_v equals E_v, the user shall assume that a recyclable material at EoL is replacing the same virgin material which was used at the input side to produce the recyclable material.

When E^*_v is different from $E_{v.}$, the user shall provide evidence that recyclable material is substituting a different virgin material than the one producing the recyclable material.

If $E^*_v \neq E_v$, E^*_v represents the actual amount of virgin material substituted by the recyclable material. In such cases, E^*_v is not multiplied by Qs_{out}/Q_p, because this parameter is indirectly taken into account when calculating the 'actual amount' of virgin material substituted. Such an amount shall be calculated taking into account that the virgin material substituted and the recyclable material fulfil the same function in terms of 'how long' and 'how well'. E^*_v shall be determined based on evidence of actual substitution of the selected virgin material.

4.4.8.13. *How to apply the formula to intermediate products (cradle-to-gate studies)*

In cradle-to-gate PEF studies, the parameters related to the product's EoL (i.e. recyclability at EoL, energy recovery, disposal) shall not be accounted for.

If the formula is applied in PEF studies for intermediate products (cradle-to-gate studies), the user of the PEF study shall:

1) use Equation 3 (CFF);

2) exclude the EoL by setting the parameters R_2, R_3, and E_d equal to 0, for the products in scope;

3) use and report the results with two A values for the product in scope:

   (a) Setting A = 1: to be used as the default in calculating the PEF profile. This value applies only to the recycled content of the product in scope. The purpose of this setting is to enable the hotspot analysis to be focused on the actual system.

   (b) Setting A = the application- or material-specific default values: these results shall be reported as 'additional technical information' and used when creating EF compliant datasets. The purpose of this setting is to enable the correct A value to be used when the dataset is used in future modelling.

Table 9 provides a summary on how to apply the CFF, depending on a study focusing on final products, or intermediate products.

Table 9

Summary table on how to apply the CFF in different situations

A value	Final products	Intermediates
A = 1	-	shall (hotspot and PEF profile)
A = default	shall	shall (additional technical info. and EF compliant dataset)

4.4.8.14. *How to deal with specific aspects*

Recovery of bottom ash or slag from incineration

Recovery of bottom ash or slag shall be included in the R_2 value (recycling output rate) of the original product/ material. Their treatment is within the E_{recEoL}.

Landfilling and incineration with energy recovery

Whenever a process, such as landfilling with energy recovery or municipal solid waste incineration with energy recovery, leads to energy recovery, it shall be modelled under the 'energy' part in Equation 3 (CFF). The credit is calculated based on the amount of output energy that is used outside the process.

Municipal solid waste

Part C of Annex II contains default values per country that shall be used to quantify the share going to landfilling and the share going to incineration unless supply-chain specific values are available.

Compost and anaerobic digestion/ sewage treatment

Compost, including digestate coming out of the anaerobic digestion, shall be treated in the 'material' part (Equation 3) like recycling with A = 0.5. The energy part of the anaerobic digestion shall be treated as a normal process of energy recovery under the 'energy' part of

Equation **3** (CFF).

Waste materials used as fuel

When waste material is used as a fuel (e.g. waste plastic used as fuel in cement kilns), it shall be treated as an energy recovery process under the 'energy' part of

Equation **3** (CFF).

Modelling complex products

When considering complex products (e.g. printed wiring boards) with complex EoL management, the default datasets for EoL treatment processes may already implement the CFF. The default values of the parameters shall refer to the ones in Part C of Annex II and shall be available as metadata information in the dataset. The bill of material (BoM) should be taken as a starting point for calculations if no default data is available.

Reuse and refurbishment

If the reuse/refurbishment of a product results in a product with different product specifications (providing another function), this shall be considered as part of the CFF, as a form of recycling. Old parts that were changed during refurbishment shall be modelled under the CFF.

In this case, reuse/refurbishment activities fall under the E_{recEoL} parameter, while the alternative function provided (or the avoided production of parts or components) falls under the E*v parameter.

4.4.9. Extended product lifetime

Extending a product's lifetime due to reuse or refurbishment may result in the following.

1. A product with the original product specifications (providing the same function).

   In this situation, the product lifetime is extended to a product with the original product specifications (providing the same function) and shall be included in the FU and reference flow. The user of the PEF method shall describe how reuse or refurbishment is included in calculating the reference flow and the full life-cycle model, taking into account the 'how long' of the FU.

2. A product with different product specifications (providing another function).

   This shall be considered as part of the CFF, as a form of recycling (see Section 4.4.8.13. How to apply the formula to intermediate products (cradle-to-gate studies)). Also, old parts that have been changed during refurbishment shall be modelled under the CFF.

4.4.9.1. *Reuse rates (situation 1 in Section 4.4.9)*

The reuse rate is the number of times a material is used at the factory. This is also often called trip rates, reuse time or number of rotations. This may be expressed as the absolute number of reuse or as % of reuse rate.

For example: a reuse rate of 80% equals 5 reuses. Equation 4 describes the conversion:

$$\text{Number of reuse} = \frac{1}{100\% - (\%\ \text{reuse rate})} \qquad \text{[Equation 4]}$$

The number of reuses applied here refers to the total number of uses during the life of the material. It includes both the first use and all of the following reuses.

4.4.9.2 *How to apply and model the 'reuse rate' (situation 1 in Section 4.4.9)*

The number of times a material is reused affects the product's environmental profile at different life-cycle stages. The following five steps explain how the user shall model the different life-cycle stages with reusable materials, using packaging as an example.

1. Raw material acquisition: the reuse rate determines the quantity of packaging material consumed per product sold. The raw material consumption shall be calculated by dividing the actual weight of the packaging by the number of times this packaging is reused. For example, a 1 l glass bottle weighs 600 grams and is reused 10 times (reuse rate of 90%). The raw material use per litre is 60 grams (= 600 grams per bottle / 10 reuses).

2. Transport from packaging manufacturer to the product factory (where the products are packed): The reuse rate determines the quantity of transport that is needed per product sold. The transport impact shall be calculated by dividing the one-way trip impact by the number of times the packaging is reused.

3. Transport from product factory to final client and back: in addition to the transport needed to go to the client, the return transport shall also be taken into account. To model the total transport, see Section 4.4.3 on modelling transport.

4. At the product factory: once the empty packaging is returned to the product factory, energy and resource use shall be taken into consideration as regards cleaning, repairing or refilling (if applicable).

5. Packaging EoL: the reuse rate determines the quantity of packaging material (per product sold) to be treated at the EoL. The amount of packaging treated at the EoL shall be calculated by dividing the actual weight of the packaging by the number of times it was reused.

4.4.9.3. *Packaging reuse rates*

A packaging return system is organised by:

1. the company that owns the packaging material (company-owned pools); or

2. a third party e.g. the government or a pooler (third party operated pools).

This may affect the material's lifetime as well as the data source to be used. Therefore, it is important to separate these two return systems.

For company-owned packaging pools, the reuse rate shall be calculated using supply chain specific data. Depending on the data available within the company, two different calculation approaches may be used (see option 'a' and option 'b' below). Returnable glass bottles are used as an example but the calculations also apply for another company-owned reusable packaging.

Option 'a': use supply-chain-specific data, based on accumulated experience over the lifetime of the previous glass bottle pool. This is the most accurate way of calculating the reuse rate of bottles for the previous bottle pool and is a proper estimate for the current bottle pool. The following supply chain-specific data is collected.

1. Number of bottles filled during the bottle pool's lifetime ($\#F_i$)

2. Number of bottles at initial stock plus purchased over the bottle pool's lifetime (#B)

$$\text{Reuse rate of the bottle pool} = \frac{\#F_i}{\#B} \qquad \text{[Equation 5]}$$

$$\text{The net glass use (kg glass/l beverage)} = \frac{\#B \times (\text{kg glass/bottle})}{\#F_i} \qquad \text{[Equation 6]}$$

This calculation option shall be used:

(i) With data from the previous bottle pool when the previous and current bottle pool are comparable, meaning, the same product category, similar bottle characteristics (e.g. size), comparable return systems (e.g. collection methods, same consumer group and outlet channels), etc.

(ii) With data from the current bottle pool when future estimations/extrapolations are available on (i) the bottle purchases, (ii) the volumes sold, and (iii) the bottle pool's lifetime.

The data shall be supply-chain-specific and shall be verified during the verification and validation process, including the reasoning for the method choice.

Option 'b': If no real data is tracked, the calculation shall be done partly based on assumptions. This option is less accurate due to the assumptions made and therefore conservative/safe estimates shall be used. The following data is needed.

1. Average number of rotations of a single bottle, during one calendar year (if not broken). One loop consists of filling, delivery, use and return to the company for washing (#Rot).

2. Estimated lifetime of the bottle pool (LT, in years).

3. Average percentage of loss per rotation. This refers to the sum of losses at the consumer stage and the bottles scrapped at filling sites (%Los).

$$\text{Reuse rate of the bottle pool} = \frac{LT}{(LT \times \%Los) + \left(\frac{1}{\#Rot}\right)} \qquad \text{[Equation 7]}$$

This calculation option shall be used when option 'a' is not applicable (e.g. the previous pool cannot be used as a reference). The data used shall be verified during the verification and validation process, including the reason for choosing between option 'a' and option 'b'.

4.4.9.4 *Average reuse rates for company-owned pools*

PEF studies that have company owned reusable packaging pools in scope shall use company specific reuse rates, calculated following the rules outlined in Section 4.4.9.3.

4.4.9.5 *Average reuse rates for third party operated pools*

The following reuse rates shall be used in those PEF studies that have third party operated reusable packaging pools in scope, unless better quality data are available:

a) glass bottles: 30 trips for beer and water, 5 trips for wine ([33]);

b) plastic crates for bottles: 30 trips ([34]);

c) plastic pallets: 50 trips (Nederlands Instituut voor Bouwbiologie en Ecologie, 2014) ([35]);

d) wooden pallets: 25 trips (Nederlands Instituut voor Bouwbiologie en Ecologie, 2014) ([36]).

The user of the PEF method may use other values if they are justified and data sources are provided.

([33]) Assumption based on the monopoly system of Finland. http://ec.europa.eu/environment/waste/studies/packaging/finland.pdf
([34]) Technical approximation as no data source could be found. Technical specifications guarantee a lifetime of 10 years. A return of 3 times per year (between 2 to 4) is taken as a first approximation.
([35]) The less conservative number is used.
([36]) Half of plastic pallets is used as an approximation

The user of the PEF method shall indicate if company-owned or third party operated pools were in scope and which calculation method or default reuse rates were used.

4.4.10 Greenhouse gases emissions and removals

The PEF method distinguishes three main categories of greenhouse gases (GHG) emissions and removals, each contributing to levels within a specific sub-category within the impact category of 'climate change':

1. fossil GHG emissions and removals (contributing to the sub-category 'Climate change – fossil');

2. biogenic carbon emissions and removals (contributing to the sub-category 'Climate change – biogenic');

3. carbon emissions from land use and land use change (contributing to the sub-category 'Climate change – land use and land use change').

Currently, credits associated with temporary and permanent carbon storage and/or delayed emissions shall not be considered in the calculation of the climate change indicator. This means that all emissions and removals shall be considered as emitted 'now', and there is no discounting of emissions over time (in line with EN ISO 14067:2018). Developments will be considered in order to keep the method updated with scientific evidence and expert-based consensus.

The sub-categories 'climate change – fossil', 'climate change – biogenic' and 'climate change - land use and land transformation', shall be reported separately if they show a contribution of more than 5% ([37]) each to the total score of climate change.

4.4.10.1 *Sub-category 1: Climate change – fossil*

This category covers GHG emissions to any media originating from the oxidation and/or reduction of fossil fuels by means of their transformation or degradation (e.g. combustion, digestion, landfilling, etc.). This impact category includes emissions from peat (used as a fuel) and calcination, and uptakes due to carbonation.

Fossil CO_2 uptake and corresponding emissions (e.g. due to carbonation) shall be modelled in a simplified way when calculating the PEF profile (meaning no emissions or uptakes shall be modelled). When knowledge about the amount of fossil CO_2 uptake is required for additional environmental information, the CO_2 uptake may be modelled with the flow 'carbon dioxide (fossil), resources from air'.

The flows falling under this definition shall be modelled consistently with the elementary flows in the most updated EF reference package and use names that end with '(fossil)', if available (e.g. 'carbon dioxide (fossil)' and 'methane (fossil)').

4.4.10.2. *Sub-category 2: Climate change – biogenic*

This sub-category covers (i) carbon emissions to air (CO_2, CO and CH_4) originating from the oxidation and/or reduction of aboveground biomass by means of its transformation or degradation (e.g. combustion, digestion, composting, landfilling), and (ii) CO_2 uptake from the atmosphere through photosynthesis during biomass growth, i.e. corresponding to the carbon content of products, biofuels or above-ground plant residues such as litter and dead wood. Carbon exchanges from native forests ([38]) shall be modelled under sub-category 3 (including connected soil emissions, derived products or residues).

([37]) For example, let: Let us assume that 'Climate change – biogenic' contributes with 7% (using absolute values) to the total climate change impact and 'Climate change – land use and land use change' contributes with 3% to the total climate change impact. In this case, the total climate change impact and the 'Climate change – biogenic' shall be reported.

([38]) Native forests refer to native or long-term, non-degraded forests. Definition adapted from Table 8 in the Annex of Commission Decision C(2010)3751 on guidelines for the calculation of land carbon stocks for the purpose of Annex V of Directive 2009/28/EC. In principle, this definition excludes short- term forests, degraded forests, managed forest, and forests with short-term or long-term rotations.

Modelling requirements: the flows falling under this definition shall be modelled consistently with the elementary flows in the most recent version of the EF package and use flow names that end with '(biogenic)'. Mass allocation shall be applied to model the biogenic carbon flows.

A simplified modelling approach should be used only if the flows which influence the results of climate change impact (namely biogenic methane emissions) are modelled. This option may apply, for example, to food PEF studies as it avoids modelling human digestion while eventually arriving at a zero balance. In this case, the following rules apply:

(i) only the emission 'methane (biogenic)' is modelled;

(ii) no further biogenic emissions and uptakes from the atmosphere are modelled;

(iii) if methane emissions are both fossil and biogenic, the release of biogenic methane shall be modelled first, followed by the remaining fossil methane.

For intermediate products (cradle-to-gate), the biogenic carbon content at the factory gate (physical content) shall always be reported as 'additional technical information'.

4.4.10.3. *Sub-category 3: Climate change – land use and land use change (LULUC)*

This sub-category accounts for carbon uptakes and emissions (CO_2, CO and CH_4) originating from carbon stock changes caused by land use change and land use. This sub-category includes biogenic carbon exchanges from deforestation, road construction or other soil activities (including 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 forests ([39]) and residues), while their CO_2 uptake is excluded.

A distinction is made between direct and indirect land use change. Direct land use change occurs as the result of a transformation from one land use type into another, which takes place in a particular/certain piece of land cover, possibly leading to changes in the carbon stock of that specific piece of land, but not in other systems. Examples of direct land use change are the conversion of land used for growing crops to industrial use or conversion from forestland to cropland.

Indirect land use change occurs when a certain change in land use, or in the use of the feedstock grown on a given piece of land, causes changes in land use outside the system boundary, i.e. in other land use types. The PEF method only considers direct land use change, while indirect land use change, due to the lack of an agreed methodology, shall not be taken into account in PEF studies. Indirect land use change may be included under additional environmental information.

Modelling requirements: the flows falling under this definition shall be modelled consistently with the elementary flows in the most recent version of the EF package and use the flow names that end with '(land use change)'. Biogenic carbon uptakes and emissions shall be inventoried separately for each elementary flow. 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.

Quoting PAS 2050:2011 (BSI 2011):

'Large emissions of GHGs can result as a consequence of land use change. Removals as a direct result of land use change (and not as a result of long-term management practices) do not usually occur, although it is recognized that this could happen in specific circumstances. Examples of direct land use change are the conversion of land used for growing crops to industrial use or conversion from forestland to cropland. All forms of land use change that result in emissions or removals are to be included. Indirect land use change refers to such conversions of land use as a consequence of changes in land use elsewhere. While GHG emissions also arise from indirect land use change, the methods and data requirements for calculating these emissions are not fully developed. Therefore, the assessment of emissions arising from indirect land use change is not included.

([39]) Following the instantaneous oxidation approach in IPCC 2013 (Section 2).

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 ([40]).

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:

   a) the earliest year in which it can be demonstrated that the land use change had occurred; or

   b) 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, before performing 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.'

Intermediate products (cradle-to-gate) derived from native forests shall always report as meta-data (in the 'additional technical information' section of the PEF report): (i) their carbon content (physical content and allocated content) and (ii) that corresponding carbon emissions shall be modelled with '(land use change)' elementary flows.

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

For **soil carbon stock**: soil carbon emissions shall be included and modelled under this sub-category (e.g. from rice fields). Soil carbon emissions derived from aboveground residues (except from native forests) shall be modelled under sub-category 2, such as the application of non-native forest residues or straw. Soil carbon uptake (accumulation) shall be excluded from the results, e.g. from grasslands or improved land management through tilling techniques or other management measures taken related to agricultural land. Soil carbon storage may only be included in the PEF study as additional environmental information and if a proof is provided. If legislation has different modelling requirements for the sector, such as the EU Decision on greenhouse gas accounting from 2013 ([41]), which indicates carbon stock accounting, it shall be modelled according to the relevant legislation and provided under additional environmental information.

4.4.11 Offsets

The term 'offset' is frequently used to refer to third-party GHG mitigation activities, e.g. regulated schemes that are part of the Kyoto Protocol (the former clean-development mechanism; joint implementation), new mechanisms discussed in the context of negotiations article 6 of the Paris agreement emissions trading schemes, or voluntary schemes. Offsets are GHG reductions used to compensate for (i.e. offset) GHG emissions elsewhere, for example to meet a voluntary or mandatory GHG target or cap. Offsets are calculated relative to a baseline that represents a hypothetical scenario for what emissions would have been in the absence of the mitigation project that generates the offsets. Examples are carbon offsetting by the clean development mechanism, carbon credits, and other system-external offsets.

Offsets shall not be included in the impact assessment of a PEF study, but shall be reported separately as additional environmental information.

4.5 *Handling multi-functional processes*

If a process or facility provides more than one function, i.e. it delivers several goods and/or services ('co-products'), it is 'multifunctional'. In these situations, all inputs and emissions linked to the process shall be partitioned between the product of interest and the other co-products in a principled manner. Systems involving multi-functionality of processes shall be modelled in line with the following decision hierarchy.

Specific allocation requirements in other sections of this method always prevail over the ones available in this section (e.g. Sections 4.4.2 on electricity, 4.4.3 on transport, 4.4.10 on GHG emissions, or 4.5.1 on slaughterhouse activities).

Decision hierarchy

1) Subdivision or system expansion

As per EN ISO 14044:2006, wherever possible, subdivision or system expansion should be used to avoid allocation. Subdivision refers to disaggregating multifunctional processes or facilities to isolate the input flows directly associated with each process or facility output. System expansion refers to expanding the system by including additional functions related to the co-products. It shall be investigated first whether it is possible to subdivide or expand the analysed process. Where subdivision is possible, inventory data shall be collected only for those unit processes directly attributable ([42]) to the goods/services of concern. Or, if the system may be expanded, the additional functions shall be included in the analysis, with results communicated for the expanded system as a whole rather than on an individual co-product level.

2) Allocation based on a relevant underlying physical relationship

Where it is not possible to apply subdivision or system expansion, allocation should be applied: the inputs and outputs of the system should be partitioned between its different products or functions in a way that reflects relevant underlying physical relationships between them (EN ISO 14044:2006).

([41]) Decision No 529/2013/EU of the European Parliament and of the Council of 21 May 2013 on accounting rules on greenhouse gas emissions and removals resulting from activities relating to land use, land-use change and forestry and on information concerning actions relating to those activities, OJ L 165/80.

([42]) Directly attributable refers to a process, activity or impact occurring within the defined system boundary.

Allocation based on a relevant underlying physical relationship refers to partitioning the input and output flows of a multi-functional process or facility in line with a relevant, quantifiable physical relationship between the process inputs and co-product outputs (for example, a physical property of the inputs and outputs that is relevant to the function provided by the co-product of interest). Allocation based on a physical relationship may be modelled using direct substitution, if it is possible to identify a product that is directly substituted.

To demonstrate that the direct substitution effect is robust, the user of the PEF method shall prove that:

(1) there is a direct, empirically demonstrable substitution effect, AND

(2) it is possible to model the substituted product and to subtract the LCI in a directly representative manner: if both conditions are fulfilled, model the substitution effect.

Or to allocate input/output based on some other relevant underlying physical relationship that relates the inputs and outputs to the function provided by the system, the user of the PEF method shall demonstrate that it is possible to define a relevant physical relationship by which to allocate the flows attributable to the provision of the defined function of the product system: if this condition is fulfilled, the user of the PEF method may allocate based on this physical relationship.

3) Allocation based on some other relationship

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. The market price of the co-functions should refer to the specific conditions and stage of the process in which the co-products are produced. In any case, to ensure the physical representativeness of the PEF results as far as possible a clear justification for having discarded 1) and 2) and for having selected a certain allocation rule in step 3) shall be provided.

Allocation based on some other relationship may be approached in one of the following alternative ways.

(i) Is it possible to identify an indirect substitution ([43]) effect and can the substituted product be modelled and the inventory subtracted in a reasonably representative manner? If yes (i.e. both conditions are verified), model the indirect substitution effect.

(ii) Is it possible to allocate the input/output flows between the products and functions on the basis of some other relationship (e.g. the relative economic value of the co-products)? If yes, allocate products and functions based on the relationship identified.

The circular footprint formula (see Section 4.4.8.1) provides the approach that shall be used to estimate the overall emissions that result from a certain process involving recycling and/or energy recovery. These moreover also relate to waste flows generated within the system boundary.

4.5.1 Allocation in animal husbandry

This section provides instructions on how to address specific issues related to the modelling of farm, slaughterhouse and rendering for cattle, pigs, sheep and goats. In particular, instructions are provided on:

1. allocation of upstream burdens at farm level among outputs leaving the farm

2. allocation of upstream burdens (linked to live animals) at slaughterhouse level among outputs leaving the slaughterhouse.

([43]) Indirect substitution occurs when a product is substituted but you do not know by which products exactly.

4.5.1.1 *Allocation within the farm module*

At farm module, subdivision shall be used for processes that are directly allocated to certain outputs (e.g. energy use and emissions related to milking processes). If the processes cannot be subdivided due to the lack of separate data or because it is technically impossible, the upstream burden, e.g. feed production, shall be allocated to farm outputs using a biophysical allocation method. Default values used for allocation are provided in the following sections for each type of animal. These default values shall be used in PEF studies unless company-specific data are collected. Changing allocation factors is only allowed if company-specific data are collected and used for the farm module. In case secondary data are used for the farm module, no change of allocation factors is allowed.

4.5.1.2 *Allocation within the farm module for cattle*

The International Dairy Federation (IDF) (2015) allocation method between milk, cull cows and surplus calves shall be used. Dead animals and all products from dead animals shall be regarded as waste and the circular footprint formula shall be applied. In this case, however, the traceability of the products from dead animals shall be guaranteed to enable PEF studies to take this aspect into consideration.

Manure exported to another farm shall be considered as one of the following.

(a) **Residual (default option):** if manure does not have an economic value at the farm gate, it is regarded as residual without allocation of an upstream burden. The emissions related to manure management up to the farm gate are allocated to the other farm outputs where manure is produced.

(b) **Co-product**: when exported manure has an economic value at the farm gate, an economic allocation of the upstream burden shall be used for manure by using the relative economic value of manure compared to milk and live animals at the farm gate. However, biophysical allocation based on IDF rules shall be applied to allocate the remaining emissions between milk and live animals.

(c) **Manure as waste**: when manure is treated as waste (e.g. landfilled), the circular footprint formula shall be applied.

The allocation factor (AF) for milk shall be calculated using the following equation:

$$AF = 1 - 6.04 * \frac{M_{meat}}{M_{milk}} \qquad \text{[Equation 8]}$$

M_{meat} is the mass of live weight of all animals sold including bull calves and culled mature animals per year and M_{milk} is the mass of fat and protein corrected milk (FPCM) sold per year (corrected to 4% fat and 3.3% protein). The constant 6.04 describes the causal relationship between the energy content in feed in relation to the milk and live weight of animals produced. The constant is determined based on a study that collected data from 536 US dairy farms ([44]) (Thoma et al., 2013). Although based on US farms, the IDF considers that the approach is applicable to European farming systems.

The FPCM (corrected to 4% fat and 3.3% protein) shall be calculated by using the following formula:

$$\text{FPCM}\left(\frac{\text{kg}}{\text{yr}}\right) = \text{Production}\left(\frac{\text{kg}}{\text{yr}}\right) * (0.1226 * \text{True Fat \%} + 0.0776 * \text{True Protein \%} + 0.2534) \qquad \text{[Equation 9]}$$

In cases where a default value of 0.02 kg_{meat}/kg_{milk} for the ratio of live weight of animals and milk produced in Equation 9 is used, the equation yields default allocation factors of 12% to live weight of animals and 88% to milk (Table 10). These values shall be used as default values used for allocating the upstream burdens to milk and live weight of animals for cattle when secondary datasets are used. If company-specific data are collected for the farming stage, the allocation factors shall be changed using the equations included in this section.

([44]) Thoma et al., 2013.

Table 10

Default allocation factors for cattle at farming

Co-product	Allocation factor
Animals, live weight	12%
Milk	88%

4.5.1.3 *Allocation within the farm module for sheep and goat*

A biophysical approach shall be used for allocating upstream burdens to the different co-products for sheep and goat. The 2006 IPCC guidelines for national GHG inventories (IPCC, 2006) contain a model for calculating energy requirements that shall be used for sheep and, as a proxy, for goats. This model is applied in this document.

Dead animals and all the products from dead animals shall be regarded as waste and the circular footprint formula (CFF, Section 4.4.8.1) shall be applied. In this case, however, the tracing of products from dead animals shall be allowed so this aspect can be taken into consideration in PEF studies.

It is mandatory to use the default allocation factors included in this document whenever secondary datasets are used for the life-cycle stage of farming for sheep and goats. If company-specific data are used for this life-cycle stage, the allocation factors shall be calculated with the company-specific data using the equations provided.

The allocation factors shall be calculated as follows ([45]):

$$\%\ \mathbf{wool} = \frac{[\mathbf{Energy\ for\ wool\ (NE_{wool})}]}{[(\mathbf{Energy\ for\ wool\ (NE_{wool})} + \mathbf{Energy\ for\ milk\ (NE_l)} + \mathbf{Energy\ for\ meat\ (NE_g)}]} \qquad \text{[Equation 10]}$$

$$\%\ \mathbf{milk} = \frac{[\mathbf{Energy\ for\ milk\ (NE_l)}]}{[(\mathbf{Energy\ for\ wool\ (NE_{wool})} + \mathbf{Energy\ for\ milk\ (NE_l)} + \mathbf{Energy\ for\ meat\ (NE_g)}]} \qquad \text{[Equation 11]}$$

$$\%\ \mathbf{meat} = \frac{[\mathbf{Energy\ for\ meat\ (NE_g)}]}{[(\mathbf{Energy\ for\ wool\ (NE_{wool})} + \mathbf{Energy\ for\ milk\ (NE_l)} + \mathbf{Energy\ for\ meat\ (NE_g)}]} \qquad \text{[Equation 12]}$$

To calculate energy for wool (NE_{wool}), energy for milk (NE_l) and energy for meat (NE_g) with company specific data, the equations included in IPPC (2006), and reported below, shall be used. In case secondary data are used instead, the default values for the allocation factors provided in this document shall be used.

Energy for wool, NE_{wool}

$$\mathbf{NE_{wool}} = \frac{(\mathbf{EV_{wool} \cdot Production_{wool}})}{\mathbf{365}} \qquad \text{[Equation 13]}$$

NE_{wool} = net energy required to produce wool, MJ day^{-1}.

EV_{wool} = the energy value of each kg of wool produced (weighed after drying but before scouring), MJ kg^{-1}. A default value of 157 MJ kg^{-1} (NRC, 2007) shall be used for this estimate ([46]).

$Production_{wool}$ = annual wool production per sheep, kg yr^{-1}.

Default values to be used for calculating NE_{wool} and the resulting net energy required are reported in Table 11.

([45]) The same naming as used in IPCC (2006) is used

([46]) The default value of 24 MJ kg^{-1} originally included in the IPPC document was modified into 157 MJ kg^{-1} following the indication of FAO - greenhouseGreenhouse gas emissions and fossil energy demand from small ruminant supply chains Guidelines for assessment (2016).

Table 11

Default values to be used in calculating NE_{wool} for sheep and goats

Parameter	Value	Source
EV_{wool} - sheep	157 MJ kg^{-1}	NRC, 2007
$Production_{wool}$ - sheep	7,121 kg	Average of the four values provided in Table 1 of 'Application of LCA to sheep production systems: investigating co-production of wool and meat using case studies from major global producers ([1]).'
NE_{wool} - sheep	3,063 MJ/d	Calculated using Eq. 14
NE_{wool} - goat	2,784 MJ/d	Calculated from NE_{wool} – sheep using Eq. 17

([1]) Wiedemann et al, Int J. of LCA 2015.

Energy for milk, NE_l

$$\mathbf{NE_l = Milk \cdot EV_{milk}} \qquad \text{[Equation 1]}$$

NE_l = net energy for lactation, MJ day^{-1}.

Milk = amount of milk produced, kg of milk day^{-1}.

EV_{milk} = the net energy required to produce 1 kg of milk. A default value of 4.6 MJ/kg (AFRC, 1993) shall be used which corresponds to a milk fat content of 7% by weight.

Default values to be used for calculating NE_l and the resulting net energy required are provided in Table 12.

Table 12

Default values to be used in calculating NE_l for sheep and goat

Parameter	Value	Source
EV_{milk} - sheep	4,6 MJ kg^{-1}	AFRC, 1993
Milk - sheep	2,08 kg/d	Estimated milk production 550 lbs of sheep milk per year (average value), milk production estimated for 120 days in one year.
NE_l - sheep	9,568 MJ/d	Calculated using Eq. 15
NE_l - goat	8,697 MJ/d	Calculated from NE_l – sheep using Eq. 17

Energy for meat, NE_g

$$NE_g = WG_{lamb} \cdot \frac{a+0.5b(BW_i+BW_f)}{365} \qquad \text{[Equation 15]}$$

NE_g = net energy needed for growth, MJ day^{-1}.

WG_{lamb} = the weight gain ($BW_f - BW_i$), kg yr^{-1}

BW_i = the live bodyweight at weaning, kg.

BW_f = the live bodyweight at 1-year old or at slaughter (live-weight) if slaughtered prior to 1 year of age, kg.

a, b = constants as described in Table 13.

Note that lambs will be weaned over several weeks as they supplement a milk diet with pasture feed or supplied feed. The time of weaning should be taken as the time at which they depend on milk for half their energy supply. The NE_g equation used for sheep includes two empirical constants ('a' and 'b') that vary by animal species/category (Table 13).

Table 13

Constants for use in calculating NEg for sheep ([1])

Animal species/category	a (MJ kg^{-1})	b (MJ kg^{-2})
Intact males	2,5	0,35
Castrates	4,4	0,32
Females	2,1	0,45

([1]) This table corresponds to Table 10.6 in IPCC (2006).

In case company-specific data are used for the farming stage, the allocation factors shall be recalculated. In this case, the parameter 'a' and 'b' shall be calculated as weighted average if more than one animal category is present.

Default values to be used in calculating NE_g are reported in Table 14.

Table 14

Default values to be used in calculating NEg for sheep and goat

Parameter	Value	Source
WG_{lamb} - sheep	26,2-15=11,2 kg	Calculated
BW_i - sheep	15 kg	It is assumed that the weaning happens at 6 weeks. Weight at 6 weeks as stated from Figure 1 in 'A generic model of growth, energy metabolism and body composition for cattle and sheep', Johnson et al, 2015 – Journal of Animal Science.
BW_f - sheep	26,2 kg	Average of the weight values for sheep at slaughter, as provided in Appendix 5, GHG emissions and fossil energy demand from small ruminant supply chains, FAO 2016b.
a - sheep	3	Average of the three values provided in Table 13.
b - sheep	0,37	Average of the three values provided in Table 13.
NE_g - sheep	0,326 MJ/d	Calculated using Eq. 16.
NEg - goat	0,296 MJ/d	Calculated from NEg – sheep using Eq. 17.

The default allocation factors to be used in PEF studies for sheep and goat are provided in Table 14 together with the calculations. The same equations ([47]) and default values used in calculating the energy requirements for sheep are used in calculating the energy requirements for goats after a correction factor has been applied.

$$\text{Net energy requirement, goat} = \left[\frac{\text{goat weight}}{\text{sheep weight}}\right]^{0.75} \times \text{Net energy requirement sheep} \qquad \text{[Equation 16]}$$

([47]) Page 10.24 of IPCC (2006).

Sheep weight: 64.8 kg, average of male and female sheep for different regions in the world, data from Appendix 5, GHG emissions and fossil energy demand from small ruminant supply chains, FAO (2016b).

Goat weight: 57.05 kg, average of male and female goats for different regions in the world, data from Appendix 5, GHG emissions and fossil energy demand from small ruminant supply chains, FAO (2016b).

$$\text{Net energy requirement, goat} = [(57.05) / (64.8)]^{0.75} \bullet \text{Net energy requirement, sheep} \quad \text{[Equation 17]}$$

Table 15

Default allocation factors to be used PEF studies for sheep at farming stage

	Sheep	Goat ([1])
Allocation factor, meat	$\%\ \mathbf{meat} = \frac{[(NE_g)]}{[(NE_{wool}) + (NE_l) + (NE_g)]} = 2.52\%$	2,51%
Allocation factor, milk	$\%\ \mathbf{milk} = \frac{[(NE_l)]}{[(NE_{wool}) + (NE_l) + (NE_g)]} = 73.84\%$	73,85%
Allocation factor, wool	$\%\ \mathbf{wool} = \frac{[(NE_{wool})]}{[(NE_{wool}) + (NE_l) + (NE_g)]} = 23.64\%$	23,64%

([1]) Allocation factors for goats are calculated starting from the net energy requirements for goats estimated from the net energy requirements for sheep and taking into consideration that: sheep weight = 64.8 kg and goat weight = 57.05 kg.

4.5.1.4 *Allocation within the farm module for pigs*

Allocation at farming stage between piglets and sows shall be made applying economic allocation. The default allocation factors to be used are reported in Table 16.

Table 16

Allocation at farming stage between piglets and sows

	Unit	Price	Allocation factors
Piglets	24,8 p	40,80 €/pig	92,63%
Sow to slaughter	84,8 kg	0,95 €/kg live weight	7,37%

4.5.1.5 *Allocation within the slaughterhouse*

Slaughterhouse and rendering processes produce multiple outputs going to the food and feed chain or to other non-food or feed value chains (e.g. the leather industry or chemical or energy recovery chains).

At the slaughterhouse and rendering module stage, subdivision shall be used for those process flows that are directly attributable to certain outputs. If it is not possible to subdivide the processes, the remaining flows (e.g. excluding those already allocated to milk for milk producing systems or to wool for wool producing systems) shall be allocated to the slaughterhouse and rendering outputs using economic allocation. Default allocation factors are provided in the following sections for cattle, pigs and small ruminants (sheep, goat). These default values shall be used in PEF studies. Changes to the allocation factors are not allowed.

4.5.1.6 **Allocation within the slaughterhouse for cattle**

At the slaughterhouse, the allocation factors are established for the five product categories described in

Table 17. If allocation factors used for subdividing the impact of the carcass among the different cuts are preferred, they shall be defined and justified in the PEF study.

The by-products that originate from the slaughterhouse and rendering are classified in three categories.

Category 1: Risk materials, e.g. infected/contaminated animals or animal by-products:

— disposal and use: incineration, co-incineration, landfill, used as biofuel for combustion, manufacture of derived products.

Category 2: Manure and digestive tract content, products of animal origin unfit for human consumption:

— disposal and use: incineration, co-incineration, landfill, fertilisers, compost, used as biofuel for combustion, manufacture of derived products.

Category 3: Carcasses and parts of animals slaughtered which are fit for human consumption but are not intended to be used for this purpose for commercial reasons, including skins and hides going to the leather industry (note that hides and skins may also belong to other categories depending on the condition and nature that is determined by the accompanying sanitary documentation):

— disposal and use: incineration, co-incineration, landfill, feed, pet food, fertilisers, compost, used as biofuel for combustion, manufacture of derived products (e.g. leather), oleo-chemicals and chemicals.

The upstream burdens to slaughterhouse and rendering outputs shall be allocated as follows:

Food grade materials: product with allocation of upstream burdens.

Category 1 material: by default upstream burdens are not allocated, as it is seen as animal by-product treated as waste according to the CFF.

Category 2 material: by default, upstream burdens are not allocated, as it is seen as animal by-product treated as waste according to the CFF.

Category 3 material has the same fate as that of Category 1 and 2 (for fat – to be burned, or bone and meat meal) **and does not have an economic value at the slaughterhouse gate**: by default, upstream burdens are not allocated, as it is treated as waste according to the CFF.

Category 3 skins and hides (unless they are classified as waste and/or follow the same way as Category 1 and Category 2): product with allocation of upstream burdens.

Category 3 materials, not included in previous categories: product with upstream burdens allocated.

The default values in

Table 17 shall be used in PEF studies. Changes to the allocation factors are not allowed.

Table 17

Economic allocation ratios for beef ([1])

	Mass fraction	Price	Economic allocation (EA)	Allocation ratio (*) **(AR)**
	%	€/kg	%	
a) Fresh meat and edible offal	49,0	3,00	92,9[57]	1,90
b) Food grade bones	8,0	0,19	1,0	0,12
c) Food grade fat	7,0	0,40	1,8	0,25
d) Category 3 slaughter by-products	7,0	0,18	0,8	0,11

e) Hides and skins	7,0	0,80	3,5	0,51
f) Category 1/2 material and waste	22,0	0,00	0,0	0,00

([1]) Based on the PEF screening study (v 1.0, November 2015) of of the pilot PEFCR on meat (bovine, pigs and sheep), available at https://webgate.ec.europa.eu/fpfis/wikis/pages/viewpage.action?pageId=81474527. ECAS registration needed to access the website

(*) AR have been calculated as 'Economic allocation' divided by 'Mass fraction'

AR shall be used to calculate the environmental impact of a unit of product by using the equation below:

$$EI_i = EI_w * AR_i \qquad \text{[Equation 18]}$$

EI_i is the environmental impact per mass unit of product i, (i = a slaughterhouse output listed in **Table 17**), EI_w is the environmental impact of the whole animal divided by live weight mass of the animal, and AR_i is the allocation ratio for product i (calculated as economic value of i divided by mass fraction of i).

EI_w shall include upstream impacts, slaughterhouse impacts that are not directly attributable to any specific product and impact from the management of slaughterhouse waste (cat. 1 and 2 material and waste in **Table 17**).

The default values for AR_i as shown in **Table 17** shall be used for the EF studies to represent the European average situation.

4.5.1.7 *Allocation within the slaughterhouse for pigs*

The default values in **Table 18** shall be used in PEF studies dealing with allocation within the slaughterhouse for pigs. Changing allocation factors based on company-specific data is not allowed.

Table 18

Economic allocation ratios for pigs ([1])

	Mass fraction	Price	Economic allocation (EA)	Allocation ratio* (AR)
	%	€/kg	%	
a) Fresh meat and edible offal	67,0	1,08	98,67	1,54
b) Food grade bones	11,0	0,03	0,47	0,04
c) Food grade fat	3,0	0,02	0,09	0,03
d) Category 3 slaughter by-products	19,0	0,03	0,77	0,04
e) Hides and skins (categorised in Category 3 products)	0,0	0,00	0	0
Total	100,0		100,0	

([1]) Based on the PEF screening study (v 1.0, November 2015) of the meat pilot, available at https://webgate.ec.europa.eu/fpfis/wikis/pages/viewpage.action?pageId=81474527

4.5.1.8 *Allocation within the slaughterhouse for sheep and goat*

The default values in Table **19** shall be used in PEF studies that deal with allocation within the slaughterhouse for sheep and goats. Changes to allocation factors based on company-specific data are not allowed. The same allocation factors used for sheep shall also be used for goats.

Table 19

Economic allocation ratios for sheep [1]

	Mass fraction	Price	Economic allocation (EA)	Allocation ratio* (AR)
	%	€/kg	%	
a) Fresh meat and edible offal	44,0	7	97,8[60]	2,22
b) Food grade bones	4,0	0,01	0,0127	0,0032
c) Food grade fat	6,0	0,01	0,0190	0,0032
d) Category 3 slaughter by-products	13,0	0,15	0,618	0,05
e) Hides and skins (categorised in Category 3 products)	14,0	0,35	1,6	0,11
f) Category 1 / 2 material and waste	19	0	0	0
Total	100		100	

[1] Based on the PEF screening study (v 1.0, November 2015) of the meat pilot, available at https://webgate.ec.europa.eu/fpfis/wikis/pages/viewpage.action?pageId=81474527

4.6 *Data collection requirements and quality requirements*

4.6.1 Company-specific data

This section describes company-specific LCI data, which are directly measured or collected at a specific facility or set of facilities, and representative of one or more activities or processes in the system boundary.

The data shall include all known inputs and outputs for the processes. Examples for inputs: use of energy, water, land, materials. Examples of outputs: the products, co-products, emissions and waste generated. Emissions are divided into three compartments (emissions to air, to water and to soil).

There are several ways to collect company-specific emission data, for example, they can be based on direct measurements or calculated using company-specific activity data and related emission factors (e.g. litre of fuel consumption and emission factors for combustion in a vehicle or boiler). Whenever the sector of the product in scope is covered by EU ETS monitoring rules, the user of the PEF method should follow quantification requirements as set out in Regulation (EU) 2018/2066 for the processes and GHGs covered therein. For carbon capture and storage, the requirements of this Annex prevail. The data may need scaling, aggregation or other forms of mathematical treatment to bring them in line with the functional unit and reference flow of the process.

Typical specific sources of company-specific data are:

(a) process- or plant-level consumption data;

(b) bills and stock/inventory changes of consumables;

(c) emission measurements (amounts and concentrations of emissions from flue gas and wastewater);

(d) composition of products and waste;

(e) procurement and sale department(s)/unit(s).

All new datasets created when conducting a PEF study shall be EF compliant.

All company-specific data shall be modelled in company-specific datasets.

The bill of material (BoM) ([48]) has two parts: the list of materials/ingredients and the quantity used for each of them.

The activity data of the BoM shall be specific to the product in scope and modelled with company-specific data. For companies producing more than one product, the activity data used (including the BoM) shall be specific to the product covered by the study.

The modelling of the manufacturing processes shall be based on company-specific data (e.g. energy needed to assemble the materials/components of the product in scope). For companies producing more than one product, the activity data used (including the BoM) shall be specific to the product covered by the study.

4.6.2 Secondary data

Secondary data refer to data not based on direct measurements or on calculation of the respective processes in the system boundary. Secondary data are either sector-specific, i.e. specific to the sector being considered for the PEF study, or multi-sector. Examples of secondary data include:

(a) data from literature or scientific papers;

(b) industry average life-cycle data from LCI databases, industry association reports, government statistics, etc.

All secondary data shall be modelled in secondary datasets which shall fulfil the data hierarchy in Section 4.6.3 and the quality requirements specified in Section 4.6.5. The sources of these data used shall be clearly documented and reported in the PEF report.

4.6.3 Datasets to be used

PEF studies shall use secondary datasets that are EF compliant, when available. To develop secondary EF compliant datasets, the Guide for EF compliant datasets shall be followed ([49]). If an EF compliant secondary dataset does not exist or cannot be developed, the selection of the datasets to be used shall be done according to the following rules, provided in hierarchical order.

1. Use an EF compliant proxy (if available); the use of proxy datasets shall be reported in the limitations section of the PEF report,;data converted from previous EF compliance systems (e.g. EF2.0 to EF3.0) are considered proxies.

2. Use an ILCD entry level (EL) compliant dataset as a proxy ([50]). A maximum of 10% of the single overall score may be derived from ILCD-EL compliant datasets .

3. If no EF compliant or ILCD-EL compliant dataset is available, then the process shall be excluded from the model. This shall be clearly stated in the 'limitations' section of the PEF report as a data gap and validated by the verifier.

4.6.4 Cut-off

Any cut-off shall be avoided, unless under the following rules.

Processes and elementary flows may be excluded up to 3.0% (cumulatively) based on material and energy flows and the level of environmental significance (single overall score). The processes subject to a cut-off shall be made explicit and justified in the PEF report, in particular with reference to the environmental significance of the cut-off applied.

This cut-off has to be considered in addition to the cut-off already included in the background datasets. This rule is valid for both intermediate and final products.

The processes that (cumulatively) account for less than 3.0% of the material and energy flow, as well as the environmental impact for each impact category may be excluded from PEF study.

([48]) In some sectors it is equivalent to the bill of components.
([49]) see https://eplca.jrc.ec.europa.eu/permalink/Guide_EF_DATA.pdf
([50]) In case an ILCD-EL compliant dataset is used, the nomenclature of the elementary flows shall be aligned with the EF reference package used by the EF compliant datasets in the rest of the model (available on the EF developer's page at the following link http://eplca.jrc.ec.europa.eu/LCDN/developerEF.xhtml).

A screening study is recommended to identify processes that may be cut off.

4.6.5 Data quality requirements

This section describes how the data quality of EF compliant datasets shall be assessed. The data quality requirements are presented in Table 20.

— Two minimum requirements:

(i) completeness;

(ii) methodological appropriateness and consistency.

Once the processes and products are chosen, which represent the system analysed, and their LCIs are inventoried, the completeness criterion evaluates how much the LCI covers all the emissions and resources of the processes and products that are required to calculate all EF impact categories. Fulfilling the completeness criterion and being fully in line with the PEF method are pre-requisites for EF compliant datasets. Therefore, these two criteria are not qualitatively rated. The Guide for EF compliant datasets explains how they shall be reported in the data set ([51]).

— Four quality criteria: technological, geographical, time-related representativeness, and precision. These criteria shall be subject to a scoring procedure. The Guide for EF compliant datasets explains how they shall be reported in the dataset ([52]) .

— Three quality aspects: documentation, nomenclature and review. These criteria are not included within the semi-quantitative assessment of the data quality. The Guide for EF compliant datasets ([53]) explains how the three quality aspects shall be performed and reported in the dataset(s).

Table 20

Data quality criteria, documentation, nomenclature and review ([1])

Minimum requirements	Completeness Methodological appropriateness and consistency ([2])
Data quality criteria (scored)	Technological Representativeness ([3]) (TeR) Geographical Representativeness ([4]) (GeR) Time-related Representativeness ([5]) (TiR) Precision ([6]) (P)
Documentation	Compliant with the ILCD format and with additional requirements on the metadata information available in the Guide for EF compliant datasets ([7])
Nomenclature	Compliant with the ILCD nomenclature structure (use of EF reference elementary flows for IT compatible inventories; see detailed requirements in Section 4.3)
Review	Review by 'Qualified reviewer' Separate review report

([1]) Detailed requirements regarding documentation and review are provided at: http://eplca.jrc.ec.europa.eu/LCDN/developerEF.xhtml.

([2]) The term 'methodological appropriateness and consistency' used in relation to this procedure method is equivalent to 'consistency' used in EN ISO 14044:2006.

([3]) The term 'technological representativeness' used in relation to this procedure method is equivalent to "technological coverage" used in EN ISO 14044:2006.

([51]) https://eplca.jrc.ec.europa.eu/permalink/Guide_EF_DATA.pdf

([52]) https://eplca.jrc.ec.europa.eu/permalink/Guide_EF_DATA.pdf

([53]) https://eplca.jrc.ec.europa.eu/permalink/Guide_EF_DATA.pdf

(4) The term 'geographical representativeness' used in relation to this procedure method is equivalent to "geographical coverage" used in EN ISO 14044:2006.
(5) The term "time-related representativeness" used in relation to this procedure method is equivalent to "time-related coverage" used in EN ISO 14044:2006.
(6) The term 'parameter uncertainty' used in relation to this procedure method is equivalent to "precision" used in EN ISO 14044:2006.
(7) https://eplca.jrc.ec.europa.eu/permalink/Guide_EF_DATA.pdf

Each data quality criterion to be scored (TeR, GeR, TiR and P) is rated according to the five levels listed in Table 21.

Table 21

Data quality rating (DQR) and data quality levels of each data quality criterion

DQR of data quality criteria (TeR, GeR, TiR, P)	Data quality level
1	Excellent
2	Very good
3	Good
4	Fair
5	Poor

4.6.5.1 *DQR formula*

Within the EF context, the data quality of each new EF compliant dataset and of the total PEF study shall be calculated and reported. The DQR calculation shall be based on four data quality criteria where TeR is the Technological-Representativeness, GeR is the Geographical-Representativeness, TiR is the Time-Representativeness, and P is Precision.

$$\mathbf{DQR} = \frac{\mathbf{TeR+GeR+TiR+P}}{\mathbf{4}} \qquad \text{[Equation 19]}$$

The representativeness (technological, geographical and time-related) characterises the degree to which the processes and products selected depict the system analysed, while the precision indicates the way the data are derived and the related level of uncertainty.

Five quality levels (from excellent to poor) can be attained according to the DQR. They are summarised in Table 22.

Table 22

Overall data quality level of EF compliant datasets, according to the achieved data quality rating

Overall DQR	Overall data quality level
DQR ≤ 1.5	'Excellent quality'
1.5 < DQR ≤ 2.0	'Very good quality'
2.0 < DQR ≤ 3.0	'Good quality'
3 < DQR ≤ 4.0	'Fair quality'
DQR >4	'Poor quality'

The DQR formula is applicable to:

1. company-specific datasets: Section 4.6.5.2 describes the procedure for calculating the DQR of company-specific datasets;

2. secondary datasets: when using a secondary EF compliant dataset in a PEF study (procedure described in Section 4.6.5.3);

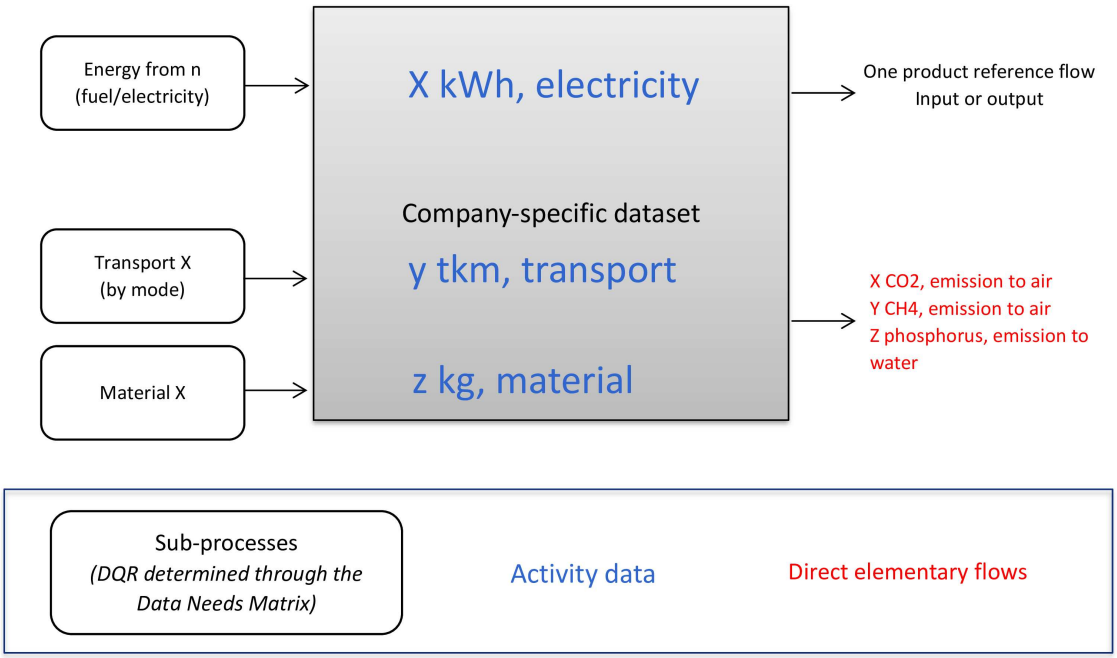
3. PEF study (procedure described in Section 4.6.5.8)

4.6.5.2 *DQR of company-specific datasets*

When creating a company-specific dataset, the data quality of i) the company-specific activity data and ii) the company-specific direct elementary flows (i.e. emission data) shall be assessed separately. The DQR of the sub-processes linked to the activity data (see Figure 9) is evaluated through the requirements provided in the Data Needs Matrix (Section 4.6.5.4).

Figure 9

Graphical representation of a company-specific dataset



A company-specific dataset is partially disaggregated: the DQR of the activity data and direct elementary flows shall be assessed. The DQR of the sub-processes shall be assessed through the Data Needs Matrix

The DQR of the newly developed dataset shall be calculated as follows.

1. Select the most-relevant activity data and direct elementary flows: most-relevant activity data are those linked to sub-processes (i.e. secondary datasets) accounting for at least 80% of the total environmental impact of the company-specific dataset. List them in order, from those which contribute the most to those which contribute the least. Most-relevant direct elementary flows are defined as those which contribute cumulatively at least 80% to the total impact of the direct elementary flows.

2. Calculate the DQR criteria – TeR, TiR, GeR and P – for each type of the most-relevant activity data and each type of most relevant direct elementary flow using Table 23.

   a. Each most-relevant direct elementary flow consists of the amount and elementary flow naming (e.g. 40 g CO_2). For each most-relevant elementary flow, the 4 DQR criteria – TeR_{EF}, TiR_{EF}, GeR_{EF}, P_{EF} – shall be evaluated (e.g. the timing of the flow measured, for which technology the flow was measured and in which geographical area).

b. For each most-relevant activity data, the 4 DQR criteria shall be evaluated (named $TeR_{-AD,}$ TiR_{-AD}, GeR_{-AD}, P_{AD}).

c. Considering that both activity data and direct elementary flows shall be company-specific, the score of P cannot be higher than 3, while the score for TiR, TeR, and GeR cannot be higher than 2 (the DQR score shall be ≤1.5).

3. Calculate as a percentage the environmental contribution of each most-relevant activity data (by linking to the appropriate sub-process) and direct elementary flow to the total sum of the environmental impact of all most-relevant activity data and direct elementary flows, (weighted, using all EF impact categories). For example, the newly developed dataset has only two most-relevant activity data, contributing to 80% of the total environmental impact of the dataset:

   Activity data 1 carries 30% of the total dataset environmental impact. This process contributes 37.5% (the weight to be used) to the total of 80%.

   Activity data 2 carries 50% of the total dataset environmental impact. This process contributes 62.5% (the weight to be used) to the total of 80%.

4. Calculate the TeR, TiR, GeR and P criteria of the newly developed dataset as the weighted average of each criteria of the most-relevant activity data and direct elementary flows. The weight is the relative contribution (in %) of each most-relevant activity data and direct elementary flow calculated in step 3.

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

$$\mathbf{DQR} = \frac{\overline{Te_R}+\overline{Ge_R}+\overline{Ti_R}+\overline{P}}{4} \quad \text{[Equation 20]}$$

Table 23

How to assign the values to DQR criteria when using company-specific information. No criteria shall be modified.

Rating	P_{EF} and P_{AD}	TiR_{-EF} and TiR_{-AD}	TeR_{-EF} and TeR_{-AD}	GeR_{-EF} and GeR_{-AD}
1	Measured/calculated and externally verified.	The data refers to the most recent annual administration period regarding the EF report publication date.	The elementary flows and the activity data explicitly depict the technology of the newly developed dataset.	The activity data and elementary flows reflect the exact geography where the modelling of the process in the newly created dataset takes place.
2	Measured/calculated and internally verified, plausibility checked by reviewer.	The data refers to a maximum of two annual administration periods regarding the EF report publication date.	The elementary flows and the activity data are a proxy of the newly developed dataset's technology.	The activity data and elementary flows partly reflect the geography where the modelling of the process 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 a maximum of three annual administration periods regarding the EF report publication date.	Not applicable.	Not applicable.

4-5	Not applicable.	Not applicable.	Not applicable.	Not applicable.

P_{EF}: Precision for elementary flows; **P_{AD}**: Precision for activity data; **TiR_{EF}**: Time representativeness for elementary flows; **TiR_{AD}**: Time representativeness for activity data; **TeR_{EF}**: Technology representativeness for elementary flows; **TeR_{AD}**: Technology representativeness for activity data**;** **GeR_{EF}**: Geographical representativeness for elementary flows; **GeR_{AD}:** Geographical representativeness for activity data.

4.6.5.3 *DQR of secondary datasets used in PEF studies*

This section describes the procedure for calculating the DQR of secondary datasets used in a PEF study. This involves re-calculating the DQR of the EF compliant secondary dataset (calculated by the data provider), when it is used in the modelling of most-relevant processes (see Section 4.6.5.4), to allow the user of the PEF method to assess the context-specific DQR criteria (i.e. TeR, TiR and GeR of most-relevant processes). The TeR, TiR and GeR criteria shall be re-evaluated based on Table 24. Modifying criteria is not allowed. The total DQR of the dataset shall be recalculated using Equation 19.

Table 24

How to assign the values to DQR criteria when using secondary datasets.

Rating	TiR	TeR	GeR
1	The EF report publication date is 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 for which the dataset is valid.
2	The EF report publication date is no later than 2 years beyond the time validity of the dataset.	The technologies used in the EF study are 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) for which the dataset is valid.
3	The EF report publication date is no 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 for which the dataset is valid.
4	The EF report publication date is no 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) for which the dataset is valid, but it is estimated that there are sufficient similarities based on expert judgement.
5	The EF report publication date is more than 6 years after the time validity of the dataset, or the time validity is not specified.	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 for which the dataset is valid.

TiR: Time representativeness; **TeR**: Technology representativeness; **GeR:** Geographic representativeness.

4.6.5.4 *The Data Needs Matrix (DNM)*

The DNM shall be used to evaluate the data requirements of all processes required to model the product in scope (see **Table 25**). It indicates for which processes company-specific data or secondary data shall or may be used, depending on how much influence the company has over the process. The following three cases are found in the DNM and explained below.

1. **Situation 1:** the process is run by the company conducting the PEF study.

2. **Situation 2:** the process is not run by the company conducting the PEF study, but this company has access to (company-) specific information.

3. **Situation 3:** the process is not run by the company conducting the PEF study and this company does not have access to (company-) specific information.

The user of the PEF method shall do the following.

1. Determine how much influence (Situation 1, 2 or 3) the company has over each process in its supply chain. This decision determines which of the options in

2. Table 25 is pertinent to each process;

3. Provide a table in the PEF report listing all processes and their situation according to the DNM;

4. Follow the data requirements indicated in Table 25;

5. Calculate/re-evaluate the DQR values (for each criterion + total) for the datasets of most-relevant processes and the new ones created, as indicated in Sections 4.6.5.6 – 4.6.5.8.

Table 25

DNM – requirements for a company conducting a PEF study

The options indicated for each situation are not listed in hierarchical order

		Data requirements
Situation 1: process run by the company	**Option 1**	Provide company-specific data (both activity data and direct emissions) and create a company-specific dataset (DQR≤1.5). Calculate DQR of the dataset following the rules in Section 4.6.5.2.
Situation 2: process not run by the company but with access to company-specific information	**Option 1**	Provide company-specific data and create a company-specific dataset (DQR≤1.5). Calculate DQR of the dataset following the rules in Section 4.6.5.2.
	Option 2	Use an EF compliant secondary dataset and apply 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). Recalculate DQR of the dataset used (see Section 4.6.5.6).
Situation 3: process not run by the company and without access to company-specific information	**Option 1**	Use an EF compliant secondary dataset in aggregated form (DQR≤3.0). Recalculate DQR of the dataset if the process is most-relevant (see Section 4.6.5.7).

Note that for any EF compliant secondary dataset, an ILCD-EL compliant dataset may be used. This can contribute up to a maximum of 10% of the single overall score of the product in scope (see Section 4.6.3). For these datasets the DQR shall not be recalculated.

4.6.5.5 *DNM Situation 1*

For all processes run by the company and where the company conducting the PEF study uses company-specific data, the DQR of the newly developed EF compliant dataset shall be evaluated as described in Section 4.6.5.2.

4.6.5.6 *DNM Situation 2*

When a process takes place under Situation 2 (i.e. the company conducting the PEF study is not running the process but has access to company-specific data) there are two possible options:

1. The user of the PEF method can access extensive supplier-specific information and can create a new EF compliant dataset (Option 1);

2. The company has some supplier-specific information and can make some minimum changes (Option 2);

Situation 2/Option 1

For all processes not run by the company and where the company conducting the PEF study uses company-specific data, the DQR of the newly developed EF compliant dataset shall be evaluated as described in Section 4.6.5.2.

Situation 2/Option 2

A disaggregated secondary EF compliant dataset is used for processes in Situation 2/Option 2. The company conducting the PEF study shall:

— use company-specific activity data for transport;

— Substitute the sub-processes for the electricity mix and transport used in the disaggregated secondary EF compliant dataset with supply chain specific EF compliant datasets.

Company-specific R_1 values may be used. The user of the PEF method shall recalculate the DQR criteria for the processes in Situation 2/Option 2. It shall make the DQR context-specific by re-evaluating TeR and TiR using **Table 24**. The GeR criterion shall be lowered by 30% and the P criterion shall keep the original value.

4.6.5.7 *DNM situation 3*

If a process takes place under Situation 3 (i.e. the company conducting the PEF study is not running the process and this company does not have access to company-specific data), the company conducting the PEF study shall use EF compliant secondary datasets.

In the case of a most-relevant process, following the procedure described in Section 7.3, the user of the PEF method shall make the DQR criteria context-specific by re-evaluating TeR, TiR and GeR using Table 24. The parameter P shall keep the original value.

For the non-most-relevant processes, following the procedure described in Section 7.3, the company conducting the PEF study shall take the DQR values from the original dataset.

4.6.5.8 *DQR of a PEF study*

To calculate the DQR of the PEF study, the user of the PEF method shall calculate the TeR, TiR, GeR and P separately. They shall be calculated as the weighted average of the DQR scores of all most-relevant processes, based on their relative environmental contribution to the single overall score, using Equation 20.

5. Environmental footprint impact assessment

Once the LCI has been compiled, the EF impact assessment ([54]) shall be carried out to calculate the environmental performance of the product, using all the EF impact categories and models. EF impact assessment includes four steps: classification, characterisation, normalisation and weighting. Results of a PEF study shall be calculated and reported in the PEF report as characterised, normalised and weighted results for each EF impact category and as a single overall score based on the weighting factors provided in Section 6.5.2.2. Results shall be reported for (i) the total life cycle, and (ii) the total life cycle excluding the use stage.

5.1 *Classification and characterisation*

5.1.1 Classification

Classification requires assigning the material/energy inputs and outputs inventoried in the LCI to the relevant EF impact category. For example, during the classification phase, all inputs/outputs that result in GHG emissions are assigned to the climate change category. Similarly, those that result in emissions of ozone-depleting substances are assigned to the ozone depletion category. In some cases, an input or output may contribute to more than one EF impact category (for example, chlorofluorocarbons (CFCs) contribute to both climate change and ozone depletion).

It is important to express the data in terms of the constituent substances for which characterisation factors (see next section) are available. For example, data for a composite NPK fertiliser shall be disaggregated and classified according to its N, P, and K fractions, because each constituent element will contribute to different EF impact categories. In practice, much of the LCI data may be drawn from existing public or commercial LCI databases, where classification has already been implemented. In such cases, it must be assured, e.g. by the provider, that the classification and linked EF impact assessment pathways correspond to the requirements of the PEF method.

All inputs and outputs inventoried while the LCI is being compiled shall be assigned to the EF impact categories to which they contribute using the classification data made available by the European Commission JRC ([55]) .

As part of the classification of the LCI, data should be expressed in terms of constituent substances for which characterisation factors are available, as far as possible.

5.1.2 Characterisation

Characterisation refers to calculating the magnitude of the contribution of each classified input and output to their respective EF impact categories, and aggregating the contributions within each category. This is carried out by multiplying the values in the LCI by the relevant characterisation factor for each EF impact category.

The characterisation factors are substance- or resource-specific. They represent the impact intensity of a substance relative to a common reference substance for an EF impact category (impact category indicator). For example, when calculating climate change impacts, all GHG emissions inventoried in the LCI are weighted in terms of their impact intensity relative to carbon dioxide, which is the reference substance for this category. This allows for the impact potential and expression to be aggregated in terms of a single equivalent substance (in this case, CO_2 equivalents) for each EF impact category.

All classified inputs and outputs in each EF impact category shall be assigned characterisation factors representing the contribution per unit of input or output to the category, using the provided characterisation factors ([56]). EF impact assessment results shall subsequently be calculated for each EF impact category by multiplying the amount of each input/output by its characterisation factor and summing the contributions of all inputs/outputs within each category to obtain a single measure expressed in the appropriate reference units.

([54]) The EF Impact Assessment does not intend to replace other (regulatory) methods that have a different scope and objective such as (Environmental) Risk Assessment ((E)RA), site- specific Environmental Impact Assessment (EIA) or health and safety regulations at product level or related to safety at the workplace. In particular, the EF Impact Assessment does not have the objective of predicting if at any specific location at any specific time thresholds are exceeded and actual impacts occur. In contrast, it describes the existing pressures on the environment. Thus, the EF Impact Assessment is complementary to other well-proven tools, adding the life- cycle perspective.

([55]) http://eplca.jrc.ec.europa.eu/LCDN/developerEF.xhtml

([56]) Available online at http://eplca.jrc.ec.europa.eu/LCDN/developerEF.xhtml

5.2 *Normalisation and weighting*

Following the steps of classification and characterisation, the EF impact assessment shall be complemented with normalisation and weighting.

5.2.1 Normalisation of environmental footprint impact assessment results

Normalisation is the step in which the LCIA results are divided by normalisation factors to calculate and compare the magnitude of their contributions to the EF impact categories relative to a reference unit. As a result, dimensionless, normalised results are obtained. These reflect the burdens that are attributed to a product relative to the reference unit. Within the PEF method the normalisation factors are expressed per capita based on a global value ([57]).

Normalised environmental footprint results do not, however, indicate the severity or relevance of the respective impacts.

In PEF studies, normalised results shall not be aggregated as this implicitly applies equal weighting. Characterised results shall be reported alongside the normalised results.

5.2.2 Weighting of environmental footprint impact assessment results

Weighting is a mandatory step in PEF studies and it supports the interpretation and communication of the analysis results. In this step, normalised results are multiplied by a set of weighting factors (in %) which reflect the relative importance of the life-cycle impact categories considered. Weighted results of different impact categories may then be compared to assess their relative importance. They may also be aggregated across life-cycle impact categories to obtain a single overall score, expressed in points.

The process underpinning the development of EF weighting factors is reported in Sala et al. 2018. The weighting factors ([58]) that shall be used in PEF studies are provided online ([59]) ([60]).

The results of the EF impact assessment prior to weighting (i.e. characterised and normalised) shall be reported alongside weighted results in the PEF report.

6. Interpretation of product environmental footprint results

6.1 *Introduction*

Interpreting the results of the PEF study serves two purposes.

1. Firstly, to ensure that the performance of the PEF model corresponds to the study's goals and quality requirements. In this sense, life-cycle interpretation may inform iterative improvements of the PEF model until all goals and requirements are met.

2. Secondly, to derive robust conclusions and recommendations from the analysis, for example, in support of environmental improvements.

To meet these objectives, the interpretation phase shall include the steps outlined in this section.

6.2 *Assessment of the robustness of the product environmental footprint model*

Assessing the robustness of the PEF model evaluates the extent to which methodological choices such as the system boundary, data sources, and allocation choices influence the analytical outcomes.

([57]) The EF normalisation factors to be used are available at http://eplca.jrc.ec.europa.eu/LCDN/developerEF.xhtml

([58]) For more information on existing weighting approaches in PEF, please refer to the reports developed by the JRC available online at http://ec.europa.eu/environment/eussd/smgp/documents/2018_JRC_Weighting_EF.pdf

([59]) http://eplca.jrc.ec.europa.eu/LCDN/developerEF.xhtml

([60]) Please note that the weighting factors are expressed in % and thus shall be divided by 100 before applying in the calculations.

Tools that should be used to assess the PEF model's robustness include the following.

(a) **Completeness checks**, to assess the LCI data to ensure it is complete relative to the defined goals, scope, system boundary and quality criteria. This includes completeness of process coverage (i.e. all processes at each supply chain stage considered have been included) and input/output coverage (i.e. all material or energy inputs and emissions associated with each process have been included).

(b) **Sensitivity checks**, to assess the extent to which the results are determined by specific methodological choices, and the impact of implementing alternative choices where these can be identified. It is useful to structure sensitivity checks for each phase of the PEF study, including goal and scope definition, the LCI, and the EF impact assessment.

(c) **Consistency checks**, to assess the extent to which assumptions, methods, and data quality considerations have been applied consistently throughout the PEF study.

Any issues flagged in this evaluation may be used to inform iterative improvements to the PEF study.

6.3 *Identification of hotspots: most-relevant impact categories, life-cycle stages, processes and elementary flows*

Once the user of the PEF method ensures that the PEF model is robust and conforms to all aspects defined in the goal and scope definition phases, the main contributing elements to the PEF results shall be identified. This step may also be referred to as 'hotspot' analysis. The user of the PEF method shall identify and list in the PEF report (together with the %) the most relevant:

1. impact categories
2. life-cycle stages
3. processes
4. elementary flows.

There is an important operational difference between most-relevant impact categories and life-cycle stages on one hand and most-relevant processes, and elementary flows on the other. In particular, most-relevant impact categories and life-cycle stages may be mainly relevant in the context of communicating the results of a PEF study. They might serve to highlight environmental areas where the organisation should focus their attention.

Identifying the most-relevant processes and elementary flows is more important for the engineers and designers to identify actions for improving the overall footprint, e.g. by-passing or changing a process, further optimising a process, or applying anti-pollution technology. This is particularly relevant for internal studies, to look deeper into how to improve the product's environmental performance. The procedure that shall be followed to identify the most-relevant impact categories, life-cycle stages, processes and elementary flows is described in the following sections.

6.3.1 Procedure to identify the most-relevant impact categories

The identification of the most-relevant impact categories shall be based on the normalised and weighted results. The most-relevant impact categories shall be identified as all of those impact categories that together contribute to at least **80%** of the single overall score. This shall start from the largest to the smallest contributions.

At least three relevant impact categories shall be identified as most-relevant ones. The user of the PEF method may add more impact categories to the list of the most-relevant ones but none shall be deleted.

6.3.2 Procedure to identify the most-relevant life-cycle stages

The most-relevant life-cycle stages are those that together contribute more than **80%** to any of the most-relevant impact categories identified. This shall start from the largest to the smallest contributions. The user of the PEF method may add more life-cycle stages to the list of the most-relevant ones but none shall be deleted. At a minimum, the life-cycle stages described at Section 4.2 shall be considered.

If the use stage accounts for more than 50% of the total impact of a most-relevant impact category, the procedure shall be re-run, excluding the use stage. In this case, the list of most-relevant life-cycle stages shall be those selected through the latter procedure plus the use stage.

6.3.3 Procedure to identify the most-relevant processes

Each most-relevant impact category shall be further investigated by identifying the most-relevant processes used to model the product in scope. The most-relevant processes are those that together contribute more than **80%** to any of the most-relevant impact categories identified. Identical processes ([61]) taking place in different life-cycle stages (e.g. transportation, electricity use) shall be accounted for separately. Identical processes taking place within the same life-cycle stage shall be accounted for together. The list of most-relevant processes shall be reported in the PEF report together with the respective life-cycle stage (or multiple life-cycle stages if relevant) and the contribution in %. The identification of the most-relevant processes shall be carried out according to Table 26.

Table 26

Criteria to select at which life-cycle stage level to identify the most-relevant processes

— **Contribution of the use stage to the total impact of a most-relevant impact category**	— **Most-relevant processes identified at the level of**
— ≥ 50%	— whole life-cycle excluding use stage, and — use stage
— < 50%	— whole life cycle

This analysis shall be reported separately for each most-relevant impact category. The user of the PEF method may add more processes to the list of the most-relevant ones but none shall be deleted.

6.3.4 Procedure to identify the most-relevant elementary flows

The most-relevant elementary flows are defined as those elementary flows that together contribute at least **80%** to the total impact of each most-relevant specific impact category for each most-relevant process, starting from those that contribute the most to those that contribute the least. This analysis shall be reported separately for each most- relevant impact category.

Elementary flows belonging to the background system of a most-relevant process may dominate the impact. Therefore, if disaggregated datasets are available, the user of the PEF method should also identify the most-relevant direct elementary flows for each most-relevant process.

Most-relevant direct elementary flows are defined as those direct elementary flows that together contribute at least **80%** to the total impact of the direct elementary flows of the process, for each most-relevant impact category. The analysis shall be limited to the direct emissions of the level-1 disaggregated datasets ([62]). This means that the 80% cumulative contribution shall be calculated against the impact caused by the direct emissions only, and not against the total impact of the process.

The user of the PEF method may add more elementary flows to the list of those that are most-relevant but none shall be deleted. The list of most-relevant elementary flows (or, if applicable, direct elementary flows) per most-relevant process shall be reported in the PEF report.

([61]) Two processes are identical when they have the same UUID.
([62]) See http://eplca.jrc.ec.europa.eu/LCDN/developerEF.xhtml) for description of level-1 disaggregated datasets.

6.3.5 Dealing with negative numbers

When identifying the percentage impact contribution for any process or elementary flow, it is important that absolute values be used. This makes it possible to identify the relevance of any credits (e.g. from recycling). In case of processes or flows with a negative impact score, the following procedure shall be applied:

(a) consider the absolute values (i.e. impacts of processes or flows to have a plus sign, namely a positive score);

(b) the total impact score needs to be recalculated including the converted negative scores;

(c) the total impact score is set to 100%;

(d) the percentage impact contribution for any process or elementary flow is assessed according to this new total.

This procedure does not apply to identify the most-relevant life-cycle stages.

6.3.6 Summary of requirements

Table 27 summarises the requirements to define most-relevant contributions.

Table 27

Summary of requirements to define most-relevant contributions

Item	At what level does relevance need to be identified?	Threshold
Most-relevant impact categories	Single overall score	Impact categories that together contribute to at least **80%** of the single overall score.
Most-relevant life-cycle stages	For each most-relevant impact category	All life-cycle stages that together contribute more than **80%** to that impact category. If the use stage accounts for more than 50% of the total impact of a most-relevant impact category, the procedure shall be re-run, excluding the use stage.
Most-relevant processes	For each most-relevant impact category	All processes that together contribute (along the entire life cycle) more than **80%** to that impact category, considering absolute values.
Most-relevant elementary flows	For each most-relevant process considering the most-relevant impact categories	All elementary flows that together contribute to at least 80% of the total impact of a most-relevant impact category for each most-relevant process. If disaggregated data are available: for each most- relevant process, all direct elementary flows that together contribute at least **80%** to that impact category (caused by the direct elementary flows only).

6.3.7 Example

Fictitious examples are provided below, which are not based on any specific PEF study results.

Most-relevant impact categories

Table 28

Contribution of different impact categories based on normalised and weighted results – example

Impact category	Contribution to the total impact (%)
Climate change	21,5
Ozone depletion	3,0
Human toxicity, cancer	6,0
Human toxicity, non-cancer	0,1
Particulate matter	14,9
Ionizing radiation, human health	0,5
Photochemical ozone formation, human health	2,4
Acidification	1,5
Eutrophication, terrestrial	1,0
Eutrophication, freshwater	1,0
Eutrophication, marine	0,1
Ecotoxicity, freshwater	0,1
Land use	14,3
Water use	18,6
Resource use, minerals and metals	6,7
Resource use, fossils	8,3
Total most-relevant impact categories (%)	**84,3**

Based on the normalised and weighted results, the most-relevant impact categories are: climate change, particulate matter, water use, land use, and resource use (minerals and metals and fossils) for a cumulative contribution of 84.3% of the total impact.

Most-relevant life-cycle stages

Table 29

Contribution of different life-cycle stages to the climate change impact category (based on the characterised inventory results) – example

Life-cycle stage	Contribution (%)
Raw material acquisition and pre-processing	46,3
Production of the main product	21,2
Product distribution and storage	16,5
Use stage	5,9
End of life	10,1
Total most-relevant life-cycle stages (%)	**88,0**

The three life-cycle stages in red will be the ones identified as 'most-relevant' for climate change as they are contributing to more than 80%. Ranking shall start from the highest contributors.

This procedure shall be repeated for all the most-relevant EF impact categories that are selected.

Most-relevant processes

Table 30

Contribution of different processes to the climate change impact category (based on the characterised inventory results) - example

Life-cycle stage	Unit process	Contribution (%)
Raw material acquisition and pre-processing	Process A	4,9
	Process B	41,4
Production of the main product	Process C	18,4
	Process D	2,8
Product distribution and storage	Process E	16,5
Use stage	Process F	5,9
EoL	Process G	10,1
Total most-relevant processes (%)		**86,4**

According to the proposed procedure, the processes B, C, E and G shall be selected as the 'most-relevant'.

This procedure shall be repeated for all the most-relevant impact categories that are selected.

Dealing with negative numbers and identical processes in different life-cycle stages

Table 31

Example on how to deal with negative numbers and identical process in different life-cycle stages

Impact Category 1 (Characterised results)

1. Characterised results of a most relevant EF Impact Category

	LC stage 1	LC stage 2	LC stage 3	LC stage 4	LC stage 5	total per process	% per process
Process A	18	23				41	44%
Process B			13			13	14%
Process C	17				-9	8	9%
Process D	5			6		11	12%
Process E	4	4	4	4	4	20	22%
Total of LC						93	100%

2. Convert everything to absolute values

	LC stage 1	LC stage 2	LC stage 3	LC stage 4	LC stage 5	total per process	% per process
Process A	18	23				41	38%
Process B			10			10	9%
Process C	17				9	26	24%
Process D	5			6		11	10%
Process E	4	4	4	4	4	20	19%
Total of LC						108	100%

Most relevant processes

3. Calculate the % per process and life cycle stage

	LC stage 1	LC stage 2	LC stage 3	LC stage 4	LC stage 5	total per process (absolute values)	% per process
Process A	17%	21%				41	38%
Process B			9%			10	9%
Process C	16%				8%	26	24%
Process D	5%			6%		11	10%
Process E	4%	4%	4%	4%	4%	20	19%
Total of LC						108	100%

6.4 *Conclusions and recommendations*

The final part of the EF interpretation phase involves:

(a) drawing conclusions based on the analytical results;

(b) answering the questions posed at the outset of the PEF study; and

(c) advancing recommendations appropriate to the intended audience and context whilst explicitly taking into account any limitations as to the robustness and applicability of the results.

The PEF complements other assessments and instruments such as site-specific environmental impact assessments or chemical risk assessments.

Potential improvements should be identified, for example, using cleaner technology or production techniques, changes in product design, applying environmental management systems (e.g. eco-management and audit scheme (EMAS) or EN ISO 14001:2015), or other systematic approaches.

Conclusions, recommendations and limitations shall be described in line with the defined goals and scope of the PEF study. The conclusions should include a summary of identified supply chain 'hotspots' and the potential improvements associated with management interventions.

7. **Product environmental footprint reports**

7.1 *Introduction*

A PEF report complements the PEF study, providing a relevant, comprehensive, consistent, accurate, and transparent summary of the study. It reproduces the best possible information in such a way as to maximise its usefulness to intended current and future users, whilst transparently communicating the limitations. Effective PEF reporting requires that several criteria, both procedural (report quality) and substantive (report content), are met. A PEF report template is available in Part E of Annex II. This template includes the minimum information to be reported in a PEF report.

At a minimum, a PEF report consists of: a summary, the main report, the aggregated EF compliant dataset and an annex. Confidential and proprietary information may be documented in a fourth item - a complementary confidential report. Review reports are annexed.

7.1.1 Summary

The summary shall be able to stand alone without compromising the results and conclusions/recommendations (if included). The summary shall fulfil the same criteria about transparency, consistency, etc. as the detailed report. To the extent possible, the summary should be written targeting a non-technical audience.

7.1.2 Aggregated EF compliant dataset

For each product in scope of the PEF study, the user shall make an aggregated EF compliant dataset available.

If the user of the PEF method or of the PEFCR publishes such an EF compliant dataset, the PEF report on the basis of which the dataset is generated shall also be made public.

7.1.3 Main report

The main report ([63]) shall, as a minimum, include the following components:

1. general information
2. goal of the study
3. scope of the study
4. life-cycle inventory analysis

([63]) The main report, as defined here, is insofar as possible in line with EN ISO 14044:2006 requirements on reporting for studies which do not contain comparative assertions to be disclosed to the public.

5. life-cycle impact assessment results

6. interpretion of PEF results.

7.1.4 Validation statement

See Section 8.5.3

7.1.5 Annexes

The annexes serve to document supporting elements to the main report which are of a more technical nature (e. g. detailed calculations for data quality assessment, alternative approach for a nitrogen field model when a PEF study has agricultural modelling in scope, results of sensitivity analysis, assessment of the PEF model's robustness, bibliographic references).

7.1.6 Confidential report

The confidential report is optional. If used, it shall contain all data (including raw data) and information that are confidential or proprietary and may not be made externally available. The confidential report shall be made available for the verification and validation procedure of the PEF study (see Section 8.4.3)

8. Verification and validation of PEF studies, reports, and communication vehicles

If policies on implementing the PEF method define specific requirements as regards verification and validation of PEF studies, reports and communication vehicles, then these requirements shall prevail.

8.1 *Defining the scope of the verification*

The verification and validation of the PEF study is mandatory whenever the study, or part of the information therein, is used for any type of external communication (i.e. communication to any interested party other than the commissioner or the user of the PEF method of the study).

Verification means the conformity assessment process carried out by an environmental footprint verifier(s) to check whether the PEF study has been carried out in compliance with Annex I.

Validation means the confirmation by the environmental footprint verifier(s) who carried out the verification, that the information and data included in the PEF study, the PEF report and the communication vehicles available at the time of validation are reliable, credible and correct.

The verification and validation shall cover the following three areas:

1. the PEF study (including, but not limited to the data collected, calculated, and estimated and the underlying model);

2. the PEF report;

3. the technical content of the communication vehicles, if applicable.

The verification of the PEF study shall ensure that the PEF study is conducted in compliance with Annex I or the applicable PEFCR.

The validation of information in the PEF study shall ensure that:

(a) the data and information used for the PEF study are consistent, reliable and traceable;

(b) the calculations performed do not include significant ([64]) mistakes.

The verification and validation of the PEF report shall ensure that:

(a) the PEF report is complete, consistent, and compliant with the PEF report template provided in Part E of Annex II;

(b) the information and data included are consistent, reliable and traceable;

([64]) Mistakes are significant if they change the final result by more than 5% for any of the impact categories, or the identified most relevant impact categories, life cycle stages and processes.

(c) the mandatory information and sections are included and appropriately filled in;

(d) all the technical information that could be used for communication purposes, independently from the communication vehicle to be used, are included in the report.

Note: confidential information shall be validated, while it may be excluded from the PEF report.

The validation of the technical content of the communication vehicle content shall ensure that:

(a) the technical information and data included are reliable and consistent with the information included in the PEF study and the PEF report;

(b) that the information is compliant with the requirements of the Unfair Commercial Practices Directive ([65]);

(c) that the communication vehicle complies with the principles of transparency, availability and accessibility, reliability, completeness, comparability and clarity, as described in the Commission Communication on Building the Single Market for Green Products ([66]).

8.2 *Verification procedure*

The verification procedure covers the following steps.

1. The commissioner shall select the verifier(s) or verification team following the rules outlined in Section 9.3.1.

2. The verification shall take place following the verification process described in Section 9.4.

3. The verifier(s) shall communicate to the commissioner any misstatement, non-conformities and need for clarifications (Section 9.3.2), and draft the validation statement (Section 8.5.2)

4. The commissioner shall respond to the verifier's comments and introduce necessary corrections and changes (if needed) to ensure the final compliance of the PEF study, PEF report and technical content of PEF communication vehicles. If, in the verifier's judgement, the commissioner does not respond appropriately within a reasonable time period, the verifier shall issue a modified validation statement.

5. The final validation statement is provided, considering (if needed) the corrections and changes introduced by the commissioner.

6. Surveillance that the PEF report is available during the validity of the validation statement (as defined in Section 8.5.3)

If a matter comes to the verifier's attention that causes the verifier to believe in the existence of fraud or noncompliance with laws or regulations, the verifier shall communicate this immediately to the commissioner of the study.

8.3 *Verifier(s)*

This section is without prejudice to specific provisions of EU legislation.

The verification/validation may be conducted by a single verifier or by a verification team. The independent verifier(s) shall be external to the organisation that conducted the PEF study.

In all cases the independence of the verifiers shall be guaranteed, i.e. they shall fulfil the intentions in the requirements of EN ISO/IEC 17020:2012 regarding a third party verifier, they shall not have conflicts of interests on concerned products.

([65]) Directive 2005/29/EC of the European Parliament and of the Council of 11 May 2005 concerning unfair business-to-consumer commercial practices in the internal market and amending Council Directive 84/450/EEC, Directives 97/7/EC, 98/27/EC and 2002/65/EC of the European Parliament and of the Council and Regulation (EC) No 2006/2004 of the European Parliament and of the Council ('Unfair Commercial Practices Directive')

([66]) https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52013DC0196

The minimum requirements and score for the verifier(s) as specified below shall be fulfilled. If the verification/validation is conducted by a single verifier, they shall satisfy all the minimum requirements and the minimum score (see Section 9.3.1); if the verification/validation is conducted by a team, the team as a whole shall satisfy all the minimum requirements and the minimum score. The documents proving the qualifications of the verifier(s) shall be provided as an annex to the verification report or they shall be made available electronically.

In case a verification team is established, one of the members of the verification team shall be appointed as lead verifier.

8.3.1 Minimum requirements for verifier(s)

This section is without prejudice to specific provisions of EU legislation.

The assessment of the competences of verifier or verification team is based on a scoring system that takes into account: (i) verification and validation experience; (ii) EF/LCA methodology and practice; and (iii) knowledge of relevant technologies, processes or other activities included in the product(s)/organisation(s) in scope of the study.

Table 32 presents the scoring system for each relevant competence and experience topic.

Unless otherwise specified in the context of the intended application, the verifier's self-declaration on the scoring system constitutes the minimum requirement. Verifier(s) shall provide a self-declaration of their qualifications (e.g. university diploma, working experience, certifications), stating how many points they achieved for each criterion and the total points achieved. This self-declaration shall form part of the PEF verification report.

A verification of a PEF study shall be conducted as per the requirements of the intended application. Unless otherwise specified, the minimum score necessary to qualify as a verifier or a verification team is six points, including at least one point for each of the three mandatory criteria (i.e. verification and validation practice, PEF/LCA methodology and practice, and knowledge of technologies or other activities relevant to the PEF study).

Table 32

Scoring system for each relevant competence and experience topic for the assessment of the competences of verifier(s)

			Score (points)				
	Topic	**Criteria**	**0**	**1**	**2**	**3**	**4**
Mandatory criteria	Verification and validation practice	Years of experience ([1])	<2	2 ≤ x < 4	4 ≤ x < 8	8≤ x < 14	≥14
		Number of verifications ([2])	≤5	5 < x ≤ 10	11 ≤ x ≤ 20	21 ≤ x ≤ 30	>30
	LCA method-logy and practice	Years of experience ([3])	<2	2 ≤ x < 4	4 ≤ x < 8	8≤ x < 14	≥14
		Number of LCA studies or reviews ([4])	≤5	5 < x ≤ 10	11 ≤ x ≤ 20	21 ≤ x ≤ 30	>30
	Knowledge of the specific sector	Years of experience ([5])	<1	1 ≤ x < 3	3 ≤ x < 6	6≤ x < 10	≥10

Additional criteria	Review, verification/ validation practice	Optional scores relating to verification/ validation	— 2 points: Accreditation as third party verifier for EMAS — 1 point: Accreditation as third party reviewer for at least one EPD scheme, EN ISO 14001:2015, or other EMS

([1]) Years of experience in the field of environmental verifications and/or review of LCA/PEF/EPD studies.
([2]) Number of verifications for EMAS, EN ISO 14001:2015, international EPD scheme or other EMS.
([3]) Years of experience in the field of LCA modelling. Work done during master and bachelor degrees shall be excluded. Work done during a relevant Ph.D./Doctorate course shall be accounted for. Experience in LCA modelling include among others:
— LCA modelling in commercial and non-commercial software;
— Datasets and database development.
([4]) Studies compliant with one of the following standards/methods: PEF, OEF, ISO 14040-44, EN ISO 14067:2018, EN ISO 14025:2010.
([5]) Years of experience in a sector related to the studied product(s). The experience in the sector may be gained through LCA studies or through other types of activities. The LCA studies shall be done on behalf of and with access to primary data of the producing/operating industry. The qualification of knowledge about technologies or other activities is assigned according to the classification of NACE codes (Regulation (EC) No 1893/2006 of the European Parliament and of the Council of 20 December 2006 establishing the statistical classification of economic activities - NACE Revision 2). Equivalent classifications of other international organisations may also be used. Experience gained with technologies or processes in a whole sector are considered valid for any of its sub-sectors.

8.3.2 Role of the lead verifier in the verification team

The lead verifier is a team member with additional tasks. The lead verifier shall:

— distribute the tasks to be fulfilled between the team members according to the specific competencies (skills /abilities) of the team members, to get the full coverage of the tasks to be done and to use in the best manner the specific competencies of the team members;

— coordinate the whole verification/validation process and ensure that all team members have a common understanding of the tasks they need to fulfil;

— assemble all comments and ensure they are communicated to the commissioner of the PEF study in a clear and understandable way;

— resolve any conflicting statements between team members;

— ensure that the verification report and validation statement are generated and are signed by each member of the verification team.

8.4 *Verification and validation requirements*

The verifier(s) shall present all the outcomes related to the verification of the PEF study and the validation of the PEF study, PEF report and PEF communication vehicles and give the commissioner of the PEF study the opportunity to improve the work, if necessary. Depending on the nature of the outcomes, additional iterations of comments and responses may be necessary. Any changes made in response to the verification or validation outcomes shall be documented and explained in the verification or validation report. Such a summary may take the form of a table in the respective documents. The summary shall include the comment(s) from the verifier(s), the commissioner's answer and the motivation for the changes.

Verification may take place after the PEF study has been concluded or in parallel (concurrent) to the study, while validation shall always take place after the study has been concluded.

The verification/validation shall combine document review and model validation.

— The document review includes the PEF report, the technical content of related communication vehicles available at the time of validation, and the data used in the calculations through requested underlying documents. Verifier(s) may organise the document review either as an 'at desk' or 'on-site' exercise, or as a mix of the two. The validation of the company-specific data shall always be organised through a visit to the production site(s) the data refer to.

— The validation of the model may take place at the production site of the commissioner of the study or be organised remotely. The verifier(s) shall access the model to verify its structure, the data used, and its consistency with the PEF report and PEF study. The commissioner of the PEF study and the verifier(s) shall agree on how the verifier(s) accesses the model.

— The validation of the PEF report shall be carried out by checking enough information to provide reasonable assurance that the content is in line with the modelling and results of the PEF study.

The verifier(s) shall ensure that data validation includes:

a) coverage, precision, completeness, representativeness, consistency, reproducibility, sources and uncertainty;

b) plausibility, quality and accuracy of the LCA-based data;

c) quality and accuracy of additional environmental and technical information;

d) quality and accuracy of the supporting information.

The verification and validation of the PEF study shall be carried out by following the minimum requirements listed in Section 8.4.1

8.4.1 Minimum requirements for the verification and validation of the PEF study

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

— The verifier(s) shall check if the correct version of all impact assessment methods was used. For each of the most-relevant EF impact categories (ICs), at least 50% of the characterisation factors shall be verified, while all normalisation and weighting factors of all ICs shall be verified. In particular, the verifier(s) shall check that the characterisation factors correspond to those included in the EF impact assessment method the study declares compliance with ([67]). This may also be done indirectly, for example:

  1) Export the EF-compliant datasets from the LCA software used to do the PEF study and run them in Look@LCI ([68]) to obtain LCIA results. If Look@LCI results are within a deviation of 1% from the results in the LCA software, the verifier(s) may assume that the implementation of the characterisation factors in the software used to do the PEF study was correct.

  2) Compare the LCIA results of the most-relevant processes calculated with the software used to do the PEF study with the ones available in the metadata of the original dataset. If the compared results are within a deviation of 1%, the verifier(s) may assume that the implementation of the characterisation factors in the software used to do the PEF study was correct.

— The verifier(s) shall check that the cut-off applied (if any) fulfils the requirements at Section 4.6.4.

— The verifier(s) shall check that all datasets used fulfil the data requirements (Section 4.6.3 and 4.6.5.).

— For at least 80% (in number) of the most-relevant processes (as defined in Section 6.3.3), the verifier(s) shall validate all related activity data and the datasets used to model these processes. If relevant, CFF parameters and datasets used to model them shall also be validated in the same way. The verifier(s) shall check that the most-relevant processes are identified as specified in Section 6.3.3.

— For at least 30% (in number) of all other processes (corresponding to 20% of the processes as defined in Section 6.3.3) the verifier(s) shall validate all related activity data and the datasets used to model these processes. If relevant, CFF parameters and datasets used to model them shall also be validated in the same way.

([67]) Available at: http://eplca.jrc.ec.europa.eu/LCDN/developer.xhtml
([68]) https://eplca.jrc.ec.europa.eu/LCDN/developer.xhtml

— The verifier(s) shall check that the datasets are correctly implemented in the software (i.e. LCIA results of the dataset in the software are within a deviation of 1% to the ones in the metadata). At least 50% (in number) of the datasets used to model most-relevant processes and 10% of those used to model other processes shall be checked.

The verifier(s) shall check if the aggregated EF compliant dataset representing the product in scope is made available to the European Commission ([69]). The commissioner of the PEF study may decide to make the dataset public.

Additional environmental and technical information fulfils the requirements at Section 3.2.4.1.

8.4.2 Verification and validation techniques

The verifier(s) shall assess and confirm whether the calculation methodologies applied are of acceptable accuracy, reliable, are appropriate and performed in line with the PEF method. The verifier(s) shall confirm the correct application of conversion of measurement units.

The verifier(s) shall check if applied sampling procedures are in line with the sampling procedure defined in the PEF method as set out in Section 4.4.6. The data reported shall be checked against the source documentation in order to check their consistency.

The verifier(s) shall evaluate whether the methods for making estimates are appropriate and have been applied consistently.

The verifier(s) may assess alternatives to estimations or choices made, to determine whether a conservative choice has been selected.

The verifier(s) may identify uncertainties that are greater than expected and assess the effect of the identified uncertainty on the final PEF results.

8.4.3 Data confidentiality

Data for validation shall be presented in a systematic and comprehensive way. All the project documentation supporting the validation of a PEF study shall be provided to the verifier(s), including the EF model, confidential information, data, and the PEF report. The verifier(s) shall treat all information and data undergoing verification/validation as confidential and shall use them only during the verification/validation process.

The commissioner of the PEF study may exclude confidential data and information from the PEF report, provided that:

— only input information is excluded and all output information is included;

— the commissioner provides the verifier(s) with sufficient information of the nature of the data and information excluded as well as the reasoning for excluding them;

— the verifier(s) accept(s) the non-disclosure and includes in the verification and validation report the reasons for doing so; if the verifier(s) do(es) not accept the non-disclosure and the commissioner does not take corrective action, the verifier(s) shall include in the verification and validation report that the non-disclosure is not justified;

— the commissioner keeps a file of the non-disclosed information for possible future re-evaluation of the decision for non-disclosure.

Business data could be of confidential nature because of competition aspects, intellectual property rights or similar legal restrictions. Therefore, business data identified as confidential and provided during the validation process shall be kept confidential. Hence, verifier(s) shall not disseminate or otherwise retain for use, without the organisation's permission, any information disclosed to them during the course of the verification/validation process. The commissioner of the PEF study may ask the verifier(s) to sign a non-disclosure agreement (NDA).

([69]) Please send your datasets to ENV-ENVIRONMENTAL-FOOTPRINT@ec.europa.eu

8.5 *Outputs of the verification/validation process*

8.5.1 Content of the verification and validation report

The verification and validation report ([70]) shall include all findings of the verification/ validation process, the actions taken by the commissioner to answer the comments of the verifier(s), and the final conclusion. The report is mandatory, but it may be confidential. Confidential information shall only be shared with the European Commission or the body overseeing the PEFCR development, and the review panel at their request.

The final conclusion may be of a different nature:

— 'compliant' if the document or on-site checks prove that the requirements of this section are fulfilled;

— 'not compliant' if the document or on-site checks prove that the requirements of this section are not fulfilled;

— 'complementary information needed' if the document or on-site checks do not allow the verifier(s) to conclude on compliance. This may happen if the information is not transparently or sufficiently documented or made available.

The verification and validation report shall clearly identify the specific PEF study under verification. To this purpose, it shall include the following information:

— title of the PEF study under verification/validation, together with the exact version of the PEF report to which the validation statement belongs;

— the commissioner of the PEF study;

— the user of the PEF method;

— the verifier(s) or, in the case of a verification team, the team members with the identification of the lead verifier;

— absence of conflicts of interest of the verifier(s) with respect to concerned products and the commissioner and any involvement in previous work (where relevant, consultancy work carried out for the user of the PEF method over the last three years);

— a description of the objective of the verification/validation;

— the actions taken by the commissioner to answer the comments of the verifier(s);

— a statement of the result (findings) of the verification/validation containing the final conclusion of the verification and validation reports;

— any limitations of the verification/validation outcomes;

— date on which the validation statement has been issued;

— version of the underlying PEF method and, if applicable, of the underlying PEFCR;

— signature of the verifier(s).

8.5.2 Content of the validation statement

The validation statement is mandatory and shall always be provided as an annex to the PEF report.

The verifier(s) shall include at least the following elements and aspects in the validation statement:

— title of the PEF study under verification/validation, together with the exact version of the PEF report to which the validation statement belongs;

— the commissioner of the PEF study;

— the user of the PEF method;

— the verifier(s) or, in the case of a verification team, the team members with the identification of the lead verifier;

([70]) The two aspects, validation and verification, are included in one report.

— absence of conflicts of interest of the verifier(s) with respect to concerned products and the commissioner and any involvement in previous work (where relevant, consultancy work carried out for the user of the PEF method over the last three years);

— a description of the objective of the verification/validation;

— a statement of the result of the verification/validation containing the final conclusion of the verification and validation reports;

— any limitations of the verification/validation outcomes;

— date on which the validation statement has been issued;

— version of the underlying PEF method and, if applicable, of the underlying PEFCR;

— signature of the verifier(s).

8.5.3 Validity of the verification and validation report and the validation statement

A verification and validation report, and a validation statement shall refer to one specific PEF report only. The verification and validation report and the validation statement shall clearly identify the specific PEF study under verification (e.g. by including the title, the commissioner of the PEF study, the user of the PEF method – see Sections 8.5.1 and 8.5.2), together with the explicit version of the final PEF report to which the verification and validation report and a validation statement apply (e.g. by including the report date, the version number).

Both the verification and validation report and the validation statement shall be completed based on the final PEF report, after the implementation of all the corrective actions requested by the verifier(s). They shall carry the handwritten or electronic signature of the verifier(s) in line with Regulation (EU) n° 910/2014 ([71]).

The maximum validity of the verification and validation report and of the validation statement shall not exceed three years starting from their issue date.

During the validity period of the verification, surveillance (follow-up) shall be agreed between the commissioner of the PEF study and the verifier(s) to evaluate if the content is still consistent with the current situation (the suggested periodicity for this follow-up is once per year, to be agreed between the PEF study commissioner and the verifier(s)).

The periodic checks shall focus on the parameters that according to the verifier(s) might lead to relevant changes in the results of the PEF study. This means, that the results shall be recalculated considering the changes of the identified parameters. The list of such parameters includes:

— bill of material/bill of components;

— energy mix used for processes in Situation 1 of the Data Needs Matrix;

— change of packaging;

— changes in the suppliers (materials/geography);

— changes in the logistics;

— relevant technological changes in the processes in Situation 1 of the Data Needs Matrix.

At the time of the periodic check the reasons for non-disclosure of information should also be reconsidered. The surveillance verification may be organised as a document check and/or through on-site inspections.

Regardless of the validity, the PEF study (and consequently the PEF report) shall be updated during the surveillance period if the results of one of the impact categories communicated has worsened by more than 10.0% compared to the verified data, or if the total aggregated score has worsened by more than 5.0% compared to the verified data.

If these changes also affect the content of the communication vehicle, it shall be updated accordingly.

([71]) Regulation N° 910/2014 of the European Parliament and of the Council of 23 July 2014 on electronic identification and trust services for electronic transactions in the internal market and repealing Directive 1999/93/EC, OJEU L 257, 28.8.2014, p. 73.

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ANNEX II

PART A

REQUIREMENTS TO DEVELOP PEFCRS AND PERFORM PEF STUDIES IN COMPLIANCE WITH AN EXISTING PRODUCT ENVIRONMENTAL FOOTPRINT CATEGORY RULE

Product Environmental Footprint Category Rules (PEFCRs) provide specific requirements for calculating the products' life cycle potential environmental impacts. This Part A of Annex II contains all additional methodological requirements for developing PEFCRs and performing PEF studies in compliance with an existing PEFCR.

A PEFCR shall be in line with all requirements of this document, shall include (as text) all requirements of this Annex and shall refer (without copying the corresponding text) to the requirements in the PEF method where relevant. It shall further specify those requirements where the PEF method leaves a choice, and may add new requirements, if relevant and in line with the PEF method. Further specified requirements in a PEFCR always prevail over those included in the PEF method.

The provisions of this annex are without prejudice of provisions to be included in future EU legislation.

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A.1 Introduction

Rules analogous to PEFCRs exist in standards for other types of life cycle-based product claims, such as EN ISO 14025:2010 (type III environmental declarations). PEFCRs are named differently to prevent confusion between other analogous rules and uniquely identify rules under the PEF method.

Based on an analysis carried out by JRC in 2010 ([1]), the Commission came to the conclusion that existing life cycle based standards do not provide sufficient specificity to ensure that the same assumptions, measurements and calculations are made to support comparability of environmental claims across products delivering the same function. PEFCRs aim at increasing comparability, reproducibility, consistency, relevance, focus and efficiency of PEF studies.

A PEFCR should be developed and written in a format that persons with technical knowledge (in LCA as well as with regard to the considered product category) can understand and can use to conduct a PEF study.

Each PEFCR shall implement the materiality principle, meaning that a PEF study shall focus on those aspects and parameters that are the most relevant for the environmental performance of a given product. By doing this the time, effort and cost of carrying out the analysis is reduced.

Each PEFCR shall specify the minimum list of processes (mandatory processes) that shall always be modelled with company-specific data. The purpose is to avoid that users of the PEFCR are able to perform a PEF study and communicate its results without having access to the relevant company-specific (primary) data and by using only default data. The PEFCR shall define this mandatory list of processes based on their relevance and the possibility to have access to company-specific data.

The definitions provided under the Annex I are applicable also for this Annex.

A.1.1. *Role of PEFCRs and relation with existing Product Category Rules*

The development of a PEFCR should take into account, to the extent possible, already existing technical documents and PCRs from other schemes.

As defined in EN ISO 14025:2010, Product Category Rules (PCRs) ([2]) include sets of specific rules, guidelines and requirements to develop 'Type III environmental declarations' for any product category (i.e. goods and/or services providing equivalent functions). 'Type III environmental declarations' are quantitative, LCA-based claims of the environmental aspects ([3]) of a certain good or service, e.g. quantitative information regarding potential environmental impacts. Type III environmental declarations may, for instance, be a potential application of a PEF study.

([1]) Analysis of Existing Environmental Footprint Methodologies for Products and Organisations: Recommendations, Rationale, and Alignment (2010), available at: http://ec.europa.eu/environment/eussd/smgp/dev_methods.htm

([2]) Product Category Rules (PCR) are a set of specific rules, requirements and guidelines for developing Type III environmental declarations for one or more product categories (EN ISO 14025:2010).

([3]) An environmental aspect is defined as an element of an organisation's activities or products that has or can have an impact on the environment.

For the development and review of Product Category Rules (PCRs), EN ISO 14025:2010 describes the procedure and establishes requirements for the comparability of different so-called 'Type III environmental declarations'. The guidelines on how to develop PEFCRs take into consideration the minimum content of a PCR document as required by EN ISO 14025:2010.

A.1.2. *How to manage modularity*

In case of intermediate products, the PEFCR becomes a 'module' to be used when developing PEFCRs for products further down the same supply chain. This is equally applicable if the intermediate product can be used in different supply chains (e.g. metal sheets). The development of 'modules' allows for a higher level of consistency among different supply chains that are using the same modules as part of their LCA. Furthermore, the development of 'modules' is essential to keep the number of PEFCRs manageable.

The possibility to build such modules should always be considered also for final products, especially for those products that share part of the production chain and then differentiate due to different functions (e.g. detergents).

There are different scenarios that may require a modular approach:

(a) A final product using in its BoM an intermediate product for which there is already an existing PEFCR (e.g. car production with leather upholstery) or a final product that becomes part of the life cycle of another product (e.g. detergent used to wash a T-shirt);

(b) A final product using a component or product that is already used as a component by another PEFCR (e.g. fittings to be used in piping systems, fertilisers).

For scenario (a), the new PEFCR shall define how to manage the product information based on the environmental relevance of the product and the DNM (see section A.4.4.4.4.). This means that if the product is 'most relevant' and it is under the company's control, company-specific data shall be requested, following the rules of the PEFCR having the module in its scope ([4]). If it is not under the company's operational control but amongst the 'most relevant' processes, the user of the PEFCR may choose either to provide company-specific data, or to use the EF compliant secondary dataset ([5]) provided with the PEFCR that has the module in its scope.

In scenario (b), the Technical Secretariat (see the role and the membership in section A.2.2. shall assess the feasibility of implementing the same modelling assumptions and secondary datasets listed in the existing PEFCR. If feasible, the Technical Secretariat shall implement the same modelling assumptions and dataset to be used in its own PEFCR. If not feasible, the Technical Secretariat shall agree on a solution with the Commission.

A.2. **The process of developing and revising a PEFCR**

The provisions of this section are without prejudice of provisions to be included in future EU legislation.

This section includes the process for developing and revising a PEFCR. The following situations might occur:

Development of a new PEFCR;

(a) Full revision of an existing PEFCR;

(b) Partial revision of an existing PEFCR.

For cases (a) and (b) the procedure described in this section (see figure A-1) shall be followed.

Case (c) is only allowed if the model of the Representative Product (RP), (see section) is updated with corrected/new data or datasets and correction of obvious mistakes, and the results of the RP change with a certain maximum:

(i) LCIA results change <10% per impact category (characterized results), and

([4]) In case the already existing PEFCR used as a module is updated during the validity of the PEFCR relying on it, the old version prevails and stays valid for the duration of the validity of the newly developed PEFCR.

([5]) This is a mandatory deliverable for any representative product developed in a PEFCR.

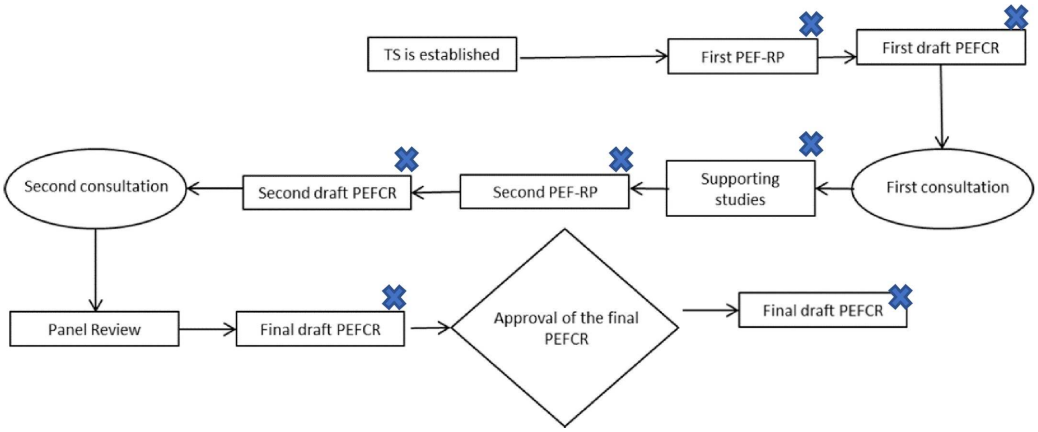
(ii) LCIA results change <5% of the single overall score, and

(iii) the list of most relevant impact categories, life cycle stages, processes, and direct elementary flows do not change.

If results of the RP change > 10% for at least one impact category (characterized results) or > 5% of the single overall score, case (c) is not applicable and a full revision of the PEFCR is required.In case (c) the Technical Secretariat shall provide an updated PEFCR to the panel review and the last three steps of Figure A-1 shall be followed (i.e. panel review, final draft PEFCR, final approval of the PEFCR).

Figure J-1

Process flow to create/revise a PEFCR. PEF-RP: PEF study of the Representative Product.



A.2.1. *Who can develop a PEFCR*

A Technical Secretariat shall be set up to develop a PEFCR. The Technical Secretariat shall represent at least 51% of the EU consumption market (sold) in terms of economic turnover. The Technical Secretariat shall achieve this market coverage directly by companies participating in it and/or indirectly, through the EU market coverage of members represented by a business association. The Technical Secretariat shall submit a confidential report proving market coverage to the Commission when establishing the Technical Secretariat.

A.2.2. *Role of the Technical Secretariat*

The Technical Secretariat (TS) is responsible for the following activities:

(a) Drafting the PEFCR in compliance with the rules included in Annex I and this Annex;

(b) Harmonisation with existing PCRs/ PEFCRs;

(c) Organising public consultations on draft versions of the documents, analysis of comments, and providing written feedback;

(d) Co-ordinating the supporting studies;

(e) Managing the public online platform for the respective PEFCR. This activity includes tasks such as the drafting of publicly available explanatory materials related to the PEFCR, online consultations on drafts and publishing of feedback on stakeholder comments;

(f) Ensuring the selection and appointment of competent independent PEFCR review panel members.

A.2.3. *Definition of the representative product(s)*

The TS shall develop a 'model' of the representative product (RP) sold on the EU market. The RP shall reflect the current situation, at the time of developing the PEFCR. This means, for example, that future technologies, future transport scenarios or future end of life treatments shall be excluded. The data used shall reflect realistic market averages and be the most recent (especially for fast developing technology products). Conservative values or estimates shall be avoided.

The RP may be a real or a virtual (non-existing) product. The virtual product should be calculated based on average European market sales-weighted characteristics of all existing technologies/materials covered by the product category or sub-category. Other weighting sets may be used, if justified, for example, weighted average based on mass (ton of material) or weighted average based on product units (pieces).

When identifying the RP there is the risk that different technologies with very different market shares get mixed up and the ones with a relatively small market share might be overlooked. In such cases the TS shall include the missing technologies/products (if in scope) in the definition of the representative product or provide written justification if this is not technically possible.

The RP is the basis for the PEF study of the representative product (PEF-RP). The RP may be a final product or an intermediate product. For final products and intermediate products where a benchmark is defined, it is also the basis for identifying the corresponding benchmark. Section A.3.1 explains for which product categories or sub-categories a RP shall be developed, while section A.3.2.3 indicates what shall be documented in the PEFCR.

A.2.4. *First PEF study of the representative product(s)*

A first PEF study shall be carried out on each representative product (first PEF-RP). The first PEF-RP aims to:

1. Identify the most relevant impact categories;

2. Identify the most relevant life cycle stages, processes and elementary flows;

3. Identify data needs, data collection activities and data quality requirements.

The TS carries out the first PEF-RP on the 'model' of the RP(s). Lack of available data and low market shares shall not be an argument for exclusions of technologies or production processes.

The TS shall use EF compliant datasets for the PEF-RP, if available. If an EF compliant dataset does not exist, the following procedure shall be followed in hierarchical order:

1. If an EF compliant proxy can be found it shall be used;

2. If an ILCD-EL compliant dataset as a proxy can be found: it shall be used but shall not be included in the list of default datasets of the first draft PEFCR. The proxy shall be listed in the limitations of the first draft PEFCR with the following text: 'This dataset is used as a proxy during the first PEF-RP only. However, the company performing the supporting study to test the first draft PEFCR shall apply an EF compliant dataset, if available (following the rules laid out in section A.4.4.2 on which datasets to use). If this is not available, the company shall use the same proxy as used for the calculation of the first PEF-RP.'

3. If no EF compliant or ILCD- EL compliant dataset can be found, another dataset may be used.

In the first PEF-RP no cut-off of processes, emissions to the environment and resources from the environment is allowed. All the life cycle stages and processes shall be covered (including capital goods). However, activities like staff commuting, canteens at production sites, consumables not strictly related to production processes, marketing, business trips and R&D activities may be excluded. Cut-offs may only be included in the final PEFCR based on the rules included in the Annex I and this Annex.

A first PEF-RP report shall be provided (following template in part E of the Annex II) and shall include the characterised, normalised and weighted results.

The first PEF-RP and its report shall be verified by the review panel and a public review report shall be provided as its annex.

A.2.5. *First draft PEFCR*

Based on the results of the first PEF-RP the TS shall produce a first draft PEFCR, used to carry out the PEFCR supporting studies. It shall be drafted according to the requirements included in this Annex and the template provided in part B of this Annex. It shall include all the requirements needed for the supporting studies, with particular reference to company-specific data collection tables and procedures.

A.2.6. *Supporting studies*

The goal of the supporting studies is to test the implementability of the first draft PEFCR and, to a lesser extent, provide indications about the suitability of the identified most relevant impact categories, life cycle stages, processes and direct elementary flows.

For each RP at least three PEF supporting studies shall be carried out.

The supporting studies shall be in compliance with all requirements included in the first draft PEFCR and the Annex I. The following additional rules shall be followed:

— No cut-off is allowed;

— Each study shall implement the hotspot analysis described in section 6.3 of Annex I and section A.6.1 of this Annex. Each study shall be carried out on real products as currently sold in the European market;

— To better analyse the applicability of the first draft PEFCR, the studies shall be carried out on products from (i) companies of different sizes, including at least one SME if present in the sector; (ii) companies characterized by different production processes/ technologies; and (iii) companies with the main production processes (i.e. the ones for which company-specific data are collected) located in different countries.

Each supporting study shall be carried out by an entity that is neither involved in the drafting of the PEFCR nor is part of the review panel. Exceptions to this rule may exist but they have to be in agreement with the European Commission. No aggregated EF compliant dataset has to be made available to the European Commission

A PEF report shall complement each supporting study and provide a relevant, comprehensive, consistent, accurate, and transparent summary of the study. The PEF report template to be used for the supporting studies template is available in Annex E of this Annex. The template includes the minimum information to be reported. The supporting studies (and their related PEF report) are confidential. They shall only be shared with the European Commission or the body overseeing the PEFCR development, and the review panel. However, the company performing the supporting study may decide to grant access to other stakeholders.

A.2.7. *Second PEF study of the representative product*

Conducting the PEF study of the representative product is an iterative process. Based on the information gathered through the first consultation and the supporting studies, the Technical Secretariat shall carry out a second PEF-RP. This second PEF-RP shall include EF compliant datasets, updated default activity data and all assumptions that are at the basis of the requirements in the second draft PEFCR. Based on the second PEF-RP, the Technical Secretariat shall draft a second PEF-RP report.

The TS shall use EF compliant datasets if available for free. In case EF compliant datasets are not available, the following rules shall be followed in hierarchical order:

— An EF compliant proxy is available for free: it shall be included in the list of default processes of the PEFCR and stated within the limitations section of the second draft PEFCR.

— An ILCD-entry level (EL) compliant dataset as proxy is available for free: A maximum of 10% of the single overall score may be derived from ILCD-EL compliant datasets.

— If no EF compliant or ILCD-EL compliant dataset is available for free: it shall be excluded from the model. This shall be clearly stated in the second draft PEFCR as a data gap and validated by the PEFCR verifiers.

The second PEF-RP shall determine all the requirements of the final PEFCR including, but not limited to, the final list of most relevant impact categories, life cycle stages, processes, direct elementary flows, cut-offs, etc. For final products, it shall also identify the values for the benchmark.

A second PEF-RP report shall be provided (following the template in part E of this annex) and shall include the characterised, normalised and weighted results.

The second PEF-RP and its report shall be reviewed by the review panel and a public review report shall be provided as its annex.

A.2.8 *The second draft PEFCR*

The TS shall draft the second draft PEFCR taking into consideration the results of the supporting studies and of the second PEF-RP. All the sections in the PEFCR template (see part B in this Annex) shall be filled in.

The PEFCR shall clarify that all the data gaps included in the PEFCR will remain data gaps for its entire validity as they have a direct impact on the benchmark. Therefore, data gaps are indirectly part of the system boundary of the PEFCR to allow a fair comparison with the benchmark.

A.2.9. *The PEFCR review*

A.2.9.1. Review panel

The TS shall set up an external independent third-party review panel for the PEFCR review.

The panel shall be composed of minimum three members (a chair and two members). In case a PEFCR entails more than five RP, the review panel could be enlarged with more members and additional co-chairs. The panel shall include one EF/LCA expert (with a background on the product category or sector under consideration and product-related environmental aspects), one industry expert and, if possible, one representative from NGOs. One member shall be selected as the lead reviewer.

The reviewers shall be independent from each other from a legal entity point of view. The panel shall not include representatives of the members ([6]) of the TS or other entities involved in the work of the TS, or employees of the companies running the supporting studies. Exceptions to this rule are to be discussed and agreed with the European Commission.

A review team can change during the development of a PEFCR. Members can leave or join in between two reviews steps. However, it is the duty of the lead reviewer to ensure that the criteria for the review panel are fulfilled at each and every step of the PEFCR development process; the new members are updated by the lead reviewer about the previous steps and issues discussed.

Lead reviewer can change as long as one of the others takes his/her role and ensures continuity of the work. The review process will include milestones, e.g. 1) 1st PEF-RP + 1st draft PEFCR, 2) supporting studies + 2nd PEF-RP +2nd draft PEFCR, 3) final draft PEFCR 4) final PEFCR. The continuity should be ensured within the same milestone. The previous requirement means that at least one member of the review team shall stay active in the project. If the requirements are not met, the review process shall start from the last milestone that fulfilled the requirements.

The assessment of the competences of the review panel is based on a scoring system that takes into account their experience, EF/LCA methodology and practice, and knowledge of relevant technologies, processes or other activities included in the product(s) in scope of the PEFCR. Table 32 of the Annex I presents the scoring system for each relevant competence and experience topic.

([6]) If an industry association is member of a Technical Secretariat, an industry expert of one company belonging to that industry association can be in the review panel. On the contrary, experts on the payroll of the association shall not be members of the review panel.

The review panel members shall provide a self-declaration of their qualifications, stating how many points they achieved for each criterion and the total points achieved. This self-declaration shall be included in the PEFCR review report.

The minimum necessary score to qualify as a reviewer is six points, including at least one point for each of the three mandatory criteria (i.e. review practice, EF/LCA methodology and practice, and knowledge of technologies or other activities relevant to the EF study).

A.2.9.2 Review procedure

The TS shall agree on the review procedure with the review panel when signing the review contract. In particular, the TS shall agree the period available to the review panel for producing comments after each document is released by the TS and how to manage the comments received.

The review panel will be responsible for the independent review of the following documents (see figure 1):

— Any draft version of the PEFCR (first, second and final);

— First and second PEF-RP, including the RP model, data and PEF-RP reports;

— Supporting studies, including the related PEF model, data and PEF report;

If the second consultation or the PEFCR review affects the results of the second PEF-RP, the second PEF-RP shall be updated and the results shall be implemented in the final draft PEFCR. In this case, the final draft PEFCR and final PEFCR shall be reviewed by the review panel.

The panel shall send the review of each document to the TS for their analysis and discussion. The TS shall review the panel's comments and proposals, and it shall develop a response for each.

For all documents, the TS shall generate written responses through review reports that may include:

— Acceptance of the proposal: change the document to reflect proposal,

— Acceptance of the proposal: change the document with modification to the original proposal,

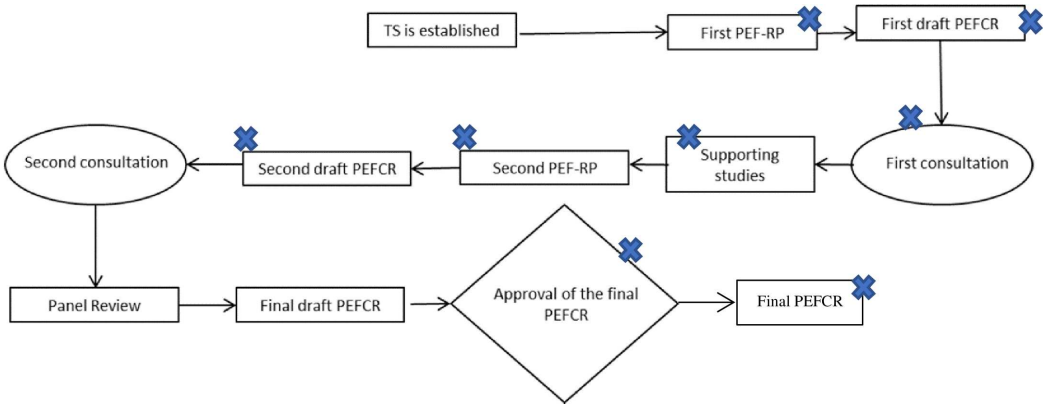
— Supporting comments on why the TS did not agree with the proposal,

— Return to the review panel with further questions on the comments/proposals.

The documents that need to go through the review procedure are presented in Figure A-1 with a cross.

Figure A-11

PEFCR development process



A.2.9.2.1. *Review of the first PEF-RP*

The first PEF-RP and its related PEF-RP report shall be reviewed by the review panel, in accordance with the verification procedure as presented in section 8.4 of the annex I. However, on-site visits do not apply and if the RP is a virtual product, the reviewers shall agree with the technical secretariat on technique(s) to validate the activity data. If the PEFCR defines several RPs, the review shall check that all the RPs defined in the PEFCR are included in the scope of the different PEF-RP studies.

In addition to the guidelines provided in section 8.4, the following review steps shall be made:

1. Assure that the instructions given in sections A.2.4., A.3.2.7., A.4.2, A.4.3., A.4.4.3, A.6.1. and 4.4.9.4 are followed;

2. Evaluate whether the methods used to make estimates are appropriate and applied consistently;

3. Identify uncertainties that are greater than expected and assess the effects of the identified uncertainty on the final PEF results;

4. For intermediate products PEF-RPs, validate if (i) the A value of the product in scope is set to 1 for the hotspot analysis and (ii) if this is documented in the PEFCR;

5. Check that the GHG emissions and removals are calculated and reported following the rules of section A.4.2.9.

6. In case non EF compliant datasets are used to model the first PEF-RP, the steps related to checking the correct implementation in the software may be skipped

A.2.9.2.2. *Supporting study review*

The supporting studies and their PEF reports shall be reviewed by the review panel. At least three supporting studies per RP shall be reviewed by the review panel. The review panel shall assure that each supporting study is carried out by a company/consultant neither involved in the drafting of the PEFCR nor part of the review panel.

The supporting study review is very similar to the PEF study verification with some specificities, e.g. on-site visits do not apply. In addition to the guidelines provided in section 8.4 in Annex I, the following review steps shall be made:

(a) the supporting study is carried out on a real product as currently sold in the European market;

(b) the draft PEFCR has been applied correctly;

(c) the supporting study follows the rules outlined in section A.2.6.;

(d) instructions given in section A.4.2. and A.4.3. are followed;

(e) the hotspot analysis described in section A.6.1. is applied and reported upon correctly;

(f) for intermediate products, validate if the A value of the product in scope is set to 1 for the hotspot analysis.

A.2.9.2.3. *Review of the second PEF-RP study*

The second PEF-RP and its related PEF-RP report shall be reviewed by the review panel, in accordance with the verification procedure as presented in section 8.4 of the annex I. However, on-site visits do not apply.

In addition to the guidelines provided in section 8.4 of Annex I, the following review steps shall be made:

that the review comments on the first PEF-RP and supporting studies are addressed, reasons for non implementation shall be provided;

that any new dataset, updated default activity data and all assumptions that are at the basis of the requirements in the second draft PEFCR are implemented correctly;

that the instructions given in sections A.2.4., A.3.2.7., A.4.2, A.4.3., A.4.4.3, A.6.1. and 4.4.9.4 are followed;

For intermediate products PEF-RPs, check if (i) the A value of the product in scope is set to 1 for the hotspot analysis and (ii) if this is documented in the PEFCR;

that the GHG emissions and removals are calculated and reported following the rules of section A.4.2.9.

A.2.9.3. Review criteria of the PEFCR document

The reviewers shall investigate whether the PEFCR (i) is developed in accordance with the requirements provided in the Annex I and this Annex, and (ii) supports the creation of credible, relevant, and consistent PEF profiles. In addition, the following review criteria shall also apply:

— The PEFCR scope and the representative products are adequately defined;

— The functional unit, allocation and calculation rules are adequate for the product category and sub-categories under consideration;

— Datasets used in the PEF-RPs and the supporting studies are relevant, representative, reliable, and in compliance with data quality requirements. The rules regarding which datasets to use are defined in section A.2.4. for the first draft PEFCR and in section A.4.4.2. for second draft and final PEFCR.

— For products with a life cycle stage with a non-equal distribution throughout the EU (e.g. wine production or sheep rearing) and/or manufacturing outside the EU, default datasets used for that non-equally distributed life cycle stage of the RP shall be checked on their geographic representativeness;

— The Data Needs Matrix of section of A.4.4.4.4 of this Annex is correctly implemented;

— The selected additional environmental information is appropriate for the product category and sub-categories under consideration;

— The performance classes in the final PEFCR (where included) are plausible.

— The model of the RP(s) and corresponding benchmark(s) (if applicable) represent correctly the product categories or sub-categories;

— The datasets representing the RP(s) from the final PEFCR, are (i) provided in disaggregated and aggregated form and (ii) EF compliant following the rules in section A.2.10.3.;

— The RP model (from final PEFCR) in its corresponding excel version is compliant with the rules outlined in section A.2.10.1.

A.2.9.4. Review report/ statements

The review panel shall produce:

For each PEF-RP: A public review report as Annex to the PEF-RP report. The public review report shall include the public review statement, all relevant information concerning the review process, the comments raised by the reviewers with the replies provided by the TS, and the outcome.

1. For each supporting study report, PEF-RP report and PEFCR: A public validation statement. The validation statement shall be in line with the rules outlined in section 8.5.2.

2. For minimum 3 (three) supporting studies: A **confidential** review report. This review report shall be shared with the EC or the body overseeing the PEFCR development, and the review panel. The company performing the supporting study may decide to grant access to other stakeholders.

3. For the final PEFCR: A public and a confidential review report.

   — The public review report shall include the public review statement (as provided in the PEFCR template), all relevant (non confidential) information concerning the review process, the comments raised by the reviewers with the replies provided by the TS, and the outcome.

   — The confidential review report shall include all comments raised by the reviewers during the development of the PEFCR and the replies provided by the TS. Any other relevant information concerning the review process and outcomes shall also be included. This review report shall be made available to the EC.

The final PEFCR shall include the following annexes: (i) its public review report, (ii) the review reports of each PEF-RP and (iii) the public validation statements of each reviewed supporting study.

A.2.10. *Final draft PEFCR*

Once the drafting work is finalised the Technical Secretariat shall send to the Commission the following documents:

1. the final draft PEFCR (including all annexes);
2. confidential review report of the PEFCR;
3. public review report of the PEFCR;
4. second PEF-RP report (including its public review report);
5. public review statements on the supporting studies;
6. all EF and ILCD-EL compliant datasets used for the modelling (both aggregated and disaggregated at level-1; see details in section A.2.10.2);
7. the model(s) of the RP(s) in excel format (see details in section A.2.10.1);
8. an EF compliant dataset of each RP (aggregated and disaggregated, see details in section A.2.10.3).

A.2.10.1. Excel model(s) of the representative product(s)

The model of the RP shall be made available in MS Excel format. In case the model of the RP is built on multiple sub-models (e.g. very different technologies), for each of these sub-models a separate excel file shall be provided in addition to the one of the overall model. The excel file shall be built in accordance with the template provided at JRC website ([7]).

A.2.10.2 Datasets listed in the PEFCR

All EF and ILCD-EL compliant datasets used in the PEFCR shall be available on a node of the Life Cycle Data Network ([8]), in aggregated and disaggregated (level-1) form.

A.2.10.3. EF compliant datasets representing the representative product(s)

The EF compliant dataset(s) representing the RP(s) shall be provided in aggregated and disaggregated form. The latter shall be disaggregated at the level coherent with the respective PEFCR. Data may be aggregated to protect confidential information.

The list of technical requirements to be fulfilled by the dataset to be EF compliant are available at http://eplca.jrc.ec.europa.eu/LCDN/developerEF.xhtml.

([7]) http://eplca.jrc.ec.europa.eu/LCDN/developerEF.xhtml

([8]) All EF and ILCD-EL compliant datasets used for modelling the RP shall be made available at the same terms and conditions as provided in the EF compliant data guide (available at http://eplca.jrc.ec.europa.eu/LCDN/developerEF.xhtml).

A.3. Defining the scope of the PEFCRs

A.3.1. *Product categories and sub-categories*

Products having similar functions and applications should be grouped within the same PEFCR. The scope of the PEFCR shall be selected in a way that it is sufficiently wide to cover different applications and/or technologies. In some cases, to fulfil this requirement, a product category may be split into multiple sub-categories. The TS shall decide if sub-categories are necessary to achieve the primary objective of the PEFCR and therefore to avoid the risk that the hotspot results from different technologies get mixed up or the results of the ones with a small market share are overlooked ([9]). It is necessary to be as specific as possible when defining the product category and sub-categories to ensure comparability of results.

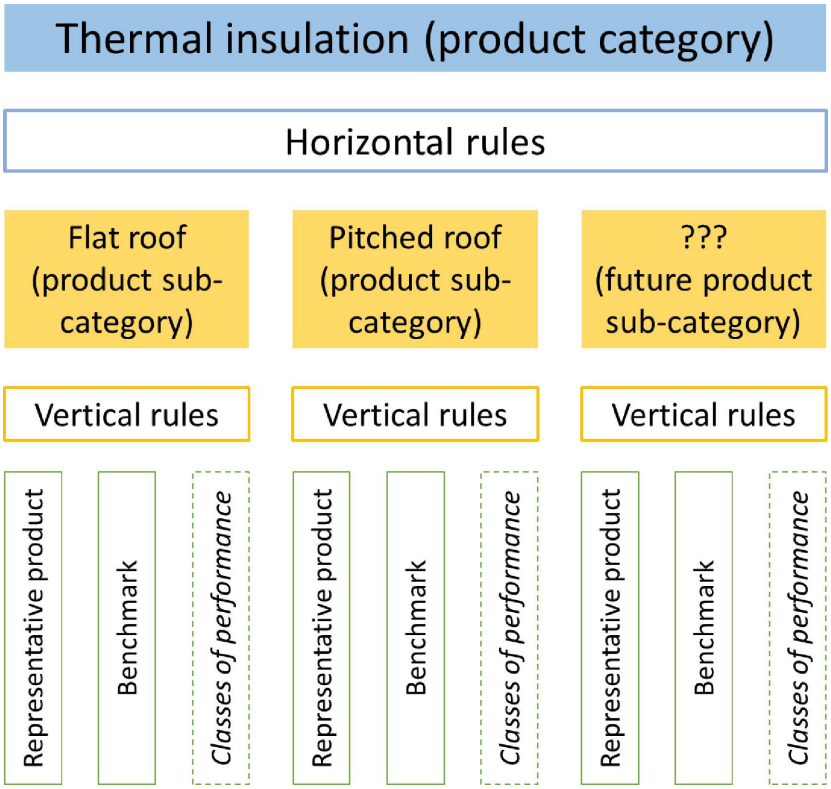
The PEFCR shall be structured with a section including the 'horizontal' rules that are common to all products in scope of the PEFCR, and then a section for each sub-category including the specific 'vertical' rules applicable only to that sub-category (Figure A-3).

As a general principle, the horizontal rules prevail over the vertical ones; however, specific derogations from this principle may be allowed if properly justified. This structure will make it easier to widen the scope of an existing PEFCR by adding more product sub-categories.

Each sub-category shall be clearly described in the scope definition of the PEFCR, each sub-category shall have its own RP and benchmark ([10]) together with its selection of most relevant processes, life cycle stages, direct elementary flows and impact categories. For each RP (and thus sub-category) at least three PEF supporting studies shall be carried out (see section A.3.6).

Figure L-3

Example of a PEFCR structure with product category specific horizontal rules, various product sub-categories, and product sub-category specific vertical rules.



([9]) This to ensure that the hotspot analysis reflects all different technologies.
([10]) A benchmark is only applicable to final products (section A.5.1)

For final products, the PEFCR shall enable the comparison of products belonging to the same product category and/or sub-category (see Table A-1). If sub-categories are part of the PEFCR scope, a comparison of products belonging to the same sub-category shall always be allowed.

However, the TS may decide, and shall explicitly state in the PEFCR, if a comparison among all products belonging to the overarching product category is allowed. In this case:

1. a RP shall be defined also at overarching product category level and it should be modelled based on the European market shares (based on turnover) of the RPs covered by the sub-categories. Other aggregation rules may be used, if justified.

2. the TS shall provide the benchmark values of each RP in the PEFCR, both at overarching category and sub-category level.

3. for the RP of the overarching category the most relevant impact categories shall be calculated for communication purposes, in addition to the calculation of the most relevant impact categories, life cycle stages, processes and direct elementary flows identified for the RP of each sub-category.

The TS may decide, and shall explicitly state in the PEFCR if a cross-comparison of products belonging to two or more different sub-categories is allowed. The definition of a benchmark at the overarching category level is not required.

Table GG-1

Table GG-1 Summary of requirements for PEFCR covering one single product category and for PEFCRs covering sub-categories. Requirements are applicable to final products.

	Single product category in PEFCR	Category and sub-categories in PEFCR	
		Within the category	Within the sub-category
Definition of a RP	Shall	May	Shall
Comparative assertion via benchmark for final products	Shall	May. Shall, if a RP is defined at overarching category level.	Shall
Comparative assertion among final products	Shall	May The technical secretariat decides in which cases comparison among products in different sub-categories is allowed.	Shall

All requirements in Annex II apply to product categories and sub-categories (if applicable).

A.3.2. *Scope of the PEFCR*

Meaningful comparisons may only be made if products are fulfilling the same main function (as expressed through the functional unit). Therefore, the scope of a PEFCR for final products should be defined based on the function, with any deviations to be justified.

The scope should include as many products as possible available in the market that deliver the same main function: this approach also enables to link the product category with the Classification of Products by Activity (CPA) codes and it is line with the definition of a product category by EN ISO 14025:2010 (i.e. a group of products that can fulfil equivalent functions).

The scope section of the PEFCR shall contain, as a minimum, the following information:

1. General description of the scope of the PEFCR:
   a. Description of the product category;
   b. List and description of sub-categories included in the PEFCR (if any);
   c. Description of the product(s) and technical performance;
2. Product classification (CPA codes for the products in scope);
3. Description of the Representative Product(s) and how it has been derived;
4. Functional unit and reference flow;
5. System boundary description and diagram;
6. List of EF impact categories;
7. Additional environmental information and additional technical information;
8. Limitations.

A.3.2.1. General description of the scope of the PEFCR

The PEFCR scope definition shall include a general description of the product category, including the granularity of scope, the product sub-categories included (if any), a description of the product(s) in scope and their technical performance. If a product fulfils more than one function and these additional functions are not included in the PEFCR scope and if other products fulfil the same function but they are not included in the scope of the PEFCR, then these omissions shall be explained and documented (see section A.3.2.4).

A.3.2.2. Use of CPA codes

The CPA codes corresponding to the products in scope shall be listed in the PEFCR.

CPA codes relate to activities as defined using NACE codes (i.e. by the Statistical classification of economic activities in the European Community (NACE)). Each CPA product is assigned to one single NACE activity; hence the CPA structure is parallel to that of NACE at all levels. The International Standard Industrial Classification (ISIC) and NACE have the same code at the highest levels, but NACE is more detailed at the lower levels.

A.3.2.3. Definition of the representative product (RP)

The PEFCR shall include in the scope a short description of the RP(s).

The Technical Secretariat shall provide information about all the steps taken to define the 'model' of the RP and report the information gathered in an Annex to the PEFCR. Should any piece of confidential information be included in the Annex, it should only be made available for reviewing (by the EC, market surveillance authorities or reviewers).

A.3.2.4. Functional unit (FU)

The FU of a PEFCR shall describe qualitatively and quantitatively the function(s) of the product according to the four aspects reported in Table HH-2 -2. The table includes additional requirements for food and non-food PEFCRs that shall be adapted in the respective PEFCRs.

In case applicable standards exist, they shall be used and cited in the PEFCR.

For intermediate products, the FU is more difficult to define because they can often fulfil multiple functions and the whole life cycle of the product is not known. Therefore, a material-based approach (or declared unit) may be chosen. For example, mass (kilogram) or volume (cubic meter).

The PEFCR shall explain and document any omission of the functions of the product in the definition of the functional unit and justify why.

Table HH-2

Four aspects of the FU with additional requirements for food and non-food PEFCRs

Elements of the FU	Non-food products	Food products
1. The function(s)/service(s) provided: 'what'	PEFCR specific	The FU shall be measured at product consumption level and should exclude inedible parts ([1]).
2. The extent of the function or service: 'how much'	PEFCR specific	PEFCR-specific
3. The expected level of quality: 'how well'	PEFCR specific, where possible.	PEFCR specific, where possible.
4. The duration/life time of the product: 'how long'	Shall be quantified if technical standards or agreed procedures at sectoral level exist or can be developed.	Food losses at storage, retail, and consumer shall be quantified if shelf-life (indicated for example as 'best before date' or 'use by date') is provided on the packaging (e.g. number of months). In case the type of packaging affects the shelf-life, this shall be taken into account.

([1]) The term 'inedible parts' shall be defined by the TS in the PEFCR.

The PEFCR shall describe (i) how each aspect of the FU affects the EF of the product, (ii) how to include this effect in the EF calculations and (iii) how an appropriate reference flow shall be calculated. In case calculation parameters are needed, the PEFCR shall provide default values or shall request these parameters in the list of mandatory company-specific information. The PEFCR shall provide a calculation example.

Example

The type of packaging might affect the amount of salad wasted at retail and at the use stage. As a consequence, the type of packaging affects the amount of salad which is needed to fulfil the 'how long' and 'how much' described in the FU. The PEFCR shall describe the potential effects of packaging on food waste and provide a table with the percentage of salad waste per packaging type used. Finally, the PEFCR shall describe how the percentage of salad waste from the table is integrated into the reference flow and added to the FU of 1kg of salad consumed. All quantitative input and output data collected in the analysis shall be calculated in relation to this reference flow of 1kg plus the percentage of waste.

A.3.2.5. System boundary

The PEFCR shall identify the processes and life cycle stages that are included in the product category/ sub-category. The PEFCR shall provide a short description of the processes and life cycle stages.

The PEFCR shall identify the processes that shall be excluded based on the cut-off rule (see section A.4.3.3.), or specify that no cut-off is applicable.

The PEFCR shall provide a system diagram indicating the processes for which mandatory company-specific data are required and the processes excluded from the system boundary.

A.3.2.6. List of EF impact categories

The PEFCR shall list the 16 EF impact categories to be used to calculate the PEF profile, as listed in Table 2 of the Annex I. Out of the 16 impact categories, the PEFCR shall list those that are most relevant for the product category and/or sub-categories in scope (see section A.6.1.1 of this Annex II).

The PEFCR shall specify if the user of the PEFCR shall calculate and report separately the sub-indicators for climate change (see section A.4.2.9).

The PEFCR shall specify the version of the EF reference package to be used ([11]).

A.3.2.7. Additional information

A.3.2.7.1. *Additional environmental information*

The PEFCR shall specify which additional environmental information to report, and whether these are mandatory or recommended additional environmental information. The use of 'should' requirements should be avoided. Additional environmental information may be included only if the PEFCR specifies the method that shall be used for its calculation.

Biodiversity

When developing a PEFCR, biodiversity shall be addressed under additional environmental information through the procedure below:

(a) When performing the first and second PEF-RP study, the Technical Secretariat shall make an assessment about the relevance of biodiversity for the product (sub)category(s) in scope of the PEFCR. This assessment may be based on expert judgement, be LCA-based, or be derived through other means already put in place within the sector covering the product group. The assessment shall be clearly explained in a dedicated section of the first and second PEF-RP report.

(b) Based on the above, the PEFCR shall clearly explain whether biodiversity is considered relevant or not. If the Technical Secretariat determines that there are significant impacts on biodiversity, then they shall describe how the user of the PEFCR shall assess and report biodiversity impacts, as additional environmental information.

While the Technical Secretariat may determine how biodiversity shall be assessed and reported in the PEFCR (if relevant), the following suggestions are available:

1. To express the (avoided) impact on biodiversity as the percentage of material that comes from ecosystems that have been managed to maintain or enhance conditions for biodiversity. This shall then be demonstrated by a regular monitoring and reporting of biodiversity levels, gains or losses (e.g. less than 15% loss of species richness due to disturbance, but the Technical Secretariat may set their own level provided this is well justified). The assessment should refer to materials that end up in the final products and to materials that have been used during the production process. For example, charcoal that is used in steel production processes, or soy that is used to feed cows that produce dairy etc.

2. To report additionally the percentage of such materials for which no chain of custody or traceability information can be found.

3. To use a certification system as a proxy. The Technical Secretariat shall determine which certification schemes provide sufficient evidence for ensuring biodiversity maintenance and describe the criteria used ([12]).

A.3.2.7.2. *Additional technical information*

The PEFCR shall list the additional technical information that shall/ should/ may be reported.

If the product in scope is an intermediate product, the PEFCR shall request the following additional technical information:

1. The biogenic carbon content at factory gate (physical content) shall be reported in the PEF study. If derived from a native forest, the PEFCR shall require that the corresponding carbon emissions shall be modelled with the elementary flow '(land use change)';

2. The recycled content (R1) shall be reported;

3. Results with application-specific A-values of the circular footprint formula, if relevant.

([11]) Available at http://eplca.jrc.ec.europa.eu/LCDN/developer.xhtm
([12]) A useful overview of standards can be found on http://www.standardsmap.org/

A.3.2.8. Assumptions and limitations

The PEFCR shall include the list of limitations a PEF study is subject to, even if carried out in accordance with the PEFCR.

The PEFCR shall include the conditions under which a comparison or comparative assertion may be made.

The PEFCR shall list the ILCD-EL compliant datasets used when modelling the representative product(s) and the data gaps.

A.4. **Life cycle inventory**

A.4.1. *Life cycle stages*

The PEFCR shall list all processes taking place in each life cycle stage: for each process, it shall include the default secondary data sets to be used by the user, unless the process is covered by mandatory company-specific data.

The default life cycle stages are listed in 4.2of the Annex I and further detailed in sections 4.2.1-4.2.5 of Annex I.

A.4.2. *Modelling requirements*

A.4.2.1. Agricultural production

For agricultural activities, the modelling guidelines of section 4.4.1 of the Annex I shall be followed for the RPs and included in the PEFCRs. Any exception shall be agreed upon with the Commission before being implemented.

A.4.2.1.1. *Fertilisers*

For nitrogen-based fertilisers, the Tier 1 emissions factors of table 2-4 of IPCC (2006) should be used, as presented in Table 3 of the Annex I.

The nitrogen field model presented in Table 3 of the Annex I has some limitations and should be improved in the future. Therefore, PEFCRs which have agricultural modelling in scope shall test (as a minimum) the following alternative approach within the PEF-RPs.

The N-balance is calculated using the parameters in Table II-3 and the formula below. The total NO_3-N emission to water is considered a variable and its total inventory shall be calculated as:

'Total NO_3-N emission to water' = 'NO_3^- base loss' + 'additional NO_3-N emissions to water', with

'Additional NO_3-N emissions to water' = 'N input with all fertilisers' + 'N_2 fixation by crop' – 'N-removal with the harvest' – 'NH_3 emissions to air' – 'N_2O emissions to air' – 'N_2 emissions to air' -'NO_3- base loss'.

If in certain low-input schemes the value for 'additional NO_3-N emissions to water' is negative, the value shall be set to '0'. Moreover, in such cases the absolute value of the calculated 'additional NO_3-N emissions to water' is to be inventoried as additional N-fertiliser input into the system, using the same combination of N-fertilisers as employed to the analysed crop. This serves to avoid fertility-depleting schemes by capturing the N-depletion by the analysed crop that is assumed to lead to the need for additional fertiliser later on to keep the same soil fertility level.

Table II-3

Alternative approach to nitrogen modelling

Emission	Compartment	Value to be applied
NO_3^- base loss (synthetic fertiliser and manure)	Water	kg NO_3^-= kg N*FracLEACH = 1*0.1*(62/14) = 0.44 kg NO_3^-/ kg N applied

N_2O (synthetic fertiliser and manure; direct and indirect)	Air	0.022 kg N_2O/ kg N fertilizer applied
NH_3 - Urea (synthetic fertiliser)	Air	kg NH_3= kg N * FracGASF= 1*0.15* (17/14)= 0.18 kg NH_3/ kg N fertilizer applied
NH_3 - Ammonium nitrate (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 - others (synthetic fertiliser)	Air	kg NH_3= kg N * FracGASF= 1*0.02* (17/14)= 0.024 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
N_2-fixation by crop		For crops with symbiotic N_2-fixation: the fixed amount is assumed to be identical to the N-content in the harvested crop
N_2	Air	0.09 kg N_2 / kg N applied

The Technical Secretariat may decide to include the above approach for N-based modelling in their PEFCR, instead of the one provided in the Annex I. Both approaches shall be tested in the supporting studies, and based on the evidences gathered, the Technical Secretariat is free to decide which of the two to apply. This shall be validated by the review panel of the PEFCR.

As a second alternative, in case better data is available, a more comprehensive nitrogen field model may be used in the PEFCR, provided (i) it covers at least the emissions requested in Table 3 of the Annex I, (ii) N shall be balanced in inputs and outputs and (iii) it shall be described in a transparent way.

A.4.2.2. Electricity use

The requirements in section 4.4.2 of the Annex I shall be applied, unless the PEFCR covers electricity as main product (e.g., photovoltaic systems).

A.4.2.2.1. *Electricity modelling for benchmark calculations*

In benchmark calculations the following electricity mix shall be used in hierarchical order:

(i) Sector specific information on the use of green electricity shall be used if:

  (a) available, and

  (b) the set of minimum criteria to ensure the contractual instruments are reliable is met.This may be combined with the remaining electricity to be modelled with the residual grid mix.

(ii) In case no sector specific information is available, the consumption grid mix shall be used.

In case the benchmark is produced in different locations or sold in different countries, the electricity mix shall reflect the ratios of production or ratios of sales between EU countries/regions. To determine the ratio, a physical unit shall be used (e.g. number of pieces or kg of product). Where such data are not available, the average EU mix (EU+EFTA), or region representative mix shall be used.

A.4.2.3. Transport and logistics

The PEFCR shall provide default transport scenarios to be used, in case these data are not listed as mandatory company-specific information (see section A.4.4.1) and supply-chain specific information is not available. The default transport scenarios shall reflect the European average transport, including all different transport options within the current product category (e.g. including home delivery, if applicable).

In case no PEFCR-specific data ([13]) is available, the default scenarios and values outlined in section 4.4.3 of the Annex I shall be used. Replacement of the default values provided in section 4.4.3 with PEFCR-specific values shall be clearly mentioned and justified in the PEFCR.

The (final and intermediate) client of the product shall be defined in the PEFCR ([14]). The final client may be a consumer (i.e. any natural person who is acting for purposes which are outside his trade, business, craft or profession) or a company that uses the product for final use, such as restaurants, professional painters, or a construction site. For the purposes of this section, re-sellers and importers are intermediate clients and not final clients.

A.4.2.3.1. *Allocation of impacts from transport – truck transport*

The PEFCR shall specify the utilisation ratio to be used for each truck transport modelled, and it shall clearly indicate whether the utilisation ratio includes empty return trips.

— If the load is mass-limited: a default utilisation ratio of 64% ([15]) shall be used. This utilisation ratio includes empty return trips. Therefore, empty returns shall not be modelled separately. The PEFCR shall list the truck dataset to be used, together with the utilisation factor to be used (64%). The PEFCR shall clearly indicate that the user shall check and adapt the utilisation ratio to the default value provided in the PEFCR.

— If the load is volume-limited and the full volume is used: the PEFCR shall indicate the company-specific utilisation ratio calculated as the kg real load/kg payload of the dataset and indicate how empty returns shall be modelled.

— If the load is delicate (e.g. flowers): it is likely that the full truck volume cannot be used. The PEFCR shall evaluate the most appropriate utilisation ratio to be applied.

— Bulk transport (e.g., gravel transport from mining pit to concrete plant) shall be modelled with a default utilisation ratio of 50% (100% loaded outbound and 0% loaded inbound).

— Reusable products and packaging shall be modelled with PEFCR-specific utilisation ratios. The default value of 64% (including empty return) cannot be used because the return transport is modelled separately for reusable products.

A.4.2.3.2. *Allocation of impacts from transport – consumer transport*

The PEFCR shall prescribe the default allocation value to be used for consumer transport, if applicable.

A.4.2.3.3. *Default scenarios – from supplier to factory*

The PEFCR shall specify default transport distances, transport modes (specific dataset) and truck load factors to be used for the transport of products from supplier to factory. If no PEFCR specific data are available, then the default data provided in section 4.4.3.4 of the Annex I shall be prescribed in the PEFCR.

A.4.2.3.4. *Default scenarios – from factory to final client*

The transport from factory to final client (including consumer transport) shall be described in the distribution stage of the PEFCR. This helps fair comparisons between products delivered through traditional shops as well as delivered at home.

([13]) Product category specific data, defined by the TS and representing the European average for the products in scope.

([14]) A clear definition of the final client facilitates a correct interpretation of the PEFCR by practitioners which will enhance the comparability of results.

([15]) Eurostat 2015 indicates that 21% of the kms truck transport are driven with empty load and 79% are driven loaded (with an unknown load). In Germany only, the average truck load is 64%.

In case no PEFCR-specific transport scenario is available, the default scenario outlined in section 4.4.3.5 of the Annex I shall be used as a basis, together with a number of PEFCR-specific values:

1. Ratio between products sold through retail, distribution centre (DC) and directly to the final client;

2. For factory to final client: Ratio between local, intracontinental and international supply chains;

3. For factory to retail: distribution between intracontinental and international supply chains.

For reusable products the return transport from retail/DC to factory shall be modelled in addition to the transport needed to go to retail/DC. The same transport distances as from product factory to final client shall be used (see section 4.4.3.5 of the Annex I), however the truck utilisation ratio might be volume-limited depending on the type of product. The PEFCR shall indicate the utilisation ratio that shall be used for the return transport.

A.4.2.4. Capital goods – infrastructure and equipment

During the execution of the PEF-RP studies all processes shall be included in the modelling without applying any cut-off, the modelling assumptions and secondary datasets used shall be clearly documented.

The PEFCR shall identify if, based on the results of the PEF-RP study, capital goods are subject to cut-off or not. If capital goods are included in the PEFCR, clear rules for their calculation shall be provided.

A.4.2.5. Sampling procedure

In some cases, a sampling procedure is needed by the user of a PEFCR to limit the data collection only to a representative sample of plants/ farms etc. Examples of cases when the sampling procedure may be needed are in case multiple production sites are involved in the production of the same Stock Keeping Unit (SKU); e.g., in case the same raw material/ input material comes from multiple sites or in case the same process is outsourced to more than one subcontractor/ supplier.

For PEFCRs a stratified sample shall be used, i.e. one that ensures that sub-populations (strata) of a given population are each adequately represented within the whole sample of a research study. With this type of sampling, it is guaranteed that subjects from each sub-population are included in the final sample, whereas simple random sampling does not ensure that sub-populations are represented equally or proportionately within the sample.

The Technical Secretariat shall decide if sampling is allowed or not allowed in its PEFCR. The Technical Secretariat may explicitly prohibit the use of sampling procedures in the PEFCR. In this case sampling will not be allowed in PEF studies and the user of the PEFCR shall collect data from all plants or farms. If the Technical Secretariat allows sampling, the PEFCR shall contain the following sentence: 'In case sampling is needed, it shall be conducted as specified in this PEFCR. However, sampling is not mandatory and any user of this PEFCR may decide to collect the data from all the plants or farms, without performing any sampling.'

In case the PEFCR allows the use of sampling, the PEFCR shall define the requirements for reporting by the user of the PEFCR. The population and the selected sample used for the PEF study shall be clearly described in the PEF report (e.g., the % of the total production or % of number of sites, following the requirements stated in the PEFCR).

A.4.2.5.1. *How to define homogeneous sub-populations (stratification)*

The PEF method requires aspects to be taken into consideration in the identification of the sub-populations (see section 4.4.6.1 of the Annex I):

1. Geographical distribution of sites;

2. Technologies/ farming practices involved;

3. Production capacity of the companies/ sites taken into consideration.

The PEFCR may list additional aspects to be taken into consideration within a specific product category.

In case additional aspects are taken into account, the number of sub-populations is calculated using the formula (equation 1) provided in section 4.4.6.1 of the Annex I 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).

A.4.2.5.2. *How to define sub-sample size at sub-population level*

The PEFCR shall specify the approach chosen among the two available in section 4.4.6.2 of the Annex I. The same approach shall be used for all the sub-populations selected.

In case the first approach is chosen the PEFCR shall establish the unit of measure for the production (e.g., t, m^3, m^2 or value in €). The PEFCR shall identify the percentage of production to be covered by each sub-population, which shall not be lower than 50%, expressed in the relevant unit. This percentage determines the sample size within the sub-population.

A.4.2.6. Use stage

A.4.2.6.1. *Main function approach or delta approach*

The PEFCR shall describe which approach shall be applied (main function approach or delta approach, section 4.4.7.1 of the Annex I).

In case the delta approach is used, the PEFCR shall specify a reference consumption to be defined for each associated product (e.g. of energy and materials). The reference consumption refers to the minimum consumption that is essential for providing the function. The consumption above this reference (the delta) will then be allocated to the product. To define the reference situation, the following shall be considered, if available:

1. Regulations applicable to the product category;

2. Standards or harmonised standards;

3. Recommendations from manufacturers or manufacturers' organisations;

4. Use agreements established by consensus in sector-specific working groups.

A.4.2.6.2. *Modelling the use stage*

For all processes belonging to the use stage (both most relevant and the others):

(a) The PEFCR shall indicate which use stage processes are product dependent and product independent (as described in the Annex I, section 4.4.7).

(b) The PEFCR shall identify for which processes default data shall be provided by following the modelling guidelines in Table JJ-4. In case modelling is optional, the Technical Secretariat shall decide whether this is included in the system boundary of the PEFCR calculation model.

(c) Per process to be modelled, the Technical Secretariat shall decide and describe in the PEFCR whether the main function approach or delta approach shall be applied:

   a. Main function approach: The default datasets presented in the PEFCR shall reflect as much as possible the reality of market situations.

   b. Delta approach: the PEFCR shall provide the reference consumption to be used.

(d) The PEFCR shall follow the modelling and reporting guidelines in Table JJ-4. This table shall be filled in by the Technical Secretariat and included in the first and second PEF-RP reports.

Table JJ-4

PEFCR guidelines for the use stage

The specific use stage process is:		Actions to be taken by the TS	
Product dependent?	**Most relevant?**	**Modelling guidelines**	**Where to report**
Yes	Yes	To be included in the PEFCR system boundary. Provide default data	Mandatory: PEF report, reported separately (*)
	No	Optional: May be included in the PEFCR system boundary when the uncertainty can be quantified (provide default data)	Optional: PEF report, reported separately (*)
No	Yes/No	Excluded from the PEFCR system boundary	Optional: qualitative information

(*) For final products, the LCIA results shall be reported as (i) the sum of all life cycle stages including the use stage and (ii) the total life cycle excluding the use stage. The use stage results shall not be reported as additional environmental or technical information.

Part D of Annex II provides default data to be used by the Technical Secretariat to model use stage activities that might be cross-cutting for several product groups. It shall be used to fill in the data gaps and ensure consistency among PEFCRs. Better data may be used but shall be justified in the PEFCR.

Example: pasta

This is a simplified example on how the environmental footprint of the use stage can be modelled and reported for the product '1 kg dry pasta' (adapted from the final PEFCR for dry pasta ([16]).

Table LL-6 presents the processes used for modelling the use stage of 1kg dry pasta (boiling time according to instructions, for instance 10 minutes; amount of water, according to the instructions, for instance 10 litres). Among the four processes, electricity and heat use are the most relevant ones. Within this example, all four processes are product dependent. The amount of water use and cooking time is in general indicated on the packaging. The manufacturer can change the recipe in order to increase or reduce the cooking time, and therefore the energy use. Within the PEFCR, default data is provided on all four processes, as indicated in Table LL-6 (activity data + LCI dataset to be used). Following the reporting guidelines, the EF of the total of all four processes is reported as separate information.

Table KK-5

Example activity data and secondary datasets used

Materials/fuels	Value	Unit
Tap water; technology mix; at user; per kg water	10	kg
Electricity mix, AC, consumption mix, at consumer, <1kV	0,5	kWh
Thermal energy, from resid. heating systems from NG, consumption mix, at consumer, temperature of 55C	2,3	kWh
Waste to treatment	Value	Unit
Waste water treatment, domestic waste water according to the Directive 91/271/EEC concerning urban waste water treatment	10	kg

([16]) Available at http://ec.europa.eu/environment/eussd/smgp/PEFCR_OEFSR_en.htm

Table LL-6

Processes of the use stage of dry pasta (adapted from the final PEFCR for dry pasta). The most relevant processes are indicated in the green box

Is the use stage process …?		Pasta processes	Actions taken by the TS:	
(ii) **Product dependent?**	(iii) **Most relevant?**		**Modelling**	**Reporting**
Yes	Yes	Electricity and Heat	Modelled as main function approach. Default data provided (total energy use).	In the PEF report, reported separately
	No	Tap water Waste water	Modelled as main function approach. Default data provided (total water use).	In the PEF report, reported separately
No	Yes/No		Excluded from the EF calculation (impact categories)	Optional: qualitative information

A.4.2.7. End of life modelling

PEFCR shall prescribe the use of the CFF formula and provide default values for all parameters to be used (see also section 4.4.8 of the Annex I).

A.4.2.7.1. *The A factor*

The A values to be used shall be clearly listed in the PEFCR, with a reference to Part C of Annex II. When developing a PEFCR the following procedure shall be applied to select the value of A to be included in the PEFCR:

Check in Part C of Annex II the availability of an application-specific A value which fits the PEFCR,

(a) If an application specific A value is not available, the material-specific A value in Part C of Annex II shall be used,

(b) If a material-specific A value is not available, the A value shall be set equal to 0.5.

A.4.2.7.2. *The B factor*

The B value shall always be equal to 0 as default unless another appropriate value is available in the part C of the Annex II. The B value to be used shall be clearly stated in the PEFCR.

A.4.2.7.3. *The quality ratios:* Qs_{in}/Q_p *and* Qs_{out}/Q_p

The quality ratios shall be determined at the point of substitution and per application or material. The quality ratios are PEFCR specific. For packaging, each PEFCR should use the default values provided in Part C of Annex II. The Technical Secretariat may decide to change the default values in the PEFCR to product category specific ones. In this case, the justification for the change shall be included in the PEFCR.

All quality ratios to be used shall be clearly stated in the PEFCR. Alternatively, clear guidance shall be provided by the PEFCR on how to determine quality ratios to be used.

The quantification of the quality ratios shall be based on:

Economic aspects: i.e. price ratio of secondary compared to primary materials at the point of substitution. In case the price of secondary materials is higher than that of the primary ones, the quality ratios shall be equal to 1.

If economic aspects are less relevant than physical aspects, the latter may be used.

A.4.2.7.4. *Recycled content (R_1)*

The PEFCR shall provide the list of default R1 values, which shall be used by the user of the PEFCR in case no company-specific values are available. For this, the Technical Secretariat shall select the appropriate application-specific R1 values available in Part C of Annex II. In case no application-specific values are available, R1 shall be set equal to 0. Material-specific values based on supply market statistics shall not be used as a proxy. All possible geographic regions shall be provided. The applied R1 values shall be subject to the PEFCR review (if applicable) or PEF study verification (if applicable).

New R1 values may be developed by the Technical Secretariat (based on new statistics) and provided to the Commission for implementation in Part C of Annex II. Newly proposed R1 values shall be provided together with a report indicating the sources and calculations, and reviewed by an external independent third party. The Commission will decide if the new values are acceptable and can be implemented in an updated version of Part C of Annex II. Once the new R1 values are integrated into Part C of Annex II, they can be used by any PEFCR. The choice for 'default R_1 values' or 'company-specific R_1 values' shall be based on the rules of the DNM (see Table A-7 Requirements regarding R_1 values in relation with the DNM).

This means that company-specific values shall be used when:

(a) the process is identified in the PEFCR as being most relevant and is run by the company using the PEFCR, or the company is not running the process but has access to company-specific information,

or

(b) the process is listed by the PEFCR as mandatory company-specific data.

In other cases 'default secondary R_1 values' shall be used for example, when R_1 is in situation 2, option 2 of the DNM. In this case company-specific data is not mandatory and default secondary R_1 values provided in the PEFCR shall be used by the company.

Table A-7

Requirements regarding R_1 values in relation with the DNM

		Most relevant process	Other process
Situation 1: process run by the company using the PEFCR	**Option 1**	Supply-chain specific R_1 value	
	Option 2		Default (application-specific) R1 value
Situation 2: process not run by the company using the PEFCR but with access to (company-)specific information	**Option 1**	Supply-chain specific R_1 value	
	Option 2	Default (application-specific) or supply-chain specific R_1 value	
	Option 3		Default (application-specific) or supply-chain specific R_1 value
Situation 3: process not run by the company using the PEFCR and without access to (company)-specific information	**Option 1**	Default (application-specific) R_1 value	
	Option 2		Default (application-specific) R_1 value

A.4.2.7.5. *Guidelines on how to deal with pre-consumer scrap*

Two options are described in the PEF method (section 4.4.8.8 of Annex I): the PEFCR shall specify which option shall be used when modelling pre-consumer scrap.

A.4.2.7.6. *Recycling output rate (R_2)*

The PEFCR shall provide the list of default R2 values to be used by the user of the PEFCR in case no company-specific values are available. For this, the Technical Secretariat shall select the appropriate application-specific R2 values available in part C of Annex II. In case no application-specific values are available in part C of Annex II, the PEFCR shall select the R2 values of the material (e.g. materials average) to be used as default. In case no R2 values are available, R2 shall be set equal to 0. All possible geographic regions shall be provided.

New R2 values may be developed by the Technical Secretariat (based on new statistics) and provided to the Commission for implementation in part C of Annex II. Newly proposed R2 values shall be provided together with a study report indicating the sources and calculations, and reviewed by an external independent third party. The Commission will decide if the new values are acceptable and can be implemented in an updated version of part C of Annex II. Once the new R2 values are integrated into part C of Annex II, they can be used by any PEFCR.To select the right R_2 value the following procedure shall be followed by the user of the PEFCR and described in the PEFCR:

Company-specific values shall be used if available.

1. If no company-specific values are available and the criteria for evaluation of recyclability are fulfilled (see section 4.4.8.9 of Annex I), application-specific R_2 values shall be used as listed in the PEFCR,

   a. If an R_2 value is not available for a specific country, then the European average shall be used.

   b. If an R_2 value is not available for a specific application, the R_2 values of the material shall be used (e.g. material's average).

   c. In case no R_2 values are available, R_2 shall be 0 or new statistics may be generated to assign an R_2 value in the specific situation.

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

A.4.2.7.7. *The R_3 value*

The PEFCR shall provide the list of default R_3 values, which shall be used by the user of the PEFCR in case no company-specific values are available. For this, the Technical Secretariat shall select the appropriate R_3 values available in part C of Annex II. In case no value is available in part C of Annex II or in the case that such values are outdated with more recent ones from the same data source ([17]), the Technical Secretariat shall provide own developed values or provide guidance for the user of the PEFCR on how to derive the necessary values. The applied R_3 values shall be subject to the PEFCR review (if applicable) or PEF study verification (if applicable).

New R_3 values may be developed by the Technical Secretariat (based on new statistics) and provided to the Commission for implementation in part C of Annex II. Newly proposed R_3 values shall be provided together with a study report indicating the sources and calculations, and reviewed by an external independent third party. The Commission will decide if the new values are acceptable and can be implemented in an updated version of part C of Annex II. Once the new R_3 values are integrated into part C of Annex II, they can be used by any PEFCR.

The choice for 'default R_3 values' or 'company-specific R_3 values' shall be based on the logic of the DNM. This means that supply chain specific values shall be used when:

1. the process is identified in the PEFCR as being most relevant and is run by the company using the PEFCR, or the company is not running the process but has access to company-specific information,

   or

([17]) For example, part C of Annex II reports data from Eurostat 2013 but more updated data were published by Eurostat in a more recent year.

2. the process is listed by the PEFCR as mandatory company-specific data.

In all other cases 'default secondary R_3 values' shall be used for example, when R_3 is in situation 2, option 2 of the DNM. In this case, company-specific data is not mandatory and default secondary R_3 values provided in the PEFCR shall be used by the company.

A.4.2.7.7. *$E_{recycled}$ and $E_{recyclingEoL}$*

The PEFCR shall list the default datasets that the user of the PEFCR shall apply to model E_{rec} and E_{recEoL}.

A.4.2.7.8. *The E*v*

The PEFCR shall list the default datasets that the user of the PEFCR shall apply to model E*v.

A.4.2.7.9. *How to apply the formula to intermediate products (cradle-to-gate PEFCRs)*

In cradle-to-gate PEF studies, the parameters related to the end-of-life of the product (i.e. recyclability at end-of-life, energy recovery and disposal) shall not be accounted for, unless the PEFCR requires to calculate additional information for the EoL stage.

If the formula is applied in PEF studies for intermediate products (cradle-to-gate studies), the PEFCR shall prescribe:

1. The use of the CFF;
2. To exclude the end of life by setting the parameters R2, R3, and Ed to 0 for the products in scope;
3. The application- or material-specific default A values for the product in scope;
4. To use and report the results with two types of A values for the product in scope:
    a. Setting A = 1: to be used as default in the PEF profile calculation.
    b. Setting A = the application- or material-specific default values as listed in the PEFCR. These results shall be reported as 'additional technical information' and be used when creating EF compliant datasets. This allows a correct A value when the dataset is used in future modelling.
5. If the EoL stage shall be calculated as additional information.

When developing the PEFCR, the A value of the product in scope shall be set to 1 for the hotspot analysis in the PEF-RP study to allow to focus the analysis on the actual system. This shall be documented in the PEFCR.

A.4.2.8. Extended product lifetime

In situation 1 described in section 4.4.9 of the Annex I, the PEFCR shall describe how reuse or refurbishment is included in the calculations of the reference flow and full life cycle model, taking into account the 'how long' of the FU. Default values for extended lifetime shall be provided in the PEFCR or shall be listed as mandatory company-specific information.

A.4.2.8.1. *How to apply 'reuse rate' (situation 1)*

At point 2) of section 4.4.9.2 of Annex I, the PEFCR shall further specify and provide one-way transport distances.

A.4.2.8.2. *Average reuse rates for company owned pools*

The average reuse rates available in section 4.4.9.4 of Annex I shall be used within the PEF-RP studies and to calculate the benchmark (corresponding to the representative product) for those PEFCRs that have company owned reusable packaging pools in scope, unless data of better quality is available.

If the Technical Secretariat decides to use other values within their PEF-RP study and benchmark calculation, it shall provide a justification and provide the data source. In case a specific packaging type is not present in the list above, sector-specific data shall be used. New values shall be subject to the PEFCR review.

The PEFCR shall prescribe the use of mandatory company-specific reuse rates for company owned packaging pools.

A.4.2.8.3. *Average reuse rates for third party operated pools*

The average reuse rates available in section 4.4.9.5 of Annex I shall be used by those PEFCRs that have third party operated reusable packaging pools in scope, unless data of better quality is available.

If the Technical Secretariat decides to use other values within their final PEFCR, it shall clearly justify why and provide the data source. In case a specific packaging type is not present in the list of section 4.4.9.5 of the Annex I, sector-specific data shall be collected and included in the PEFCR. New values shall be subject to the PEFCR review.

A.4.2.9. Greenhouse gas emissions and removals

To provide all necessary information for developing the PEFCR, the PEF-RP study shall always calculate the three climate change sub-categories separately. If climate change is identified as a most-relevant impact category, the PEFCR shall (i) request to report the total climate change as the sum of the three sub-categories, and (ii) request the reporting of the sub-categories 'climate change -fossil', 'climate change – biogenic' and 'climate change - land use and land use change', separately if the PEF-RP study shows a contribution of more than 5% ([18]) each to the total score.

A.4.2.9.1. *Sub-category 2: Climate change – biogenic*

The PEFCR shall specify if a simplified modelling approach shall be used when modelling the foreground emissions.

In the case a simplified modelling approach is chosen, the PEFCR shall include the following text: 'Only the emission 'methane (biogenic)' is modelled, while no further biogenic emissions and uptakes from the 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.'

In the case a simplified modelling approach is not chosen, the PEFCR shall include the following text: 'All biogenic carbon emissions and removals shall be modelled separately. However, note that the corresponding characterisation factors for biogenic CO_2 uptakes and emissions within the EF impact assessment method are set to zero'.

A.4.4.9.2. *Sub-category 3: Climate change – land use and land use change (LULUC)*

The Technical Secretariat may decide to include soil carbon storage in the PEFCR as additional environmental information. In case of inclusion, the PEFCR shall specify how this shall be modeled and calculated, and which proof shall be provided. If legislation provides specific modelling requirements for the sector, it shall be modelled according to this legislation.

([18]) For example, if 'Climate change - biogenic' contributes with 7% (using absolute values) to the total climate change impact and 'Climate change – land use and land use change' contributes with 3% to the total climate change impact. In that case, the total climate change impact and the 'Climate change – biogenic' shall be reported. The Technical Secretariat may decide where and how to report the latter ('Climate change – biogenic').

A.4.2.10. Packaging

European average packaging datasets shall be used in case the PEFCR does not request the use of company-specific data, no supplier-specific information is available or the packaging is not relevant. Although the default secondary datasets shall be listed in the PEFCR, for some multi-material packaging the PEFCR shall provide additional information to allow the user to perform a correct modelling. This is for example the case for beverage cartons and bag-in-box packaging:

— Beverage cartons are made out of LDPE granulates and liquid packaging board, with or without aluminium foil. The amount of LDPE granulates, board and foil (also called the bill of material of beverage cartons) depends on the application of the beverage carton and shall be defined in the PEFCR if applicable (e.g. wine cartons, milk cartons). Beverage cartons shall be modelled by combining the PEFCR prescribed amounts of material datasets with the beverage carton conversion dataset.

— Bag in box is made out of corrugated board and packaging film. If applicable, the PEFCR should define the amount of corrugated board, as well as the amount and type of packaging film. If this is not prescribed by the PEFCR, the user of the PEFCR shall use the default dataset for bag-in-box.

A.4.3. *Handling multi-functional processes*

Systems involving multi-functionality of processes shall be modelled in accordance with the decision hierarchy provided in section 4.5 of Annex I.

The PEFCR shall further specify multi-functionality solutions within the defined system boundary and, where appropriate, for upstream and downstream stages. If applicable, the PEFCR shall further provide specific factors to be used in the case of allocation solutions. All such multi-functionality solutions specified in the PEFCR shall be clearly justified with reference to the PEF multi-functionality solution hierarchy:

(a) Where subdivision is applied, the PEFCR shall specify which processes are to be sub-divided and the principles that such subdivision should adhere to.

(b) Where allocation by physical relationship is applied, the PEFCR shall specify the relevant underlying physical relationships that shall be considered and list the specific allocation values that shall be fixed for all studies using the PEFCR.

(c) Where allocation by some other relationship is applied, the PEFCR shall specify this relationship and list the specific allocation values that shall be fixed for all studies using the PEFCR.

A.4.3.1. Animal husbandry

A.4.3.1.1. *Allocation within the farm module*

Default values for each type of animal shall be provided in the PEFCR and used by PEF studies. The default values available in sections 4.5.1.2-4.5.1.4 of Annex I should be used, unless more sector-specific data are available.

A.4.3.1.2. *Allocation within the slaughterhouse*

Default values for prices and mass fractions are provided in the Annex I for cattle, pigs and small ruminants (sheep, goat) and these default values shall be included in relevant PEFCRs and used by PEF studies, PEF supporting studies and PEF-RP studies. No change of allocation factors is allowed in PEF studies.

A.4.3.1.3. *Allocation within the slaughterhouse for cattle*

If allocation factors to subdivide the impact of the carcass among the different cuts are desired, they shall be defined in the relevant PEFCR.

A.4.4. *Data collection requirements and quality requirements*

The materiality principle

One of the main features of the PEF method is the 'materiality' approach, i.e. focusing where it really matters. In the PEF context, the materiality approach is developed around two main areas:

Impact categories, life cycle stages, processes and direct elementary flows: the PEFCR shall identify the most relevant ones. These are the environmental contributions on which companies, stakeholders, consumers, and policymakers should focus (see section 7.3 of the Annex I);

Data requirements: as the most relevant processes are those driving the environmental profile of a product, these shall be assessed by using data of higher quality compared to the less relevant processes, independently from where these processes happen in the life cycle of the product.

Once the model(s) for the representative product(s) is developed, the Technical Secretariat shall address the following two questions with the PEF-RP studies:

(a) Which are the processes for which company-specific information is mandatory?

(b) Which are the processes that are driving the environmental profile of the product (most relevant processes)?

A.4.4.1. List of mandatory company-specific data

The list of mandatory company-specific data refers to the activity data, direct elementary flows and (unit) processes for which company-specific data shall be collected. This list defines the minimum data requirements to be fulfilled by the users of the PEFCR. The purpose is to avoid that a user without access to the relevant company-specific data is able to perform a PEF study and communicate its results by only applying default data and datasets. The PEFCR shall define the list of mandatory company-specific data

For the selection of the mandatory company-specific data, the Technical Secretariat shall consider its relevance within the EF profile, the level of effort needed to collect these data (especially for SMEs) and the overall quantity of data / time required to collect all mandatory company-specific data and existing legal requirements defined in EU law on measuring certain emissions. For instance, in case specific EU ETS monitoring rules exist for the sector to which the product in scope of the PEFCR belongs, the PEFCR should refer to EU ETS quantification requirements as set out in Regulation (EU) 2018/2066 for the processes and GHGs covered therein. In case of carbon capture and storage (CC), the requirements of Annex I prevail.

This decision has, in particular, two consequences: (i) companies may perform a PEF study by only searching for these data and using default data for everything outside this list, while (ii) companies that don't have company-specific data for any of the listed data cannot calculate a PEFCR-compliant PEF profile of the product in scope.

For each process for which company-specific data is mandatory the PEFCR shall provide the following information:

1. the list of the company-specific activity data to be declared by the user of the PEFCR together with the default secondary datasets to be used. The list of activity data shall be as specific as possible in terms of units of measure and any other characteristics that could help the user in implementing the PEFCR;

2. the list of direct (i.e. foreground) elementary flows to be measured by the user of the PEFCR. This is the list of most relevant direct emissions and resources. For each emission and resource flow, the PEFCR shall specify the frequency of measurements, the measurement methods and any other technical information necessary to ensure that PEF profiles are comparable. Note that the direct elementary flows listed shall be aligned with the nomenclature used by the most recent version of the EF reference package ([19]) .

Considering that the data for these processes shall be company-specific, the score of P cannot be higher than 3, the score for TiR, TeR, and GeR cannot be higher than 2, and the DQR score shall be equal or lower than 1.5 (≤1.5). To assess the DQR, follow the requirements of Table 23 of Annex I. The developed datasets shall be EF compliant.

([19]) Available at http://eplca.jrc.ec.europa.eu/LCDN/developerEF.xhtml

For processes selected to be modelled mandatorily with company-specific data, the PEFCR shall follow the requirements set out in this section. For all other processes, the user of the PEFCR shall apply the Data Needs Matrix as explained in section 4.4.4.4 of this Annex.

A.4.4.2. Datasets to be used

When developing the final PEFCR, EF compliant datasets ([20]) shall be used. In case EF compliant datasets are not available, the following rules shall be followed in hierarchical order:

1. An EF compliant proxy is available for free: it shall be included in the list of default processes of the PEFCR and stated within the limitations section of the PEFCR.

2. An ILCD-EL compliant dataset as proxy is available for free: A maximum of 10% of the single overall score may be derived from ILCD-EL compliant datasets.

3. If no EF compliant or ILCD-EL compliant dataset is available for free: it shall be excluded from the model. This shall be clearly stated in the PEFCR as a data gap and validated by the PEFCR reviewers.

For the user of the PEFCR, the secondary datasets listed in the PEFCR shall be used. Whenever a dataset needed to calculate the PEF profile is not among those listed, the following rules shall be followed in hierarchical order:

1. Use an EF compliant dataset available on one of the nodes of the Life Cycle Data Network ([21]) ;

2. Use an EF compliant dataset available in a free or commercial source;

3. Use another EF compliant dataset considered to be a good proxy. In this case, this information shall be included in the 'limitations' section of the Annex I.

4. Use an ILCD-EL compliant dataset as proxy. In such cases, these datasets shall be included in the 'limitations' section of the Annex I. This up to a imaximum contribution of 10% of the single overall score of the product in scope

5. If no EF compliant or ILCD-EL compliant dataset is available: it shall be excluded from the PEF study. This shall be clearly stated in the PEF report as a data gap and validated by the PEF study and PEF report verifiers.

Whenever an EF or ILCD-EL compliant dataset is used, the nomenclature of the elementary flows shall be aligned with the EF reference package used in the rest of the model ([22]) .

A.4.4.3. Cut-off

Any cut-off shall be avoided in the first PEF-RP study and supporting studies.

Based on the results of the first PEF-RP study and if confirmed by the supporting study results, the second PEF-RP study and PEFCR may exclude processes from the RP system boundaries by applying the following rule:

(a) In case processes are excluded from the model, this shall be done based on a 3% cut-off considering their environmental impact for all impact categories, additionally to the cut-off already included in the background datasets. This rule is valid for both intermediate and final products. The processes that in total (cumulatively) account less than 3% of the environmental impact for each impact category may be excluded from the RP. In case the Technical Secretariat decides to apply the cut-off rule, second PEF-RP shall exclude the processes and the PEFCR shall list the processes that shall be excluded based on the cut-off.

(b) In case the processes identified for cut-off from the first PEF-RP study are not confirmed by the supporting studies, the decision about their exclusion or inclusion shall be left to the review panel and reported explicitly in the review report to be annexed to the PEFCR.

The PEFCR shall list the processes that shall be excluded from the modelling based on the cut-off rule and indicate that no additional cut-offs are allowed by the user of the PEFCR. In case the Technical Secretariat decides that no cut-off is allowed, this requirement shall be explicitly mentioned in the PEFCR.

([20]) http://eplca.jrc.ec.europa.eu/LCDN/contactListEF.xhtml
([21]) http://eplca.jrc.ec.europa.eu/LCDN/
([22]) http://eplca.jrc.ec.europa.eu/LCDN/developerEF.xhtml

A.4.4.4. Data quality requirements

A.4.4.4.1. *The DQR formula*

The PEFCR shall provide tables with the criteria to be used for the semi-quantitative assessment of each data quality criteria. The PEFCR may specify more stringent or specify additional data quality requirements if appropriate for the sector in question.

A.4.4.4.2. *The DQR of company-specific datasets*

When creating a company-specific dataset, the data quality of i) the company-specific activity data and ii) the company-specific direct elementary flows (i.e. emission data) shall be assessed separately by the user of the PEFCR. To allow the evaluation of the DQR of data sets with company-specific data, the PEFCR shall include at least one table on how to assess the value of the DQR criteria for these processes. The table(s) to be included in the PEFCR shall be based on Table 23 of Annex I: only the reference years criteria ($Ti_{R\text{-}EF}$, $Ti_{R\text{-}AD}$) may be adapted by the Technical Secretariat.

The DQR of the sub-processes linked to the activity data (see Figure 9 of the Annex I) are evaluated through the requirements provided in the DNM (section A.4.4.4.4 of this Annex).

The DQR of the newly developed dataset shall be calculated as follows:

(a) Select the most relevant activity data and direct elementary flows: most relevant activity data are the ones linked to sub-processes (i.e. secondary datasets) that account for at least 80% of the total environmental impact of the company-specific dataset, listing them from the most contributing to the least contributing one. Most relevant direct elementary flows are defined as those direct elementary flows contributing cumulatively at least with 80% to the total impact of the direct elementary flows.

(b) Calculate the DQR criteria TeR, TiR, GeR and P for each most relevant activity data and each most relevant direct elementary flow. The values of each criteria shall be assigned based on the table on how to assess the value of the DQR criteria provided in the PEFCR.

   a. Each most relevant direct elementary flow consists of the amount and elementary flow naming (e.g. 40 g carbon dioxide). For each most relevant elementary flow, the user of the PEFCR shall evaluate the 4 DQR criteria named TeR-EF, TiR-EF, GeR-EF, PEF. Examples of elements to be evaluated include the timing of the flow measured, the technology for which the flow was measured and in which geographical area the measurement was made.

   b. For each most relevant activity data, the 4 DQR criteria shall be evaluated (named TeR-AD,TiR-AD, PAD, GeR-AD,) by the user of the PEFCR.

   c. Considering that the data for the mandatory processes shall be company-specific, the score of P cannot be higher than 3 while the score for TiR, TeR, and GeR cannot be higher than 2 (The DQR score shall be ≤1.5).

(c) Calculate the environmental contribution of each most-relevant activity data (through linking to the appropriate sub-process) and each most-relevant direct elementary flow to the total sum of the environmental impact of all most-relevant activity data and direct elementary flows, in % (weighted, using all EF impact categories). For example, the newly developed dataset has only two most relevant activity data, contributing in total to 80% of the total environmental impact of the dataset:

   a. Activity data 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).

   b. data 2 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).

(d) Calculate the TeR, TiR, GeR and P criteria of the newly developed dataset as the weighted average of each criterion of the most relevant activity data and direct elementary flows. The weight is the relative contribution (in %) of each most relevant activity data and direct elementary flow calculated in step (3).

(e) The user of the PEFCR shall calculate the total DQR of the newly developed dataset using Equation 20 of the Annex I, where $\overline{Te_R}, \overline{Ge_R}, \overline{Ti_R}, \overline{P}$ are the weighted averages calculated as specified in point (4).

A.4.4.4.3. *The DQR of secondary datasets used in a PEF study*

To allow the user to assess the context-specific DQR criteria TeR, TiR and GeR of most relevant processes, the PEFCR shall include at least one table on how to assess the criteria. The assessment of the TeR, TiR and GeR criteria shall be based on Table 24 of Annex I. The Technical Secretariat may only adapt the reference years for the criterion TiR. It is not allowed to modify the text for the other criteria.

A.4.4.4.4. *The Data Needs Matrix*

All processes required to model the product and that are not on the list of mandatory company-specific data shall be evaluated using the Data Needs Matrix (see Table MM-8).

Rules to be followed when developing a PEFCR

The PEFCR shall include the following information for all processes that are not on the list of mandatory company-specific data:

(1) provide the list of default secondary datasets to be used within the scope of the PEFCR (dataset name, together with the UUID of the aggregated version ([23]), the web address of the node, and the data stocks). For each dataset the aggregated and disaggregated (level-1) form shall be available;

(2) report the default DQR values (for each criterion) as provided in their meta data, for all default EF datasets listed;

(3) indicate the most relevant processes;

(4) provide one or more DQR table(s) for the most relevant processes;

(5) indicate the processes expected to be in situation 1;

(6) for those processes expected to be in situation 1, explicitly list the activity data and direct elementary flows (resources and emissions) to be measured by the user of the PEFCR as a minimum ([24]). This list shall be as specific as possible in terms of unit of measurement, how to measure or average data, and any other characteristics that could help the user in implementing the PEFCR.

Rules for the user of the PEFCR

The user of the PEFCR shall apply the DNM to evaluate which data is needed. It shall be used within the modelling of its PEF study, depending on the level of influence the user (company) has on the specific process. The following three cases are found in the DNM:

(1) **Situation 1:** the process is run by the company using the PEFCR;

(2) **Situation 2:** the process is not run by the company using the PEFCR but the company has access to company-specific information;

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

The user of the PEFCR shall:

(1) determine the level of influence (Situation 1, 2 or 3 described below) the company has over each process in its supply chain. This decision determines which of the options in **Table MM**-8 is pertinent for each process;

(2) follow the rules of Table MM-8 for the most relevant processes and for the other processes. The DQR value mentioned in brackets is the maximum DQR value allowed.

([23]) Each EF compliant dataset tendered by the Commission is available in both an aggregated and disaggregated (at level-1) form.

([24]) Note that the direct elementary flows listed shall be aligned with the nomenclature used by the most recent version of the EF reference package (available at http://eplca.jrc.ec.europa.eu/LCDN/developerEF.xhtml).

(3) Calculate or re-evaluate the DQR values (for each criterion + total) for all the datasets used for the most relevant processes and the new ones created. For all remaining 'other processes' the DQR values provided in the PEFCR shall be used.

(4) If one or more processes are not included in the list of default processes in the PEFCR, the user shall identify a suitable dataset according to requirements provided in section A.4.4.2 of this Annex.

Table MM-8

Data Needs Matrix (DNM) – Requirements for the user of the PEFCR. The options indicated for each situation are not listed in hierarchical order. See Table A-7 to determine the R_1 value to be used.

		Most relevant process	Other process
Situation 1: process run by the company using the PEFCR	**Option 1**	Provide company-specific data (as requested in the PEFCR) and create a company-specific dataset, in aggregated form (DQR≤1.5) ([25]) 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 using 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, in aggregated form (DQR≤1.5) 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 using 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

([25]) Company-specific datasets shall be made available to the Commission.

Note that for any EF compliant secondary dataset, an ILCD-EL compliant dataset may be used. This up to a maximum contribution of 10% of the single overall score of the product in scope (see section 4.6.3 of Annex I). For these datasets the DQR shall not be recalculated.

A.4.4.4.5. *DNM 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 processes, 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 using the PEFCR uses company-specific data, the DQR of the newly developed dataset shall be evaluated as described in section A.4.4.4.2 while using the PEFCR-specific DQR tables.

Situation 1/ Option 2

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

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

A.4.4.4.6. *DNM situation 2*

If a process is in situation 2 (i.e. the user of the PEFCR is not running the process but has access to company-specific data) there are three possible options:

— The user of the PEFCR has access to extensive supplier-specific information and wants to create a new EF compliant dataset (Option 1);

— The user of the PEFCR has some supplier-specific information and wants to make some minimum changes (Option 2);

— The process is not in the list of most relevant processes, still the company wants to make some minimum changes (Option 3).

Situation 2/ Option 1

For all processes not run by the company and where the user of the PEFCR applies company-specific data. The DQR of the newly developed dataset shall be evaluated as described in section 4.6.5.2 of Annex I while using the PEFCR-specific DQR tables.

Situation 2/ Option 2

The user of the PEFCR applies company-specific activity data for transport and substitutes the sub-processes used for the electricity mix and transport with supply chain specific EF compliant datasets 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.

For the most relevant processes, the user of the PEFCR shall make the DQR context-specific by re-evaluating TeR and TiR using the table(s) provided in the PEFCR (adapted from Table 24 of Annex I). The criteria GeR shall be lowered by 30% ([26]) and the criteria P shall keep the original value.

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

Situation 2/ Option 3

The user of the PEFCR applies company-specific activity data for transport and substitutes the sub-processes used for the electricity mix and transport with supply chain specific EF compliant datasets 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.

In this case, the user of the PEFCR shall apply the default DQR values. If the default dataset to be used for the process is not listed in the PEFCR, the user of the PEFCR shall take the DQR values from the original dataset.

A.4.4.4.7. *DNM situation 3*

If a process is in situation 3 (i.e. the company using the PEFCR is not running the process and this company does not have access to company-specific data), there are two possible options:

— It is on the list of most relevant processes (situation 3, option 1);

— It is not on the list of most relevant processes (situation 3, option 2).

Situation 3/ Option 1

In this case, the user of the PEFCR shall make the DQR context-specific by re-evaluating TeR, TiR and GeR using the table(s) provided in the PEFCR (adapted from Table 24 of Annex I). The criterion P shall keep the original value.

Situation 3/ Option 2

The user of the PEFCR shall apply 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 user of the PEFCR shall take the DQR values from the original dataset.

A.4.4.4.8. *DQR of a PEF study*

The PEFCR shall require the delivery of an EF compliant dataset of the product in scope (meaning, the PEF study). The DQR of this dataset shall be calculated and the PEF report shall report it. To calculate the DQR of the PEF study, the PEFCR shall specify that the user of the PEFCR shall follow the DQR calculation rules of section 4.6.5.8 of Annex I.

A.5. **PEF results**

A.5.1. *Benchmark*

The benchmark shall be provided for each RP and shall correspond to the PEF profile of the second PEF-RP modelled after the supporting studies results are taken into consideration.

The PEFCR shall provide the results of the benchmark for each RP as characterised, normalised and weighted results for each of the EF impact categories (not only the most relevant ones) and as a single overall score based on the weighting factors provided in section 5.2.2 of Annex I, each in a different table. Results shall be provided for (i) the total life cycle, and (ii) the total life cycle excluding the use stage.

Benchmarking may be excluded for intermediate products. The reporting of the characterised, normalised and weighted results calculated for each intermediate RP is optional in the PEFCR, but mandatory in the PEF study and PEF report.

A.5.2. *Classes of performance*

The identification of classes of performance is not obligatory. Each Technical Secretariat is free to define a method to identify the classes of performance, in case they deem it appropriate and relevant. The procedure described below is provided only as an example.

In this procedure 5 classes of performance are identified, from category A being the best class with lowest environmental impact, up to category E being the worst class with the highest impact. The classes of performance are identified at the level of the single overall score of all 16 EF impact categories (see section 5.2.2 of Annex I).

First, the single overall score of the representative product (BM, calculated from the second PEF-RP) represents the midpoint of class C.

Second, the upper limit and lower limit of the lowest category A and highest category E are identified through a sensitivity analysis on the model of the RP (on each representative product if there are multiple). The sensitivity analysis will identify the most relevant parameters contributing to the single overall score. Once these parameters are identified, based on industry data provided by the Technical Secretariat members, the theoretical best product (calculated by assigning the best technically feasible value for each parameter) and the theoretical worst product (calculated by assigning the worst technically value for each parameter) are identified. They help to define the upper limit of category A (OS-BP) and lower limit of category E (OS-WP).

Once the two extremes and the midpoint of class C are identified, the remaining limits of the different categories are identified according to the table below:

Table NN-9

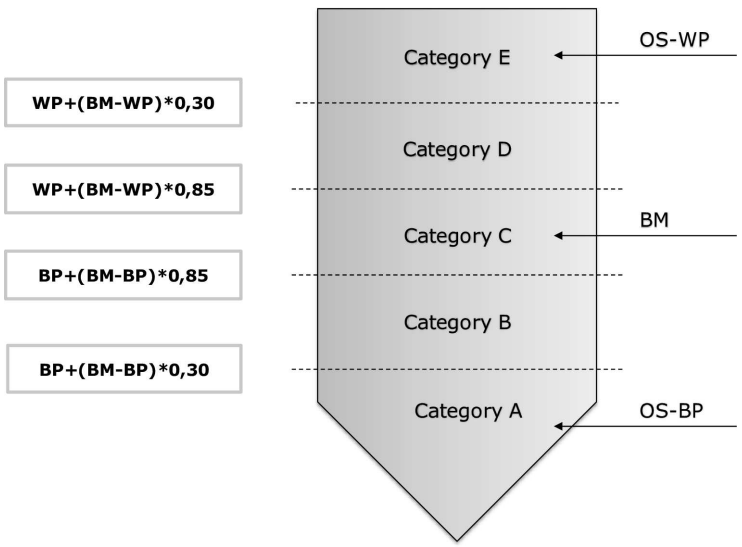
Establishing the limits of performance classes

Category	Class of performance boundaries
A	OS < BP+(BM-BP)*0.30
B	BP+(BM-BP)*0.30 ≤ OS < BP+(BM-BP)*0.85
C	BP+(BM-BP)*0.85 ≤ OS < WP+(BM-WP)*0.85
D	WP+(BM-WP)*0.85 ≤ OS < WP+(BM-WP)*0.30
E	OS ≥ WP+(BM-WP)*0.30

where OS-**BP** is the single overall score of the best product, OS-**WP** is the single overall score of the worst product, **BM** is the single overall score of the representative product (benchmark value), **OS** is the single overall score of a specific product calculated based on a PEF study carried out in compliance with the PEFCR.

Figure M-3

PEF Classes of performance



A.6. **Interpretation of Product Environmental Footprint results**

A.6.1. *Identification of hotspots*

The identification of most relevant impact categories, life cycle stages, processes, direct elementary flows, benchmark and classes of performance shall be based on the first and second PEF-RP study. The second PEF-RP study determines the identification that will be required in the PEFCR. The identification of the most relevant processes and direct elementary flows has a key role in the process to identify data-related requirements (see previous sections on data quality requirements for further information).

A.6.1.1. Procedure to identify the most relevant impact categories

The identification of the most relevant impact categories shall follow the requirements at section 6.3.1 of Annex I. The PEFCR may add more impact categories to the list of the most relevant ones but none shall be deleted.

A.6.1.2. Procedure to identify the most relevant life cycle stages

The identification of the most relevant life cycle stages shall follow the requirements in section 6.3.2 of Annex I. The Technical Secretariat may decide to split or add additional life cycle stages if there are good reasons for it. This shall be justified in the PEFCR. E.g., the life cycle stage 'Raw material acquisition and pre-processing' may be split into 'Raw material acquisition', 'pre-processing', and 'raw materials supplier transport'.

A.6.1.3. Procedure to identify the most relevant processes

The identification of the most relevant processes shall follow the requirements in section 6.3.3 of Annex I. The PEFCR may add more processes to the list of the most relevant ones but none shall be deleted.

In most cases, vertically aggregated datasets may be identified as representing relevant processes. In such cases, it may not be obvious which process is responsible for contributing to an impact category. The Technical Secretariat may decide whether to seek further disaggregated data or to treat the aggregated dataset as a process for the purposes of identifying relevance.

A.6.1.4. Procedure to identify the most relevant direct elementary flows

The identification of the most relevant direct elementary flows shall follow the requirements at 6.3.4 of Annex I. The Technical Secretariat may add more elementary flows to the list of the most relevant ones but none shall be deleted. For each most relevant process, the identification of the most relevant direct elementary flows is important to define which direct emissions or resource use should be requested as company-specific data (i.e. the foreground elementary flows within the processes listed in the PEFCR as mandatory company-specific data).

A.7. **Product Environmental Footprint reports**

General requirements regarding PEF reports are available in Annex I (section 8). Any PEF study (including PEF-RP studies and supporting studies) shall include a PEF report. A PEF report provides a relevant, comprehensive, consistent, accurate, and transparent account of the study and of the calculated environmental impacts associated with the product.

A PEF report template is available in part E of this annex. The template includes the detailed information to be provided in a PEF report. The Technical Secretariat may decide to require further information to be provided in the PEF report, in addition to the ones listed in part E of this annex.

A.8. **Verification and validation of PEF studies, reports, and communication vehicles**

A.8.1. *Defining the scope of the verification*

The verification of the PEF study shall ensure that the PEF study is conducted in compliance with the PEFCR it refers to.

A.8.2. *Verifier(s)*

The independence of the verifiers shall be guaranteed (i.e. they shall fulfil the intentions in the requirements of EN ISO/IEC 17020:2012 regarding a 3rd party verifier, they shall not have conflicts of interests on concerned products and cannot include members of the Technical Secretariat or of the consultants involved in previous part of the work - PEF-RP studies, supporting studies, PEFCR review, etc.).

A.8.3. *Verification/Validation requirements: requirements for the verification/validation when a PEFCR is available*

The verifier(s) shall verify that the PEF report, PEF communication (if any) and PEF study is in compliance with the following documents:

(a) most recent version of the PEFCR applicable for the specific product in scope;

(b) conformance with Annex I.

The verification and validation of the PEF study shall be carried out following the minimum requirements listed in section 8.4.1 of the Annex I and section A.2.3 of this annex and the additional PEFCR-specific requirements specified by the Technical Secretariat and documented in the PEFCR section 'Verification'.

A.8.3.1 Minimum requirements for the verification and validation of the PEF study

In addition to the requirements specified in the PEF method, for all processes used in the PEF study that are to be validated, the verifier(s) shall check if the DQR satisfies the minimum DQR as specified in the PEFCR.

The PEFCR may specify additional requirements for the validation that shall be added to the minimum requirements stated in this document. The verifier(s) shall check that all the minimum and additional requirements are satisfied during the verification process.

A.8.3.2. Verification and validation techniques

In addition to the requirements specified in the PEF method, the verifier shall check if the applied sampling procedures are in accordance with the sampling procedure defined in the PEFCR. The data reported shall be checked against the source documentation to check their consistency.

A.8.3.3. Content of the validation statement

In addition to the requirements specified in the PEF method (section 8.5.2 of Annex I), the following element shall be included in the validation statement: absence of conflict of interest of the verifier(s) with respect to concerned products and any involvement in previous work (PEFCR development, PEF-RP studies, supporting studies, Technical Secretariat membership and consultancy work carried out for the user of the PEFCR during the last three years).

PART B:

PEFCR TEMPLATE

Note: the text included in italics in each section shall not be modified when drafting the PEFCR, except for references to tables, figures and equations. References shall be revised and linked correctly. Further text may be added if relevant.

In case of conflicting requirements between the ones in this Annex and Annex I, the latter prevail

The text included in [] are instructions for the PEFCR developers.

The order of sections and their titles shall not be modified.

[The first page shall include at least the following information:

— The product category for which the PEFCR is valid

— Version number

— Date of publication

— Time validity]

Table of contents

Acronyms

[List in this section all the acronyms used in the PEFCR. Those already included in Annex I or the part A of Annex II shall be copied in their original form. The acronyms shall be provided in alphabetical order.]

Definitions

[List in this section all the definitions that are relevant for the PEFCR. Those already included in Annex I or in part A of Annex II shall be copied in their original form. The definitions shall be provided in alphabetical order.]

B.1. Introduction

The Product Environmental Footprint (PEF) method provides detailed and comprehensive technical rules on how to conduct PEF studies that are more reproducible, consistent, robust, verifiable and comparable. Results of PEF studies are the basis for the provision of EF information and they may be used in a diverse number of potential fields of applications, including in-house management and participation in voluntary or mandatory programmes.

For all requirements not specified in this Product Environmental Footprint Category Rule (PEFCR) the user of the PEFCR shall refer to the documents this PEFCR is in conformance with (see section B.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.

B.2. General information about the PEFCR

B.2.1. *Technical Secretariat*

[The list of the organisations in the Technical Secretariat at the time of approval of the final PEFCR shall be provided. For each one, the type of organisation shall be reported (industry, academia, NGO, consultant, etc.), as well as the starting date of participation. The Technical Secretariat may decide to include also the names of the members of the persons involved for each organisation]

Name of the organisation	Type of organisation	Name of the members (not mandatory)

B.2.2. *Consultations and stakeholders*

[For each public consultation the following information shall be provided:

— Opening and closing date of the public consultation

— Number of comments received

— Names of organisations that have provided comments

— Link to the online platform]

B.2.3. *Review panel and review requirements of the PEFCR*

[This section shall include the names and affiliations of the members of the review panel. The member that is chairing the review panel shall be identified.]

Name of the member	Affiliation	Role

The reviewers have verified that the following requirements are fulfilled:

(a) The PEFCR has been developed in accordance with the requirements provided in Annex I and Annex II;

(b) The PEFCR supports the creation of credible, relevant and consistent PEF profiles;

(c) The PEFCR scope and the representative products are adequately defined;

(d) The functional unit, allocation and calculation rules are adequate for the product category under consideration;

(e) Datasets used in the PEF-RPs and the supporting studies are relevant, representative, reliable, and in compliance with data quality requirements;

(f) The selected additional environmental and technical information are appropriate for the product category under consideration and the selection is done in accordance with the requirements stated in Annex I,

(g) The model of the RP and corresponding benchmark (if applicable) represent correctly the product category or sub-category;

(h) The RP models, disaggregated in line with the PEFCR and aggregated in ILCD format, are EF compliant following the rules available at http://eplca.jrc.ec.europa.eu/LCDN/developerEF.xhtml;

(i) The RP model in its corresponding excel version is compliant with the rules outlined in section A.2.3 of Annex II;

(j) The Data Needs Matrix is correctly implemented;

(k) The classes of performance, if identified, are appropriate for the product category.

[The Technical Secretariat may add additional review criteria as appropriate]

The public review reports are provided in Annex 3 of this PEFCR.

[The review panel shall produce: i) a public review report for each PEF-RP, ii) a public review report for the final PEFCR].

B.2.4. *Review statement*

This PEFCR was developed in compliance with the PEF Method adopted by the Commission on [indicate the date of approval of the latest version available].

The representative product(s) correctly describe the average product(s) sold in Europe (EU+EFTA) for the product category/sub-category 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 section on limitations). [the last part of this statement shall be deleted in case the PEFCR is for intermediate product(s)].

[The review statement shall be completed by the reviewer.]

B.2.5. *Geographic validity*

This PEFCR is valid for products in scope sold or consumed in the EU+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, EU+EFTA shall be considered as the default market, with an equal market share for each country.

B.2.6. *Language*

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

B.2.7. *Conformance to other documents*

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

Product Environmental Footprint (PEF) method

….

[The PEFCR shall list additional documents, if any, with which the PEFCR is in conformance with.]

B.3. **PEFCR scope**

[This section shall i) include a description of the scope of the PEFCR, ii) list and describe the sub-categories included in the PEFCR (if any), describe the product(s) in scope and the technical performance]

B.3.1. *Product classification*

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

[Based on the product category/sub-category, provide the corresponding Classification of Products by Activity (CPA) (based on the latest CPA list version available). Where multiple production routes for similar products are defined using alternative CPAs, the PEFCR shall accommodate all such CPAs. Identify the sub-categories not covered by the CPA, if any.]

B.3.2. *Representative product(s)*

[The PEFCR shall include a description of the representative product(s) and how it has been derived. The Technical Secretariat shall provide in an Annex to the PEFCR information about all the steps taken to define the 'model' of the RP(s) and report the information gathered].

The PEF study of the representative product(s) (PEF-RP) is available upon request to the TS coordinator that has the responsibility of distributing it with an adequate disclaimer about its limitations.

B.3.3. *Functional unit and reference flow*

The functional unit (FU) is … [to be filled in].

Table B. 1 defines the key aspects used to define the FU.

Table B. 1.

Key aspects of the FU

What?	[to be filled in. Note that in case the PEFCR uses the term 'inedible parts' a definition shall be provided by the TS]
How much?	[to be filled in]
How well?	[to be filled in]
How long?	[to be filled in]

The reference flow is the amount of product needed to fulfil the defined function and shall be measured in … [fill in the units]. All quantitative input and output data collected in the study shall be calculated in relation to this reference flow.

[The PEFCR shall describe (i) how each aspect of the functional unit affects the environmental footprint of the product, (ii) how to include this effect in the EF calculations and (iii) how an appropriate reference flow ([27]) shall be calculated. Furthermore, the PEFCR shall explain and document any omission of the functions of the product in the definition of the functional unit and justify why. In case calculation parameters are needed, the PEFCR shall provide default values or shall request these parameters in the list of mandatory company-specific information. A calculation example shall be provided].

B.3.4. *System boundary*

[This section shall include a system diagram clearly indicating the processes and life cycle stages that are included in the product category/sub-category. A short description of the processes and life cycle stages shall be provided. The diagram shall include an indication of the processes for which company-specific data are required and the processes excluded from the system boundary.]

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

Table B. 2.

Life cycle stages

Life cycle stage	Short description of the processes included

According to this PEFCR, the following processes may be excluded based on the cut-off rule: [include the list of processes that shall be excluded based on the cut off rule]. No additional cut-off is allowed. OR According to this PEFCR, no cut-off is applicable.

Each PEF study done in accordance with this PEFCR shall provide in the PEF study a diagram indicating the activities falling in situation 1, 2 or 3 of the data needs matrix.

B.3.5. *List of EF impact categories*

Each PEF study carried out in compliance with this PEFCR shall calculate the PEF-profile including all EF impact categories listed in the Table below. [The Technical Secretariat shall indicate in the table if the sub-categories for climate change shall be calculated separately. In case one or both sub-categories are not reported on, the Technical Secretariat shall include a footnote explaining the reasons, e.g.: '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.']

([27]) The reference flow is the amount of product needed to fulfil the defined functional unit.

Table B. 3.

List of the impact categories to be used to calculate the PEF profile

EF Impact category	Impact category Indicator	Unit	Characterization model	Robust-ness
Climate change, total ([1])	Global warming potential (GWP100)	kg $CO_{2\ eq}$	Bern model - Global Warming Potentials (GWP) over a 100 year time horizon (based on IPCC 2013)	I
Ozone depletion	Ozone Depletion Potential (ODP)	kg CFC-11 $_{eq}$	EDIP model based on the ODPs of the World Meteorological Organisation (WMO) over an infinite time horizon (WMO 2014 + integrations)	I
Human toxicity, cancer	Comparative Toxic Unit for humans (CTU_h)	CTUh	based on USEtox2.1 model (Fantke et al. 2017), adapted as in Saouter et al., 2018	III
Human toxicity, non-cancer	Comparative Toxic Unit for humans (CTU_h)	CTUh	based on USEtox2.1 model (Fantke et al. 2017), adapted as in Saouter et al., 2018	III
Particulate matter	Impact on human health	disease incidence	PM model (Fantke et al., 2016 in UNEP 2016)	I
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)	II
Photochemical ozone formation, human health	Tropospheric ozone concentration increase	kg NMVOC $_{eq}$	LOTOS-EUROS model (Van Zelm et al, 2008) as applied in ReCiPe 2008	II
Acidification	Accumulated Exceedance (AE)	mol H^+ $_{eq}$	Accumulated Exceedance (Seppälä et al. 2006, Posch et al, 2008)	II
Eutrophication, terrestrial	Accumulated Exceedance (AE)	mol N $_{eq}$	Accumulated Exceedance (Seppälä et al. 2006, Posch et al, 2008)	II
Eutrophication, freshwater	Fraction of nutrients reaching freshwater end compartment (P)	kg P $_{eq}$	EUTREND model (Struijs et al, 2009) as applied in ReCiPe	II
Eutrophication, marine	Fraction of nutrients reaching marine end compartment (N)	kg N $_{eq}$	EUTREND model (Struijs et al, 2009) as applied in ReCiPe	II
Ecotoxicity, freshwater	Comparative Toxic Unit for ecosystems (CTU_e)	CTUe	based on USEtox2.1 model (Fantke et al. 2017), adapted as in Saouter et al., 2018	III
Land use ([2])	Soil quality index ([3])	Dimensionless (pt)	Soil quality index based on LANCA model (De Laurentiis et al. 2019) and on the LANCA CF version 2.5 (Horn and Maier, 2018)	III

Water use	User deprivation potential (deprivation-weighted water consumption)	m^3 water eq of deprived water	Available WAter REmaining (AWARE) model (Boulay et al., 2018; UNEP 2016)	III
Resource use, minerals and metals	Abiotic resource depletion (ADP ultimate reserves)	kg Sb_{eq}	van Oers et al., 2002 as in CML 2002 method, v.4.8	III
Resource use, fossils	Abiotic resource depletion – fossil fuels (ADP-fossil) ([4])	MJ	van Oers et al., 2002 as in CML 2002 method, v.4.8	III

([1]) The indicator "Climate Change, total" is constituted by three sub-indicators: Climate Change, fossil; Climate Change, biogenic; Climate Change, land use and land use change. The sub-indicators are further described in section 4.4.10. The sub-categories 'Climate change –fossil', 'Climate change – biogenic' and 'Climate change - land use and land use change', shall be reported separately if they show a contribution of more than 5% each to the total score of climate change.

([2]) Refers to occupation and transformation

([3]) This index is the result of the aggregation, performed by JRC, of 4 indicators (biotic production, erosion resistance, mechanical filtration, and groundwater replenishment) provided by the LANCA model for assessing impacts due to land use as reported in De Laurentiis et al, 2019.

([4]) In the EF flow list, and for the current recommendation, Uranium is included in the list of energy carriers, and it is measured in MJ.

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 is available at this link http://eplca.jrc.ec.europa.eu/LCDN/developerEF.xhtml. [The Technical Secretariat shall specify the EF reference package that shall be used.]

B.3.6. *Additional technical information*

[The Technical Secretariat shall list the additional technical information to be reported]:

— …

[For intermediate products:]

— The biogenic carbon content at factory gate (physical content) shall be reported. If derived from a native forest, it shall report that the corresponding carbon emissions shall be modelled with the elementary flow '(land use change)'.

— The recycled content (R_1) shall be reported.

— Results with application-specific A-values shall be reported, if relevant.

B.3.7. *Additional environmental information*

[Specify which additional environmental information shall/should be reported (provide units). Avoid if possible the use of should. Reference all methods used to report additional information.]

Biodiversity is considered as relevant for this PEFCR.

OR

Biodiversity is not considered as relevant for this PEFCR.

[If biodiversity is relevant, the PEFCR shall describe how biodiversity impacts shall be assessed by the user of the PEFCR.]

B.3.8. *Limitations*

[This section shall include the list of limitations a PEF study will have, even if carried out in accordance with this PEFCR.]

B.3.8.1. Comparisons and comparative assertions

[This section shall include the conditions under which a comparison or comparative assertion may be made.]

B.4. **Most relevant impact categories, life cycle stages, processes and elementary flows**

B.4.1. *Most relevant EF impact categories*

[In case the PEFCR has no sub-categories] The most relevant impact categories for the product category in scope of this PEFCR are the following:

— [list the most relevant impact categories per category].

[In case the PEFCR has sub-categories] The most relevant impact categories for the sub-category [name] in scope of this PEFCR are the following:

— [list the most relevant impact categories per each sub-category].

B.4.2. *Most relevant life cycle stages*

[In case the PEFCR has no sub-categories] The most relevant life cycle stages for the product category in scope of this PEFCR are the following:

— [list the most relevant life cycle stages per sub-category]

[In case the PEFCR has sub-categories] The most relevant life cycle stages for the sub-category [name] in scope of this PEFCR are the following:

— [list the most relevant life cycle stages per each sub-category]

B.4.3. *Most relevant processes*

The most relevant processes for the product category in scope of this PEFCR are the following [this table shall be filled in based on the final results of the PEF studies of the representative product(s). Provide one table per sub-category, if appropriate.]

Table B. 4.

List of the most relevant processes

Impact category	Processes
Most relevant impact category 1	Process A (from life cycle stage X)
	Process B (from life cycle stage Y)
Most relevant impact category 2	Process A (from life cycle stage X)
	Process B (from life cycle stage X)
Most relevant impact category n	Process A (from life cycle stage X)
	Process B (from life cycle stage X)

B.4.4. *Most relevant direct elementary flows*

The most relevant direct elementary flows for the product category in scope of this PEFCR are the following [the list shall be provided based on the final results of the PEF studies of the representative product(s). Provide one list per sub-category, if appropriate.]

B.4.4.1. Data gaps and proxies

[This section shall include:

The list of data gaps on the company-specific data to be collected that most frequently are encountered by companies in the specific sectors and how these data gaps may be solved in the context of the PEF study;

The list of processes excluded from the PEFCR due to missing datasets that shall not be filled in by the user of the PEFCR;

The list of processes for which the user of the PEFCR shall apply ILCD-EL compliant datasets.

The Technical Secretariat may decide to indicate in the LCI excel file (see section B.5 of this Annex) for which processes no datasets are available and therefore are considered data gaps and for which processes proxies shall be used.]

B.5. Life cycle inventory

All newly created datasets shall be EF or ILCD-EL compliant (see rules in section B 5.5).

[The PEFCR shall indicate if sampling is allowed. If the Technical Secretariat allows sampling, the PEFCR shall describe the sampling procedure as described in the PEF method and contain the following sentence:] In case sampling is needed, it shall be conducted as specified in this PEFCR. However, sampling is not mandatory and any user of this PEFCR may decide to collect the data from all the plants or farms, without performing any sampling.

B.5.1. *List of mandatory company-specific data*

[The Technical Secretariat shall here list the processes to be modelled with mandatory company-specific data (i. e. activity data and direct elementary flows). Note that the direct elementary flows listed shall be aligned with the nomenclature used by the most recent version of the EF reference package ([28]) .

Process A

[Provide a short description of process A. List all the activity data and direct elementary flows that shall be collected and the default datasets of the sub-processes linked to the activity data within process A. Use the table below to introduce minimum one example in the PEFCR. In case not all processes are introduced here, the full list of all processes shall be include in an excel file.]

Table B. 5.

Data collection requirements for mandatory process A

Requirements for data collection purposes			Requirements for modelling purposes								Re-m-arks
Activity data to be collec-ted	Specific require-ments (e.g. frequency, measure-ment standard, etc.)	Unit of mea-su-re	Default dataset to be used	Dataset source (i. e. node)	UUID	Ti-R	Te-R	G-eR	P	DQR	
Inputs:											
[E.g.: yearly electri-city use]	[E.g.: 3 year average]	[E.g. kWh/ year]	[E.g.: Electricity grid mix 1kV-60kV/ EU28+3]	[Link to appropri-ate node of the Life Cycle Data Network.	[E.g.: 0af0a6-a8-aebc-4eeb-99f8-5cc-f2304-b99d]	[E. g 1.-6]					

([28]) Available at http://eplca.jrc.ec.europa.eu/LCDN/developerEF.xhtml

				The 'data stock' shall also be specified]							
Outputs:											
…	…	…	…	…	…	…					

[List all the emissions and resources that shall be modelled with company-specific information (most relevant foreground elementary flows) within process A.]

Table B. 6.

Direct elementary flow collection requirements for mandatory process A

Emissions/resources	Elementary flow	UUID	Frequency of measurement	Default measurement method [1]	Remarks

[1] Unless specific measurements/methods are foreseen in a country-specific legislation.

See excel file named '[Name PEFCR_version number] - Life cycle inventory' for the list of all company-specific data to be collected.

B.5.2. *List of processes expected to be run by the company*

[The processes listed in this section shall be additional to the ones listed as mandatory company-specific data. No repetition of processes or data is allowed. In case there are no further processes expected to be run by the company, please state 'There are no further processes expected to be run by the company in addition to those listed as mandatory company-specific data.']

The following processes are expected to be run by the user of the PEFCR:

Process X

Process Y

…

Process X:

[Provide a short description of process 'x'. List the activity data and direct elementary flows that shall be collected as a minimum, and the datasets of the sub-processes linked to the activity data within process 'x'. Indicate the unit of measurement, how to measure and any other characteristic that could help de user. Note that the direct elementary flows listed shall be aligned with the nomenclature used by the most recent version of the EF reference package [29] . Use the table below to introduce minimum one example in the PEFCR. In case not all processes are introduced here, the full list of all processes shall be include in an excel file.]

[29] Available at http://eplca.jrc.ec.europa.eu/LCDN/developerEF.xhtml

Table B. 7.

Data collection requirements for process X

Requirements for data collection purposes			Requirements for modelling purposes								Re-marks
Activity data to be collected	Specific requirements (e.g. frequency, measurement standard, etc.)	Unit of measu-re	Default dataset to be used	Dataset source (i.e. node and data stock)	UUID	Ti-R	Te-R	G-eR	P	DQR	
Inputs:											
[E.g.: yearly electricity use]	[E.g.: 3 year average]	[E.g. kWh/year]	[E.g.: Electricity grid mix 1kV-60kV/EU28+3]	[Link to appropriate node of the Life Cycle Data Network. The 'data stock' shall also be specified]	[E.g.: 0af0a6-a8-aebc-4eeb-99f8-5cc-f2304-b99d]	[E.g 1.-6]					

Requirements for data collection purposes			Requirements for modelling purposes								Re-marks
Outputs:											
…	…	…	…	…	…	…					

Table B. 8.

Direct elementary flow collection requirements for process X

Emissions/resources	Elementary flow	UUID	Frequency of measurement	Default measurement method [1]	Remarks

[1] Unless specific measurement methods are foreseen in a country-specific legislation

See excel file named '[Name PEFCR_version number] - Life cycle inventory' for the list of all processes expected to be in situation 1.

B.5.3. *Data quality requirements*

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

$$DQR = \frac{TeR+GeR+TiR+P}{4} \qquad \text{[Equation B.1]}$$

where TeR is technological representativeness, GeR is geographical representativeness, TiR is time representativeness, and P is precision. The representativeness (technological, geographical and time-related) characterises to what degree the processes and products selected are depicting the system analysed, while the precision indicates the way the data is derived and related level of uncertainty.

The next sections provide tables with the criteria to be used for the semi-quantitative assessment of each criterion.

[The PEFCR may specify more stringent data quality requirements and specify additional criteria for the assessment of data quality. The PEFCR shall report the formulas to be used for assessing the DQR of i) company-specific data (equation 20 of Annex I), ii) secondary datasets (equation 19 of Annex I), iii) PEF study (equation 20 of Annex I).]

B.5.3.1. Company-specific datasets

The DQR shall be calculated at the level-1 disaggregation, before any aggregation of sub-processes or elementary flows is performed. The DQR of company-specific datasets shall be calculated as following:

1) Select the most relevant activity data and direct elementary flows: most relevant activity data are the ones linked to sub-processes (i.e. secondary datasets) that account for at least 80% of the total environmental impact of the company-specific dataset, listing them from the most contributing to the least contributing one. Most relevant direct elementary flows are defined as those direct elementary flows contributing cumulatively at least with 80% to the total impact of the direct elementary flows.

2) Calculate the DQR criteria TeR, TiR, GeR and P for each most relevant activity data and each most relevant direct elementary flow. The values of each criterion shall be assigned based on Table B.9.

   a. Each most relevant direct elementary flow consists of the amount and elementary flow naming (e.g. 40 g carbon dioxide). For each most relevant elementary flow, the user of the PEFCR shall evaluate the 4 DQR criteria named TeR_{EF}, TiR_{EF}, GeR_{EF}, P_{EF}. For example, the user of the PEFCR shall evaluate the timing of the flow measured, for which technology the flow was measured and in which geographical area.

   b. For each most relevant activity data, the 4 DQR criteria shall be evaluated (named T_eR_{AD} TiR_{AD}, GeR_{AD}, P_{AD})by the user of the PEFCR.

   c. Considering that the data for the mandatory processes shall be company-specific, the score of P cannot be higher than 3, while the score for TiR, TeR, and GeR cannot be higher than 2 (The DQR score shall be ≤1.5).

3) Calculate the environmental contribution of each most relevant activity data (through linking to the appropriate sub-process) and each most relevant direct elementary flow to the total sum of the environmental impact of all most-relevant activity data and direct elementary flows, in % (weighted, using all EF impact categories). For example, the newly developed dataset has only two most relevant activity data, contributing in total to 80% of the total environmental impact of the dataset:

   a. Activity data 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).

b. Activity data 2 carries 50% of the total dataset environmental impact. The contribution of this process to the total of 80% is 62.5% (the latter is the weight to be used).

4) Calculate the TeR, TiR, GeR and P criteria of the newly developed dataset as the weighted average of each criteria of the most relevant activity data and direct elementary flows. The weight is the relative contribution (in %) of each most relevant activity data and direct elementary flow calculated in step 3.

5) The user of the PEFCR shall calculate the total DQR of the newly developed dataset using Equation B.2, where $\overline{\mathrm{TeR}}$, $\overline{\mathrm{TiR}}$, $\overline{\mathrm{GeR}}$, $\overline{\mathrm{P}}$ are the weighted average calculated as specified in point (4).

$$\mathrm{DQR} = \frac{\overline{\mathrm{Te_R}} + \overline{\mathrm{Ge_R}} + \overline{\mathrm{Ti_R}} + \overline{\mathrm{P}}}{4} \qquad \text{[Equation B.2]}$$

Table B. 9.

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

[Note that the reference years for criterion TiR may be adapted by the TS; more than one table may be included in the PEFCR].

Rating	P_{EF} and P_{AD}	TiR_{EF} and TiR_{AD}	TeR_{EF} and TeR_{AD}	GeR_{EF} and GeR_{AD}
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 elementary flows and the activity data explicitly depict the technology of the newly developed dataset	The activity data and elementary flows reflect 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 elementary flows and the activity data are a proxy of the technology of the newly developed dataset	The activity data and elementary flows partly reflect 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
4-5	Not applicable	Not applicable	Not applicable	Not applicable

P_{EF}: Precision for elementary flows; **P_{AD}**: Precision for activity data; **TiR_{EF}**: Time Representativeness for elementary flows; **TiR_{AD}**: Time representativeness for activity data; **TeR_{EF}**: Technology representativeness for elementary flows; **TeR_{AD}**: Technology representativeness for activity data**;** **GeR_{EF}**: Geographical representativeness for elementary flows; **GeR_{AD}:** Geographical representativeness for activity data.

B.5.4. *Data needs matrix (DNM)*

All processes required to model the product and outside the list of mandatory company-specific data (listed in section B.5.1) shall be evaluated using the Data Needs Matrix (see Table B.10). The user of the PEFCR shall apply the DNM to evaluate which data is needed and shall be used within the modelling of its PEF, depending on the level of influence the user of the PEFCR (company) has on the specific process. The following three cases are found in the DNM and are explained below:

1. **Situation 1:** the process is run by the company applying the PEFCR;

2. **Situation 2:** the process is not run by the company applying the PEFCR but the company has access to (company-)specific information;

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

Table B. 10.

Data Needs Matrix (DNM) ([30]). ***Disaggregated datasets shall be used.**

		Most relevant process	Other process
Situation 1: process run by the company using the PEFCR	Option 1	Provide company-specific data (as requested in the PEFCR) and create a company-specific dataset, in aggregated form (DQR≤1.5) 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 using 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, in aggregated form (DQR≤1.5) 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.

([30]) The options described in the DNM are not listed in order of preference.

Situation 3: process not run by the company using 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

([1]) Company-specific datasets shall be made available to the Commission.

B.5.4.1. Processes in situation 1

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

1) 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);

2) 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 user of the PEFCR applies company-specific data. The DQR of the newly developed dataset shall be evaluated as described in section B.5.3.1.

Situation 1/Option 2

For the non-most relevant processes only, if the user of the PEFCR decides to model the process without collecting company-specific data, then the user 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 user of the PEFCR shall take the DQR values from the metadata of the original dataset.

B.5.4.2. Processes in situation 2

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

1) The user of the PEFCR has access to extensive supplier-specific information and wants to create a new EF compliant dataset (Option 1);

2) The company has some supplier-specific information and want to make some minimum changes (Option 2);

3) The process is not in the list of most relevant processes and the company wants to make some minimum changes (Option 3).

Situation 2/Option 1

For all processes not run by the company and where the user of the PEFCR applies company-specific data, the DQR of the newly developed dataset shall be evaluated as described in section B.5.3.1

Situation 2/Option 2

The user of the PEFCR shall use company-specific activity data for transport and shall substitute the sub-processes used for electricity mix and transport with supply-chain specific PEF compliant datasets, starting from the default secondary dataset provided in the PEFCR.

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

The user of the PEFCR shall make the DQR context-specific by re-evaluating TeR and TiR using the table(s) B.11. The criteria GeR shall be lowered by 30% ([31]) and the criteria P shall keep the original value.

Situation 2/Option 3

The user of the PEFCR shall apply company-specific activity data for transport and shall substitute the sub-processes used for electricity mix and transport with supply-chain specific EF compliant datasets, 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.

In this case, the user of the PEFCR shall use the default DQR values. If the default dataset to be used for the process is not listed in the PEFCR, the user of the PEFCR shall take the DQR values from the original dataset.

Table B. 11.

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

[More than one table may be included in the PEFCR and entered in the section on life cycle stages]

	TiR	TeR	GeR
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 are 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.

([31]) In situation 2, option 2 it is proposed to lower the parameter GeR by 30% in order to incentivise 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.

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

B.5.4.3. Processes in situation 3

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

1) It is in the list of most relevant processes (situation 3, option 1);

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

Situation 3/Option 1

In this case, the user of the PEFCR shall make the DQR values of the dataset used context-specific by re-evaluating TeR, TiR and GeR, using the table(s) provided. The criteria P shall keep the original value.

Situation 3/Option 2

For the non-most relevant processes, the user of the PEFCR shall apply 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 user of the PEFCR shall take the DQR values from the original dataset.

B.5.5. *Datasets to be used*

This PEFCR lists the secondary datasets to be applied by the user of the PEFCR. Whenever a dataset needed to calculate the PEF profile is not among those listed in this PEFCR, then the user shall choose between the following options (in hierarchical order):

1) Use an EF compliant dataset available on one of the nodes of the Life Cycle Data Network ([32]);

2) Use an EF compliant dataset available in a free or commercial source

3) Use another EF compliant dataset considered to be a good proxy. In such case this information shall be included in the 'limitations' section of the PEF report

4) Use an ILCD-EL compliant dataset as proxy. These datasets shall be included in the 'limitations' section of the PEF report. A maximum of 10% of the single overall score may be derived from ILCD-EL compliant datasets. The nomenclature of the elementary flows of the dataset shall be aligned with the EF reference package used in the rest of the model ([33]) .

5) If no EF compliant or ILCD-EL compliant dataset is available, it shall be excluded from the PEF study. This shall be clearly stated in the PEF report as a data gap and validated by the PEF study and PEF report verifiers.

B.5.6. *How to calculate the average DQR of the study*

To calculate the average DQR of the PEF study, the user of the PEFCR shall calculate separately the TeR, TiR, GeR and P for the PEF study as the weighted average of all most relevant processes, based on their relative environmental contribution to the total single overall score. The calculation rules explained in section 4.6.5.8 of Annex I shall be used.

B.5.7. *Allocation rules*

[The PEFCR shall define which allocation rules shall be applied by the user of the PEFCR and how the modelling/calculations shall be made. In case economic allocation is used, the calculation method on how to derive the allocation factors shall be fixed and prescribed in the PEFCR. The following template shall be used:]

([32]) http://eplca.jrc.ec.europa.eu/LCDN/
([33]) http://eplca.jrc.ec.europa.eu/LCDN/developerEF.xhtml

Table B. 12.

Allocation rules

Process	Allocation rule	Modelling instructions	Allocation factor
[Example: Process A]	[Example: Physical allocation]	[Example: The mass of the different outputs shall be used.]	[Example: 0.2]
…	…		

B.5.8. *Electricity modelling*

The following electricity mix shall be used in hierarchical order:

(a) Supplier-specific electricity product shall be used if for a country there is a 100% tracking system in place, or if :

(i) available, and

(ii) the set of minimum criteria to ensure the contractual instruments are reliable is met.

(b) The supplier-specific total electricity mix shall be used if:

(i) available, and

(ii) the set of minimum criteria to ensure the contractual instruments are reliable is met.

(c) The 'country-specific residual grid mix, consumption mix' shall be used. Country-specific means the country in which the life cycle stage or activity occurs. This may be an EU country or non-EU country. The residual grid mix prevents double counting with the use of supplier-specific electricity mixes in (a) and (b).

(d) As a last option, the average EU residual grid mix, consumption mix (EU+EFTA), or region representative residual grid mix, consumption mix, shall be used.

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

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

Set of minimum criteria to ensure contractual instruments from suppliers

A supplier-specific electricity product/ mix may only be used if the user of the PEF method ensures that the contractual instrument meets the criteria specified below. If contractual instruments do not meet the criteria, then country-specific residual electricity consumption-mix shall be used in the modelling.

The list of criteria below is based on the criteria of the GHG Protocol Scope 2 Guidance ([34])–. A contractual instrument used for electricity modelling shall:

Criterion 1 – Convey attributes

1) Convey the energy type mix associated with the unit of electricity produced.

([34]) *World Resources Institute (WRI) and World Business Council for Sustainable Development WBCSD (2015): GHG Protocol Scope 2 Guidance. An amendment to the GHG Protocol. Corporate Standard*

2) The energy type mix shall be calculated based on delivered electricity, incorporating certificates sourced and retired (obtained or acquired or withdrawn) 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.

Criterion 2 – Be a unique claim

1) Be the only instruments that carry the environmental attribute claim associated with that quantity of electricity generated.

2) 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).

Criterion 3 – Be as close as possible to the period to which the contractual instrument is applied

[The Technical Secretariat may provide more information following the PEF method]

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

Datasets for residual grid mix, consumption mix, per energy type, per country and per voltage are made available by data providers.

If no suitable dataset is available, the following approach should 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 combine 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:

1) Domestic production mix per production technologies;

2) Import quantity and from which neighbouring countries;

3) Transmission losses;

4) Distribution losses;

5) 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 (www.iea.org).

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

1) fuel supply (share of resources used, by import and/ or domestic supply);

2) energy carrier properties (e.g. element and energy contents);

3) technology standards of power plants regarding efficiency, firing technology, flue-gas desulphurisation, NOx removal and de-dusting.

Allocation rules:

[The PEFCR shall define which physical relationship shall be used by PEF studies: (i) to subdivide the electricity consumption among multiple products for each process (e.g. mass, number of pieces, volume…) and (ii) 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. Where such data are not available, the average EU mix (EU +EFTA), or region representative mix, shall be used. The following template shall be used:]

Table B. 13.

Allocation rules for electricity

Process	Physical relationship	Modelling instructions
Process A	Mass	
Process B	N of pieces	
…	…	

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) If 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) If 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) If all the products produced in the specific plant are supplied with a publically available PEF study, the company wanting 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:

1) No contractual instruments have been sold to a third party: the own electricity mix (combined with LCI datasets) shall be modelled.

2) 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 may be seen as a multifunctional situation. The system will provide two functions (e.g. product + electricity) and the following rules shall be followed:

1) If possible, apply subdivision. Subdivision applies both to separate electricity productions or to a common electricity production where you may 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 windmill on its production site and exports 30% of the produced electricity, emissions related to 70% of produced electricity should be accounted in the PEF study).

2) If not possible, direct substitution shall be used. The country-specific residual consumption electricity mix shall be used as substitution ([35]).

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

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

B.5.9. *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 (CO2, CO and CH4) 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 ([36]) shall be modelled under sub-category 3 (incl. connected soil emissions, derived products, residues). The emission flows ending with '(biogenic)' shall be used.

   [Choose the right statement]

   A simplified modelling approach shall be used when modelling foreground emissions.

   [OR]

   A simplified modelling approach shall not be used when modelling foreground emissions.

   [If a simplified modelling approach is used, include in the text: 'Only the emission 'methane (biogenic)' is modelled, while no further biogenic emissions and uptakes from atmosphere are included. If methane emissions can be both fossil or biogenic, the release of biogenic methane shall be modelled first and then the remaining fossil methane.']

   [If no simplified modelling is used, include the text: 'All biogenic carbon emissions and removals shall be modelled separately.']

   [For intermediate products only:]

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

3. **Climate change – land use and land use change**: This sub-category accounts for carbon uptakes and emissions (CO2, CO and CH4) originating from carbon stock changes caused by land use change and land use. This sub-category includes biogenic carbon exchanges from deforestation, road construction or other soil activities (including 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 ([37]) and residues), while their CO_2 uptake is excluded. The emission flows ending with '(land use change)' shall be used.

   For land use change, all carbon emissions and removals shall be modelled following the modelling guidelines of PAS 2050:2011 (BSI 2011) and the supplementary document PAS2050-1:2012 (BSI 2012) for horticultural products. PAS 2050:2011 (BSI 2011): 'Large emissions of GHGs can result as a consequence of land use change. Removals as a direct result of land use change (and not as a result of long-term management practices) do not usually occur, although it is recognized that this could happen in specific circumstances. Examples of direct land use change are the conversion of land used for growing crops to industrial use or conversion from forestland to cropland. All forms of land use change that result in emissions or removals are to be included. Indirect land use change refers to such conversions of land use as a consequence of changes in land use elsewhere. While GHG emissions also arise from indirect land use change, the methods and data requirements for calculating these emissions are not fully developed. Therefore, the assessment of emissions arising from indirect land use change is not included.

([36]) Native forests – represents native or long-term, non-degraded forests. Definition adapted from Table 8 in the Annex of Commission Decision C(2010)3751 on guidelines for the calculation of land carbon stocks for the purpose of Annex V of Directive 2009/28/EC.

([37]) Following the instantaneous oxidation approach in IPCC 2013 (Section 2).

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 ([38]).

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

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

   the earliest year in which it can be demonstrated that the land use change had occurred; or

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

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.' [end of quote from PAS 2050:2011]

[Choose the right statement]

Soil carbon storage shall be modelled, calculated and reported as additional environmental information.

[OR]

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

[If it shall be modelled, 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.

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

[If climate change is selected as a relevant impact category, the PEFCR shall (i) always request to report the total climate change as the sum of the three sub-indicators, and (ii) for the sub-indicators 'Climate change – fossil', 'Climate change – biogenic' and 'Climate change - land use and land use change', request separate reporting for those contributing more than 5% each to the total score.]

[Choose the right statement]

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

[OR]

The sub-category 'Climate change-biogenic' shall not be reported separately.

The sub-category 'Climate change-land use and land transformation' shall be reported separately.

[OR]

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

B.5.10. *Modelling of end of life and recycled content*

The end of life 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 products. Overall, this should be modelled and reported at the life cycle stage where the waste occurs. This section provides rules on how to model the end of life of products as well as the recycled content.

The circular footprint formula (CFF) 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.
E_{ER}:	specific emissions and resources consumed (per functional unit) arising from the energy recovery process (e.g. incineration with energy recovery, landfill with energy recovery, etc.).
$E_{SE,heat}$ 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.

[Within the respective sections, the following parameters shall be provided in the PEFCR:

1) All A values to be used shall be listed in the PEFCR, together with a reference to the PEF method and part C of Annex II. In case specific A values cannot be determined by the PEFCR, the PEFCR shall prescribe the following procedure for its users:

   a. Check in part C of Annex II the availability of an application-specific A value which fits the PEFCR,

   b. If an application-specific A value is not available, the material-specific A value in part C of Annex II shall be used,

   c. If a material-specific A value is not available, the A value shall be set equal to 0.5.

2) All quality ratios (Qsin, Qsout/Qp) to be used.

3) Default R_1 values for all default material datasets (in case no company-specific values are available), together with a reference to the PEF method and part C of Annex II. They shall be set to 0% when no application-specific data is available.

4) Default R_2 values to be used in case no company-specific values are available, together with a reference to the PEF method and part C of Annex II.

5) All datasets to be used for Erec, ErecEoL, Ev, E*v, EER, ESE,heat and ESE,elec, ED]

[Default values for all parameters shall be listed in a table in the section of the appropriate life cycle stage. Furthermore, the PEFCR shall clearly describe for each parameter if only defaults can be used or also company-specific data, following the overview in section A.4.2.7. of Annex II]

Modelling recycled content (if applicable)

[If applicable the following text shall be included:]

The following part of the circular footprint formula is used to model the recycled content:

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

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

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

1) The supplier information (through e.g., statement of conformity or delivery note) shall be maintained during all stages of production and delivery at the converter;

2) Once the material is delivered to the converter for production of the end products, the converter shall handle information through their regular administrative procedures;

3) The converter for production of the end products claiming recycled content shall demonstrate through its management system the [%] of recycled input material into the respective end product(s).

4) The latter demonstration shall be transferred upon request to the user of the end product. In case a PEF profile is calculated and reported, this shall be stated as additional technical information of the PEF profile.

5) Company-owned traceability systems may be applied as long as they cover the general guidelines outlined above.

[Industry systems may be applied as long as they cover the general guidelines outlined above. In that case, the text above may be replaced by those industry specific rules. If not, they shall be supplemented with the general guidelines above.]

[For intermediate products only:]

The PEF profile shall be calculated and reported using A equal to 1 for the product in scope.

Under additional technical information the results shall be reported for different applications/materials with the following A values:

Application/material	A value to be used

B.6. Life cycle stages

B.6.1. *Raw material acquisition and pre-processing*

[The PEFCR shall list all technical requirements and assumptions to be applied by the user of the PEFCR. Furthermore, it shall list all processes taking place in this life cycle stage (according to the model of the RP), following the table provided below (transport in separate table). The table may be adapted by the TS as appropriate (e.g. by including relevant parameters of the circular footprint formula).]

Table B. 14.

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

Process name*	Unit of measure-ment (output)	Default				UUID	Default DQR				Most relevant process [Y/N]
		R_1	Amou-nt per FU	Dataset	Dataset source (Node and data stock)		P	TiR	GeR	TeR	

[Please write in CAPITAL LETTERS the name of those processes expected to be run by the company]

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

[Packaging shall be modelled as part of the raw material acquisition stage of the life cycle.]

[PEFCRs that include the use of beverage cartons or bag-in-box packaging shall provide information on the amounts of input materials (also called the bill of material) and state that the packaging shall be modelled by combining the prescribed amounts of the material datasets with the prescribed conversion dataset.]

[PEFCRs that include reusable packaging from third party operated pools shall provide default reuse rates. PEFCRs with company-owned packaging pools shall specify that the reuse rate shall be calculated using supply-chain-specific data only. The two different modelling approaches as presented in Annex I shall be used and copied in the PEFCR. The PEFCR shall include the following: 'The raw material consumption of reusable packaging shall be calculated by dividing the actual weight of the packaging by the reuse rate.']

[For the different ingredients transported from supplier to factory, the user of the PEFCR needs data on (i) transport mode, (ii) distance per transport mode, (iii) utilisation ratios for truck transport and (iv) empty return modelling for truck transport. The PEFCR shall provide default data for these or request these data in the list of mandatory company-specific information. The default values provided in Annex I shall be applied unless PEFCR-specific data is available.]

Table B. 15.

Transport (capitals indicate those processes expected to be run by the company)

Process name (*)	Unit of measurement (output)	Default (per FU)			De-fault data-set	Data-set source	UUID	Default DQR				Most relevant [Y/N]
		Dis-tance	Utilisa-tion ratio*	Empty return				P	TiR	GeR	TeR	

(*) The user of the PEFCR shall always check the utilisation ratio applied in the default dataset and adapt it accordingly.

[Please write in CAPITAL LETTERS the name of processes expected to be run by the company.]

[PEFCRs that include reusable packaging shall include the following: 'The reuse rate affects the quantity of transport 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.']

B.6.2. *Agricultural modelling [to be included only if applicable]*

[In case agricultural production is part of the scope of the PEFCR the following text shall be included. Sections that are not relevant may be removed.]

Handling multi-functional processes: The rules described in the LEAP guidelines shall be followed: 'Environmental performance of animal feeds supply chains (pages 36-43), FAO 2015, available at http://www.fao.org/partnerships/leap/publications/en/'.

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:

1) 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, etc.). 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 another 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.

2) For perennial plants (including entire plants and edible portions of perennial plants) a steady state situation (i.e. where all development stages are proportionally represented in the studied time period) shall be assumed and a three-year period shall be used to estimate the inputs and outputs ([39]).

3) 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.

4) For crops that are grown and harvested in less than one year (e.g. lettuce 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 may best be done by first gathering annual data and calculating the life cycle inventory per year and then determining the three years average.

Pesticide emissions shall be modelled as specific active ingredients. As a default approach, 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:

1) NH3, to air (from N-fertiliser application)

2) N2O, to air (direct and indirect) (from N-fertiliser application)

3) CO2, to air (from lime, urea and urea-compounds application)

4) NO3, to water unspecified (leaching from N-fertiliser application)

5) PO4, to water unspecified or freshwater (leaching and run-off of soluble phosphate from P-fertiliser application)

6) P, to water unspecified or freshwater (soil particles containing phosphorous, from P-fertiliser application).

([39]) The underlying assumption in the cradle-to-gate life cycle inventory assessment of horticultural products is that the inputs and outputs of the cultivation are in a 'steady state', which means that all development stages of perennial crops (with different quantities of inputs and outputs) shall be proportionally represented in the time period of cultivation that is studied. This approach gives the advantage that inputs and outputs of a relatively short period can be used for the calculation of the cradle-to-gate life cycle inventory from the perennial crop product. Studying all development stages of a horticultural perennial crop can have a lifespan of 30 years and more (e.g. in case of fruit and nut trees).

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).

[For nitrogen based fertilisers, the PEFCR shall describe the LCI model to be used. The Tier 1 emission factors of IPCC (2006) should be used. A more comprehensive nitrogen field model may be used by the PEFCR provided (i) it covers at least the emissions requested above, (ii) N is balanced in inputs and outputs and (iii) it is described in a transparent way.]

Table B. 16.

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

FracGASF: fraction of synthetic fertiliser N applied to soils that volatilises as NH_3 and NO_x. FracLEACH: fraction of synthetic fertiliser and manure lost to leaching and runoff as NO3-.

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 TS shall select one of the two modelling approaches to be used]

1) 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.

2) The final fate (emission compartment) of the heavy metal elementary flows is considered within the system boundary: the inventory does account for the final emissions (release) of the heavy metals in the environment and therefore shall also account for the uptake of heavy metals by the crop. For example, heavy metals in agricultural crops cultivated for feed will mainly end up in the animal digestion and used as manure back on the field where the metals are released in the environment and their impacts are captured by the impact assessment methods. Therefore, the inventory of the agricultural stage shall account for the uptake of heavy metals by the crop. A limited amount ends up in the animal, which may be neglected for simplification.

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 [The TS shall select what shall be included]:

a) Input of seed material (kg/ha)

b) Input of peat to soil (kg/ha + C/N ratio)

c) Input of lime (kg CaCO3/ha, type)

d) Machine use (hours, type) (to be included if there is high level of mechanisation)

e) Input N from crop residues that stay on the field or are burned (kg residue + N content/ha)

f) Crop yield (kg/ha)

g) Drying and storage of products

h) Field operations through …[to be filled in]

B.6.3. *Manufacturing*

[The PEFCR shall list all technical requirements and assumptions to applied by the user of the PEFCR. Furthermore, it shall list all processes taking place in this life cycle stage, according to the table provided below. The table may be adapted by the TS as appropriate (e.g. by including relevant parameters of the circular footprint formula).]

Table B. 17.

Manufacturing (capitals indicate those processes expected to be run by the company)

Name of the process	Unit of measure-ment (output)	Default amount per FU	Default dataset to be used	Dataset source (Node and data stock)	UUID	Default DQR				Most relevant process [Y/N]
						P	TiR	GeR	TeR	

[Please write in CAPITAL LETTERS the name of those processes expected to be run by the company]

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

[PEFCRs that include reusable packaging shall account for the additional energy and resource used for cleaning, repairing or refilling.]

The waste of products used during the manufacturing shall be included in the modelling. [Default loss rates per type of product and how these shall be included in the reference flow shall be described.]

B.6.4. *Distribution stage [to be included if applicable]*

Transport from factory to final client (including consumer transport) shall be modelled within this life cycle stage. The final client is defined as … [to be filled in].

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

[A default transport scenario shall be provided by the TS in the PEFCR. In case no PEFCR-specific transport scenario is available, the transport scenario provided in the PEF method shall be used as a basis together with (i) a number of PEFCR-specific ratios, (ii) PEFCR-specific utilisation ratios for truck transport, and (iii) PEFCR-specific allocation factor for consumer transport. For reusable products, the return transport from retail/DC to factory shall be added in the transport scenario. For cooled or frozen products, the default truck/van transport processes should be changed. The PEFCR shall list all processes taking place in scenario (according to the model of the RP) using the table below. The table may be adapted by the TS as appropriate]

Table B. 18.

Distribution (capitals indicate those processes expected to be run by the company)

Process name*	Unit of measurement (output)	Default (per FU)			Default dataset	Dataset source	UUID	Default DQR				Most relevant [Y/N]
		Distance	Utilisation ratio	Empty return				P	TiR	GeR	TeR	

[Please write in CAPITAL LETTERS the name of those processes expected to be run by the company.]

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

The waste of products during distribution and retail shall be included in the modelling. [Default loss rates per type of product and how these shall be included in the reference flow shall be described. The PEFCR shall follow the part F of this Annex in case no PEFCR-specific information is available.]

B.6.5. *Use stage [to be included if applicable]*

[The PEFCR shall provide a clear description of the use stage and list all processes taking place therein (according to the model of the RP) according to the table provided below. The table may be adapted by the TS as appropriate.]

Table B. 19.

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	TeR	GeR	

[Please write in CAPITAL LETTERS the name of those processes expected to be run by the company.]

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

[In this section the PEFCR shall also list all technical requirements and assumptions that the user of the PEFCR shall apply. The PEFCR shall state if a delta approach is used for certain processes. In case the delta approach is used, the PEFCR shall state the minimum consumption (reference) to be used when calculating the additional consumption allocated to the product.]

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

The waste of products during the use stage shall be included in the modelling. [Default loss rates per type of product and how these shall be included in the reference flow shall be described. The PEFCR shall follow part E of this Annex in case no PEFCR-specific information is available.]

B.6.6. *End of life [to be included if applicable]*

The end of life stage begins when the product in scope and its packaging is discarded by the user and ends when the product is returned to nature as a waste product or enters another product's life cycle (i.e. as a recycled input). In general, it includes the waste of the product in scope, such as the food waste, and primary packaging.

Other waste (different from the product in scope) generated during the manufacturing, distribution, retail, use stage or after use shall be included in the life cycle of the product and modelled at the life cycle stage where it occurs.

[The PEFCR shall list all technical requirements and assumptions that the user of the PEFCR shall apply. Furthermore, it shall list all processes taking place in this life cycle stage (according to the model of the RP) according to the table provided below. The table may be adapted by the TS as appropriate (e.g. by including relevant parameters of the circular footprint formula). Please note that the transport from collection place to EoL treatment may be included in the landfill, incineration and recycling datasets: the TS shall check if it is included in the default datasets provided. However, there might be some cases, where additional default transport data is needed and thus shall be included here. The PEF method provides default values to be used in case no better data is available.]

Table B. 20.

End of life (capitals indicate those processes expected to be run by the company)

Name of the process*	Unit of measure-ment (output)	Default amount per FU	Default dataset to be used	Dataset source	UUID	Default DQR				Most relevant process [Y/N]
						P	TiR	Ter	GeR	

[Please write in CAPITAL LETTERS the name of those processes expected to be run by the company.]

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

The end of life shall be modelled using the circular footprint formula and rules provided in section 'End of life modelling' of this PEFCR and in the PEF method, together with the default parameters listed in the table [Table number].

Before selecting the appropriate R_2 value, the user of the PEFCR shall carry out an evaluation for recyclability of the material. The PEF study shall include a statement on the recyclability of the materials/ products. The statement on recyclability shall be provided together with an evaluation for recyclability that 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 ([40]).

Following the evaluation for recyclability, the appropriate R_2 values (supply-chain specific or default) shall be used. If one criterion is not fulfilled or the sector-specific recyclability guidelines indicate 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, if available. If no company-specific values are available and the criteria for the evaluation of recyclability are fulfilled (see below), application-specific R_2 values shall be used as listed in the table below.

a) If an R2 value is not available for a specific country, the European average shall be used.

b) If an R2 value is not available for a specific application, the R2 values of the material shall be used (e.g. materials average).

c) In case no R2 values are available, R2 shall be set equal to 0 or new statistics may be generated in order to assign an R2 value in the specific situation.

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

[The PEFCR shall list in a table all the parameters to be used by the user to implement the CFF, distinguishing between those that have a fixed value (to be provided in the same Table; from the PEF method or PEFCR-specific) and those that are PEF study-specific (e.g. R_2, etc.). Furthermore, the PEFCR shall include additional modelling rules derived from the PEF method, if applicable. Within this table, the B value shall be equal to 0 as default.]

[PEFCRs that include reusable packaging shall include the following: 'The reuse rate determines the quantity of packaging material (per product sold) to be treated at the end of life. The amount of packaging treated at the end of life shall be calculated by dividing the actual weight of the packaging by the number of times this packaging was reused.']

B.7. **PEF results**

B.7.1. *Benchmark values*

[Here the TS shall report the results of the benchmark for each representative product. The results shall be provided characterised, normalised, and weighted (as absolute values), each in a different table, according to the template provided below. Results shall also be provided as a single overall score, based on the weighting factors provided in Section 5.2.2 of Annex I and of Annex B.1]

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

Table B. 21.

Characterised benchmark values for [introduce name of the representative product]

Impact category	Unit	Life cycle excl. use stage	Total life cycle
Climate change, total	kg $CO_{2\ eq}$		
Climate change - fossil			
Climate change - biogenic			
Climate change – land use and land use change			
Ozone depletion	kg CFC-11 $_{eq}$		
Particulate matter	disease incidence		
Ionising radiation, human health	kBq U^{235} $_{eq}$		
Photochemical ozone formation, human health	kg NMVOC $_{eq}$		
Acidification	mol H+ $_{eq}$		
Eutrophication, terrestrial	mol N $_{eq}$		
Eutrophication, freshwater	kg P $_{eq}$		
Eutrophication, marine	kg N $_{eq}$		
Human toxicity, cancer	CTUh		
Human toxicity, non-cancer	CTUh		
Ecotoxicity	CTUe		
Land use	Dimensionless (pt)		
Water use	m^3 water eq of deprived water		
Resource use, minerals and metals	kg Sb $_{eq}$		
Resource use, fossils	MJ		

Table B. 22.

Normalised benchmark values for [introduce name of the representative product]

Impact category	Life cycle excl. use stage	Total life cycle
Climate change (total)		
Climate change - fossil		
Climate change - biogenic		
Climate change – land use and land use change		
Ozone depletion		

Impact category	Life cycle excl. use stage	Total life cycle
Particulate matter		
Ionising radiation, human health		
Photochemical ozone formation, human health		
Acidification		
Eutrophication, terrestrial		
Eutrophication, freshwater		
Eutrophication, marine		
Human toxicity, cancer		
Human toxicity, non-cancer		
Ecotoxicity		
Land use		
Water use		
Resource use, minerals and metals		
Resource use, fossils		

Table B. 23.

Weighted benchmark values for [introduce name of the representative product]

Impact category	Life cycle excl. use stage	Total life cycle
Climate change (total)		
Climate change - fossil		
Climate change - biogenic		
Climate change – land use and land use change		
Ozone depletion		
Particulate matter		
Ionising radiation, human health		
Photochemical ozone formation, human health		
Acidification		
Eutrophication, terrestrial		
Eutrophication, freshwater		
Eutrophication, marine		
Human toxicity, cancer		
Human toxicity, non-cancer		
Ecotoxicity		
Land use		

Impact category	Life cycle excl. use stage	Total life cycle
Water use		
Resource use, minerals and metals		
Resource use, fossils		

B.7.2. *PEF profile*

The user of the PEFCR 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:

a) full life cycle inventory;

b) characterised results in absolute values, for all impact categories (as a table);

c) normalised results in absolute values, for all impact categories (as a table);

d) weighted result in absolute values, for all impact categories (as a table);

e) the aggregated single overall score in absolute values.

Together with the PEF report, the user of the PEFCR shall develop an aggregated EF compliant dataset of its product in scope. This dataset shall be made available to the European Commission and may be made public. The disaggregated version may remain confidential.

B.7.3. *Classes of performance*

[The identification of classes of performance is not obligatory. Each Technical Secretariat is free to define a method to identify the classes of performance, in case they deem it appropriate and relevant. In case classes of performance are identified, they shall be described and provided in this section. Please refer to A.5.2 for further guidance.]

B.8. **Verification**

The verification of a PEF study/ report carried out in compliance with this PEFCR shall be done according to all the general requirements included in section 9 of the Annex I, including part A of this Annex, and the requirements listed below.

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

In case policies implementing the PEF method define specific requirements regarding verification and validation of PEF studies, reports and communication vehicles, the requirements in said policies shall prevail.

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:

1. the verifier(s) shall check if the correct version of all impact assessment methods was used. For each of the most relevant EF impact categories (ICs), at least 50% of the characterisation factors shall be verified, while all normalisation and weighting factors of all ICs shall be verified. In particular, the verifier(s) shall check that the characterisation factors correspond to those included in the EF impact assessment method the study declares compliance with ([41]). This may also be done indirectly, for example:

    a. Export the EF-compliant datasets from the LCA software used to do the PEF study and run them in Look@LCI ([42]) to obtain LCIA results. If Look@LCI results are within a deviation of 1% from the results in the LCA software, the verifier(s) may assume that the implementation of the characterisation factors in the software used to do the PEF study was correct.

([41]) Available at: http://eplca.jrc.ec.europa.eu/LCDN/developer.xhtml
([42]) https://eplca.jrc.ec.europa.eu/LCDN/developer.xhtml

b. Compare the LCIA results of the most relevant processes calculated with the software used to do the PEF study with the ones available in the metadata of the original dataset. If the compared results are within a deviation of 1%, the verifier(s) may assume that the implementation of the characterisation factors in the software used to do the PEF study was correct

2. cut-off applied (if any) fulfils the requirements at section 4.6.4 of Annex I.

3. all datasets used shall be checked against the data requirements (sections 4.6.3 and 4.6.5. of Annex I).

4. For at least 80% (in number) of the most relevant processes (as defined in section 6.3.3 of Annex I), the verifier(s) shall validate all related activity data and the datasets used to model these processes. If relevant, CFF parameters and datasets used to model them shall also be validated in the same way. The verifier(s) shall check that the most relevant processes are identified as specified in section 6.3.3 of Annex I;

5. For at least 30% (in number) of all other processes (corresponding to 20% of the processes as defined in section 6.3.3 of Annex I) the verifier(s) shall validate all related activity data and the datasets used to model these processes. If relevant, CFF parameters and datasets used to model them shall also be validated in the same way;

6. The verifier(s) shall check that the datasets are correctly implemented in the software (i.e. LCIA results of the dataset in the software are within a deviation of 1% to the ones in the metadata). At least 50% (in number) of the datasets used to model most relevant processes and 10% of those used to model other processes shall be checked.

In particular, verifier(s) shall verify if the DQR of the process satisfies the minimum DQR as specified in the DNM for the selected processes.

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

The verification of the PEF report shall be carried out by randomly checking enough information to provide reasonable assurance that the PEF report fulfils all the conditions listed in section 8 of Annex I, including part A of this Annex.

[The PEFCR may specify additional requirements for the verification that should be added to the minimum requirements stated in this document].

References

[List the references used in the PEFCR.]

Annexes

ANNEX B1 – List of EF normalisation and weighting factors

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

[The TS shall provide the list of normalisation and weighting factors that the user of the PEFCR shall apply. Normalisation and weighting factors are available at: http://eplca.jrc.ec.europa.eu/LCDN/developerEF.xhtml ([43])]

([43]) Please note that the weighting factors are expressed in % and thus shall be divided by 100 before applying in the calculations.

ANNEX B2 – PEF study template

[The PEFCR shall provide as an annex a checklist listing all the items that shall be included in PEF studies, using the PEF study template available as part E of this Annex of this document. The items already included are mandatory for every PEFCR. In addition, each technical secretariat may decide to add additional points to the template.]

ANNEX B3 – Review reports of the PEFCR and PEF-RP(s)

[Insert here the critical review panel reports of the PEFCR and PEF-RP(s), including all findings of the review process and the actions taken by the technical secretariat to answer the comments of the reviewers.]

ANNEX B4 – Other annexes

[The TS may decide to add other Annexes that are considered important. Such as, an example on the application of the DNM or DQR calculations, and explanations on decisions taking during the PEFCR development.].

PART C

LIST OF DEFAULT CFF PARAMETERS

Part C of Annex II is available at http://eplca.jrc.ec.europa.eu/LCDN/developerEF.xhtml.

The list of values in part C of Annex II is periodically reviewed and updated by the European Commission; users of the PEF method are invited to check and use the most updated values provided in the Annex.

PART D

DEFAULT DATA FOR MODELLING THE USE STAGE

The following tables shall be used in PEF studies and when developing PEFCRs unless better data is available. The data provided is based on assumptions, except if specified otherwise.

Product	Use stage assumptions per product category
Meat, fish, eggs	Chilled storage. Cooking: 10 minutes in frying pan (75% on gas and 25% electricity), 5 gram sunflower oil (incl. its life cycle) per kg product. Dishwashing of frying pan.
Milk	Chilled storage, drunk cold in 200 ml glass (i.e., 5 glasses per L milk), incl. glass life cycle and dishwashing.
Pasta	Per kg pasta cooked in pot with 10 kg water, 10 min boiling (75% on gas and 25% electricity). Boiling phase: 0.18 kWh per kg of water, Cooking phase: 0.05 kWh per minute of cooking.
Frozen dishes	Frozen storage. Cooked in oven 15 minutes at 200°C (incl. a fraction of a stove, a fraction of a baking sheet). Baking sheet rinsing: 5 L water.
Roast and ground coffee	7 g roast and ground coffee per cup Filter coffee preparation in a filter coffee machine: machine production and end-of-life (1.2 kg, 4 380 uses, with 2 cups/use), paper filter (2 g/use), electricity consumption (33 Wh/cup) and water consumption (120 ml/cup). Machine rinsing/washing: 1 L cold water per use, 2 L hot water per 7 uses, decanter dishwashing (every 7 uses) Cup (mug) production and end-of-life and dishwashing Source: based on PEFCR Coffee (draft as of Feb 1, 2015 ([44])
Beer	Cooling, drunk in 33 cl glass (i.e., 3 glasses per L beer), glass production, end-of-life and dishwashing. See also PEFCR of beer ([45]).

([44]) https://webgate.ec.europa.eu/fpfis/wikis/display/EUENVFP/PEFCR+Pilot%3A+Coffee, ECAS registration is needed to access this website
([45]) http://ec.europa.eu/environment/eussd/smgp/pdf/Beer%20PEFCR%20June%202018%20final.pdf

Product	Use stage assumptions per product category
Bottled water	Chilled storage. Storage duration: 1 day. 2.7 glasses per L water drunk, 260 gram glass production, end-of-life and dishwashing.
Pet food	Pet food dish production, end-of-life and dishwashing
Goldfish	Electricity and water use and treatment for the aquarium (43 kWh and 468 L per year). Goldfish feed production (1 g/day, assumed 50% fish meal, 50% soybean meal). Lifetime of the goldfish assumed to be 7.5 years.
T-shirt	Washing machine, tumble dryer use and ironing. 52 washing at 41 degree, 5.2 tumble drying (10%) and 30 times ironing per T-shirt. Washing machine: 70 kg, 50% steel, 35% plastic, 5% glass, 5% aluminium, 4% copper, 1% electronics, 1 560 cycles (=loads) within its lifetime. 179 kWh and 8 700 L water for 220 cycles at 8 kg load (based on http://www.bosch-home.com/ch/fr/produits/laver-et-s%C3%A9cher/lave-linge/WAQ28320FF.html?source=browse) being 0.81 kWh and 39.5 L/cycle, as well as 70 ml laundry detergent/cycle. Tumble dryer: 56 kg, same composition share and lifetime as for washing machine assumed. 2.07 kWh/cycle for 8 kg clothes load.
Paint	Paint brush production, sand paper, … (see PEFCR of decorative paints ([46]).
Cell phone	2 kWh/year for the charge, 2 years lifetime.
Laundry detergent	Use of a washing machine (see T-shirt data for washing machine model). 70 ml laundry detergent assumed per cycle, i.e., 14 cycles per kg detergent.
Automotive oil	10% losses during use assessed as hydrocarbons emissions to water.

Default assumptions for storage (always based on assumptions, except if specified otherwise).

Product	Assumptions common to several product categories
Ambient storage (at home)	Ambient storage at home is considered, for the sake of simplification, as having no impact.
Chilled storage (in a fridge, at home)	Storage time: product dependent. As default 7 days storage in fridge (ANIA and ADEME 2012 ([47]). Storage volume: assumed to be 3x the actual product volume Energy consumption: 0.0037 kWh/L (i.e., 'the storage volume') - day (ANIA and ADEME 2012). Fridge production and end-of-life considered (assuming 15 years of lifetime).
Chilled storage (at the pub/restaurant)	The fridge at the pub is assumed to consume 1 400 kWh/ yr (Heineken green cooling expert, 2015). 100% of this energy consumption is assumed to be for the cooling of beer. The throughput of the fridge is assumed to be 40hl/ yr. This means 0.035 kWh/ l for pub / supermarket cooling for the full storage time. Fridge production and end-of-life considered (assuming 15 years of lifetime).
Frozen storage (in a freezer, at home)	Storage time: 30 days in freezer (based on ANIA and ADEME 2012). Storage volume: assumed to be 2x the actual product volume. Energy consumption: 0.0049 kWh/L (i.e., 'the storage volume') - day (ANIA and ADEME 2012). Freezer production and end-of-life considered (assuming 15 years of lifetime): assumed similar to fridge.

([46]) http://ec.europa.eu/environment/eussd/smgp/documents/PEFCR_decorative_paints.pdf
([47]) ANIA and ADEME. (2012). Projet de référentiel transversal d'évaluation de l'impact environnemental des produits alimentaires (mainly annexe 4) (« GT1 »), 23/04/12.

Product	Assumptions common to several product categories
Cooking (at home)	Cooking: 1 kWh/h use (derived from consumptions for induction stove (0.588 kWh/h), ceramic stove (0.999 kWh/h) and electric stove (1.161 kWh/h) all from (ANIA and ADEME 2012). Backing in oven: electricity considered: 1.23 kWh/h (ANIA and ADEME 2012).
Dishwashing (at home)	Dishwasher use: 15 L water, 10 g soap and 1.2 kWh per washing cycle (Kaenzig and Jolliet 2006). Dishwasher production and end-of-life considered (assuming 1 500 cycle per lifetime). When dishwashing is done by hand, one assumes an equivalent of 0.5 L of water and 1 g of soap for the value above of 2.5% (with a scaling in terms of water use and soap, using the % above). The water is assumed to be warmed by natural gas, considering a delta T of 40 °C and an efficiency of energy from natural gas heating to water heat of 1/1.25 (meaning that to heat the 0.5 L of water one needs to use 1.25 * 0.5 * 4 186 * 40 = 0.1 MJ of 'Heat, natural gas, at boiler').

PART E

PEF REPORT TEMPLATE

This Annex presents the PEF report template that shall be applied for all types of PEF studies (e.g., including PEF-RPs or supporting studies of PEFCRs). The template presents the mandatory report structure to be followed and the information to be reported as a non-exhaustive list. All items required to be reported by the PEF method shall be included, even if they are not explicitly mentioned in this template.

Product Environmental Footprint

Report

[Insert product name here]

Table of contents

Acronyms

[List in this section all the acronyms used in the PEF study. Those already included in the Annex I shall be copied in their original form. The acronyms shall be provided in alphabetical order.]

Definitions

[List in this section all the definitions that are relevant for the PEF study. Those already included in the Annex I shall be copied in their original form. The definitions shall be provided in alphabetical order.]

E.1 **Summary**

[The summary shall include as a minimum the following elements:

a) The goal and scope of the study, including relevant limitations and assumptions;

b) A short description of the system boundary;

c) Relevant statements about data quality,

d) The main results of the LCIA: these shall be presented showing the results of all EF impact categories (characterized, normalized, weighted);

e) A description of what has been achieved by the study, any recommendation made and conclusions drawn;

To the extent possible, the summary should be written with a non-technical audience in mind and should not be longer than 3-4 pages.]

E.2. **General**

[The information below should ideally be placed on the front-page of the study:

a) Name of the product (including a photo),

b) Product identification (e.g. model number),

c) Product classification (CPA) based on the latest CPA list version available,

d) Company presentation (name, geographic location),

e) Date of publication of the PEF study (the date shall be written in extended format, e.g. 25 June 2015, to avoid confusion over the date format),

f) Geographic validity of the PEF study (countries where the product is consumed/sold),

g) Compliance with the PEF method,

h) Conformance to other documents, additional to the PEF method,

i) Name and affiliation of the verifier(s)]

E.3. **Goal of the study**

[Mandatory reporting elements include, as a minimum:

a) Intended application(s);

b) Methodological limitations;

c) Reasons for carrying out the study;

d) Target audience;

e) Commissioner of the study;

f) Identification of the verifier]

E.4. **Scope of the study**

[The scope of the study shall identify the analysed system in detail and address the overall approach used to establish: i) functional unit and reference flow, ii) system boundary, iii) list of EF impact categories, iv) additional information (environmental and technical) iv) assumptions and limitations.]

E.4.1. *Functional/declared unit and reference flow*

[Provide the functional unit, defining the four aspects:

a) The function(s)/service(s) provided: 'what';

b) The extent of the function or service: 'how much';

c) The expected level of quality: 'how well';

d) The duration/life time of the product: 'how long';

Provide the declared unit, in case the functional unit cannot be defined (e.g. if the product in scope is an intermediate product)

Provide reference flow]

E.4.2. *System boundary*

[This section shall include as a minimum:

a) All life-cycle stages that are part of the product system. In case the naming of the default life cycle stages has changed, the user shall specify to which default life cycle stage it corresponds. Document and justify if life cycle stages were split and/or new ones were added.

b) The main processes covered in each life cycle stage (details are in the LCI section A.5). The co-products, by-products and waste streams of at least the foreground system shall be clearly identified.

c) The reason for and potential significance of any exclusion.

d) A system boundary diagram with the processes that are included and those excluded, highlight those activities which falls respectively under situation 1, 2, and 3 of the Data Needs Matrix, and highlight where company-specific data are used.]

E.4.3. *Environmental Footprint impact categories*

[Provide a table with the list of EF impact categories, units, and EF reference package used (see http://eplca.jrc.ec.europa.eu/LCDN/developerEF.xhtml for further details).

For climate change, specify if the results of the three sub-indicators are reported separately in the results section.]

E.4.4. *Additional information*

[Describe any additional environmental information and additional technical information included in the PEF study. Provide references and exact calculations rules adopted.

Explain if biodiversity is relevant/not relevant for the product in scope.

When the product in scope is an intermediate product, additional technical information shall include:

1. The biogenic carbon content at factory gate (physical content and allocated content).

2. Recycled content (R_1).

3. Results with application-specific A-values of the circular footprint formula, if relevant.]

E.4.5. *Assumptions and limitations*

[Describe all limitations and assumptions. Provide list of data gaps, if any, and the way in which these gaps were filled. Provide list of proxy datasets used.]

E.5. **Life cycle inventory analysis**

[This section shall describe the compilation of the LCI and include:

a) Screening step, if performed,

b) List and description of life cycle stages,

c) Description of modelling choices,

d) Description of allocation approaches applied,

e) Description and documentation of data used and sources,

f) Data quality requirements and rating]

E.5.1. *Screening step [if applicable]*

[Provide a description of the screening step, including relevant information regarding data collection, data used (e.g. list of secondary data sets, activity data, direct elementary flows), cut-off, and results of the life cycle impact assessment phase.

Document main findings and any refinement of the initial scope settings (if any).]

E.5.2. *Modelling choices*

[Describe all modelling choices for the applicable aspects listed below (more can be added, when relevant):

a) Agricultural production (PEF studies which have agricultural modelling in scope and have tested the alternative approach described in section 4.4.1.5 and Table 4 of Annex I, shall report the results in an Annex of the PEF report);

b) Transport and logistics: all data used shall be provided in the report (e.g. transportation distance, payload, re-use rate for packaging, etc.). If default scenarios were not used in the modelling, provide documentation of all specific data used;

c) Capital goods: if capital goods are included, the PEF report shall include a clear and extensive explanation, reporting all assumptions made;

d) Storage and retail;

e) Use stage: Product dependent processes shall be included in the system boundary of the PEF study. Product independent processes shall be excluded from the system boundary and qualitative information may be provided, see section 4.4.7 of Annex I. Describe the approach taken to model the use stage (main function approach or delta approach);

f) End of life modelling, including values of parameters of the circular footprint formula (A, B, R1, R2, Qs/Qp, R3, LHV, XER,heat, XER,elec), list of processes and datasets used (Ev, Erec, ErecEoL, E*v, Ed, EEr, ESE,heat, ESE,elec) with reference to part C of Annex II;

g) Extended product lifetime;

h) Electricity use;

i) Sampling procedure (report if a sampling procedure was applied and indicate the approach taken);

j) Greenhouse gas emissions and removals (report if a simplified approach was not used to model biogenic carbon flows);

k) Offsets (if reported as additional environmental information).]

E.5.3. *Handling multi-functional processes*

[Describe the allocation rules used in the PEF study and how the modelling/calculations were made. Provide the list of all allocation factors used for each process and the detailed list of processes and datasets used, in case substitution is applied.]

E.5.4. *Data collection*

[This section shall include as a minimum:

a) Description and documentation of all company-specific data collected:

   a. list of processes covered by company-specific data indicating to which life cycle stage they belong;

b. list of resource use and emissions (i.e. direct elementary flows);

c. list of activity data used;

d. link to detailed bill of materials and/or ingredients, including substance names, units and quantities, including information on grades/ purities and other technically and/or environmentally relevant characterisation of these;

e. company-specific data collection/estimation/calculation procedures;

b) List of all secondary datasets used (process name, UUID, dataset source (node on Life Cycle Data Network, data stock) and compliance with the EF reference package);

c) Modelling parameters;

d) Cut-off applied, if any;

e) Sources of published literature;

f) Validation of data, including documentation;

g) If a sensitivity analysis has been conducted, this shall be reported.]

E.5.5. *Data quality requirements and rating*

[Provide a table listing all processes and their situation according to the Data Needs Matrix (DNM).

Provide the DQR of the PEF study.]

E.6. **Impact assessment results [confidential, if relevant]**

E.6.1. *PEF results*

[This section shall include as a minimum:

a) Characterised results of all EF impact categories shall be calculated and reported as absolute values in the PEF report. The sub-categories 'climate change –fossil', 'climate change – biogenic' and 'climate change - land use and land use change', shall be reported separately if they show a contribution of more than 5% each to the total score of climate change);

b) Normalised and weighted results as absolute values;

c) Weighted results as single score;

d) For final products the LCIA results shall be reported for (i) the sum of all life cycle stages and (ii) the total life cycle excluding the use stage.]

E.6.2. *Additional information*

[This section shall include:

a) Results of the additional environmental information;

b) Results of the additional technical information.]

E.7. **Interpreting PEF results**

[This section shall include as a minimum:

a) Assessment of the robustness of the PEF study;

b) List of most relevant impact categories, life cycle stages, processes and elementary flows (see tables below);

c) Limitations and relationship of the EF results relative to the defined goal and scope of the PEF study,

d) Conclusions, recommendations, limitations and improvement potentials)].

Item	At what level does relevance need to be identified?	Threshold
Most relevant impact categories	Single overall score	Impact categories cumulatively contributing at least **80%** of the single overall score
Most relevant life cycle stages	For each most relevant impact category	All life cycle stages contributing cumulatively more than **80%** to that impact category. If the use stage accounts for more than 50% of the total impact of a most relevant impact category, the procedure shall be re-run with the exclusion of the use stage
Most relevant processes	For each most relevant impact category	All processes contributing cumulatively (along the entire life cycle) more than **80%** to that impact category, considering absolute values.
Most relevant elementary flows	For each most relevant process considering the most relevant impact categories	All elementary flows contributing cumulatively to at least 80% of the total impact of a most relevant impact category for each most relevant process. If disaggregated data are available: for each most relevant process, all direct elementary flows contributing cumulatively at least to **80%** to that impact category (caused by the direct elementary flows only)

Example:

Most relevant impact category	[%]	Most relevant life cycle stages	[%]	Most relevant processes	[%]	Most relevant elementary flows	[%]
IC 1		End of life		Process 1		el. flow 1	
						el. flow 2	
				Process 2		el. flow 2	
		Raw material acquisition and p.p.		Process 4		el. flow 1	
IC 2		Manufacturing		Process 1		el. flow 2	
						el. flow 3	
IC 3		Manufacturing		Process 1		el. flow 2	
						el. flow 3	

E.8. **Validation statement**

[The validation statement is mandatory and shall always be provided as public annex of the public PEF report.

The following elements and aspects shall be included in the validation statement, as a minimum:

a) title of the PEF study under verification/validation, together with the exact version of the report to which the validation statement belongs;

b) the commissioner of the PEF study;

c) the user of the PEF method;

d) the verifier(s) or, in the case of a verification team, the team members with the identification of the lead verifier;

e) absence of conflicts of interest of the verifier(s) with respect to concerned products and any involvement in previous work (where relevant, PEFCR development, Technical Secretariat membership, consultancy work carried out for the user of the PEF method or of the PEFCR during the last three years);

f) a description of the objective of the verification/validation;

g) a statement of the result of the verification/validation;

h) any limitations of the verification/validation outcomes;

i) date in which the validation statement has been issued;

j) signature by the verifier(s).]

ANNEX I of the validation statement

[The Annex serves to document supporting elements to the main report which are of a more technical nature. It could include:

a) Bibliographic references;

b) Detailed life cycle inventory analysis (optional if considered sensitive and communicated separately in the confidential annex, see below)

c) Detailed assessment of data quality: Provide i) Data Quality Rating per process in accordance with the PEF Method and ii) Data Quality Rating for the newly created EF compliant datasets. In case information is confidential, it shall be included in Annex II.]

ANNEX II of the validation statement – CONFIDENTIAL REPORT

[The Confidential annex is an optional section that shall contain all those data (including raw data) and information that are confidential or proprietary and cannot be made externally available.]

ANNEX III of the validation statement – EF COMPLIANT DATASET

[The aggregated EF compliant dataset of the product in scope shall be made available to the European Commission.]

PART F

DEFAULT LOSS RATES PER TYPE OF PRODUCT

Default loss rates per type of product during distribution and at consumer (including restaurant, etc.) (assumptions if not specified otherwise). For simplification purposes, the values for restaurant are considered the same as for consumer at home.

Retail trade sector	Category	Loss rate (incl. broken products but not products returned to the manufacturer) during distribution (overall consolidated value for transportation, storage and retail place)	Loss rate at consumer (including restaurant, etc.)
Food	Fruits and vegetables	10% (FAO 2011)	19% (FAO 2011)
	Meat and meat alternatives	4% (FAO 2011)	11% (FAO 2011)

Retail trade sector	Category	Loss rate (incl. broken products but not products returned to the manufacturer) during distribution (overall consolidated value for transportation, storage and retail place)	Loss rate at consumer (including restaurant, etc.)
	Dairy products	0,5% (FAO 2011)	7% (FAO 2011)
	Grain products	2% (FAO 2011)	25% (FAO 2011)
	Oils and fats	1% (FAO 2011)	4% (FAO 2011)
	Prepared/processed meals (ambient)	10%	10%
	Prepared/processed meals (chilled)	5%	5%
	Prepared/processed meals (frozen)	0,6% (primary data based on Picard – oral communication from Arnaud Brulaire)	0,5% (primary data based on Picard – oral communication from Arnaud Brulaire)
	Confectionery	5%	2%
	Other foods	1%	2%
Beverages	Coffee and tea	1%	5%
	Alcoholic beverages	1%	5%
	Other beverages	1%	5%
Tobacco		0%	0%
Pet food		5%	5%
Live animals		0%	0%
Clothing and textile		10%	0%
Footwear and leather goods		0%	0%
Personal accessories	Personal accessories	0%	0%
Home and professional supplies	Home hardware supplies	1%	0%
	Furniture, furnishings and decor	0%	0%
	Electrical household appliances	1%	0%
	Kitchen utensils	0%	0%
	Information and communication equipment	1%	0%
	Office machinery and supplies	1%	0%
Cultural and recreational goods	Books, newspapers and paper/paper supplies	1%	0%
	Music and videos	1%	0%

Retail trade sector	Category	Loss rate (incl. broken products but not products returned to the manufacturer) during distribution (overall consolidated value for transportation, storage and retail place)	Loss rate at consumer (including restaurant, etc.)
	Sporting equipment and gadgets	0%	0%
	Other cultural and recreational goods	1%	0%
Healthcare		5%	5%
Cleaning/hygiene products, cosmetics and toiletries		5%	5%
Fuels, gases, lubricants and oils		1%	0%
Batteries and power		0%	0%
Plants and garden supplies	Flowers, plants and seeds	10%	0%
	Other garden supplies	1%	0%
Other goods		0%	0%
Gas station	Gas station products	1%	0%

Food losses at the distribution center, during transport and at retail place, and at home: assumed to be 50% trashed (i.e., incinerated and landfilled), 25% composted and 25% methanised.

Product losses (excluding food losses) and packing/repacking/unpacking at distribution center, during transport and at retail place: assumed to be 100% recycled.

Other waste generated at the distribution center, during transport and at the retailer (except food and product losses) such as repacking/unpacking are assumed to follow the same EoL treatment as for home waste.

Liquid food wastes (as for instance milk) at consumer (including restaurant, etc.) are assumed to be poured in the sink and therefore treated in the wastewater treatment plant.

ANNEX III

Organisation Environmental Footprint Method

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Abbreviations

ADEME	Agence de l'Environnement et de la Maîtrise de l'Energie
AF	allocation factor
AR	allocation ratio
B2B	business to business
B2C	business to consumer
BoC	bill of components
BoM	bill of materials
BP	best practice
BSI	British Standards Institution
CF	characterization factor
CFCs	chlorofluorocarbons
CFF	Circular Footprint Formula
CPA	Classification of Products by Activity
DC	distribution centre
DMI	dry matter intake
DNM	Data Needs Matrix
DQR	Data Quality Rating
EC	European Commission
EF	environmental footprint
EI	environmental impact

EMAS	Eco-Management and Audit Scheme
EMS	Environmental Management Systems
EoL	End of life
EPD	Environmental Product Declaration
FU	functional unit
GE	gross energy intake
GHG	greenhouse gas
GR	geographical representativeness
GRI	Global Reporting Initiative
GWP	global warming potential
ILCD	International Reference Life-cycle Data System
ILCD-EL	International Reference Life-cycle Data System – Entry Level
IPCC	Intergovernmental Panel on Climate Change
ISIC	international standard industrial classification
ISO	International Organisation for Standardisation
IUCN	International Union for Conservation of Nature and Natural Resources
JRC	Joint Research Centre
LCA	Life-cycle Assessment
LCDN	Life-cycle Data Network
LCI	life-cycle inventory
LCIA	life-cycle impact assessment
LCT	life-cycle thinking
LT	lifetime
NACE	Nomenclature Générale des Activités Economiques dans les Communautés Européennes
NDA	non-disclosure agreement
NGO	non-governmental organisation
NMVOC	non-methane volatile compounds
P	precision
PAS	publicly available specification
PCR	product category rules
PEF	product environmental footprint
PEFCR	product environmental footprint category rules
PP	product portfolio
OEF	organisation environmental footprint
OEF-RO	OEF study of the representative organisation
OEFSR	organisation environmental footprint sector rules
RF	reference flow
RP	representative product
RU	reporting unit
SB	system boundary
SMRS	sustainability measurement & reporting system
SS	supporting study

TeR	technological representativeness
TiR	time representativeness
TS	Technical Secretariat
UNEP	United Nations Environment Programme
UUID	Universally Unique Identifier
WBCSD	World Business Council for Sustainable Development
WRI	World Resources Institute

Terminology: shall, should, may

This Annex III uses precise terminology to indicate the requirements, the recommendations and options that companies may choose.

The term 'shall' indicates what is required in order for an OEF study to be compliant with this method.

The term 'should' indicates a recommendation rather than a requirement. Any deviation from a "should" recommendation must be justified by the party conducting of the study and made transparent.

The term 'may' indicates an option that is permissible

Definitions

Activity data - information that is associated with processes while modelling Life-cycle Inventories (LCI). The aggregated LCI results of the process chains, which 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. Examples of activity data include the 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. Synonym of '*non-elementary flow*'.

Acidification – EF impact category that addresses impacts due to acidifying substances in the environment. Emissions of NO_x, NH_3 and SO_x lead to releases of hydrogen ions (H^+) when the gases are mineralised. The protons contribute to the acidification of soils and water when they are released in areas where the buffering capacity is low, resulting in forest decline and lake acidification.

Additional environmental information – environmental information outside the EF impact categories that is calculated and communicated alongside OEF results.

Additional technical information – non-environmental information that is calculated and communicated alongside OEF results.

Aggregated dataset - Complete or partial life-cycle of a product system that - next to the elementary flows (and possibly not relevant amounts of waste flows and radioactive wastes) – itemises only the product(s) of the process as reference flow(s) in the input-output list, but no other goods or services.

Aggregated datasets are also called 'LCI results' datasets. The aggregated dataset may have been aggregated horizontally and/or vertically.

Allocation – an approach to solving multi-functionality problems. It refers to 'partitioning the input or output flows of a process or a product system between the product system under study and one or more other product systems'.

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

Attributional – process-based modelling intended to provide a static representation of average conditions, excluding market-mediated effects.

Average Data – production-weighted average of specific data.

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

Background processes – refers to those processes in the product life-cycle for which no direct access to information is possible. For example, most of the upstream life-cycle processes and generally all processes further downstream will be considered part of the background processes

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 the product in scope of the OEF study. In some sectors it is equivalent to the bill of components.

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.

Characterisation – calculation of the magnitude of the contribution of each classified input/output to their respective EF impact categories, and aggregation of contributions within each category.

This requires a linear multiplication of the inventory data with characterisation factors for each substance and EF impact category of concern. For example, with respect to the EF impact category 'climate change', the reference substance is CO2 and the reference unit is kg CO_2-equivalents.

Characterisation factor – factor derived from a characterisation model which is applied to convert an assigned life-cycle inventory result to the common unit of the EF impact category indicator.

Classification – assigning the material/energy inputs and outputs tabulated in the life-cycle inventory to EF impact categories according to each substance's potential to contribute to each of the EF impact categories considered.

Climate change – EF impact category considering all inputs and outputs that result in greenhouse gas (GHG) emissions. The consequences include increased average global temperatures and sudden regional climatic changes. Climate change is an impact affecting the environment on a global scale.

Co-function - any of two or more functions resulting from the same unit process or product system.

Commissioner of the EF study - organisation (or group of organisations), such as a commercial company, a non-profit organisation, that finances the EF study in accordance with the OEF method and the relevant OEFSR, if available.

Company-specific data – refers to directly measured or collected data from one or more facilities (site-specific data) that are representative for the activities of the company (company is used as synomym of organisation). It is synonymous to 'primary data'. To determine the level of representativeness a sampling procedure may be applied.

Company-specific dataset – refers to a dataset (disaggregated or aggregated) compiled with company-specific data. In most cases, the activity data is company-specific while the underlying sub-processes are datasets derived from background databases.

Comparative assertion – an environmental claim regarding the superiority or equivalence of one organisation versus a competing organisation that performs the same function.

Comparison – a comparison, not including a comparative assertion, (graphic or otherwise) of two or more products based on the results of an OEF study and supporting OEFSRs.

Consumer - an individual member of the general public purchasing or using goods, property or services for private purposes.

Co-product – any of two or more products resulting from the same unit process or product system.

Cradle to gate – a partial product supply chain, from the extraction of raw materials (cradle) up to the manufacturer's 'gate'. The distribution, storage, use stage and end of life stages of the supply chain are omitted.

Cradle to grave – a product's life-cycle that includes raw material extraction, processing, distribution, storage, use, and disposal or recycling stages. All relevant inputs and outputs are considered for all of the stages of the life-cycle.

Critical review – process intended to ensure consistency between an OEFSR and the principles and requirements of the OEF method.

Data quality – characteristics of data that relate to their ability to satisfy stated requirements. Data quality covers various aspects, such as technological, geographical and time-related representativeness, as well as completeness and precision of the inventory data.

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.

Delayed emissions - emissions that are released over time, e.g. through long use or final disposal stages, versus a single emission at time t.

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.

Direct land use change (dLUC) – the transformation from one land use type into another, which takes place in a unique land area and does not lead to a change in another system.

Directly attributable – refers to a process, activity or impact occurring within the defined system boundary.

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

Downstream – occurring along a product supply chain after the point of referral.

Ecotoxicity, freshwater – EF impact category that addresses the toxic impacts on an ecosystem, which damage individual species and change the structure and function of the ecosystem. Ecotoxicity is a result of a variety of different toxicological mechanisms caused by the release of substances with a direct effect on the health of the ecosystem.

EF communication vehicles – all the possible ways that may be used to communicate the results of the EF study to the stakeholders (e.g. labels, environmental product declarations, green claims, websites, infographics, etc.).

EF compliant dataset – dataset developed in compliance with the EF requirements regularly updated by DG JRC ([2]).

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

Elementary flows – in the life-cycle inventory, elementary flows include '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'.

Elementary flows include resources taken from nature or emissions into air, water, soil that are directly linked to the characterisation factors of the EF impact categories.

Environmental aspect – element of an organisation's activities or products or services that interacts or can interact with the environment.

Environmental Footprint (EF) impact assessment – phase of the OEF analysis aimed at understanding and evaluating the magnitude and significance of the potential environmental impacts for a product system throughout the life-cycle of the product. The impact assessment methods provide impact characterisation factors for elementary flows to aggregate the impact so as to obtain a limited number of midpoint indicators.

Environmental Footprint (EF) impact assessment method – protocol for converting the life-cycle inventory data into quantitative contributions to an environmental impact of concern.

Environmental Footprint (EF) impact category – class of resource use or environmental impact to which the life-cycle inventory data are related.

([2]) https://eplca.jrc.ec.europa.eu/permalink/Guide_EF_DATA.pdf
([3]) https://ec.europa.eu/energy/intelligent/projects/en/projects/e-track-ii

Environmental Footprint (EF) impact category indicator – quantifiable representation of an EF impact category.

Environmental impact – any change to the environment, whether adverse or beneficial, that wholly or partially results from an organisation's activities, products or services.

Environmental mechanism – system of physical, chemical and biological processes for a given EF impact category linking the life-cycle inventory results to EF category indicators.

Eutrophication – EF impact category related to nutrients (mainly nitrogen and phosphorus) from sewage outfalls and fertilised farmland that accelerate the growth of algae and other vegetation in water.

The degradation of organic material consumes oxygen resulting in oxygen deficiency and, in some cases, fish death. Eutrophication translates the quantity of substances emitted into a common measure expressed as the oxygen required for the degradation of dead biomass.

Three EF impact categories are used to assess the impacts due to eutrophication: eutrophication, terrestrial; eutrophication, freshwater; eutrophication, marine.

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

Extrapolated data – data from a given process that is used to represent a similar process for which data is not available, on the assumption that it is reasonably representative.

Flow diagram – schematic representation of the flows occurring during one or more process stages within the life-cycle of the product being assessed.

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

Foreground processes – Refer to those processes in the product life-cycle for which direct access to information is available. For example, the producer's site and other processes operated by the producer or its contractors (e.g. goods transport, head-office services, etc.).

Functional unit – defines the qualitative and quantitative aspects of the function(s) and/or service(s) provided by the product being evaluated. The functional unit definition answers the questions 'what?', 'how much?', 'how well?', and 'for how long?'.

Global warming potential (GWP) – an index measuring the radiative forcing of a unit mass of a given substance accumulated over a chosen time horizon. It is expressed in terms of a reference substance (for example, CO_2-equivalent units) and specified time horizon (e.g. GWP 20, GWP 100, GWP 500, for 20, 100, and 500 years respectively).

By combining information on both radiative forcing (the energy flux caused by emission of the substance) and on the time it remains in the atmosphere, GWP gives a measure of a substance's capacity to influence the global average surface-air temperature and therefore subsequently influence various climate parameters and their effects, such as storm frequency and intensity, rainfall intensity and frequency of flooding, etc.

Horizontal averaging - the action of aggregating multiple unit process datasets or aggregated process datasets in which each provides the same reference flow in order to create a new process dataset.

Human toxicity – cancer – EF impact category that accounts for adverse health effects on human beings caused by the intake of toxic substances through inhalation of air, food/water ingestion, penetration through the skin insofar as they are related to cancer.

Human toxicity - non-cancer – EF impact category that accounts for the adverse health effects on human beings caused by the intake of toxic substances through inhalation of air, food/water ingestion, penetration through the skin insofar as they are related to non-cancer effects that are not caused by particulate matter/respiratory inorganics or ionising radiation.

Independent external expert – competent person, not employed in a full-time or part-time role by the commissioner of the EF study or the user of the EF method, and not involved in defining the scope or conducting the EF study.

Indirect land use change (iLUC) – this occurs when a demand for a certain land use leads to changes, outside the system boundary, i.e. in other land use types. These indirect effects may be mainly assessed by means of economic modelling of the demand for land or by modelling the relocation of activities on a global scale.

Input flows – product, material or energy flow that enters a unit process. Products and materials include raw materials, intermediate products and co-products.

Intermediate product – output form of a unit process that is input to other unit processes that require further transformation within the system. An intermediate product is a product that requires further processing before it is saleable to the final consumer.

Ionising radiation, human health – EF impact category that accounts for the adverse health effects on human health caused by radioactive releases.

Land use – EF impact category related to use (occupation) and conversion (transformation) of land area by activities such as agriculture, forestry, roads, housing, mining, etc.

Land occupation considers the effects of the land use, the amount of area involved and the duration of its occupation (changes in soil quality multiplied by area and duration). Land transformation considers the extent of changes in land properties and the area affected (changes in soil quality multiplied by the area).

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

Life-cycle – consecutive and interlinked stages of a product system, from the acquisition of raw materials or generation from natural resources to final disposal.

Life-cycle approach – takes into consideration the spectrum of resource flows and environmental interventions associated with a product from a supply-chain perspective, including all stages from raw material acquisition through processing, distribution, use, and end of life processes, and all relevant related environmental impacts (instead of focusing on a single issue).

Life-cycle assessment (LCA) – compilation and evaluation of the inputs, outputs and the potential environmental impacts of a product system throughout its life-cycle.

Life-cycle impact assessment (LCIA) – phase of life-cycle assessment that aims at understanding and evaluating the magnitude and significance of the potential environmental impacts for a system throughout the life-cycle.

The LCIA methods used provide impact characterisation factors for elementary flows to in order to aggregate the impact to obtain a limited number of midpoint and/or damage indicators.

Life-cycle inventory (LCI) - the combined set of exchanges of elementary, waste and product flows in a LCI dataset.

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

Loading rate – ratio of actual load to the full load or capacity (e.g. mass or volume) that a vehicle carries per trip.

Material-specific – a generic aspect of a material. For example, the recycling rate of polyethylene terephthalate (PET).

Multi-functionality – if a process or facility provides more than one function, i.e. it delivers several goods and/or services ('co-products'), then it is 'multifunctional'. In these situations, all inputs and emissions linked to the process will be partitioned between the product of interest and the other co-products according to clearly stated procedures.

Non-elementary (or complex) flows – in the life-cycle inventory, non-elementary flows include all the inputs (e.g. electricity, materials, transport processes) and outputs (e.g. waste, by-products) in a system that need further modelling efforts to be transformed into elementary flows.

Synonym of '*activity data*'.

Normalisation – after the characterisation step, normalisation is the step in which the life-cycle impact assessment results are divided by normalisation factors that represent the overall inventory of a reference unit (e.g. a whole country or an average citizen).

Normalised life-cycle impact assessment results express the relative shares of the impacts of the analysed system in terms of the total contributions to each impact category per reference unit.

Displaying the normalised life-cycle impact assessment results of the different impact topics next to each other, it becomes evident which impact categories are affected most and least by the analysed system.

Normalised life-cycle impact assessment results reflect only the contribution of the analysed system to the total impact potential, not the severity/relevance of the respective total impact. Normalised results are dimensionless, but not additive.

OEF profile – the quantified results of an OEF study. It includes the quantification of the impacts for the various impact categories and the additional environmental information considered necessary to report.

OEF report – document that summarises the results of the OEF study.

OEF study – term used to identify the totality of actions needed to calculate the OEF results. It includes the modelling, the data collection, and the analysis of the results. OEF study results are the basis for drafting OEF reports.

OEF study of the representative organisation (OEF-RO) – OEF study carried out on the representative organisation(s) and intended to identify the most-relevant life-cycle stages, processes, elementary flows, impact categories and any other major requirements needed for the sector/sub-sector in scope of the OEFSR.

OEFSR supporting study – OEF study based on a draft OEFSR. It is used to confirm the decisions taken in the draft OEFSR before the final OEFSR is released.

Organisation Environmental Footprint Sectorial Rules (OEFSRs) - sector specific, life-cycle based rules that complement general methodological guidance for OEF studies by providing further specification at the level of a specific sector.

OEFSRs help to shift the focus of the OEF 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 OEF method. Only the OEFSRs developed by or in cooperation with the European Commission, or adopted by the European Commission or as EU acts are recognised as in line with this method.

Organisation Life-cycle Assessment (OLCA) – compilation and evaluation of the inputs, outputs, and potential environmental impacts of activities associated with the organisation as a whole or a portion thereof adopting a life-cycle perspective. The results of an OLCA are sometimes referred to as an organisation's environmental footprint. (ISO 14072:2014).

Output flows – product, material or energy flow that leaves a unit process. Products and materials include raw materials, intermediate products, co-products and releases. Output flows are also considered to cover elementary flows.

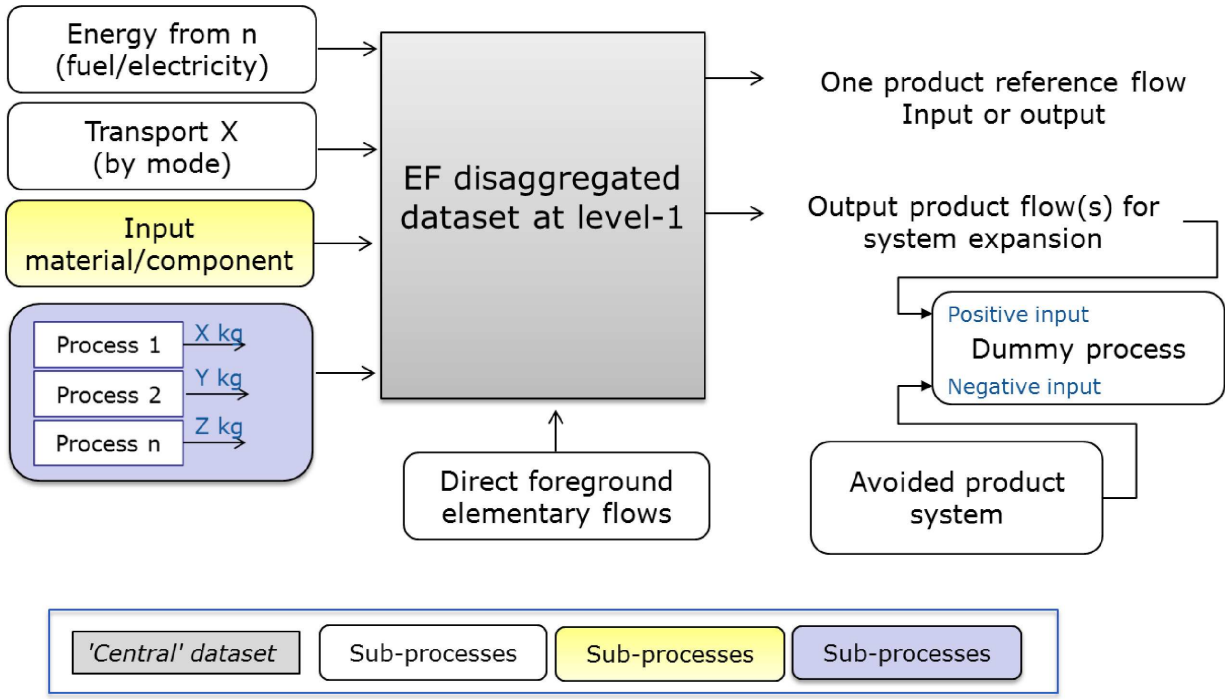
Ozone depletion – EF impact category that accounts for the degradation of stratospheric ozone due to emissions of ozone-depleting substances, for example, long-lived chlorine and bromine-containing gases (e.g. chlorofluorocarbons (CFCs), hydrochlorofluorocarbons (HCFCs), halons).

Partially disaggregated dataset - a dataset with an LCI that contains elementary flows and activity data, and that yields a complete aggregated LCI dataset when combined with its complementing underlying datasets.

Partially disaggregated dataset at level-1 - a partially disaggregated dataset at level-1 contains elementary flows and activity data of one level down in the supply chain, while all complementing underlying datasets are in their aggregated form.

Figure 1

Example of dataset partially disaggregated at Level-1



Particulate matter – EF impact category that accounts for the adverse effects on human health caused by emissions of particulate matter (PM) and its precursors (NO_x, SO_x, NH_3).

Photochemical ozone formation – EF impact category that accounts for the formation of ozone at the ground level of the troposphere caused by photochemical oxidation of volatile organic compounds (VOCs) and carbon monoxide (CO) in the presence of nitrogen oxides (NO_x) and sunlight.

High concentrations of ground-level tropospheric ozone damage vegetation, human respiratory tracts and manmade materials by reacting with organic materials.

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

Primary data - data from specific processes within the supply chain of the user of the OEF method or user of the OEFSR.

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 user of the OEF method or user of the OEFSR.

In this method, primary data is a synonym of '*company-specific data*' or '*supply chain specific data*'.

Product – any good or service.

Product category – group of products (or services) that can fulfil equivalent functions.

Product Category Rules (PCRs) – set of specific rules, requirements and guidelines for developing Type III environmental declarations for one or more product categories.

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 for a specific product category.

PEFCRs help to shift the focus of the PEF study towards those aspects and parameters that matter most, and hence increase the relevance, reproducibility and consistency of the results by reducing costs versus a study based on the comprehensive requirements of the PEF method.

Only PEFCRs developed by or in cooperation with the European Commission, or adopted by the Commission or as EU acts, are recognised as being in line with this method.

Product flow – products entering from or leaving to another product system.

Product system – collection of unit processes with elementary and product flows, performing one or more defined functions, which models the life-cycle of a product.

Raw material – primary or secondary material that is used to produce a product.

Reference flow – measure of the outputs from processes in a given product system required to fulfil the function expressed by the functional unit.

Refurbishment – the process of restoring components to a functional and/ or satisfactory state in relation 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.

Releases – emissions to air and discharges to water and soil.

Reporting unit (RU) – the organisation is the reference unit for the analysis and, along with the product portfolio, the basis for defining the reporting unit (RU). It is parallel to the concept of 'functional unit' in a traditional Life-cycle Assessment (LCA).

Representative organisation (RO) (model) - the RO model is in many cases a virtual (non-existing) organisation built, for example, from the average EU sales-weighted characteristics of all existing technologies, production processes and organisation types

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 of which the sample is a subset.

Resource use, fossil – EF impact category that addresses the use of non-renewable fossil natural resources (e.g. natural gas, coal, oil).

Resource use, minerals and metals – EF impact category that addresses the use of non-renewable abiotic natural resources (minerals and metals).

Review – procedure intended to ensure that the process of developing or revising an OEFSR has been carried out in accordance with the requirements provided in the OEF method and the part A of the Annex IV.

Review report - a documentation of the review process that includes the review statement, all relevant information concerning the review process, the detailed comments from the reviewer(s) and the corresponding responses and the outcome. The document shall carry the electronic or handwritten signature of the reviewer (or the lead reviewer, if a reviewer panel is involved) .

Review panel – team of experts (reviewers) who will review the OEFSR

Reviewer – independent external expert conducting the review of the OEFSR and possibly taking part in a reviewer panel.

Sample – 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- data that is not from a specific process within the supply-chain of the company performing an OEF study.

This refers to data that is not directly collected, measured, or estimated by the company, but sourced from a third party LCI database or other sources.

Secondary data includes industry average data (e.g., from published production data, government statistics and industry associations, literature studies, engineering studies and patents) and may also be based on financial data, and contain proxy, and other generic data.

Primary data that go through a horizontal aggregation step are considered to be secondary data.

Sensitivity analysis – Systematic procedures for estimating the effects of the choices made regarding methods and data on the results of an OEF study.

Site-specific data –directly measured or collected data from one facility (production site). A synonym of 'primary data'.

Single overall score - Sum of the weighted EF results of all impact categories.

Specific Data – Refers to directly measured or collected data representative of activities at a specific facility or set of facilities.

A synonym of *'primary data'*.

Subdivision – Subdividing involves disaggregating multifunctional processes or facilities to isolate the input flows directly associated with each process or facility output. The process is investigated to see whether it may be subdivided. Where subdivision is possible, inventory data should be collected only for those unit processes directly attributable to the products/services of concern.

Sub-population – 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

A synonym of *'stratum'*.

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

Sub-sample - a sample of a sub-population.

Supply chain –all of the upstream and downstream activities associated with the operations of the user of the OEF method, including the use of sold products by consumers and the end-of-life treatment of sold products after consumer use.

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

System boundary – definition of aspects included or excluded from the study. For example, for a 'cradle-to-grave' EF analysis, the system boundary includes all activities ranging from the extraction of raw materials through processing, distribution, storage, and use, to the disposal or recycling stages.

System boundary diagram – raphic representation of the system boundary defined for the OEF study.

Temporary carbon storage – this happens when a product reduces the greenhouse gases in the atmosphere or creates negative emissions, by removing and storing carbon for a limited amount of time.

Type III environmental declaration – an environmental declaration providing quantified environmental data using predetermined parameters and, where relevant, additional environmental information.

Uncertainty analysis – procedure for assessing uncertainty in the results of an OEF study due to data variability and choice-related uncertainty.

Unit process – smallest element considered in the LCI for which input and output data are quantified.

Unit process, black box – process chain or plant level unit process. This covers horizontally averaged unit processes across different sites. Also covers multi-functional unit processes, where the different co-products undergo different processing steps within the black box, hence causing allocation problems for this dataset ([4]).

Unit process, single operation - unit operation type unit process that cannot be further subdivided. Covers multi-functional processes of the unit operation type ([5]).

Upstream – occurring along the supply chain of purchased goods/ services prior to entering the system boundary.

User of the OEFSR – a stakeholder producing an OEF study based on an OEFSR.

User of the OEF method – a stakeholder producing an OEF study based on the OEF method.

User of the OEF results – a stakeholder using the OEF results for any internal or external purpose.

Validation - confirmation - by the environmental footprint verifier- , that the information and data in the OEF study, OEF report and communication vehicles are reliable, credible and correct.

Validation statement – conclusive document aggregating the conclusions from the verifiers or the verification team regarding the EF study. This document is mandatory and shall carry the electronic or handwritten signature of the verifier or (where a verification panel is involved) of the lead verifier.

Verification - conformity assessment process carried out by an environmental footprint verifier to demonstrate whether the OEF study has been carried out in compliance with Annex III.

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 may be confidential. The document shall carry the electronic or handwritten signature of the verifier or (where a verification panel is involved) the lead verifier.

Verification team – eam of verifiers who will verify the EF study, of the EF report and EF communication vehicles.

Verifier – independent external expert performing a verification of the EF study and possibly taking part in a verification team.

Vertical aggregation - technical- or engineering-based aggregation refers to vertical aggregation of unit processes that are directly linked within a single facility or process train. Vertical aggregation involves combining unit process datasets (or aggregated process datasets) together linked by a flow.

Waste – substances or objects which the holder intends or is required to dispose of.

Water use – EF impact category that represents the relative available water remaining per area in a watershed, after demand from humans and aquatic ecosystems has been met. It assesses the potential for water deprivation, to either humans or ecosystems, based on the assumption that the less water remaining available per area, the more likely it is that another user will be deprived.

Weighting – a step that supports the interpretation and communication of the analysis results. OEF results are multiplied by a set of weighting factors (in %), which reflect the perceived relative importance of the impact categories considered. Weighted EF results may be directly compared across impact categories, and also summed across impact categories to obtain a single overall score.

Relationship to other methods and standards

Each requirement specified in the OEF method was developed taking into consideration the recommendations of similar, widely recognised product environmental accounting methods and guidance documents. Specifically, the methodological guides considered were:

([4]) More details can be found in the Guide for EF compliant datasets at https://eplca.jrc.ec.europa.eu/permalink/Guide_EF_DATA.pdf.
([5]) More details can be found in the Guide for EF compliant datasets at https://eplca.jrc.ec.europa.eu/permalink/Guide_EF_DATA.pdf.

ISO standards, in particular:

(a) EN ISO 14040:2006 Environmental management — Life-cycle assessment — Principles and framework;

(b) EN ISO 14044:2006 Environmental management — Life-cycle assessment — Requirements and guidelines;

(c) EN ISO 14067:2018 Greenhouse gases — Carbon footprint of products — Requirements and guidelines for quantification;

(d) ISO 14046:2014 Environmental management — Water footprint — Principles, requirements and guidelines;

(e) EN ISO 14020:2001 Environmental labels and declarations — General principles;

(f) EN ISO 14021:2016 Environmental labels and declarations — Self-declared environmental claims (Type II environmental labelling)

(g) EN ISO 14025:2010 Environmental labels and declarations – Type III environmental declarations – Principles and procedures;

(h) ISO 14050:2020 Environmental management — vocabulary

(i) ISO 14064 (2006): Greenhouse gases – Part 1 and 3;

(j) ISO/WD TR 14069:2013 GHG – Quantification and reporting of GHG emissions for organisations;

(k) CEN ISO/TS 14071:2016 Environmental management — Life-cycle assessment — Critical review processes and reviewer competencies: Additional requirements and guidelines to EN ISO 14044:2006

(l) ISO/TS 14072:2014 Environmental management — Life-cycle assessment Requirements and guidelines for organisational life-cycle assessment

(m) ISO 17024:2012 Conformity assessment – General requirements for bodies operating certification of persons.

OEF Guide, Annex to Commission Recommendation 2013/179/EU on the use of common methods to measure and communicate the life-cycle environmental performance of products and organisations (April 2013);

ILCD (International Reference Life-cycle Data System) Handbook ([6]) developed by EC Joint Research Centre;

Ecological Footprint Standards ([7]);

Greenhouse Gas Protocol - Product Life-cycle Accounting and Reporting Standard ([8]) (World Ressources Institute - WRI/ World Business Council for Sustainable Development - WBCSD);

BP X30-323-0:2015 General principles for an environmental communication on mass market products (Agence de la transition écologique, ADEME) ([9]);

PAS 2050:2011 Specification for the assessment of the life-cycle greenhouse gas emissions of goods and services (British Standards Institution - BSI);

ENVIFOOD Protocol ([10]).

FAO:2016. Environmental performance of animal feeds supply chains: Guidelines for assessment. LEAP Partnership.

A detailed description of most of the analysed methods and the outcome of the analysis is available in 'Analysis of Existing Environmental Footprint methodologies for Products and Organisations: Recommendations, Rationale, and Alignment' ([11]).

([6]) Available online at http://eplca.jrc.ec.europa.eu/?page_id=86
([7]) Global Footprint Network Standards Committee (2009) Ecological Footprint Standards 2009.
([8]) WRI/WBCSD 2011, Greenhouse Gas Protocol – Product Life-cycle Accounting and Reporting Standard.
([9]) Withdrawn on May 2016.
([10]) ENVIFOOD Protocol, Environmental Assessment of Food and Drink Protocol, European Food Sustainable Consumption and Production Round Table (SCP RT), Working Group 1, Brussels, Belgium
([11]) European Commission - Joint Research Centre - Institute for Environment and Sustainability (2011b). Analysis of Existing Environmental Footprint methodologies for Products and Organisations: Recommendations, Rationale, and Alignment. EC – IES - JRC, Ispra, November 2011.

1. **Organisation Environmental Footprint Sector Rules (OEFSRs)**

The primary objective of an OEFSR is to fix a consistent and specific set of rules for calculating the relevant environmental information of products belonging to the sector category in scope. An important objective is to focus on what matters most for a specific product category to make OEF studies easier, faster and less costly.

An equally important objective is to enable comparisons and comparative assertions i) between organisations or production sites within a same sector, or ii) of the performance of a single organisation or production site throughout time (see part A of the Annex IV for further details)

Comparisons and comparative assertions are allowed only if OEF studies are conducted in compliance with an OEFSR. The product portfolios of different organisations or production sites, or of a same organisation over different reporting years, are usually different (e.g. in terms of amounts of products included), therefore the OEFSR shall provide guidance on how to ensure comparability, for example by normalizing the results of OEF studies against an appropriate reference system (e.g. yearly turnover)

An OEF study shall be conducted in compliance with an OEFSR, if an OEFSR is available for the portfolio of products or sector in scope.

Requirements for developing OEFSRs are specified in part A of Annex IV. An OEFSR may further specify requirements made in the OEF method and add new requirements if the OEF method leaves more than one choice. The objective is to ensure that OEFSRs are developed according to the OEF method and that they provide the specifications needed to achieve the comparability, increased reproducibility, consistency, relevance, focus and efficiency of OEF studies.

OEFSRs should, as far as possible, and recognising the different application contexts, be compliant with existing relevant international sector rules and with Product Environmental Footprint Category Rules (PEFCRs) these are to be listed and evaluated. They may be used as a basis for developing an OEFSR, in line with the requirements provided in part A of Annex IV.

1.1. *Approach and examples for potential applications*

The rules provided in the OEF method enable practitioners to conduct OEF studies that are more reproducible, consistent, robust, verifiable and comparable. The results of OEF studies are the basis for the provision of EF information and they may be used in a diverse number of potential fields of applications.

Applications of OEF studies without an existing OEFSR for the portfolio of product(s) in scope will include:

1) In-house applications

   a) supporting to environmental management,

   b) identifying environmental hotspots,

   c) environmental performance improvement and tracking,

   d) optimising processes along the supply chain,

2) External applications: (e.g. business to business (B2B), business to consumer (B2C)):

   a) responding to investors' information requests

   b) sustainability or environmental reports

   c) marketing,

   d) responding to requirements of environmental policies at EU level or at the level of the individual Member States,

   e) participating in 3rd party schemes related to environmental claims or giving visibility to products that calculate and communicate their life-cycle environmental performance.

Applications of OEF studies performed in compliance with an existing OEFSR for the organisation in scope, in addition to those listed above, will include:

a) Identifying significant environmental impacts common to a sector,

b) Comparisons and comparative assertions (i.e. claims of overall superiority or equivalence fro the environmental performance of one organisation compared to another) based on OEF studies, when the performance of the product portfolio is normalized against a reference system (e.g. yearly turnover of the product portfolio),

c) Participation in third party schemes related to the environemtnal performance of organisations (e.g. ratings, reputational schemes).

d) Green procurement (public and corporate).

2. General considerations for Organisation Environmental Footprint (OEF) studies

2.1. *How to use this method*

This method provides the rules necessary to conduct an OEF study and is presented in a sequential manner, in the order of the methodological steps that shall be completed when calculating an OEF.

Where appropriate, Sections begin with a general description of the methodological step, along with an overview of necessary considerations and supporting examples.

When additional requirements for creating OEFSRs are specified, these are available in part A of Annex IV.

2.2. *Principles for Organisation Environmental Footprint studies*

To produce reliable, reproducible, and verifiable OEF studies, a core suite of analytical principles shall be adhered to. These principles provide overarching guidance on how to apply the OEF method. They shall be considered with respect to each phase of OEF studies, from defining the goal and the scope, through data collection, impact assessment, reporting and verification of study outcomes.

Users of this method shall observe the following principles in conducting an OEF study:

(1) **Relevance**

All methods used and data collected for the purpose of quantifying the OEF shall be as relevant to the study as possible.

(2) **Completeness**

Quantification of the OEF shall include all environmentally relevant material/energy flows and other environmental interventions as required for adherence to the defined system boundary, the data requirements, and the impact assessment methods employed.

(3) **Consistency**

Strict conformity to this method shall be observed in all steps of the OEF study to ensure internal consistency and comparability.

(4) **Accuracy**

All reasonable effort shall be taken to reduce uncertainties in product system modelling and the reporting of results.

(5) **Transparency**

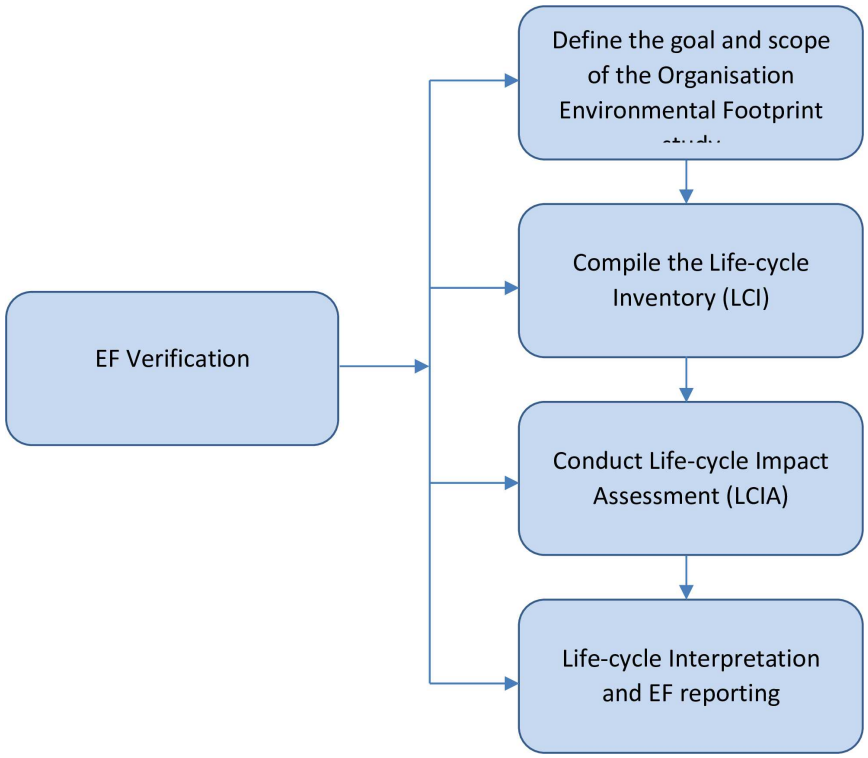
OEF information shall be disclosed in such a way as to provide intended users with the necessary basis for decision-making, and for stakeholders to assess its robustness and reliability.

2.3. *Phases of an Organisation Environmental Footprint study*

A number of phases shall be completed in carrying out an OEF study in line with this method - i.e. goal definition, scope definition, life-cycle inventory (LCI), life-cycle impact assessment (LCIA), interpretation of OEF results and OEF reporting – see Figure 2.

Figure 2

Phases of an Organisation Environmental Footprint study



In the goal definition phase, the aims of the study are defined, namely the intended application, the reasons for carrying out the study and the intended audience. In the scope definition phase, the main methodological choices are made, for example the exact definition of the reporting unit, identifying the system boundary, selecting additional environmental and technical information, and the main assumptions and limitations.

The LCI phase involves data collection and the calculation procedure for quantifying of inputs and outputs of the studied system. Inputs and outputs concern energy, raw material and other physical inputs, products and co-products and waste, and emissions to air/water/soil. Data collected concern foreground processes and background processes. Data are put in relationship to the process units and reporting unit. The LCI is an iterative process. In fact, as data are collected and more is learned about the system, new data requirements or limitations may be identified that require a change in the data collection procedures so that the goals of the study will still be met.

In the impact assessment phase, LCI results are associated with environmental impact categories and indicators. This is done through LCIA methods, which first classify emissions into impact categories and then characterise them as common units (e.g. CO_2 and CH_4 emissions are both expressed in CO_2 equivalent emissions by using their global warming potential). Examples of impact categories are climate change, acidification or resource use.

In the interpretation phase, results from LCI and LCIA are interpreted in accordance with the stated goal and scope. In this phase, most-relevant impact categories, life-cycle stages, processes and elementary flows are identified. Conclusions and recommendations can be drawn, based on the analytical results. It also includes the reporting step designed to summarise the results of the OEF study in the OEF report.

Finally, during the verification phase, a conformity assessment process is carried out to check whether the OEF study has been carried out in compliance with the present OEF method. The verification is mandatory whenever the OEF study, or part of the information in it, is used for any type of external communication.

3. Defining the goal(s) and scope of the Organisation Environmental Footprint study

3.1. *Goal definition*

Goal definition is the first step of an OEF study, and sets the overall context for the study. The purpose of clearly defining goals is to ensure that the aims, methods, results and intended applications are aligned, and that a shared vision is in place to guide participants in the study. The decision to use the OEF method implies that some aspects of the goal definition will be decided a priori, due to the specific requirements provided by the OEF method.

In defining goals, it is important to identify the intended applications and the degree of analytical depth and rigour of the study. This shall be reflected in the defined study limitations (scope definition phase).

The goal definition for an OEF study shall include:

1. Intended application(s);
2. Reasons for carrying out the study and decision context;
3. Target audience;
4. Commissioner of the study;
5. Identity of the verifier.

Table 1

Example of goal definition - Organisation Environmental Footprint of a company producing jeans and T-shirts

Aspects	Detail
Intended application(s):	Corporate sustainability reporting
Reasons for carrying out the study and decision context:	Demonstrate commitment to and practice of continuous improvement
Target audience:	Customers.
Comparisons and comparative assertions intended to be disclosed to the public: (only applicable if the study was conducted in compliance with the relevant OEFSR):	No, it will be publically available but it is not intended to be used for comparisons or comparative assertions.
Verification procedure	Independent external verifier, Mr Y
Commissioner of the study:	G company limited

3.2. *Scope definition*

The scope of the OEF study describes in detail the system to be evaluated and the technical specifications.

The scope definition shall be in line with the defined goals of the study and shall include (see subsequent Sections for a more detailed description):

1. Definition of the reporting unit (RU): description of the organisation and the product portfolio (suite and the amounts of goods/services provided over the reporting interval);
2. System boundary (OEF boundary and organisational boundary);
3. EF impact categories ([12]);
4. Additional information to be included;
5. Assumptions/limitations.

([12]) The term "EF impact category" will be used throughout this method in place of the term "impact category" used in EN ISO 14044:2006.

3.2.1 Reporting unit: organisation and product portfolio

The organisation is the reference unit for the analysis and, along with the product portfolio, the basis for defining the reporting unit (RU). It is parallel to the concept of "functional unit" in a traditional Life-cycle Assessment (LCA) ([13])

In the most general sense, the overarching function of the organisation, for the purpose of calculating the OEF, is the provision of goods and services over a specified reporting interval. The reporting interval should be one year. Deviations from this reporting interval shall be justified.

The product portfolio (PP) refers to the amount and nature of goods and services provided by the organisation over the reporting interval. The OEF may be limited to a clearly defined subset of the product portfolio of the organisation: a typical example is an organisation that is operating in various sectors and decides to restrict its analysis to one sector. The OEF study shall justify and report whether it is limited to a subset of its product portfolio.

The RU for an OEF study shall be defined according to the following aspects:

i) Definition of the organisation:

   a. Name of the organisation;

   b. The kinds of goods/services the organisation produces (i.e. the sector);

   c. Locations of operation (e.g. countries, cities);

ii) Definition of the product portfolio:

   a. The good(s)/service(s) provided: **'what'**;

   b. The extent of the good or service:**'how much'**;

   c. The expected level of quality: **'how well'**;

   d. The duration/ lifetime of the good(s)/ service(s): **'how long'**;

iii) The reference year;

iv) The reporting interval

Example

Definition of the organisation:

Organisation: Y Company Ltd.

Goods/services sector: garment manufacturer

Location(s): Paris, Berlin, Milan

NACE code(s): 14

Definition of the Product Portfolio:

What: T-shirts and trousers ([14])

How much: 40 000 T-shirts, 20 000 trousers

How well: Wear once per week and use washing machine at 30 degrees for cleaning once weekly; the energy use of the washing machine equals 0.72 MJ/kg clothing and the water use 10 litres/kg clothing for one wash cycle. One T-shirt weighs 0.16 kg and one pair of trousers weighs 0.53 kg. This results in an energy use of 0.4968 MJ/week and water consumption of 6.9 litres/week.

How long: use stage of 5 years for both the T-shirts and the trousers.

Reference year: 2017

Reporting interval: one year.

If the product portfolio is constituted by intermediate products, some aspects of the PP (i.e. how well and how long) are more difficult to define: if justification is provided, they may be omitted.

([13]) Life-cycle assessment – compilation and evaluation of the inputs, outputs and the potential environmental impacts of a product system throughout its life-cycle (EN ISO 14040:2006)

([14]) In OEF studies wider grouping of products is also possible (e.g. shoes, outer garment, etc), if that fits with the PP of the organisation.

3.2.2. System boundary

The system boundary defines which parts of the PP and which associated life-cycle stages and processes belong to the analysed system, except for those processes excluded based on the cut-off rule (see Section 4.6.4). The reason for and potential significance of any exclusion shall be justified and documented.

The system boundary shall be defined following a general supply-chain logic, with reference to the products/ services included in the PP, including all stages from raw material acquisition and pre-processing, production, distribution and storage, use stage and end of life. The co-products, by-products and waste streams of at least the foreground system shall be clearly identified.

Two levels of system boundary definition are necessary for the OEF study:

— organisational boundary (in relation to the defined organisation);

— OEF boundary (that specify upstream and downstream processes are included in the analysis).

3.2.2.1. *Organisational boundary*

The organisational boundary is defined so as to encompass all facilities and associated processes that are fully or partially owned and/or operated by the organisation and that directly contribute to the provision of the PP. The activities and impacts linked to processes within the defined organisational boundary are considered 'direct' activities and impacts.

For example, in the case of retailers, products produced by other organisations are not included in the organisational boundary of the retailer. The retailers' boundaries are then limited to their capital goods and all processes/activities related to the retailing service. However, products produced or transformed by the retailer shall be included in the organisational boundary.

All activities and processes which occur within the organisational boundary but which are not necessary for the functioning of the organisation shall be included in the analysis. Examples of such processes/ activities are gardening activities, food served by the company in the canteen, etc.

As some jointly owned/ operated facilities may contribute to the provision both of the defined PP of the organisation as well as of the product portfolio(s) of other organisations, it may be necessary to allocate inputs and outputs accordingly.

3.2.2.2. *OEF boundary*

The OEF boundary is broader than the organisational boundary and includes all indirect activities and associated impacts. Indirect activities are those that occur upstream or downstream along the supply chains linked to organisational activities (see Section 4.2.1).

The OEF boundary shall be defined following a general supply chain logic. The OEF boundary shall by default include all stages from raw material acquisition through manufacturing, distribution, storage, use and end of life treatment of the PP (i.e. cradle-to-grave).

All processes within the defined OEF boundary shall be considered (except for the ones fulfilling the cut-off criteria). Explicit justification shall be provided if downstream (indirect) activities are excluded (e.g. use stage and end of life stage of intermediate products or products with an undeterminable fate): in this case the OEF boundary shall include, at a minimum, site-level (direct) and upstream (indirect) activities associated with the organisation's PP.

In some cases the same process may belong either to the organisational boundary or to the OEF boundary: for example, employee transport occurs i) within the organisational boundary when employees commute using cars owned or operated by the employer, or use public transport paid for by the employer; or ii) it is regarded as an indirect process, when employees commute by private cars or public transport paid for by the employee.

3.2.2.3. *System boundary diagram*

A system boundary diagram (or flow diagram) is a schematic representation of the analysed system. It shall clearly indicate the activities or processes that are included and those that are excluded from the analysis.

The organisational boundary and the OEF boundary shall be indicated. Furthermore, the user of the OEF method shall highlight where company-specific data were used.

The activity and/or process names in the system diagram and in the OEF report shall bealigned. The system diagram shall be included in the scope definition and included in the OEF report.

3.2.3. Environmental Footprint impact categories

The purpose of LCIA is to group and aggregate the collected LCI data according to the respective contributions to each EF impact category. The selection of EF impact categories covers a broad range of relevant environmental issues related to the product supply chain of interest, following the general completeness requirements for OEF studies.

EF impact categories ([15]) refer to specific categories of impacts considered in an OEF study and they constitute the EF impact assessment method. Characterisation models are used to quantify the environmental mechanism between the LCI (i.e. inputs (e.g. resources) and emissions associated with the product life-cycle) and the category indicator of each EF impact category.

Table 2 provides a default list of EF impact categories and related assessment methods. For an OEF study, all EF impact categories shall be applied, without exclusion. The full list of CFs that shall be used is provided within the EF reference package ([16])

Table 2

EF impact categories with respective impact category indicators and characterization models.

EF impact category	Impact category indicator	Unit	Characterisation model	Robust-ness
Climate change, total ([1])	Global warming potential (GWP100)	kg $CO_{2\ eq}$	Bern model - global warming potentials (GWP) over a 100 year time horizon (based on IPCC 2013)	I
Ozone depletion	Ozone depletion potential (ODP)	kg $CFC\text{-}11_{eq}$	EDIP model based on the ODPs of the World Meteorological Organisation (WMO) over an infinite time horizon (WMO 2014 + integrations)	I
Human toxicity, cancer	Comparative toxic unit for humans (CTU_h)	CTUh	based on USEtox2.1 model (Fantke et al. 2017), adapted as in Saouter et al., 2018	III
Human toxicity, non-cancer	Comparative toxic unit for humans (CTU_h)	CTUh	based on USEtox2.1 model (Fantke et al. 2017), adapted as in Saouter et al., 2018	III
Particulate matter	Impact on human health	disease incidence	PM model (Fantke et al., 2016 in UNEP 2016)	I

([15]) The term "EF impact category" is used throughout the OEF method in place of the term "impact category" used in EN ISO 14044:2006.

([16]) The EF reference package includes all information to perform the LCIA phase (in ILCD format). It includes reference items such as elementary flows, flow properties, unit groups, impact assessment methods etc. and is available at

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)	II
Photochemical ozone formation, human health	Tropospheric ozone concentration increase	kg NMVOC $_{eq}$	LOTOS-EUROS model (Van Zelm et al, 2008) as applied in ReCiPe 2008	II
Acidification	Accumulated exceedance (AE)	mol H^+ $_{eq}$	Accumulated Exceedance (Seppälä et al. 2006, Posch et al, 2008)	II
Eutrophication, terrestrial	Accumulated exceedance (AE)	mol N $_{eq}$	Accumulated Exceedance (Seppälä et al. 2006, Posch et al, 2008)	II
Eutrophication, freshwater	Fraction of nutrients reaching freshwater end compartment (P)	kg P $_{eq}$	EUTREND model (Struijs et al, 2009) as applied in ReCiPe	II
Eutrophication, marine	Fraction of nutrients reaching marine end compartment (N)	kg N $_{eq}$	EUTREND model (Struijs et al, 2009) as applied in ReCiPe	II
Ecotoxicity, freshwater	Comparative toxic unit for ecosystems (CTU_e)	CTUe	based on USEtox2.1 model (Fantke et al. 2017), adapted as in Saouter et al., 2018	III
Land use [2]	Soil quality index [3]	Dimension-less (pt)	Soil quality index based on LANCA model (De Laurentiis et al. 2019) and on the LANCA CF version 2.5 (Horn and Maier, 2018)	III
Water use	User deprivation potential (deprivation-weighted water consumption)	m^3 water eq of deprived water	Available WAter REmaining (AWARE) model (Boulay et al., 2018; UNEP 2016)	III
Resource use, minerals and metals	Abiotic resource depletion (ADP ultimate reserves)	kg Sb $_{eq}$	van Oers et al., 2002 as in CML 2002 method, v.4.8	III
Resource use, fossils	Abiotic resource depletion – fossil fuels (ADP-fossil) [4]	MJ	van Oers et al., 2002 as in CML 2002 method, v.4.8	III

[1] The indicator "Climate Change, total" is constituted by three sub-indicators: Climate Change, fossil; Climate Change, biogenic; Climate Change, land use and land use change. The sub-indicators are further described in Section 4.4.10 of the Annex I. The sub-categories 'Climate change –fossil', 'Climate change – biogenic' and 'Climate change - land use and land use change', shall be reported separately if they show a contribution of more than 5% each to the total score of climate change.

[2] Refers to occupation and transformation

[3] This index is the result of the aggregation, performed by JRC, of 4 indicators (biotic production, erosion resistance, mechanical filtration, and groundwater replenishment) provided by the LANCA model for assessing impacts due to land use as reported in De Laurentiis et al, 2019.

[4] In the EF flow list, and for the current recommendation, Uranium is included in the list of energy carriers, and it is measured in MJ.

Further information on impact assessment calculations is provided in Section 5 of this Annex.

3.2.4. Additional information to be included in the OEF

Relevant potential environmental impacts of a product may go beyond the EF impact categories. It is important to report them, whenever feasible, as additional environmental information.

Similarly, relevant technical aspects and/or physical properties of the product in scope may need to be taken into account. These aspects shall be reported as additional technical information.

3.2.4.1. *Additional environmental information*

Additional environmental information shall be:

(a) In compliance with relevant legislation, for instance the Unfair Commercial Practices Directive (UCPD) ([17]) and related guidance;

(b) Based on information that is substantiated and has been reviewed or verified, according to EN ISO 14020:2001 and Clause 5 of EN ISO 14021:2016;

(c) Relevant to the specific sector;

(d) Additional to the EF impact categories: additional environmental information shall not reflect the same or similar EF impact categories, shall not substitute the characterisation models of the EF impact categories and shall not report results of new |characterisation factors (CFs) added to EF impact categories. The supporting models for this additional information shall be clearly referenced and documented together with the corresponding indicators. For example, biodiversity impacts due to land use changes may occur in association with a specific site or activity. This may require the application of additional impact categories that are not included among the EF impact categories, or even additional qualitative descriptions where impacts may not be linked to the product supply chain in a quantitative manner. Such additional methods should be viewed as complementary to the EF impact categories

Additional environmental information shall only be related to environmental aspects. Information and instructions, e.g. product safety sheets that are not related to the environmental performance of the product, shall not be part of additional environmental information.

Additional environmental information may include:

(a) Information on local/site-specific impacts;

(b) Offsets;

(c) Environmental indicators or product responsibility indicators (e.g. as per the Global Reporting Initiative (GRI));

(d) For gate-to-gate assessments, number of IUCN (International Union for Conservation of Nature and Natural Resources) Red List species and national conservation list species with habitats in areas affected by operations, by level of extinction risk;

(e) Description of significant impacts of activities, products, and services on biodiversity in protected areas and in areas of high biodiversity value outside protected areas;

(f) Noise impacts;

(g) Other environmental information considered relevant within the scope of the OEF study.

([17]) The UCPD and related guidance is available at https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=LEGISSUM%3Al32011

Biodiversity

The OEF method does not include any impact category named 'biodiversity', as currently there is no international consensus on an LCIA method capturing that impact. However, the OEF method includes at least eight impact categories that have an effect on biodiversity (i.e., climate change, eutrophication (aquatic freshwater), eutrophication (aquatic marine), eutrophication (terrestrial), acidification, water use, land use, ecotoxicity freshwater).

Considering the high relevance of biodiversity for many sectors, each OEF study shall explain whether biodiversity is relevant for the organisation in scope. If that is the case, the user of the OEF method shall include biodiversity indicators under additional environmental information.

The following options may be used to cover biodiversity:

(a) Expressing the (avoided) impact on biodiversity as the percentage of material that comes from ecosystems that have been managed to maintain or enhance conditions for biodiversity, as demonstrated by regular monitoring and reporting of biodiversity levels and gains or losses (e.g. less than 15% loss of species richness due to disturbance - through the OEF studies may set their own loss level if they can make a convincing case for it and not in contradiction to a relevant existing OEFSR).

The assessment should refer to materials that end up in the PP and to materials that have been used during the production process. For example, charcoal that is used in steel production processes, or soy that is used to feed cows that produce dairy etc.

(b) To report additionally the percentage of such materials for which no chain of custody or traceability information can be found.

(c) To use a certification system as a proxy. The user of the OEF method should determine which certification schemes provide sufficient evidence for ensuring biodiversity maintenance and describe the criteria used.

The user of the OEF method may choose other, relevant indicators to cover the impacts of the product on biodiversity. The OEF study shall motivate the choice and describe the chosen methodology.

3.2.4.2. *Additional technical information*

Additional technical information may include (non-exhaustive list):

(h) Information on the use of hazardous substances;

(i) Information on the disposal of hazardous/non-hazardous waste;

(j) Information on energy consumption;

(k) Technical parameters, such as the use of renewable versus non-renewable energy, renewable versus non-renewable fuels, secondary materials, fresh water resources;

(l) Total weight of waste by type and disposal method;

(m) Weight of transported, imported, exported, or treated waste deemed hazardous under the terms of the Basel Convention ([18]) Annexes I, II, III, and VIII, and percentage of transported waste shipped internationally;

3.2.5. Assumptions/ limitations

In OEF studies, several limitations on carrying out the analysis may arise and therefore assumptions need to be made. All limitations (e.g. data gaps) and assumptions shall be transparently reported.

4. **Life cycle inventory**

An inventory of all material, energy and waste inputs and outputs and emissions into air, water and soil for the product supply chain shall be compiled as a basis for modelling the OEF.

([18]) OJ L 39, 16.2.1993, p. 3–22

Detailed data requirements and quality requirements are described in Section 4.6.

The life-cycle inventory (LCI) shall adopt the following classification of flows included:

1) elementary flows;

2) non-elementary (or complex) flows.

Within the OEF study, all non-elementary flows in the LCI shall be modelled up to the level of elementary flows, apart from the product flow for the product in scope. For example, waste flows shall not only be included in the study as kg of household waste or hazardous waste, but shall be modelled up to the stage of emissions into water, air and soil from the treatment of the solid waste. The LCI modelling is therefore only completed when all non-elementary flows are expressed as elementary flows. Therefore, the LCI dataset of the OEF study shall contain only elementary flows, apart from the product flow for the product(s) in scope.

4.1. *Screening step*

An initial screening of the LCI, the 'screening step', may be performed because it helps focus data collection activities and data quality priorities. A screening step shall include the LCIA phase and result in further iterative refinements to the life-cycle model for the product in scope, as more information becomes available. Within a screening step no cut-off is allowed and readily available primary or secondary data may be used, fulfilling the data quality requirements to the extent possible (as defined in Section 4.6). Once the screening is performed, the initial scope settings may be refined.

4.2. *Direct activities, indirect activities and life-cycle stages*

Users of the OEF method shall identify direct and indirect activities (see Section 4.2.1) and report separately their impact.

If the product portfolio of the organisation is made of products, the user of the OEF method shall also identify the life-cycle stages of the products belonging to the PP and describe them in the OEF report (Section 4.2.2).

If the product portfolio includes services, the user of the OEF method may identify the life-cycle stages, if applicable.

4.2.1. Direct and indirect activities

Direct activities are the ones occurring within the organisational boundary and therefore are owned and/or operated by the organisation (i.e. site-level activities). Indirect activities refer to the use of materials, energy and emissions associated with goods/services sourced from upstream, or occurring downstream, of the organisational boundary in support of producing the PP.

Examples of direct activities are:

— Generation of energy resulting from combustion of fuels in stationary sources (e.g. boilers, furnaces, turbines);

— Physical or chemical processing (e.g. from manufacturing, processing, cleaning, etc.);

— Transportation of materials, products and waste (resources and emissions from the combustion of fuels) in company-owned and/or operated vehicles, described in terms of mode of transport, vehicle type and distance;

— Employees commuting (resources and emissions from the combustion of fuels) using vehicles owned and/or operated by the organisation, described in terms of mode of transport, vehicle type and distance;

— Business travel (resources and emissions from the combustion of fuels) in vehicles owned and/or operated by the organisation, described in terms of mode of transport, vehicle type, and distance;

— Client and visitor transportation (resources and emissions from the combustion of fuels) in vehicles owned and/or operated by the organisation, described in terms of mode of transport, vehicle type and distance;

— Transportation from suppliers (resources and emissions from the combustion of fuels) in vehicles owned and/or operated by the organisation, described in terms of mode of transport, vehicle type, distance and load;

— Disposal and treatment of waste (composition, volume) when processed in facilities owned and/or operated by the organisation;

— Emissions from intentional or unintentional releases (e.g. hydrofluorocarbon (HFC) emissions during the use of air-conditioning equipment);

— Other site-specific activities.

Examples of indirect activities are:

— Extraction of raw materials needed for the production of the PP;

— Extraction, production and transportation of purchased electricity, steam and heating/cooling energy;

— Extraction, production and transportation of purchased materials, fuels and other products;

— Generation of electricity consumed by upstream activities;

— Disposal and treatment of waste generated by upstream activities;

— Disposal and treatment of waste generated on site when processed in facilities not owned and/or operated by the organisation;

— Transportation of materials and products between suppliers and from suppliers in vehicles not owned and/or operated by the organisation (mode of transport, vehicle type, distance);

— Employees commuting using vehicles not owned or operated by the organisation (mode of transport, vehicle type, distance);

— Business travel (resources and emissions from the combustion of fuels) in vehicles not owned and/or operated by the organisation (mode of transport, vehicle type, distance);

— Client and visitor transportation (resources and emissions from the combustion of fuels) in vehicles not owned and/or operated by the organisation (mode of transport, vehicle type, distance);

— Processing of goods/ services provided;

— Use of goods/ services provided (see Section 4.4.7 for more detailed specifications);

— EoL treatment of goods/services provided (see Section 4.4.8 for more detailed specifications);

— Any other upstream and downstream process/activity.

4.2.2. Life-cycle stages

When the PP is covering products, life-cycle stages shall be identified and described in the OEF report. If the PP is covering services, life-cycle stages shall be identified and reported on, if applicable.

As a minimum, the default life-cycle stages in an OEF study shall be:

1) raw material acquisition and pre-processing (including production of parts and components);

2) manufacturing (production of the main product);

3) distribution (product distribution and storage);

4) use stage;

5) end of life (including product recovery or recycling).

If a different name is used for any of the default life-cycle stages, the user shall specify which default life-cycle stage it corresponds to.

If there is a valid need to do so, the user of the OEF method may decide to split or add life-cycle stages. The reasons(s) for doing this shall be set out in the OEF report. For example, the life-cycle stage 'Raw material acquisition and pre-processing' may be split into 'Raw material acquisition', 'pre-processing', and 'raw materials supplier transport'.

For OEF studies where the PP is made up of intermediate products, the following life-cycle stages shall be excluded:

1) distribution (justified exceptions are allowed);

2) use stage;

3) end of life (including product, recovery / recycling)

4.2.3. Raw material acquisition and pre-processing

This life-cycle stage starts when resources are extracted from nature and ends when product components enter (through the gate of) the product's production facility. Examples of processes that may occur in this stage include:

1) mining and extraction of resources;

2) pre-processing of all material inputs to the product in scope, including recyclable materials;

3) agricultural and forestry activities;

4) transportation within and between extraction and pre-processing facilities, and to the production facility.

Packaging production shall be modelled as part of the 'Raw material acquisition and pre-processing' life-cycle stage.

4.2.4. Manufacturing

The production stage begins when the product components enter the production site and ends when the finished product leaves the production facility. Examples of production-related activities include:

1) chemical processing;

2) manufacturing;

3) transport of semi-finished products between manufacturing processes;

4) assembly of material components.

Waste from products used during manufacturing shall be included in the modelling for the manufacturing stage. The circular footprint formula (Section 4.4.8) shall be applied to such waste.

4.2.5. Distribution stage

Products are distributed to users and may be stored at various points along the supply chain. The distribution stage includes transport from factory gate to warehouse /retail, storage at warehouse/retail, and transport from warehouse/retail to consumer home.

Examples of processes to include:

1) energy inputs for warehouse lighting and heating;

2) use of refrigerants in warehouses and transport vehicles;

3) fuel use by vehicles;

4) roads and trucks.

Waste from products used during distribution and storage shall be included in the modelling. The circular footprint formula (Section 4.4.8) shall be applied to such waste, and the results taken into consideration under the distribution stage.

Default loss rates per type of product during distribution and at the consumer are provided in part F of Annex IV and shall be used if no specific information is available. Allocation rules on energy consumption at storage are presented in Section 4.4.5. For transport see Section 4.4.3.

4.2.6. Use stage

The use stage describes how the product is expected to be used by the end user (e.g. the consumer). Thisstage starts the moment the end user uses the product until it leaves its place of use and enters the end of life (EoL) life-cycle stage (e.g., recycling or final treatment).

The use stage includes all activities and products that are needed for a proper use of the product (i.e. to ensure it performs its original function throughout its lifetime). Waste generated by using the product, as well as its transport to EoL facilities, such as food waste and its primary packaging or the product itself once no longer functional, is excluded from the use stage and shall be part of the EoL stage of the product.

Some examples include: the provision of tap water when cooking pasta; the manufacturing and distribution of, and waste from materials needed for maintenance, repair or refurbishment (e.g. spare parts needed to repair the product, coolant production and waste management due to losses). The EoL of coffee capsules, residues for coffee making and packaging of ground coffee belong to the end of life stage.

In some cases, some products are needed for a proper use of the product in scope and they are used in a way that they become physically integrated: in this case, the waste treatment of these products belongs to the EoL of the product in scope. For example, when the product in scope is a detergent, the treatment of the waste water, following the use of the detergent, belongs to the end of life stage.

The use scenario also needs to reflect whether or not the use of the analysed products might lead to changes in the systems in which they are used.

The following sources of technical information on the use scenario may be taken into account:

1) Market surveys or other market data;

2) Published international standards that specify guidance and requirements for developing of scenarios for the use stage and scenarios for (i.e. estimation of) the service life of the product;

3) Published national guidelines for the development of scenarios for the use stage and scenarios for (i.e. estimation of) the service life of the product;

4) Published industry guidelines for the developingof scenarios for the use stage and scenarios for (i.e. estimation of) the service life of the product.

The manufacturer's recommended method to be applied in the use stage (e.g. cooking in an oven at a specified temperature for a specified time) should be used to provide a basis for determining the use stage of a product. The actual usage pattern may, however, differ from those recommended and should be used if this information is available and documented.

Default loss rates per type of product during distribution and at consumer are provided in part F of Annex IV and shall be used if no specific information is available.

Documentation of methods and assumptions shall be provided in the OEF report. All relevant assumptions for the use stage shall be documented.

Technical specifications to model the use stage are available in Section 4.4.7.

4.2.7. End of life (including product recovery and recycling)

The EoL stage begins when the products in the PP in scope and their packaging are discarded by the user and ends when the products are returned to nature as a waste product or enters another product's life-cycle (i.e. as a recycled content). In general this includes the waste from the product(s) in scope, such as food waste and primary packaging.

Waste generated during the manufacturing, distribution, retail, use stage or after use shall be included in the life-cycle of the product and modelled at the life-cycle stage where it occurs.

The end of life stage shall be modelled using the circular footprint formula and requirements provided in Section 4.4.8. The user of the OEF method shall include all EoL processes applicable to the PP in scope. Examples of processes to be covered in this life-cycle stage include:

1) collection and transport of the product in scope and its packaging to end of life treatment facilities;

2) dismantling of components;

3) shredding and sorting;

4) wastewater from products used, dissolved in or with water (e.g. detergents, shower gels, etc.);

5) conversion into recycled material;

6) composting or other organic-waste-treatment methods;

7) incineration and disposal of bottom ash;

8) landfilling and landfill operation and maintenance.

For intermediate products, the EoL of the product in scope shall be excluded.

4.3. *Nomenclature for the life-cycle inventory*

LCI data shall be compliant with EF requirements:

— For all elementary flows, the nomenclature shall be aligned with the most recent version of the EF reference package available on the EF developer's page.

— For the process datasets and product flow, the nomenclature shall be compliant with the 'ILCD Handbook – Nomenclature and other conventions' ([19]) .

4.4. *Modelling requirements*

This Section provides detailed guidance and requirements on how to model specific life-cycle stages, processes and other aspects of the product life-cycle, in order to compile the LCI. Covered aspects include:

(a) agricultural production;

(b) electricity use;

(c) transport and logistics;

(d) capital goods (infrastructure and equipment);

(e) storage at distribution center or retail;

(f) sampling procedure;

(g) use stage;

(h) end of life modelling;

(i) extended product lifetime;

(j) packaging;

(k) GHG emissions and removals;

(l) offsets;

(m) handling multi-functional processes;

(n) data collection requirements and quality requirements;

(o) cut-off.

4.4.1. Agricultural production

4.4.1.1. *Handling multi-functional processes*

The rules described in the LEAP Guideline shall be followed ([20]).

([19]) http://eplca.jrc.ec.europa.eu/repository/EF

([20]) Environmental performance of animal feeds supply chains (pages 36-43), FAO 2016, available at: http://www.fao.org/partnerships/leap/publications/en/

4.4.1.2. *Crop type specific and country, region or climate specific data*

Crop type specific and country/region/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, shall be used.

4.4.1.3. *Averaging data*

Cultivation data shall be collected over a period of time sufficient to provide an average assessment of the LCI associated with the inputs and outputs of cultivation that will offset fluctuations due to seasonal differences. This shall be undertaken as described in the LEAP guidelines, set out below:

(a) 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, etc). 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 or plants grown in greenhouses shall be considered to be 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 to be annual crops.

(b) For perennial plants (including entire plants and edible portions of perennial plants) a steady state situation (i.e. where all development stages are proportionally represented in the studied time period) shall be assumed and a three-year period shall be used to estimate the inputs and outputs.

(c) Where the different stages in the cultivation cycle may be of differing duration, 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 corrections shall be explained and recorded in the OEF report. The LCI of perennial plants and crops shall not be undertaken until the production system actually yields output.

(d) For crops that are grown and harvested in less than one year (e.g. lettuce 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 may best be done by first gathering annual data and calculating the LCI per year and then determining the three years average.

4.4.1.4. *Pesticides*

Pesticide emissions shall be modelled as specific active ingredients. The USEtox life-cycle impact assessment method has a built-in multimedia fate model which simulates the fate of the pesticides starting from the different emission compartments. Therefore, the ratio of default emission fractions to environmental emission compartments is needed in the LCI modelling. The pesticides applied to the field shall be modelled as 90% emitted to the agricultural soil compartment, 9% emitted to air and 1% emitted to water (based on expert judgement due to current limitations). More specific data may be used if available.

4.4.1.5. *Fertilisers*

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

(a) NH_3, to air (from the use of N-fertiliser);

(b) N_2O, to air (direct and indirect) (from use of N-fertiliser);

(c) CO_2, to air (from the use of lime, urea and urea-compounds);

(d) NO_3, to water unspecified (leaching from use of N-fertiliser);

(e) PO_4, to water unspecified or freshwater (leaching and run-off of soluble phosphate from use of P-fertiliser);

(f) P, to water unspecified or freshwater (soil particles containing phosphorous, from use of P-fertiliser).

The impact assessment model for freshwater eutrophication starts (i) when P leaves the agricultural field (run off) or (ii) from the application of manure or fertiliser on the agricultural field.

Within LCI modelling, the agricultural field (soil) is often seen as belonging to the technosphere and thus included in the LCI model. This aligns with approach (i), where the impact assessment model starts after run-off, i.e. when P leaves the agricultural field. Therefore, within the EF context, the LCI 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 to 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 and included in the characterization factor for soil.

The impact assessment marine eutrophication starts after N leaves the field (soil). Therefore, N emissions to soil shall not be modelled. The amount of emissions ending up in the different air and water compartments per amount of fertilisers applied to the field shall be modelled within the LCI.

N emissions shall be calculated from nitrogen applications by the farmer to the field and excluding external sources (e.g. rain deposition). The number of emissions factors is fixed in the EF context by following a simplified approach. For N-fertilisers, the Tier 1 emissions factors of Table 2-4 of IPCC (2006) shall be used, as reproduced in Table 3, except when better data is available. If better data is available, a more comprehensive nitrogen field model may be used in the OEF study, provided (i) it covers at least the emissions requested above, (ii) N shall be balanced in inputs and outputs and (iii) it shall be described in a transparent way.

Table 3

Tier 1 emissions factors of IPCC (2006) (modified)

Note that these values shall not be used to compare different types of synthetic fertilisers.

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**

FracGASF: fraction of synthetic fertiliser N applied to soils that volatilises as NH_3 and NO_x. FracLEACH: fraction of synthetic fertiliser and manure lost to leaching and runoff as NO3-

The above nitrogen field model has limitations, therefore, an OEF study which has agricultural modelling in scope may test the following alternative approach and report the results in an Annex of the OEF report.

The N-balance is calculated using the parameters in Table 4 and the formula below. The total NO_3^-N emission to water is considered a variable and its total inventory shall be calculated as:

'Total NO_3^-N emission to water' = 'NO_3^- base loss' + 'additional NO_3^- N emissions to water', with

'Additional NO_3^- N emissions to water' = 'N input with all fertilisers' + 'N_2 fixation by crop' – 'N-removal with the harvest' – 'NH_3 emissions to air' – 'N_2O emissions to air' – 'N_2 emissions to air' -'NO_3^- base loss'.

If in certain low-input schemes the value for 'additional NO_3-N emissions to water' becomes negative, the value shall be set to '0'. Moreover, in such cases the absolute value of the calculated 'additional NO_3-N emissions to water' is to be inventoried as additional N-fertiliser input into the system, using the same combination of N-fertilisers as employed for the analysed crop. This last step serves to avoid fertility-depletion schemes by capturing the N-depletion by the analysed crop that is assumed to lead to the need for additional fertiliser later on and to keep the same soil fertility level.

Table 4

Alternative approach to nitrogen modelling

Emission	Compartment	Value to be applied
NO_3^- base loss (synthetic fertiliser and manure)	Water	kg NO_3^-= kg N*FracLEACH = 1*0.1*(62/14) = 0.44 kg NO_3^-/ kg N applied
N_2O (synthetic fertiliser and manure; direct and indirect)	Air	0.022 kg N_2O/ kg N fertiliser applied
NH_3 - Urea (synthetic fertiliser)	Air	kg NH_3= kg N * FracGASF= 1*0.15* (17/14)= 0.18 kg NH_3/ kg N fertiliser applied
NH_3 - Ammonium nitrate (synthetic fertiliser)	Air	kg NH_3= kg N * FracGASF= 1*0.1* (17/14)= 0.12 kg NH_3/ kg N fertiliser applied
NH_3 - others (synthetic fertiliser)	Air	kg NH_3= kg N * FracGASF= 1*0.02* (17/14)= 0.024 kg NH_3/ kg N fertiliser 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
N_2-fixation by crop		For crops with symbiotic N_2-fixation: the fixed amount is assumed to be identical to the N-content in the harvested crop
N_2	Air	0.09 kg N_2 / kg N applied

4.4.1.6. *Heavy metal emissions*

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. Two different modelling approaches are allowed:

(a) The final fate of the heavy metal elementary flows is 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 grown 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.

(b) The final fate (emission compartment) of the heavy metal elementary flows is considered within the system boundary: the inventory does account for the final emissions (release) of the heavy metals in the environment and therefore shall also account for the uptake of heavy metals by the crop.

For example, heavy metals in crops grown for feed will mainly end up in the animal digestion and used as manure back on the field where the metals are released in the environment and their impacts are captured by the impact assessment methods. Therefore, the inventory of the agricultural stage shall account for the uptake of heavy metals by the crop. A limited amount ends up in the animal, which may be neglected for simplification.

4.4.1.7. *Rice cultivation*

Methane emissions from rice cultivation shall be included based on the calculation rules in Section 5.5. of IPCC (2006)

4.4.1.8. *Peat soils*

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

4.4.1.9. *Other activities*

If applicable, the following activities shall be included in agricultural modelling, unless they are allowed to be excluded based on the cut-off criteria:

(a) input of seed material (kg/ha),

(b) input of peat to soil (kg/ha + C/N ratio),

(c) input of lime (kg $CaCO_3$/ha, type),

(d) machine use (hours, type) (to be included if there is high level of mechanisation),

(e) input N from crop residues that stay on the field or are burned (kg residue + N content/ha). Including emissions from residues burning, drying and storage of products.

Unless it is clearly documented that operations are carried out manually, field operations shall be accounted for through total fuel consumption or through inputs of specific machinery, transports to/ from the field, energy for irrigation, or similar.

4.4.2. Electricity use

Electricity used from the grid must be modelled as precisely as possible giving preference to supplier-specific data. If (part of) the electricity is renewable, it is important that no double counting occurs. Therefore, the supplier shall guarantee that the electricity supplied to the organisation to produce the product is effectively generated using renewable sources and is not available anymore for other consumers.

4.4.2.1. *General guidelines*

The following Section introduces two types of electricity mixes: (i) the consumption grid mix which reflects the total electricity mix transferred over a defined grid including green claimed or tracked electricity, and (ii) the residual grid mix, consumption mix (also named residual consumption mix), which characterizes the unclaimed, untracked or publicly shared electricity only.

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

(a) Supplier-specific electricity product ([21]) shall be used if, for a country, there is a 100% tracking system in place, or if :

  (i) available, and

  (ii) the set of minimum criteria to ensure the contractual instruments are reliable is met.

(b) The supplier-specific total electricity mix shall be used if:

  (i) available, and

  (ii) the set of minimum criteria to ensure the contractual instruments are reliable is met.

([21]) See EN ISO 14067:2018

(c) The 'country-specific residual grid mix, consumption mix' shall be used. Country-specific means the country in which the life-cycle stage or activity occurs. This may be an EU country or non-EU country. The residual grid mix prevents double counting with the use of supplier-specific electricity mixes in (a) and (b).

(d) As a last option, the average EU residual grid mix, consumption mix (EU+EFTA), or region representative residual grid mix, consumption mix, shall be used.

The environmental integrity of the use of supplier-specific electricity mix depends on ensuring that contractual instruments (for tracking) are **reliable and unique**. Without this, the OEF lacks the accuracy and consistency needed to drive product/corporate electricity procurement decisions and accurate consideration of the supplier-specific mix by buyers of electricity. 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 a supplier-specific mix within OEF studies.

4.4.2.2. *Set of minimum criteria to ensure contractual instruments from suppliers*

A supplier-specific electricity product/ mix may only be used if the user of the OEF method ensures that the contractual instrument meets the criteria specified below. If contractual instruments do not meet the criteria, then country-specific residual electricity consumption-mix shall be used in the modelling.

The list of criteria below is based on the criteria of the 'GHG Protocol Scope 2 Guidance – An amendment to the GHG Protocol Corporate Standard' (Mary Sotos, World Resource Institute) ([22]). A contractual instrument used for electricity modelling shall meet the following criteria:

Criterion 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 (obtained or acquired or withdrawn) on behalf of its customers. Electricity from facilities for which the attributes have been sold off (via contracts or certificates) must be characterised as having the environmental attributes of the country residual consumption mix where the facility is located.

Criterion 2 – be a unique claim

— Be the only instrument that carries 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 handled automatically through other disclosure registries, systems, or mechanisms).

Criterion 3 – Be as close as possible to the period to which the contractual instrument is applied

Table 5

Minimum criteria to ensure contractual instruments from suppliers – guidance to fulfil criteria

Criterion 1	**CONVEY ENVIRONMENTAL ATTRIBUTES AND GIVE EXPLANATION ABOUT THE CALCULATION METHOD** Convey the energy type mix (or other related environmental attributes) associated with the unit of electricity produced. Explain the calculation method used to determine this mix
Context	Each programme or policy will establish their own eligibility criteria and the attributes to be conveyed. These criteria specify energy resource type and certain energy generation facility characteristics, such as type of technology, facility age, or facility location (but differ from one programme/ policy to another).

([22]) https://ghgprotocol.org/sites/default/files/standards/Scope%202%20Guidance_Final_Sept26.pdf

Conditions for satisfying the criterion	1. Convey the energy mix: if there is no energy type mix specified in the contractual instruments, ask your supplier to provide you with this information or other environmental attributes (e.g. GHG emission rate). If the supplier does not respond, use the 'country-specific residual grid mix, consumption mix'. If the supplier responds, go to step 2).
	2. Explain about the calculation method used: ask your supplier to provide details of the calculation method details to ensure that they follow the above principle. If your supplier does not provide this information, apply the supplier-specific electricity mix, include the information received and document that it was not possible to check for double counting.
Criterion 2	**UNIQUE CLAIMS** Be the only instrument that carries the environmental attribute claim associated with that quantity of electricity generation. 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 handled automatically through other disclosure registries, systems, or mechanisms).
Context	Certificates generally serve four main purposes: (i) supplier disclosure, (ii) supplier quotas for the delivery or sales of specific energy sources, (iii) tax exemption, and (iv) voluntary consumer programmes. Each programme or policy will establish their own eligibility criteria. These criteria specify certain characteristics of the energy generation facility, such as type of technology, facility age, or facility location (but differ from one program/policy to another one). Certificates shall come from facilities meeting these criteria to be eligible for use in that programme. In addition, individual country markets or policy-making bodies may carry out these different functions using a single certificate system or a multi-certificate system.
Conditions for satisfying the criterion	1. Is the plant located in a country with no tracking system? Information provided by the 'Association of issuing bodies' ([23]) should be used. If yes, use the 'country-specific residual grid mix, consumption mix'; If no, go to the second question. 2. Is the plant located in a country where consumption is partly untracked (> 95%)? If yes, use the 'country-specific residual grid mix, consumption mix' as the best data available to calculate the residual consumption mix; If no, go to the third question. 3. Is the plant located in a country with a single certificate system or a multi-certificate system? If the plant is located in a region/country with a single certificate system the unique claim criteria is met. Use energy type mix mentioned on the contractual instrument. If the plant is located in a region/country with a multi-certificate system, the unique claim is not ensured. Contact the country-specific issuing body (The European organisation which governs the European Energy Certificate System, http://www.aib-net.org) to find out whether you need to ask for more than one contractual instrument(s) to ensure there is no risk of double counting. If more than one contractual instrument is needed, request all contractual instruments from the supplier to avoid double counting;

([23]) European Residual Mix | AIB (aib-net.org)

	If it is not possible to avoid double counting, report this in the OEF study and use the 'country-specific residual grid mix, consumption mix'.
Criteria 3	**Be issued and redeemed as close as possible to the period of electricity consumption to which the contractual instrument is applied.**

4.4.2.3. *How to model 'country-specific residual grid mix, consumption mix'*

The user of the OEF method should identify suitable datasets for residual grid mix, consumption mix, per energy type, per country and per voltage

If no suitable dataset is available, the following approach should 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 combine them with LCI datasets per energy type and country/region (e.g. LCI dataset for the production of 1MWh hydro energy in Switzerland).

1) Activity data related to non-EU country consumption mix per detailed energy type shall be determined based on:

   (a) domestic production mix per production technology;

   (b) import quantity and from which neighbouring countries;

   (c) transmission losses;

   (d) distribution losses;

   (e) type of fuel supply (share of resources used, by import and / or domestic supply).

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

2) Available LCI datasets per fuel technology. The LCI datasets available are generally specific to a country or a region in terms of:

   (a) fuel supply (share of resources used, by import and/ or domestic supply);

   (b) energy carrier properties (e.g. element and energy contents);

   (c) technology standards of power plants regarding efficiency, firing technology, flue-gas desulphurisation, NO_x removal and de-dusting.

4.4.2.4. *A single location with multiple products and more than one electricity mix*

This Section describes how to proceed if only some of the electricity used is covered by a supplier-specific mix or on-site electricity generation and how to allocate the electricity mix among products produced at the same location. In general, the subdivision of electricity supply used among multiple products is based on a physical relationship (e.g. number of pieces or kg of product). 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 comes from a specific supplier, a supplier-specific electricity mix shall be used for this amount. See Section 4.4.2.7 for on-site electricity use.

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

(a) If the production (and the related electricity consumption) of a product occurs in a separate site (building), the energy type that is physically related to this separated site may be used.

(b) If the production (and the related electricity consumption) of a product occurs in a space shared with specific energy metering or purchase records or electricity bills, the product-specific information (measure, record, bill) may be used.

(c) If all the products produced in the specific plant are supplied with a publically available OEF study, the company that wants to make the claim related to energy used shall make all OEF studies available. The allocation rule applied shall be described in the OEF study, consistently applied in all OEF studies connected to the site and verified. An example is the 100% allocation of a greener electricity mix to a specific product.

4.4.2.5. *For multiple locations producing one product*

In case a product is produced in different locations or sold in different countries, the electricity mix shall reflect the ratios of production or ratios of sales between EU countries/regions. To determine the ratio, a physical unit shall be used (e.g. number of pieces or kg of product). For OEF studies where such data are not available, the average EU residual consumption mix (EU+EFTA), or region-representative residual mix, shall be used. The same general guidelines mentioned above shall be applied.

4.4.2.6. *Electricity use at the use stage*

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

4.4.2.7. *On-site electricity generation*

If on-site electricity production equals the site's consumption, two situations apply:

(a) no contractual instruments have been sold to a third party: the user of the OEF method shall model its own electricity mix (combined with LCI datasets).

(b) contractual instruments have been sold to a third party: the user of the OEF method shall use 'country-specific residual grid mix, consumption mix' (combined with LCI datasets).

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

(a) If possible, apply subdivision. This applies both to separate electricity productions or to a common electricity production where you may allocate based on electricity amounts the upstream and direct emissions to your own consumption and to the share you sell to a third party (e.g. if a company uses a windmill on its production site and exports 30% of the produced electricity, emissions related to 70% of produced electricity should be accounted in the OEF study).

(b) If not possible, direct substitution shall be used. The country-specific residual consumption electricity mix shall be used as substitution ([24]). Subdivision is not considered possible when upstream impacts or direct emissions are closely related to the product itself.

4.4.3. Transport and logistics

The following parameters shall be taken into account when modelling transport activities:

(1) **Transport type:** the type of transport, e.g. by land (truck, rail, pipe), by water (boat, ferry, barge), or air (airplane);

(2) **Vehicle type:** the type of vehicle by transport type;

(3) **Loading rate (=utilisation ratio; see next Section)** ([25]): environmental impacts are directly linked to the actual loading rate, which shall therefore be considered. The loading rate affects the vehicle's fuel consumption;

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

([25]) The loading rate is the ratio of actual load to the full load/ capacity (e.g. mass or volume) that a vehicle carries per trip.

(4) **Number of empty returns:** the number of empty returns (i.e. the ratio of the distance travelled to collect the next load after unloading the product to the distance travelled to transport the product), when applicable and relevant, shall be taken into account. The kilometres travelled by the empty vehicle shall be allocated to the product. In default transport datasets this is often already taken into account in the default utilisation ratio.

(5) **Transport distance**: transport distances shall be documented, applying average transport distances specific to the context being considered;

Within the EF compliant datasets, the fuel production and fuel consumption by the transport vehicle, the necessary infrastructure needed and the amount of additional resources and tools needed for logistic operations (e.g. cranes and transporters) are included in the transport datasets.

4.4.3.1. *Allocation of impacts from transport – truck transport*

EF compliant datasets for truck transport are per tkm (tonne*km) expressing the environmental impact for 1 tonne (t) of product that is transported for 1km in a truck with a certain load. The transport payload (=maximum mass allowed) is indicated in the dataset. For example, a truck of 28-32 t has a payload of 22 t; the LCA dataset for 1 tkm (fully loaded) expresses the environmental impact for 1 t of product that is transported for 1km within a 22 t loaded truck. The transport emissions are allocated based on the transported product's mass and you get only a share of 1/22 of the truck's full emissions. When the load transported is lower than the maximum load capacity (e.g., 10 t), the environmental impact for 1 t of product is affected in two ways. First, the truck has less fuel consumption per total load transported and second, its environmental impact is allocated by the load transported (e.g., 1/10 t). When a full freight's mass is lower than the truck's load capacity (e.g. 10 t), the transport of the product may be considered volume limited. In this case, the environmental impact shall be calculated using the real mass loaded.

In EF compliant datasets the transport payload should be modelled in a parameterised way through the utilisation ratio. The utilisation ratio affects (i) the truck's total fuel consumption and (ii) the allocation to impact per ton. The utilisation ratio is calculated as the kg real load divided by the kg payload and shall be adjusted when the dataset is used. In case the real load is 0 kg, a real load of 1 kg shall be used for the calculation. Empty return trips may be included in the utilisation ratio by taking into account the percentage of empty km driven. e.g., if the truck is fully loaded for delivery but half-empty upon at its return, the utilisation ratio is (22 t real load / 22 t payload * 50% km + 11 t real load / 22 t payload * 50% km) = 75%.

OEF studies shall specify the utilisation ratio to be used for each type of truck transport modelled and clearly indicate whether the utilisation ratio includes empty return trips. The following default utilisation ratios apply:

(a) If the load is mass-limited: a default utilisation ratio of 64% ([26]) shall be used, unless specific data is available. This default utilisation ratio includes empty return trips and thus shall not be modelled separately.

(b) Bulk transport (e.g., gravel transport from mining pit to concrete plant) shall be modelled with a default utilisation ratio of 50% (100% loaded outbound and 0% loaded inbound), unless specific data is available.

4.4.3.2. *Allocation of impacts from transport – van transport*

Vans are often used for home delivery, e.g. delivery of books and clothes or home delivery from retailers. For vans, the limiting factor is volume rather than mass. If no specific information is available to perform the OEF study, a lorry of <1.2 t with a default utilisation ratio of 50% shall be used. In case no dataset of a lorry of <1.2 t is available, a lorry of <7.5 t shall be used as an approximation, with an utilisation ratio of 20%. A lorry of <7.5 t with a payload of 3.3 t and a utilisation ratio of 20% has to the same load as a van with a payload of 1.2 t and utilisation ratio of 50%.

([26]) Eurostat 2015 indicates that 21% of the km truck transport is driven with an empty load and 79% is driven loaded (with an unknown load). In Germany only, the average truck load is 64%.

4.4.3.3. *Allocation of impacts from transport – consumer transport*

Allocation of the car impact shall be based on volume. The maximum volume to be considered for consumer transport is 0.2 m^3 (around 1/3 of a trunk of 0.6 m^3). For products larger than 0.2 m^3 the full car transport impact shall be considered. For products sold through supermarkets or shopping malls, the product volume (including packaging and empty spaces such as between fruits or bottles) shall be used to allocate the transport burdens between the products transported. The allocation factor shall be calculated as the volume of the product transported divided by 0.2 m^3. To simplify the modelling, all other types of consumer transport (like buying in specialised shops or using combined trips) shall be modelled as if sold through a supermarket.

4.4.3.4. *Default scenarios – from supplier to factory*

For suppliers located within Europe, if no specific data are available to perform the OEF study, then the default data provided below shall be used:

For packaging materials from manufacturing plants to filler plants (beside glass; values based on Eurostat 2015 ([27]), the following scenario shall be used:

(a) 230 km by truck (>32 t, EURO 4);

(b) 280 km by train (average freight train); and

(c) 360 km by ship (barge).

For transport of empty bottles, the following scenario shall be used:

(a) 350 km by truck (>32 t, EURO 4);

(b) 39 km by train (average freight train); and

(c) 87 km by ship (barge).

For all other products from supplier to factory (values based on Eurostat 2015 ([28]), the following scenario shall be used:

(a) 130 km by truck (>32 t, EURO 4);

(b) 240 km by train (average freight train); and

(c) 270 km by ship (barge).

For suppliers located outside of Europe, if no specific data are available to perform the OEF study, then the default data provided below shall be used:

(a) 1 000 km by truck (>32 t, EURO 4), for the sum of distances from harbour/airport to factory outside and inside Europe; and

(b) 18 000 km by ship (transoceanic container) or 10 000 km by plane (cargo).

(c) if producers' country (origin) is known, the adequate distance for ship and airplane should be determined using specific calculators ([29])

(d) in case it is not known whether the supplier is located within or outside of Europe, transport shall be modelled as if the supplier was located outside of Europe.

4.4.3.5. *Default scenarios – from factory to final client*

The transport from factory to final client (including consumer transport) shall be included in the distribution stage of the OEF study. In case no specific information is available, the default scenario outlined below shall be used as a basis. The following values shall be determined by the user of the OEF method (specific information shall be used, unless it is unavailable):

— ratio between products sold through retail, distribution centre (DC) and directly to the final client;

([27]) Calculated as the mass weighted average of the goods categories 06, 08 and 10 using the Ramon goods classification for transport statistics after 2007. The category 'non-metallic mineral products' is excluded as they can double count with glass.

([28]) Calculated as the mass weighted average of the goods of all categories.

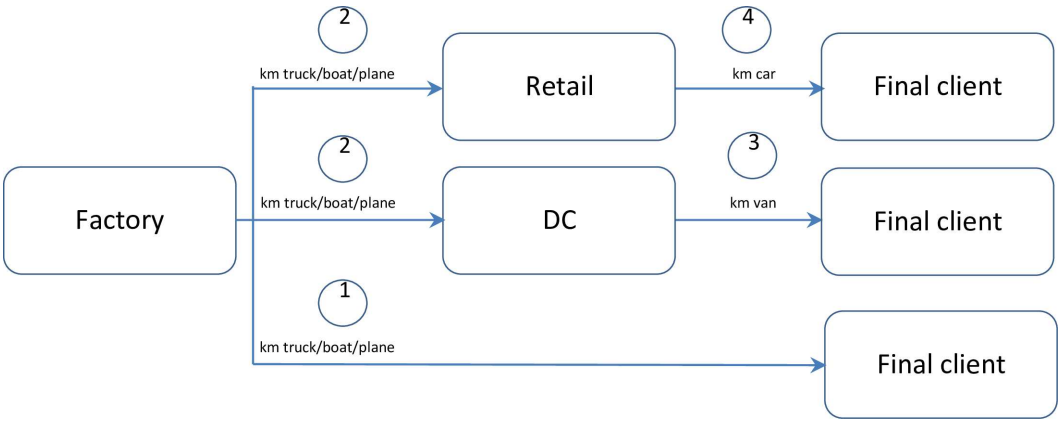
([29]) https://www.searates.com/services/distances-time/ or https://co2.myclimate.org/en/flight_calculators/new

— for factory to final client: ratio between local, intracontinental and international supply chains;

— for factory to retail: distribution between intracontinental and international supply chains.

Figure 3

Default transport scenario



The following is the default transport scenario from factory to client represented in Figure 3:

1. X% from factory to final client:

   X% local supply chain: 1 200 km by truck (>32 t, EURO 4)

   X% intracontinental supply chain: 3 500 km by truck (>32 t, EURO 4)

   X% international supply chain: 1 000 km by truck (>32 t, EURO 4) and 18 000 km by ship (transoceanic container). Note that for specific cases, plane or train may be used instead of ship.

2. X% from factory to retail/ distribution centre (DC):

   X% local supply chain: 1 200 km by truck (>32 t, EURO 4).

   X% intracontinental supply chain: 3 500 km by truck (>32 t, EURO 4).

   X% international supply chain: 1 000 km truck (>32 t, EURO 4), and 18 000 km by ship (transoceanic container). Note that for specific cases, plane or train may be used instead of ship.

3. X% from DC to final client:

   100% local: 250 km round trip by van (lorry <7.5 t, EURO 3, utilisation ratio of 20%).

4. X% from retail to final client:

   62%: 5 km, by passenger car (average)

   5%: 5 km round trip, by van (lorry <7.5 t, EURO 3 with utilisation ratio of 20%)

   33%: no impact modelled

For reusable products, the return transport from retail/ DC to factory shall be modelled in addition to the transport needed to go to retail/ DC. The same transport distances as from product factory to the final client shall be used (see above). However the truck utilisation ratio might be volume-limited depending on the type of product.

Frozen or cooled products shall be transported in freezers or coolers.

4.4.3.6. *Default scenarios – from EoL collection to EoL treatment*

The transport from where EoL products are collected to where they are treated may already be included in the landfill, incineration and recycling LCA datasets.

However, there are some cases where additional default data may be needed in the OEF study. The following values shall be used in case no better data is available:

(a) consumer transport from home to sorting place: 1 km by passenger car;

(b) transport from collection place to methanisation: 100 km by truck (>32 t, EURO 4);

(c) transport from collection place to composting: 30 km by truck (lorry <7.5 t, EURO 3).

4.4.4. Capital goods – infrastructure and equipment

Capital goods (including infrastructure) and their EoL should be excluded, unless there is evidence from previous studies that they are relevant. If capital goods are included, the OEF report shall include a clear and extensive explanation, on why they are relevant, reporting all assumptions made.

4.4.5. Storage at the distribution centre or retail

Storage activities consume energy and refrigerant gases. The following default data shall be used, unless better data is available:

— Energy consumption at the distribution centre: the storage energy consumption is 30 kWh/m^2/year and 360 MJ bought (= burnt in boiler) or 10 Nm^3 natural gas/m^2·year (if you use the value per Nm^3, do not forget to consider emissions from combustion, not only production of natural gas). For centres that contain cooling systems, the additional energy use for the chilled or frozen storage is 40 kWh/m^3·year (with an assumption of 2 m high for the fridges and freezers). For centres with both ambient and cooled storage: 20% of the DC's area is chilled or frozen. Note: the energy used for chilled or frozen storage is only the energy used to maintain the temperature.

— Energy consumption at retail: General energy consumption of 300 kWh/m^2/year for the entire building surface shall be considered as the default. For retail specialised in non-food/ non-beverage products, 150 kWh/m^2·year for the entire building surface shall be considered. For retail specialised in food/ beverage products, 400 kWh/m^2·year for the entire building surface plus energy consumption for chilled and frozen storage of 1 900 kWh/m^2·year and 2 700 kWh/m^2·year respectively is to be considered (PERIFEM and ADEME, 2014).

— Refrigerant gases consumption and leakages at DCs with cooling systems: gas content in fridges and freezers is 0.29 kg R404A per m^2 (retail OEFSR ([30]). Annual leakage of 10% is considered (Palandre 2003). For the portion of refrigerant gases that remain in the equipment at end of life, 5% is emitted at end of life and the remaining fraction is treated as hazardous waste.

Only the portion of the emissions and resources emitted or used at storage systems shall be allocated to the product stored. This allocation shall be based on the space (in m^3) and time (in weeks) occupied by the product stored. For this, the total storage capacity of the system shall be known, and the product-specific volume and storage time shall be used to calculate the allocation factor (as the ratio between product-specific volume*time and storage capacity volume*time).

An average DC is assumed to store 60 000 m^3 of product, out of which 48 000 m^3 for ambient storage and 12 000 m^3 for chilled or frozen storage. For 52 weeks of storage, a default total storage capacity of 3 120 000 m^3 *weeks/year shall be assumed.

An average retail place is assumed to store 2 000 m^3 of products (assuming that 50% of the 2 000 m^2 building area is covered by shelves that are 2 m high) over 52 weeks, i.e. 104 000 m^3 * weeks/year.

([30]) The OEFSR of the retail sector (v 1.0) is available at http://ec.europa.eu/environment/eussd/smgp/pdf/OEFSR-Retail_15052018.pdf.

4.4.6. Sampling procedure

In some cases, the user of the OEF method needs a sampling procedure to limit the data collection to only to a representative sample of plants, farms etc. The user of the OEF method shall (i) specify in the OEF report if sampling was applied, (ii) follow the requirements described in this Section and (iii) indicate which approach was used.

Examples of cases when the sampling procedure may be needed are those where multiple production sites are involved in producing of the same product. E.g., if the same raw material/input material comes from multiple sites or if the same process is outsourced to more than one subcontractor/ supplier.

The representative sample shall be derived via a stratified sample, i.e. one that ensures that sub-populations (strata) of a given population are each adequately represented within the whole sample of a research study.

Using a stratified sample allows for more precision than a simple random sample, provided that the sub-populations have been chosen so that the items of the same sub-population are as similar as possible in terms of the characteristics of interest. In addition, a stratified sample guarantees better coverage of the population ([31]).

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

i. define the population;

ii. define homogeneous sub-populations (stratification);

iii. define the sub-samples at sub-population level;

iv. define the sample for the population starting from the definition of sub-samples at sub-population level.

4.4.6.1. *How to define homogeneous 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.

The following aspects need to be taken into consideration in identifying the sub-populations:

(a) geographical distribution of sites;

(b) technology/ farming practices involved;

(c) production capacity of the companies/sites taken into consideration.

Additional aspects to be taken into consideration may be added.

The number of sub-populations shall be calculated as follows:

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

— 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 above formula just provided and multiplying the result by the numbers of classes identified for each additional aspect (e.g., those sites which have an environmental management or reporting system in place).

Example 1

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

([31]) The researcher has control over the sub-populations that are included in the sample, whereas simple random sampling does not guarantee that sub-populations (strata) of a given population are each adequately represented within the final sample. However, one main disadvantage of stratified sampling is that it may be difficult to identify appropriate sub-populations for a population.

Out of 350 farmers located in the same region in Spain, all the farmers have more or less the same annual production and use the same harvestings techniques.

In this case:

g=1: all the farmers are located in the same country

t=1: all the farmers use the same harvesting techniques

c=1: the capacity of the companies is almost the same (i.e. they 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 across three different countries (100 in Spain, 200 in France and 50 in Germany). There are two different harvesting techniques used, and these 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 10 000 t and 100 000 t. According to expert judgement/ relevant literature, it has been estimated that farmers with an annual production lower than 50 000 t are completely different in terms of efficiency compared to the farmers with an annual production higher than 50 000 t. Two classes of companies are defined based on annual production: class 1, if production is lower than 50 000 and class 2, if production is higher than 50 000. (Spain: 80 class 1, 20 class 2; France: 50 class 1, 150 class 2; Germany: 50 class 1).

Table **6** includes the details about the population.

Table 6

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 summarised in Table 7:

Table 7

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

4.4.6.2. *How to define sub-sample size at sub-population level*

Once the sub-populations have been identified, the sample size of each shall be calculated (the sub-sample size). Two alternative approaches are possible:

i. Based on the total production of the sub-population:

The user of the OEF method shall identify the percentage of production that each sub-population will cover. It shall not be lower than 50%, expressed in the relevant unit. This percentage determines the sample size within the sub-population.

ii. 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

The chosen approach shall be specified in the OEF report. The same approach shall be used for all the sub-populations selected.

Example

Table 8

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

4.4.6.3. *How to define the sample for the population*

The representative sample of the population corresponds to the sum of the sub-samples at sub-population level.

4.4.6.4. *What to do in case rounding is necessary*

If rounding is necessary, the general rule used in mathematics shall be applied:

(a) If the number you are rounding is followed by 5, 6, 7, 8, or 9, round the number up.

(b) If the number you are rounding is followed by 0, 1, 2, 3, or 4, round the number down.

4.4.7. Modelling requirements for the use stage

The use stage often involves multiple processes. A distinction shall be made between (i) product independent and (ii) product dependent processes.

(i) ***Product independent processes*** have no relationship with the way the product is designed or distributed. The use stage process impacts will remain the same for all products in this product (sub-)category even if the producer changes the product's characteristics. Therefore, they do not contribute to any form of differentiation between two products or might even hide the difference. Examples are the use of a glass for drinking wine (considering that the product does not determine a difference in glass use); frying time when using olive oil; energy use for boiling one litre of water used for preparing coffee made from bulk instant coffee; and the washing machine used for heavy laundry detergents (capital good).

(ii) ***Product dependent processes*** are directly or indirectly determined or influenced by the product design or are related to instructions for using the product. These processes depend on the product characteristics and therefore help differentiate between two products. All instructions provided by the producer and directed towards the consumer (through labels, websites or other media) shall be considered as product dependent. Examples of instructions are indications on how long the food must be cooked, how much water must be used, or in the case of drinks the recommended serving temperature and storage conditions. An example of a direct dependent process is the energy use used by electrical equipment under normal conditions.

Product dependent processes shall be included in the system boundary of the OEF study. Product independent processes shall be excluded from the system boundary and qualitative information may be provided.

For final products the LCIA results shall be reported for (i) the total life-cycle and (ii) the total life-cycle excluding the use stage.

4.4.7.1. *Main function approach or delta approach*

Modelling of the use stage may be done in different ways. Very often the related impacts and activities are modelled fully, e.g. the total electricity consumption when using a coffee machine, or the total cooking time and related gas consumption when boiling pasta. In these cases, the use stage processes for drinking coffee or eating pasta are related to the product's main function (referred to as 'main function approach').

In some cases, the use of one product may influence the environmental impact of another, as decribed in the following examples:

(a) A toner cartridge is not 'responsible' for the paper it prints on. But if a remanufactured toner cartridge works less efficiently and causes more paper loss compared to an original cartridge, the additional paper loss should be considered. In that case, the paper loss is a product-dependent process of the use stage of a remanufactured cartridge.

(b) The energy consumption during the use stage of the battery/ charger system is not related to the amount of energy stored and released from the battery. It only refers to the energy loss in each loading cycle, which may be caused by the loading system or the internal losses in the battery.

In these cases, only the additional activities and processes should be allocated to the product (e.g. paper and energy for the remanufactured toner cartridge and battery respectively). The allocation method involves taking all associated products in the system (in this case, paper and energy), and allocating the excess consumption of these associated products to the product which is considered responsible for this excess. This requires a reference amount of consumption to be defined for each associated product (e.g. of energy and materials), which refers to the minimum consumption that is essential for providing the function. The consumption above this reference (the delta) will then be allocated to the product (referred to as 'Delta approach') ([32]).

This approach shall only be used to increase impacts and to account for additional consumption above the reference. To define the reference situation, the following shall be considered, if available:

(a) regulations applicable to the product in scope;

(b) standards or harmonised standards;

(c) recommendations from manufacturers or manufacturers' organisations;

(d) use agreements established by consensus in sector-specific working groups.

The user of the OEF method is free to decide which approach is taken and shall describe the one applied in the OEF report (main function approach or delta approach).

4.4.7.2. *Modelling the use stage*

Part D of Annex IV provides default data to be used to model use stage activities. If available, better data should be used, and shall be made transparent and justified in the OEF report.

4.4.8. Recycled content and end of life modelling

The recycled content and end of life shall be modelled using the circular footprint formula (CFF) at the life-cycle stage where the activity occurs. The following Sections describe the formula and parameters to be used and how they shall be applied to final and intermediate products (Section 4.4.8.12)

4.4.8.1. *The circular footprint formula (CFF)*

The circular footprint formula is a combination of 'material + energy + disposal', i.e.:

Equation 3

The circular footprint formula (CFF)

Material

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

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

$$(1 - R_2 - R_3)E_D$$

([32]) Specifications for drafting and revising product category rules (10.12.2014), ADEME.

Parameters of the CFF

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.
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:	the proportion of material in the input to the production that has been recycled from a previous system.
R_2:	the proportion of the material in the product that will be recycled (or reused) in a subsequent system. Therefore R2 shall 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:	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 the collection, sorting and transportation processes.
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.
E_{ER}:	specific emissions and resources consumed (per functional unit) arising from the energy recovery process (e.g. incineration with energy recovery, landfill with energy recovery, etc.).
$E_{SE,heat}$ 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 analysed product's EOL, 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 used for energy recovery.

Users of the OEF method shall report all the parameters used. Default values for some parameters (A, R_1, R_2, R_3 and Q_s/Q_p for packaging) are available in Part C of Annex IV ([33]) (see following Sections for further details): users of the OEF method shall refer to the version of Part C of Annex IV they are using ([34]).

4.4.8.2. *The A factor*

The A factor allocates burdens and credits from recycling and virgin material production between two life-cycles (i.e. the one supplying and the one using recycled material) and it aims to reflect market realities.

An A factor equal to 1 would reflect a 100:0 approach (i.e. credits are given only to the recycled content), while an A factor equal to 0 would reflect a 0:100 approach (i.e. credits are given only to the recyclable materials at the EoL).

In OEF studies the A factor values shall be in the range **$0.2 \leq A \leq 0.8$**, to always capture both aspects of recycling (recycled content and recyclability at end of life).

([33]) The European Commission periodically reviews and updates the list of values in the part C of the Annex IV; users of the OEF method are invited to check and use the most updated values provided at http://eplca.jrc.ec.europa.eu/LCDN/developerEF.xhtml.

([34]) Part C of Annex IV is available at http://eplca.jrc.ec.europa.eu/LCDN/developerEF.xhtml

The driver determining the values of the A factor is the analysis of the market situation. This means:

1) **A = 0.2 –** low offer of recyclable materials and high demand: the formula focuses on recyclability at EoL.

2) **A = 0.8 –**high offer of recyclable materials and low demand: the formula focuses on recycled content.

3) **A = 0.5 –**equilibrium between offer and demand: the formula focuses both on recyclability at EoL and recycled content.

Default application-specific and material-specific A values are available in Part C of Annex IV. The following procedure shall be applied (in hierarchical order) to select the value of A to be used in an OEF study:

1) check in Part C of Annex IV the availability of an application-specific A value which fits the OEF study,

2) if an application-specific A value is not available, the material-specific A value in Part C of Annex IV shall be used,

3) if a material-specific A value is not available, the user shall apply an A value of 0.5.

4.4.8.3. *The B factor*

The B factor is used as an allocation factor of energy recovery processes. It applies both to burdens and credits. Credits refer to the amount of heat and electricity sold, not to the total energy produced, taking into account relevant variations over a 12-month period, e.g. for heat.

In OEF studies the B value shall, by default, be equal to 0, unless another appropriate value is available in part C of Annex IV.

To avoid double-counting between the current and the subsequent system in case of energy recovery, the subsequent system shall model its own energy use from energy recovery processes as primary energy (if the B value has been set at a value other than 0 in the upstream system, the user of the OEF method shall ensure that no double counting occurs).

4.4.8.4. *The point of substitution*

It is necessary to determine the point of substitution to apply the 'material' part of the formula. The point of substitution is to the point in the value chain where secondary materials substitute for primary materials.

The point of substitution should be identified in correspondence to the process where input flows come from 100% primary sources and 100% secondary sources (level 1 in Figure 4). In some cases, the point of substitution may be identified after some mixing of primary and secondary material flows has occurred (level 2 in Figure 4).

— **Point of substitution at level 1**: this corresponds to e.g. the point where metal scrap, glass cullet and pulp input to the process.

— **Point of substitution at level 2**: this corresponds to e.g. the point where e.g. metal ingots, glass and paper input to the process.

The point of substitution at this level may be applied only if the datasets used to model e.g. E_{rec} and E_v take into account the real (average) flows regarding primary and secondary material. For example, if E_{rec} corresponds to the 'production of 1 t of secondary material' (see Figure 4) and it has an average input of 10% from primary raw materials, the amount of primary materials, together with their environmental burdens, shall be included in the E_{rec} dataset.

Figure 4

Point of substitution at level 1 and level 2

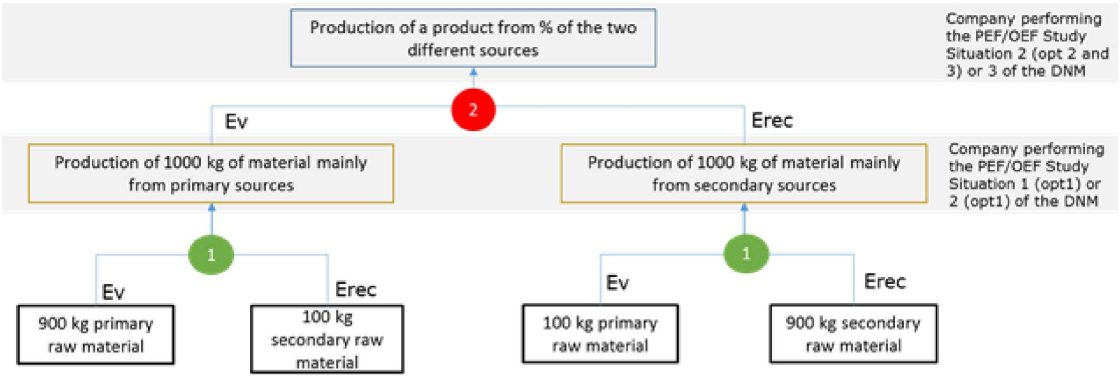
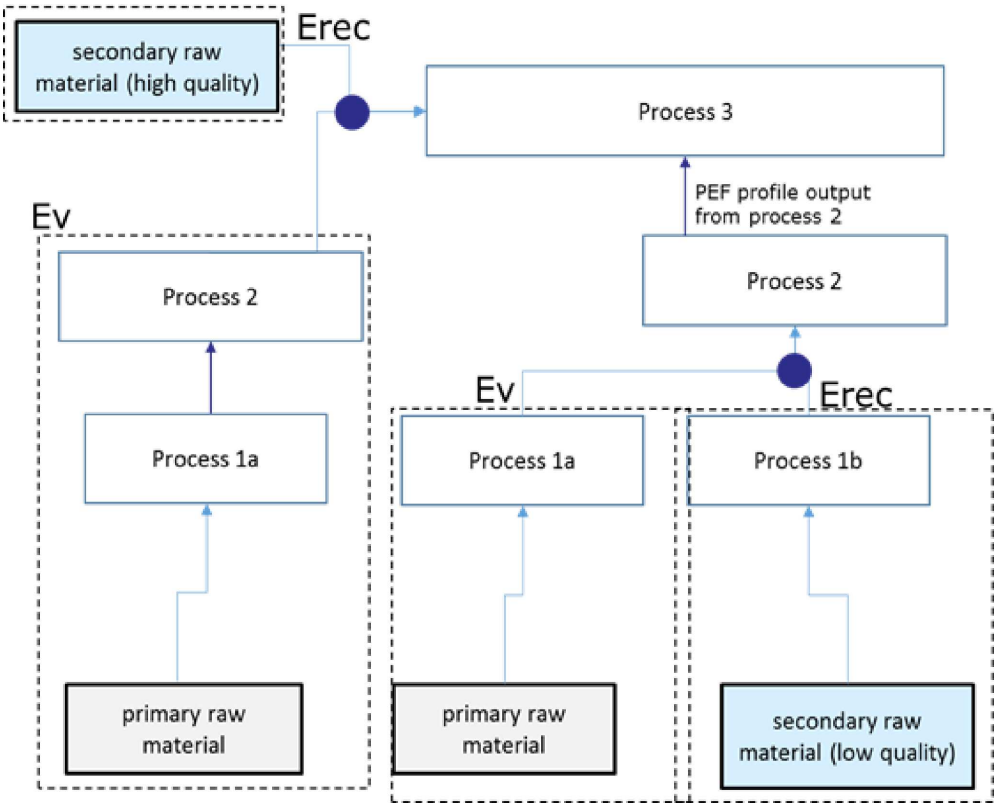


Figure 4 is a schematic representation of a generic situation (flows are 100% primary and 100% secondary). In practice in some situations, more than one point of substitution may be identified at different steps in the value chain, as represented in Figure 5, where e.g. scrap of two different qualities is processed at different steps.

Figure 5

Example of point of substitutions at different steps in the value chain.



4.4.8.5. *The quality ratios: Qsin/Qp and Qsout/Qp*

Two quality ratios are used in the CFF, to take into account the quality of both the ingoing and the outgoing recycled materials: Qsin/Qp and Qsout/Qp.

Two different cases are distinguished:

(a) **If Ev=E*v**, the two quality ratios are needed: Qs_{in}/Q_p associated to the recycled content, and Qs_{out}/Q_p associated to recyclability at EoL. The quality factors are there to capture the downcycling of a material compared to the original primary material and, in some cases, may capture the effect of multiple recycling loops.

(b) **If Ev≠E*v**, one quality ratio is needed: Qs_{in}/Q_p associated to the recycled content. In this case E*v refers to the Reporting unit of the material substituted in a specific application. For example, plastic recycled to produce a bench modelled via substitution of cement shall also take into account the 'how much', 'how long' and 'how well'. Therefore, the E*v parameter indirectly integrates the Qs_{out}/Q_p parameter, and therefore the Qs_{out} and Qp parameters are not part of the CFF.

The quality ratios shall be determined at the point of substitution and per application or material.

The quantification of the quality ratios shall be based on the following:

(a) Economic aspects: i.e. price ratio of secondary compared to primary materials at the point of substitution. If the price of secondary materials is higher than that of primary ones, the quality ratios shall be set equal to 1.

(b) When economic aspects are less relevant than physical aspects, the latter may be used.

Packaging materials used by industry are often the same within different sectors and product groups: Part C of Annex IV provides one worksheet with Qs_{in}/Q_p and Qs_{out}/Q_p values applicable to packaging materials. The company conducting an OEF study may use different values, which shall be made transparent and justified in the OEF report.

4.4.8.6. *Recycled content (R1)*

The R_1 values applied shall be company-specific or default secondary (application-specific), depending on the information accessible to the company conducting the OEF study. Default secondary (application-specific) R_1 values are available in Part C of Annex IV. The following procedure shall be applied (in hierarchical order) to select the value of R_1 to be used in an OEF study:

(a) Supply-chain specific values shall be used when the process is run by the company conducting the OEF study or when the process is not run by the company conducting the OEF study but the company has access to (company-) specific information. (Situation 1 and Situation 2 of the Data Needs Matrix (DNM), see Section 4.6.5.4).

(b) In all other cases, the default secondary R_1 values of Part C of Annex IV (application-specific) shall be applied.

(c) When no application-specific value is available in Part C of Annex IV, R_1 shall be set to 0%. (material-specific values based on supply market statistics are not accepted as a proxy and therefore shall not be used).

The applied R_1 values shall be subject to OEF study verification.

4.4.8.7. *Guidelines when using company-specific R1 values*

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

1) the supplier information (through e.g., statement of conformity or delivery note) shall be maintained during all the production and delivery stages at the converter;

2) once the material is delivered to the converter for producing the end products, the converter shall handle information through their regular administrative procedures;

3) the converter for producing the end products claiming recycled content shall demonstrate through its management system the percentage [%] of recycled input material into the respective end product(s).

4) the latter demonstration shall be transferred upon request to the person using the end product. If an OEF profile is calculated and reported, this shall be stated as additional technical information of the OEF profile.

5) Industry- or company-owned traceability systems may be applied as long as they cover the general guidelines outlined above. If not, they shall be supplemented with the general guidelines above.

For the packaging industry, the following industry-specific guidelines are recommended:

1) for the container glass industry: the European Commission Regulation No 1179/2012. This Regulation requests a statement of conformity delivered by the cullet producer.

2) for the paper industry: the European Recovered Paper Identification System (CEPI – Confederation of European Paper Industries, 2008). This document prescribes rules and guidance on necessary information and steps, with a delivery note that shall be received at the reception of the mill.

3) for beverage cartons no recycled content is used so far. If needed, the same guidelines used for paper shall be used in this case as they are the most suitable (beverage cartons are covered by a recovered paper grade category under the European list of waste paper grades,EN643).

4) for the plastics industry: EN standard 15343:2007. This standard prescribes rules and guidelines on traceability. The supplier of the recyclate is requested to provide specific information.

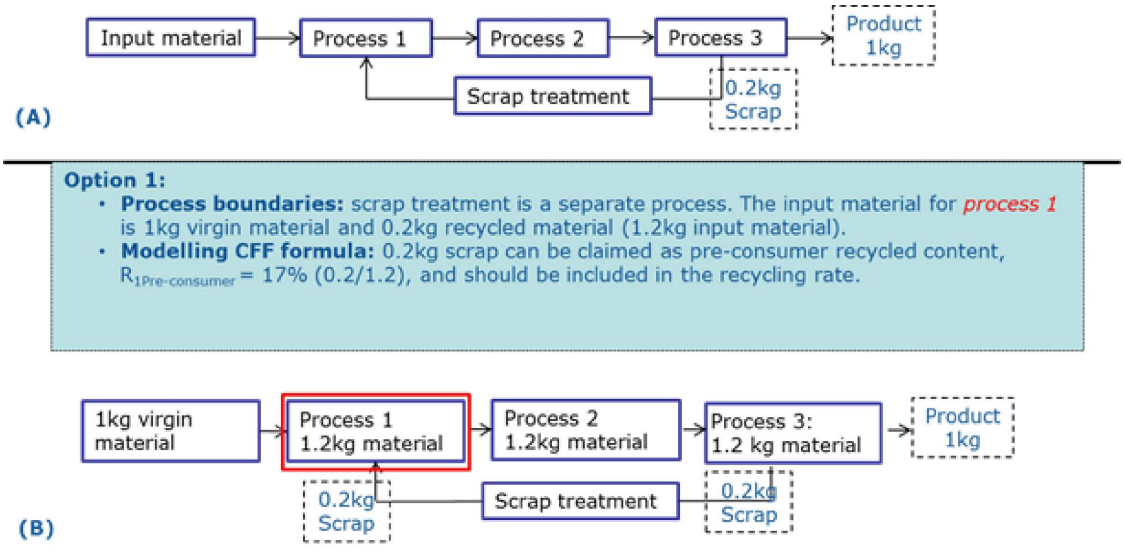
4.4.8.8. *Guidelines on how to deal with pre-consumer scrap*

When dealing with pre-consumer scrap, two options may be applied:

Option 1: the impacts to produce the input material that leads to the pre-consumer scrap in question shall be allocated to the product system that generated this scrap. Scrap is claimed as pre-consumer recycled content. Process boundaries and modelling requirements applying the CFF are shown in Figure 6.

Figure 6

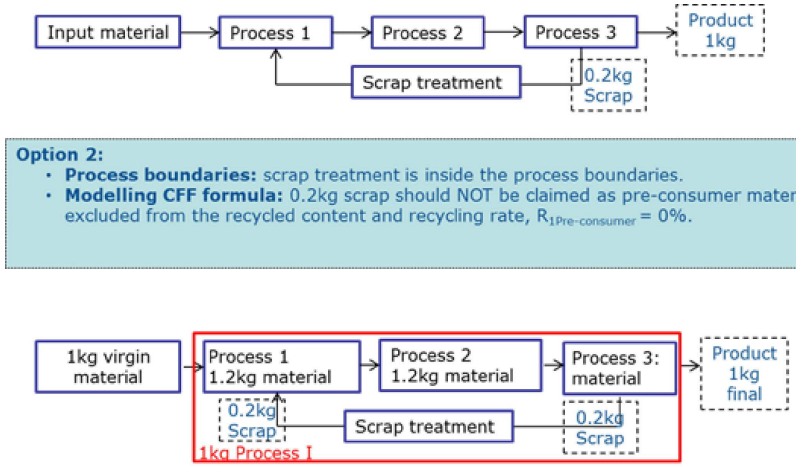
Modelling option when pre-consumer scrap is claimed as pre-consumer recycled content



Option 2: Any material that circulates within a process chain or pool of process chains is excluded from being defined as recycled content and it is not included in R_1. Scrap is not claimed as pre-consumer recycled content. Process boundaries and modelling requirements applying the CFF are shown in **Figure 7**.

Figure 7

Modelling option when pre-consumer scrap is not claimed as pre-consumer recycled content

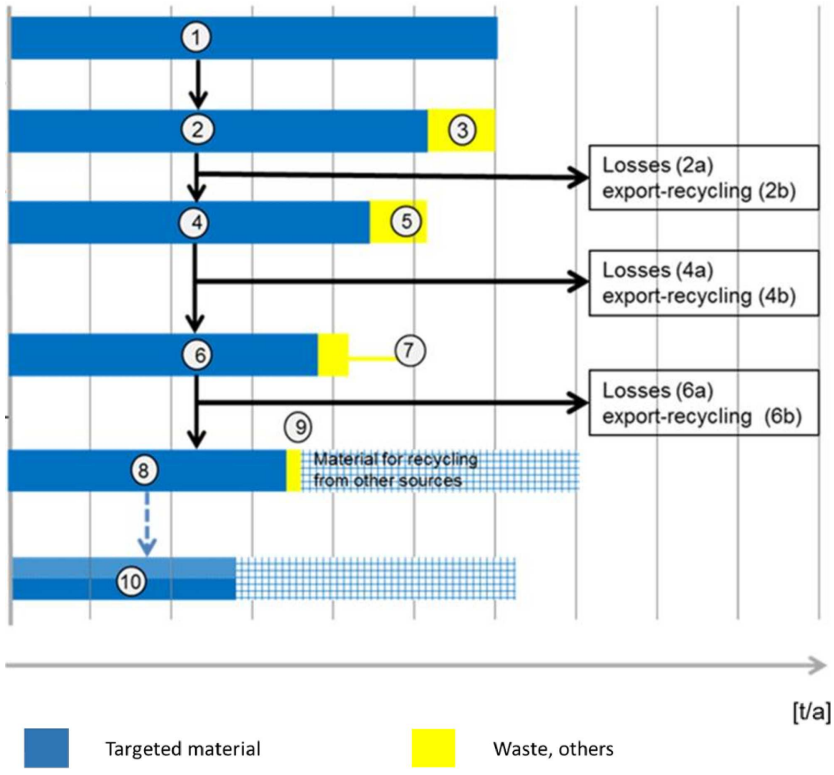


4.4.8.9. *Recycling output rate (R2)*

The R_2 parameter refers to the 'recycling output rate': Figure 8 provides a visual representation. Often, values are available for point 8 ([35]) in Figure 8, therefore such values shall be corrected to the actual output recycling rate (point 10) taking into account possible process losses. In Figure 8 the output recycling rate (R_2) corresponds to point 10.

Figure 8

Simplified collection recycling scheme of a material



([35]) Statistical data gathered which corresponds to point 8 in Figure 8 may be used to help calculate the recycling output rate. Point 8 corresponds to recycling targets calculated according to the general rule provided in Directive (EU) 2018/851 of 30 May 2018. In some cases, under strict conditions and by way of derogation from the general rule, data may be available at point 6 in Figure 8 and may be used to help calculate the recycling output rate.

The product design and composition will determine wether if its material is actually suitable for recycling. Therefore, before selecting the appropriate R_2 value, an evaluation of the material's recyclability shall be made and the OEF study shall include a statement on the recyclability of the materials/ products.

The statement on recyclability shall be provided together with an evaluation for recyclability that includes evidence for the following three criteria (as described by EN ISO 14021:2016, 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) Recycling facilities to accommodate the collected materials exist;

3) Evidence is available to show that the product for which recyclability is claimed is being collected and recycled. For PET bottles the European PET Bottle Platform (EPBP) guidelines should be used (https://www.epbp.org/design-guidelines), while for generic plastics the recyclability by design should be used (www.recoup.org).

If one criterion is not fulfilled, or the sector-specific recyclability guidelines indicate limited recyclability, an R_2 value of 0% shall be applied. Point 1) and 3) may be proven by recycling statistics, which should be country specific derived from industry associations or national bodies. Approximation to evidence at point 3) may be provided by applying for example the design for evaluating recyclability outlined in EN 13430 Material recycling (Annexes A and B) or other sector-specific recyclability guidelines if available.

Default application-specific R_2 values are available in Part C of Annex II. The following procedure shall be followed to select the R_2 value to be used in an OEF study:

(a) Company-specific values shall be used when available, after recyclability has been evaluated.

(b) If no company-specific values are available and the criteria used for evaluating recyclability are fulfilled (see above), application-specific R_2 values shall be used selecting the appropriate value available in Part C of Annex II:

— 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.

Note that new R_2 values may be provided to the Commission to be implemented in Part C of Annex II. Newly proposed R_2 values (based on new statistics) shall be provided together with a study report indicating the sources and calculations, and reviewed by an external independent third party. The Commission will decide if the new values are acceptable and can be implemented in an updated version of Part C of Annex II. Once the new R_2 values are integrated into Part C of Annex II, they may be used by any OEF study.

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

4.4.8.10. *The R3 value*

The R_3 value is the proportion of the product's material that is used for energy recovery at EoL. TThe R_3 values applied shall be company-specific or default values taken from Part C of Annex IV, depending on the information available to the company conducting the OEF study. The following procedure shall be applied (in hierarchical order) to select the value of R_3 to be used in an OEF study:

(a) Supply-chain specific values shall be used when the process is run by the company conducting the OEF study or when the process is not run by the company conducting the OEF study but that company has access to (company-)specific information. (Situation 1 and Situation 2 of the DNM, see Section 4.6.5.4).

(b) In all other cases, the default secondary R_3 values of Part C of Annex IV shall be applied.

(c) When no value is available in Part C of Annex II, new values can be used for R_3 (using statistics or other data sources) or shall be set to 0%.

The applied R_3 values shall be subject to OEF study verification.

4.4.8.11. *$E_{recycled}$ (E_{rec}) and $E_{recyclingEoL}$ (E_{recEoL})*

E_{rec} and E_{recEoL} are the specific emissions and resources consumed (per functional unit) arising from the recycling process of the recycled material and at EoL. The system boundary of E_{rec} and E_{recEoL} shall take into account all the emissions and resources consumed starting from collection up to the defined point of substitution.

If the point of substitution is identified at 'level 2' E_{rec} and E_{recEoL} shall be modelled using the real input flows. Therefore, if a portion of the input flows are from primary raw materials, it shall be included in the datasets used to model E_{rec} and E_{recEoL}.

In some cases E_{rec} may correspond to E_{recEoL}, for example in cases where closed loops occur.

4.4.8.12. *E^*_v*

E^*_v are the 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. When default E^*_v equals E_v, the user shall assume that a recyclable material at EoL is replacing the same virgin material which was used at the input side to produce the recyclable material.

When E^*_v is different from E_v, the user shall provide evidence that a recyclable material is substituting a different virgin material than the one producing the recyclable material.

If $E^*_v \neq E_v$, E^*_v represents the actual amount of virgin material substituted by the recyclable material. In such cases E^*_v is not multiplied by Qs_{out}/Q_p, because this parameter is indirectly taken into account when calculating the 'actual amount' of virgin material substituted. Such an amount shall be calculated taking into account that the virgin material substituted and the recyclable material last as long as each other and are of equal quality (meaning that fulfil the same function in terms of 'how long' and 'how well'). E^*_v shall be determined based on evidence of actual substitution of the selected virgin material.

4.4.8.13. *How to apply the formula when intermediate products are included in the product porfolio*

The parameters related to the EoL of the intermediate products belonging to the PP (i.e. recyclability at end of life, energy recovery, disposal) shall not be accounted for.

If the formula is applied in OEF studies for intermediate products (cradle-to-gate studies), the user of the OEF study shall:

1) use of Equation 3 (CFF), and

2) exclude the EoL by setting the parameters R_2, R_3, and E_d equal to 0, for the products in scope;

3) use and report the results with two A values for the product in scope:

   (a) Setting A = 1: to be used as the default in calculating the OEF profile. This value applies only to the recycled-content of the product(s) in the PP in scope. The purpose of this setting is to enable the hotspot analysis to be focused on the actual system.

   (b) Setting A = the application- or material-specific default values: these results shall be reported as 'additional technical information' and to be used when creating EF compliant datasets. The purpose of this setting is to enable the correct A value to be used when the dataset is used in future modelling.

Table 9 provides a summary on how to apply the CFF, depending on a study focusing on final products, or intermediate products.

Table 9

Summary table on how to apply the CFF in different situations

A value	Final products	Intermediates
A = 1	-	shall (hotspot and OEF profile)
A = default	Shall	shall (additional technical info. and EF compliant dataset)

4.4.8.14. *How to deal with specific aspects*

Recovery of bottom ashes or slag from incineration

Recovery of bottom ashes/ slag shall be included in the R_2 value (recycling output rate) of the original product/ material. Their treatment is within the E_{recEoL}.

Landfill and incineration with energy recovery

Whenever a process, such as landfill with energy recovery or municipal solid waste incineration with energy recovery leads to an energy recovery, it shall be modelled under the 'energy' part in Equation 3 (CFF). The credit is calculated based on the amount of output energy that is used outside the process.

Municipal solid waste

Part C of Annex IV contains default values per country that shall be used to quantify the share going to landfill and the share going to incineration, unless supply-chain specific values are available.

Compost and anaerobic digestion/ sewage treatment

Compost, including digestate coming out of the anaerobic digestion, shall be treated in the 'material' part (Equation 3) like recycling with A = 0.5. The energy part of the anaerobic digestion shall be treated as a normal process of energy recovery under the 'energy' part of

*Equation **3*** (CFF).

Waste materials used as fuel

When waste material is used as a fuel (e.g. waste plastic used as fuel in cement kilns), it shall be treated as an energy recovery process under the 'energy' part of

Equation ***3*** (CFF).

Modelling complex products

When considering complex products (e.g. printed wiring boards) with complex EoL management, the default datasets for EoL treatment processes may already implement the CFF. The default values of the parameters shall refer to the ones in Part C of Annex IV and shall be available as metadata information in the dataset. The Bill of Material (BoM) should be taken as a starting point for calculations if no default data is available.

Reuse and refurbishment

If the reuse/ refurbishment of a product results in a product with different product specifications (providing another function), this shall be considered as part of the CFF, as a form of recycling. Old parts that were changed during refurbishment shall be modelled under the CFF.

In this case, reuse/ refurbishment activities fall under the E_{recEoL} parameter, while the alternative function provided (or the avoided production of parts or components) falls under the E*v parameter.

4.4.9. Extended product lifetime

Extending a product's lifetime due to reuse or refurbishment of a product may result in the following:

1. A product with the original product specifications (providing the same function)

   In this situation, the product lifetime is extended to a product with the original product specifications (providing the same function) and shall be included in the RU and PP ([36]) and reference flow. The user of the OEF method shall describe how reuse or refurbishment is included in calculating the reference flow and the full life-cycle model, taking into account the 'how long' of the FU.

([36]) In some cases, it may be appropriate to include it in the functional unit and reference flow of the product.

2. A product with different product specifications (providing another function).

This shall be considered as part of the CFF, as a form of recycling (see S ection 4.4.8.13. How to apply the formula). Also, old parts that have been changed during refurbishment shall be modelled under the CFF.

4.4.9.1. *Reuse rates (situation 1 in Section 4.4.9)*

The reuse rate is the number of times a material is used at the factory. This is also often called trip rates, reuse time or number of rotations. This may be expressed as the absolute number of reuse or as %.

For example: a reuse rate of 80% equals 5 reuses. Equation 4 describes the conversion:

$$\text{Number of reuse} = \frac{1}{100\% - (\%\ \text{reuse rate})} \qquad \text{[Equation 4]}$$

The number of reuses applied here refers to the total number of uses during the life of the material. It includes both the first use and all of the following reuses.

4.4.9.2 *How to apply and model the 'reuse rate' (situation 1 in Section 4.4.9)*

The number of times a material is reused affects the product's environmental profile at different life-cycle stages. The following five steps explain how the user shall model the different life-cycle stages with reusable materials, using packaging as an example:

1. Raw material acquisition: the reuse rate determines the quantity of packaging material consumed per product sold. The raw material consumption shall be calculated by dividing the actual weight of the packaging by the number of times this packaging is reused. For example, a 1 l glass bottle weights 600 grams and is reused 10 times (reuse rate of 90%). The raw material use per litre is 60 gram (= 600 gram per bottle / 10 reuses).

2. Transport from packaging manufacturer to the product factory (where the products are packed): The reuse rate determines the quantity of transport that is needed per product sold. The transport impact shall be calculated by dividing the one-way trip impact by the number of times the packaging is reused.

3. Transport from product factory to final client and back: in addition to the transport needed to go to the client, the return transport shall also be taken into account. To model the total transport, Section 4.4.3 on modelling transport shall be followed.

4. At the product factory: once the empty packaging is returned to the product factory, energy and resource use shall be taken into consideration as regards cleaning, repairing or refilling (if applicable).

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

4.4.9.3. *Packaging reuse rates*

A packaging return system is organized by:

1. the company that owns the packaging material (company-owned pools), or

2. a third party e.g., the government or a pooler (third party operated pools).

This may influence the material's lifetime as well as the data source to be used. Therefore, it is important to separate these two return systems.

For company owned packaging pools the reuse rate shall be calculated using supply chain specific data. Depending on the data available within the company, two different calculation approaches may be used (see option 'a' and option 'b' below). Returnable glass bottles are used as example but the calculations also apply for other company-owned reusable packaging.

Option 'a': use supply-chain-specific data, based on accumulated experience over the lifetime of the previous glass bottle pool. This is the most accurate way of calculating the reuse rate of bottles for the previous bottle pool and is a proper estimate for the current bottle pool. The following supply chain-specific data is collected:

1. Number of bottles filled during the bottle pool's lifetime ($\#F_i$)

2. Number of bottles at initial stock plus purchased over the bottle pool's lifetime (#B)

$$\text{Reuse rate of the bottle pool} = \frac{\# F_i}{\#B} \qquad \text{[Equation 5]}$$

$$\text{The net glass use (kg glass/l beverage)} = \frac{\#B \times (kg\ glass/bottle)}{\#F_i} \qquad \text{[Equation 6]}$$

This calculation option shall be used:

(i) With data from the previous bottle pool when the previous and current bottle pool are comparable. meaning, the same product category, similar bottle characteristics (e.g., size), comparable return systems (e. g., way of collection methods, same consumer group and outlet channels), etc.

(ii) With data from the current bottle pool when future estimations/ extrapolations are available on (i) the bottle purchases, (ii) the volumes sold, and (iii) the bottle pool's lifetime.

The data shall be supply-chain-specific and shall be verified during the verification and validation process, including the reasoning for the method choice.

Option 'b': If no real data is tracked, the calculation shall be done partly based on assumptions. This option is less accurate due to the assumptions made and therefore conservative/safe estimates shall be used. The following data is needed.

1. Average number of rotations of a single bottle, during one calendar year (if not broken). One loop or rotation consists of filling, delivery, use and return to the company for washing (#Rot);

2. Estimated lifetime of the bottle pool (LT, in years);

3. Average percentage of loss per rotation. This refers to the sum of losses at the consumer stage and the bottles scrapped at filling sites (%Los).

$$\text{Reuse rate of the bottle pool} = \frac{LT}{(LT \times \%Los) + \left(\frac{1}{\#Rot}\right)} \qquad \text{[Equation 7]}$$

This calculation option shall be used when option 'a' is not applicable (e.g., the previous pool cannot be used as a reference). The data used shall be verified during the verification and validation process, including the reasons for choosing between option 'a' and option 'b'.

4.4.9.4 *Average reuse rates for company-owned pools*

OEF studies that have company owned reusable packaging pools in scope shall use company specific reuse rates, calculated following the rules outlined in Section 4.4.9.3.

4.4.9.5 *Average reuse rates for third party operated pools*

The following reuse rates shall be used in those OEF studies that have third party operated reusable packaging pools in scope, unless data of better quality are available:

a) glass bottles: 30 trips for beer and water, 5 trips for wine ([37]);

([37]) Assumption based on the monopoly system of Finland. http://ec.europa.eu/environment/waste/studies/packaging/finland.pdf

b) plastic crates for bottles: 30 trips ([38]);

c) plastic pallets: 50 trips (Nederlands Instituut voor Bouwbiologie en Ecologie, 2014) ([39]);

d) wooden pallets: 25 trips (Nederlands Instituut voor Bouwbiologie en Ecologie, 2014) ([40]).

The user of the OEF method may use other values if they are justified and data sources are provided.

The user of the OEF method shall indicate if company owned or third party operated pools were in scope and which calculation method or default reuse rates were used.

4.4.10 Greenhouse gases emissions and removals

The OEF method distinguishes three main categories of greenhouse gases (GHG) emissions and removals, each contributing to a specific sub-category of the impact category 'climate change':

1. fossil GHG emissions and removals (contributing to the sub-category 'Climate change – fossil');

2. biogenic carbon emissions and removals (contributing to the sub-category 'Climate change – biogenic');

3. carbon emissions from land use and land use change (contributing to the sub-category 'Climate change – land use and land use change').

Currently, credits associated with temporary and permanent carbon storage and/or delayed emissions shall not be considered in the calculation of the climate change indicator. This means that all emissions and removals shall be considered as emitted 'now' and there is no discounting of emissions over time (in line with EN ISO 14067:2018). Developments will be considered in order to keep the method updated with scientific evidence and expert consensus.

The sub-categories 'climate change – fossil', 'climate change – biogenic' and 'climate change - land use and land transformation', shall be reported separately if they show a contribution of more than 5% ([41]) each to the total score of climate change.

4.4.10.1 *Sub-category 1: Climate change – fossil*

This category covers GHG emissions to any media originating from the oxidation and/or reduction of fossil fuels by means of their transformation or degradation (e.g. combustion, digestion, landfilling, etc.). This impact category includes emissions from peat (used as a fuel) and calcination, and uptakes due to carbonation.

Fossil CO_2 uptake and corresponding emissions (e.g. due to carbonation) shall be modelled in a simplified way when calculating the OEF profile (meaning, no emissions or uptakes shall be modelled). When knowledge about the amount of fossil CO_2 uptake is required for additional environmental information, the CO_2 uptake may be modelled with the flow 'carbon dioxide (fossil), resources from air'.

The flows falling under this definition shall be modelled consistently with the elementary flows in the most updated EF reference package and use the names that end with '(fossil)', if available (e.g., 'carbon dioxide (fossil)' and 'methane (fossil)'.

([38]) Technical approximation as no data source could be found. Technical specifications guarantee a lifetime of 10 years. A return of 3 times per year (between 2 to 4) is taken as a first approximation.
([39]) The less conservative number is used.
([40]) Half of plastic pallets is used as an approximation.
([41]) For example: Let us assume that 'Climate change – biogenic' contributes with 7% (using absolute values) to the total climate change impact and 'Climate change – land use and land use change' contributes with 3% to the total climate change impact. In this case, the total climate change impact and the 'Climate change – biogenic' shall be reported.

4.4.10.2 *Sub-category 2: Climate change – biogenic*

This sub-category covers (i) carbon emissions to air (CO_2, CO and CH_4) originating from the oxidation and/or reduction of aboveground biomass by means of its transformation or degradation (e.g. combustion, digestion, composting, landfilling), and (ii) CO_2 uptake from the atmosphere through photosynthesis during biomass growth – i.e. corresponding to the carbon content of products, biofuels or above ground plant residues such as litter and dead wood. Carbon exchanges from native forests ([42]) shall be modelled under sub-category 3 (including connected soil emissions, derived products or residues).

Modelling requirements: the flows falling under this definition shall be modelled consistently with the elementary flows in the most recent version of the EF package and use the flow names that end with '(biogenic)'. Mass allocation shall be applied to model the biogenic carbon flows.

A simplified modelling approach should be used if the flows which influence the results of climate change impact (namely biogenic methane emissions) are modelled. This option may apply for example to food OEF studies as it avoids modelling human digestion while eventually arriving at a zero balance. In this case, the following rules apply:

(i) only the emission 'methane (biogenic)' is modelled;

(ii) no further biogenic emissions and uptakes from atmosphere are modelled;

(iii) if methane emissions are both fossil and biogenic, the release of biogenic methane shall be modelled first followed by the remaining fossil methane.

For intermediate products (cradle-to-gate), the biogenic carbon content at factory gate (physical content) shall always be reported as 'additional technical information'.

4.4.10.3 *Sub-category 3: Climate change – land use and land use change (LULUC)*

This sub-category accounts for carbon uptakes and emissions (CO_2, CO and CH_4) originating from carbon stock changes caused by land use change and land use. This sub-category includes biogenic carbon exchanges from deforestation, road construction or other soil activities (including 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 forests ([43]) and residues), while their CO_2 uptake is excluded.

A distinction is made between direct and indirect land use change. Direct land use change occurs as the result of a transformation from one land use type into another, which takes place in a unique land cover, possibly leading to changes in the carbon stock of that specific piece of land, but not leading to a change in other systems. Examples of direct land use change are the conversion of land used for growing crops to industrial use or conversion from forestland to cropland.

Indirect land use change occurs when a certain change in land use, or in the use of the feedstock grown on a given piece of land, causes changes in land use outside the system boundary, i.e. in other land use types. The OEF method only considers direct land use change, while indirect land use change, due to the lack of an agreed methodology, shall not be taken into account in OEF studies. Indirect land use change may be included under additional environmental information.

Modelling requirements: the flows falling under this definition shall be modelled consistently with the elementary flows in the most recent version of the EF package and use the flow names that end with '(land use change)'. Biogenic carbon uptakes and emissions shall be inventoried separately for each elementary flow

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.

([42]) Native forests refer ti native or long-term, non-degraded forests. Definition adapted from Table 8 in the Annex of Commission Decision C(2010)3751 on guidelines for the calculation of land carbon stocks for the purpose of Annex V of Directive 2009/28/EC. In principle, this definition excludes short term forests, degraded forests, managed forest, and forests with short-term or long-term rotations.

([43]) Following the instantaneous oxidation approach in IPCC 2013 (Section 2).

Quoting PAS 2050:2011 (BSI 2011):

[Large emissions of GHGs can result as a consequence of land use change. Removals as a direct result of land use change (and not as a result of long-term management practices) do not usually occur, although it is recognized that this could happen in specific circumstances. Examples of direct land use change are the conversion of land used for growing crops to industrial use or conversion from forestland to cropland. All forms of land use change that result in emissions or removals are to be included. Indirect land use change refers to such conversions of land use as a consequence of changes in land use elsewhere. While GHG emissions also arise from indirect land use change, the methods and data requirements for calculating these emissions are not fully developed. Therefore, the assessment of emissions arising from indirect land use change is not included.

The GHG emissions and removals arising from direct land use change shall be assessed for any input to the life-cycle of a product originating from that land and shall be included in the assessment of GHG emissions. The emissions arising from the product shall be assessed on the basis of the default land use change values provided in PAS 2050:2011 Annex C, unless better data is available. For countries and land use changes not included in this annex, the emissions arising from the product shall be assessed using the included GHG emissions and removals occurring as a result of direct land use change in accordance with the relevant Sections of the IPCC (2006). The assessment of the impact of land use change shall include all direct land use change occurring not more than 20 years, or a single harvest period, prior to undertaking the assessment (whichever is the longer). The total GHG emissions and removals arising from direct land use change over the period shall be included in the quantification of GHG emissions of products arising from this land on the basis of equal allocation to each year of the period ([44]).

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:

   a) the earliest year in which it can be demonstrated that the land use change had occurred; or

   b) 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].

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

Intermediate products (cradle-to-gate) derived from native forests shall always report as meta-data (in the 'additional technical information' Section of the OEF report) (i) their carbon content (physical content and allocated content) and (ii) that corresponding carbon emissions shall be modelled with '(land use change)' elementary flows.

For **soil carbon stock**: soil carbon emissions shall be included and modelled under this sub-category (e.g. from rice fields). Soil carbon emissions derived from aboveground residues (except from native forests) shall be modelled under sub-category 2, such as the application of non-native forest residues or straw. Soil carbon uptake (accumulation) shall be excluded from the results, e.g. from grasslands or improved land management through tilling techniques or other management measures taken related to agricultural land. Soil carbon storage may only be included in the OEF study as additional environmental information and if proof is provided. If legislation has different modelling requirements for the sector, such as the EU Decision on greenhouse gas accounting from 2013 ([45]), which indicates carbon stock accounting, it shall be modelled according to the relevant legislation and provided under additional environmental information.

4.4.11. Offsets

The term 'offset' is frequently used to refer to third-party GHG mitigation activities, e.g. regulated schemes that are part of the Kyoto Protocol (the former clean-development mechanism; joint implementation), new mechanisms discussed in the context of negotiations article 6 of the Paris agreement emissions trading schemes, or voluntary schemes. Offsets are GHG reductions used to compensate for (i.e., offset) GHG emissions elsewhere, for example to meet a voluntary or mandatory GHG target or cap. Offsets are calculated relative to a baseline that represents a hypothetical scenario for what emissions would have been in the absence of the mitigation project that generates the offsets. Examples are carbon offsetting by the clean development mechanism, carbon credits, and other system-external offsets.

Offsets shall not be included in the impact assessment of an OEF study, but shall be reported separately as additional environmental information.

4.5 *Handling multi-functional processes*

If a process or facility provides more than one function, i.e. it delivers several goods and/or services ('co-products'), it is 'multifunctional'. In these situations, if the co-products are not part of the PP, all inputs and emissions linked to the process shall be partitioned between the product(s) of interest and the other co-products in a principled manner.

Systems involving multi-functionality of processes shall be modelled in line with the following decision hierarchy.

Specific allocation requirements in other Sections of this method always prevail over the ones available in this Section (e.g., Section 4.4.2 on electricity 4.4.3 on transport, 4.4.10 on GHG emissions, or 4.5.1 on slaughterhouse activities).

Decision hierarchy

1) Subdivision or system expansion

As per EN ISO 14044:2006, wherever possible, subdivision or system expansion should be used to avoid allocation. Subdivision refers to disaggregating multifunctional processes or facilities to isolate the input flows directly associated with each process or facility output. System expansion refers to expanding the system by including additional functions related to the co-products. It shall be investigated first whether it is possible to subdivide or expand the analysed process. Where subdivision is possible, inventory data shall be collected only for those unit processes directly attributable ([46]) to the goods/services of concern. Or, if the system may be expanded, the additional functions shall be included in the analysis with results communicated for the expanded system as a whole rather than on an individual co-product level.

([45]) Decision No 529/2013/EU of the European Parliament and of the Council of 21 May 2013 on accounting rules on greenhouse gas emissions and removals resulting from activities relating to land use, land-use change and forestry and on information concerning actions relating to those activities, OJ L 165/80.

([46]) Directly attributable refers to a process, activity or impact occurring within the defined system boundary.

2) Allocation based on a relevant underlying physical relationship

Where it is not possible to apply subdivision or system expansion, allocation should be applied: the inputs and outputs of the system should be partitioned between its different products or functions in a way that reflects relevant underlying physical relationships between them (EN ISO 14044:2006).

Allocation based on a relevant underlying physical relationship refers to partitioning the input and output flows of a multi-functional process or facility in line with a relevant, quantifiable physical relationship between the process inputs and co-product outputs (for example, a physical property of the inputs and outputs that is relevant to the function provided by the co-product of interest). Allocation based on a physical relationship may be modelled using direct substitution, if it is possible to identify a product that is directly substituted.

To demonstrate whether the direct substitution effect is robust, the user of the OEF method shall prove that (1) there is a direct, empirically demonstrable substitution effect, AND (2) it is possible to model the substituted product and to subtract the LCI in a directly representative manner: if both conditions are fulfilled, model the substitution effect.

Or to allocate input/output based on some other relevant underlying physical relationship that relates the inputs and outputs to the function provided by the system, the user of the OEF method shall demonstrate that it is possible to define a relevant physical relationship by which to allocate the flows attributable to the provision of the defined function of the product system: if this condition is fulfilled, the user of the OEF method may allocate based on this physical relationship.

3) Allocation based on some other relationship

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. The market price of the co-functions should refer to the specific condition and point in which the co-products are produced. In any case, a clear justification for having discarded 1) and 2) and for having selected a certain allocation rule in step 3) shall be provided, to ensure the physical representativeness of the OEF results as far as possible.

Allocation based on some other relationship may be approached in one of the following alternative ways:

(i) Is it possible to identify an indirect substitution ([47]) effect and may the substituted product be modelled and the inventory subtracted in a reasonably representative manner? If yes (i.e. both conditions are verified), model the indirect substitution effect.

(ii) Is it possible to allocate the input/output flows between the products and functions on the basis of some other relationship (e.g. the relative economic value of the co-products)? If yes, allocate products and functions based on the relationship identified.

The circular footprint formula (see Section 4.4.8.1) provides the approach that shall be used to estimate the overall emissions that result from a certain process involving recycling and/or energy recovery. These moreover also relate to waste flows generated within the system boundary.

4.5.1 Allocation in animal husbandry

This Section provides instructions on how to address specific issues related to the modelling of farm, slaughterhouse and rendering for cattle, pigs, sheep and goats. In particular, instructions are provided on:

1. allocation of upstream burdens at farm level among outputs leaving the farm;

2. allocation of upstream burdens (linked to live animals) at slaughterhouse level among outputs leaving the slaughterhouse.

([47]) Indirect substitution occurs when a product is substituted but you do not know by which products exactly.

4.5.1.1 *Allocation within the farm module*

At farm module, subdivision shall be used for processes that are directly allocated to certain outputs (e.g. energy use and emissions related to milking processes). If the processes cannot be subdivided due to the lack of separate data or because it is technically impossible, the upstream burden, e.g. feed production, shall be allocated to farm outputs using a biophysical allocation method. Default values used for allocation are provided in the following Sections for each type of animal. These default values shall be used by OEF studies unless company-specific data are collected. Changing allocation factors is only allowed if company-specific data are collected and used for the farm module. In case secondary data are used for the farm module, no change of allocation factors is allowed.

4.5.1.2 *Allocation within the farm module for cattle*

The International Dairy Federation (IDF) (2015) allocation method between milk, cull cows and surplus calves shall be used. Dead animals and all products from dead animals shall be regarded as waste and the circular footprint formula shall be applied. In this case, however, the traceability of the products from dead animals shall be guaranteed to enable OEF studies to take this aspect into consideration.

Manure exported to another farm shall be considered as one of the following:

(a) **Residual (default option):** if manure does not have an economic value at the farm gate, it is regarded as residual without allocation of an upstream burden. The emissions related to manure management up to farm gate are allocated to the other farm outputs where manure is produced.

(b) **Co-product**: when exported manure has an economic value at farm gate, an economic allocation of the upstream burden shall be used for manure by using the relative economic value of manure compared to milk and live animals at the farm gate. However, biophysical allocation based on IDF rules shall nevertheless be applied to allocate the remaining emissions between milk and live animals.

(c) **Manure as waste**: when manure is treated as waste (e.g. landfilled), the circular footprint formula shall be applied.

The allocation factor (AF) for milk shall be calculated using the following equation:

$$AF = 1 - 6.04 * \frac{M_{meat}}{M_{milk}} \qquad \text{[Equation 8]}$$

Where M_{meat} is the mass of live weight of all animals sold including bull calves and culled mature animals per year and M_{milk} is the mass of fat and protein corrected milk (FPCM) sold per year (corrected to 4% fat and 3.3% protein). The constant 6.04 describes the causal relationship between the energy content in feed in relation to the milk and live weight of animals produced. The constant is determined based on a study that collected data from 536 US dairy farms ([48]) (Thoma et al., 2013). Although based on US farms, the IDF considers that the approach is applicable to the European farming systems.

The FPCM (corrected to 4% fat and 3.3% protein) shall be calculated by using the following formula:

$$\text{FPCM}\left(\frac{\text{kg}}{\text{yr}}\right) = \text{Production}\left(\frac{\text{kg}}{\text{yr}}\right) * (0.1226 * \text{True Fat \%} + 0.0776 * \text{True Protein \%} + 0.2534) \qquad \text{[Equation 9]}$$

In cases where a default value of 0.02 kg_{meat}/kg_{milk} for the ratio of live weight of animals and milk produced in Equation 9 is used, the equation yields default allocation factors of 12% to live weight of animals and 88% to milk (Table 10). These values shall be used as default values used for allocating the upstream burdens to milk and live weight of animals for cattle when secondary datasets are used. If company-specific data are collected for the farming stage, the allocation factors shall be changed using the equations included in this Section.

([48]) Thoma et al., 2013

Table 10

Default allocation factors for cattle at farming

Co-product	Allocation factor
Animals, live weight	12%
Milk	88%

4.5.1.3 *Allocation within the farm module for sheep and goat*

A biophysical approach shall be used for allocating of upstream burdens to the different co-products for sheep and goat. The 2006 IPCC guidelines for national GHG inventories (IPCC, 2006) contain a model for calculating energy requirements that shall be used for sheep and, as a proxy, for goats. This model is applied in here.

Dead animals and all the products coming from dead animals shall be regarded as waste and the circular footprint formula (CFF, Section 4.4.8.1) shall be applied. In this case, however, the tracing of products from dead animals shall be allowed so this aspect can be taken into consideration in OEF studies.

It is mandatory to use the default allocation factors included in this document whenever secondary datasets are used for the life-cycle stage of farming for sheep and goats. If company-specific data are used for this life-cycle stage, the calculation of the allocation factors shall be calculated with the company-specific data using the equations provided.

The allocation factors shall be calculated as follows ([49]):

$$\%\ \boldsymbol{wool} = \frac{[\boldsymbol{Energy\ for\ wool}\ (\boldsymbol{NE_{wool}})]}{[(\boldsymbol{Energy\ for\ wool}\ (\boldsymbol{NE_{wool}}) + \boldsymbol{Energy\ for\ milk}\ (\boldsymbol{NE_l}) + \boldsymbol{Energy\ for\ meat}\ (\boldsymbol{NE_g})]} \qquad \text{[Equation 10]}$$

$$\%\ \boldsymbol{milk} = \frac{[\boldsymbol{Energy\ for\ milk}\ (\boldsymbol{NE_l})]}{[(\boldsymbol{Energy\ for\ wool}\ (\boldsymbol{NE_{wool}}) + \boldsymbol{Energy\ for\ milk}\ (\boldsymbol{NE_l}) + \boldsymbol{Energy\ for\ meat}\ (\boldsymbol{NE_g})]} \qquad \text{[Equation 11]}$$

$$\%\ \boldsymbol{meat} = \frac{[\boldsymbol{Energy\ for\ meat}\ (\boldsymbol{NE_g})]}{[(\boldsymbol{Energy\ for\ wool}\ (\boldsymbol{NE_{wool}}) + \boldsymbol{Energy\ for\ milk}\ (\boldsymbol{NE_l}) + \boldsymbol{Energy\ for\ meat}\ (\boldsymbol{NE_g})]} \qquad \text{[Equation 12]}$$

To calculate energy for wool (NE_{wool}), energy for milk (NE_l) and energy for meat (NE_g) with company specific data, the equations included in IPPC (2006), and reported below shall be used. In case secondary data are used instead, the default values for the allocation factors provided in this document shall be used.

Energy for wool, NE_{wool}

$$\boldsymbol{NE_{wool}} = \frac{(\boldsymbol{EV_{wool}} \cdot \boldsymbol{Production_{wool}})}{\mathbf{365}} \qquad \text{[Equation 13]}$$

NE_{wool} = net energy required to produce wool, MJ day^{-1}

EV_{wool} = the energy value of each kg of wool produced (weighed after drying but before scouring), MJ kg^{-1}. A default value of 157 MJ kg^{-1} (NRC, 2007) shall be used for this estimate ([50]).

$Production_{wool}$ = annual wool production per sheep, kg yr^{-1}

Default values to be used for calculating NE_{wool} and the resulting net energy required are reported in Table 11.

([49]) The same naming as used in IPCC (2006) is used.

([50]) The default value of 24 MJ kg^{-1} originally included in the IPPC document was modified into 157 MJ kg^{-1} following the indication of FAO - Greenhouse gas emissions and fossil energy demand from small ruminant supply chains Guidelines for assessment (2016).

Table 11

Default values to be used for calculating NE_{wool} for sheep and goats

Parameter	Value	Source
$\boldsymbol{EV_{wool}}$ - sheep	157 MJ kg^{-1}	NRC, 2007
$\boldsymbol{Production_{wool}}$ - sheep	7,121 kg	Average of the four values provided in Table 1 of 'Application of LCA to sheep production systems: investigating co-production of wool and meat using case studies from major global producers' ([51]).
$\boldsymbol{NE_{wool}}$ - sheep	3,063 MJ/d	Calculated using Eq. 14
$\boldsymbol{NE_{wool}}$ - goat	2,784 MJ/d	Calculated from NE_{wool} – sheep using Eq. 17

Energy for milk, NE_l

$$\boldsymbol{NE_l = Milk.\ EV_{milk}} \quad \text{[Equation 14]}$$

NE_l = net energy for lactation, MJ day^{-1}

Milk = amount of milk produced, kg of milk day^{-1}

EV_{milk} = the net energy required to produce 1 kg of milk. A default value of 4.6 MJ/kg (AFRC, 1993) shall be used which corresponds to a milk fat content of 7% by weight.

Default values to be used for calculating NE_l and the resulting net energy required are provided in Table 12.

Table 12

Default values to be used for calculating NE_l for sheep and goat

Parameter	Value	Source
$\boldsymbol{EV_{milk}}$ - sheep	4,6 MJ kg^{-1}	AFRC, 1993
Milk - sheep	2,08 kg/d	Estimated milk production 550 lbs of sheep milk per year (average value), milk production estimated for 120 days in one year.
$\boldsymbol{NE_l}$ - sheep	9,568 MJ/d	Calculated using Eq. 15
$\boldsymbol{NE_l}$ - goat	8,697 MJ/d	Calculated from NE_l – sheep using Eq. 17

Energy for meat, NE_g

$$NE_g = WG_{lamb} \cdot \frac{a+0.5b(BW_i+BW_f)}{365} \quad \text{[Equation 15]}$$

NE_g = net energy needed for growth, MJ day^{-1}

WG_{lamb} = the weight gain ($BW_f - BW_i$), kg yr^{-1}

BW_i = the live bodyweight at weaning, kg

BW_f = the live bodyweight at 1-year old or at slaughter (live-weight) if slaughtered prior to 1 year of age, kg

a, b = constants as described in Table 13.

Note that lambs will be weaned over several weeks as they supplement a milk diet with pasture feed or supplied feed. The time of weaning should be taken as the time at which they depend on milk for half their energy supply. The NE_g equation used for sheep includes two empirical constants ('a' and 'b') that vary by animal species/ category (Table 13).

([51]) Wiedemann et al, Int J. of LCA 2015

Table 13

Constants for use in calculating NEg for sheep ([1])

Animal species/category	a (MJ kg^{-1})	b (MJ kg^{-2})
Intact males	2,5	0,35
Castrates	4,4	0,32
Females	2,1	0,45

([1]) This table corresponds to Table 10.6 in IPCC (2006).

In case company-specific data are used for the farming stage, the allocation factors shall be recalculated. In this case, the parameter 'a' and 'b' shall be calculated as weighted average if more than one animal category is present.

Default values to be used in calculating NE_g are reported in Table 14.

Table 14

Default values to be used in calculating NEg for sheep and goat

Parameter	Value	Source
WG_{lamb} - sheep	26,2-15=11,2 kg	Calculated
BW_i - sheep	15 kg	It is assumed that the weaning happens at 6 weeks. Weight at 6 weeks as stated from Figure 1 in 'A generic model of growth, energy metabolism and body composition for cattle and sheep', Johnson et al, 2015 – Journal of Animal Science.
BW_f - sheep	26,2 kg	Average of the weight values for sheep at slaughter, sheep as provided in Appendix 5, GHG emissions and fossil energy demand from small ruminant supply chains, FAO (2016b).
a - sheep	3	Average of the three values provided in Table 13.
b - sheep	0,37	Average of the three values provided in Table 13
NE_g - sheep	0,326 MJ/d	Calculated using Eq. 16
NEg - goat	0,296 MJ/d	Calculated from NEg – sheep using Eq. 17

The default allocation factors to be used in OEF studies for sheep and goat are provided in Table 14 together with the calculations. The same equations ([52]) and default values used in calculating the energy requirements for sheep are used in calculating the energy requirements for goats after a correction factor has been applied.

$$Net\ energy\ requirement, goat = \left[\frac{goat\ weight}{sheep\ weight}\right]^{0.75} \times Net\ energy\ requirement\ sheep \qquad \text{[Equation 16]}$$

Sheep weight: 64.8 kg, average of male and female sheep for different regions in the world, data from Appendix 5, GHG emissions and fossil energy demand from small ruminant supply chains, FAO (2016b).

Goat weight: 57.05 kg, average of male and female goats for different regions in the world, data from Appendix 5, GHG emissions and fossil energy demand from small ruminant supply chains, FAO (2016b).

Net energy requirement, goat = $[(57.05) / (64.8)]^{0.75}$ • Net energy requirement, sheep [Equation 17]

([52]) Page 10.24 of IPCC (2006).

Table 15

Default allocation factors to be used OEF studies for sheep at farming stage

	Sheep	Goat ([1])
Allocation factor, meat	$\%\ \boldsymbol{meat} = \frac{[(NE_g)]}{[(NE_{wool}) + (NE_l) + (NE_g)]} = 2.52\%$	2,51 %
Allocation factor, milk	$\%\ \boldsymbol{milk} = \frac{[(NE_l)]}{[(NE_{wool}) + (NE_l) + (NE_g)]} = 73.84\%$	73,85%
Allocation factor, wool	$\%\ \boldsymbol{wool} = \frac{[(NE_{wool})]}{[(NE_{wool}) + (NE_l) + (NE_g)]} = 23.64\%$	23,64%

([1]) Allocation factors for goats are calculated starting from the net energy requirements for goats estimated from the net energy requirements for sheep and taking into consideration that: sheep weight = 64.8 kg and goat weight = 57.05 kg.

4.5.1.4 *Allocation within the farm module for pig*

Allocation at farming stage between piglets and sows shall be made applying economic allocation. The default allocation factors to be used are reported in Table 16.

Table 16

Allocation at farming stage between piglets and sows

	Unit	Price	Allocation factors
Piglets	24,8 p	40,80 €/pig	92,63%
Sow to slaughter	84,8 kg	0,95 €/kg live weight	7,37%

4.5.1.5 *Allocation within the slaughterhouse*

Slaughterhouse and rendering processes produce multiple outputs going to the food and feed chain or to other non-food or feed value chains as the leather industry or chemical or energy recovery chains.

Within the slaughterhouse and rendering module, subdivision shall be used for those process flows that are directly attributable to certain outputs. If it is not possible to subdivide the processes, the remaining flows (e.g. excluding those already allocated to milk for milk producing systems or to wool for wool producing systems) shall be allocated to the slaughterhouse and rendering outputs using economic allocation. Default allocation factors are provided in the following Sections for cattle, pigs and small ruminants (sheep, goat). These default values shall be used in OEF studies. Changes to the allocation factors are not allowed.

4.5.1.6 *Allocation within the slaughterhouse for cattle*

At the slaughterhouse, the allocation factors are established for the five product categories described in

Table 17. If allocation factors used for subdividing the impact of the carcass among the different cuts are preferred, they shall be defined and justified in the OEF study.

The by-products that originate from the slaughterhouse and rendering are classified in three categories:

Category 1: Risk materials, e.g. infected/ contaminated animals or animal by-products

— disposal and use: incineration, co-incineration, landfill, used as biofuel for combustion, manufacture of derived products.

Category 2: Manure and digestive tract content, products of animal origin unfit for human consumption:

— disposal and use: incineration, co-incineration, landfill, fertilisers, compost, used as biofuel for combustion, manufacture of derived products.

Category 3: Carcasses and parts of animals slaughtered which are fit for human consumption but are not intended to be used for this purpose for commercial reasons, including skins and hides going to the leather industry (note that hides and skins may also belong to other categories depending on the condition and nature that is determined by the accompanying sanitary documentation):

— disposal and use: incineration, co-incineration, landfill, feed, pet food, fertilisers, compost, used as biofuel for combustion, manufacture of derived products (e.g. leather), oleo-chemicals and chemicals.

The upstream burdens to slaughterhouse and rendering outputs shall be allocated as follows:

Food grade materials: product with allocation of upstream burdens.

Category 1 material: by default upstream burdens are not allowed, as it is seen as animal by-product treated as waste according to the CFF.

Category 2 material: by default upstream burdens are not allowed, as it is seen as animal by-product treated as waste according to the CFF.

Category 3 material has the same fate as that of Category 1 and Category 2 (for fat – to be burned, or bone and meat meal) **and does not have an economic value at the slaughterhouse gate**: by default upstream burdens are not allocated, as it is treated as waste according to the CFF.

Category 3 skins and hides (unless they are classified as waste and/or follow the same way as **Category** 1 and **Category** 2): product with allocation of upstream burdens.

Category 3 materials, not included in previous categories: product with upstream burdens allocated.

The default values in

Table 17 shall be used in OEF studies. Changes to allocation factors are not allowed.

Table 17

Economic allocation ratios for beef [1]

	Mass fraction	Price	Economic allocation (EA)	Allocation ratio (*) (AR)
	%	€/kg	%	
a) **Fresh meat and edible offal**	49,0	3,00	92,9[54]	1,90
b) **Food grade bones**	8,0	0,19	1,0	0,12
c) **Food grade fat**	7,0	0,40	1,8	0,25
d) **Cat. 3 slaughter by-products**	7,0	0,18	0,8	0,11
e) **Hides and skins**	7,0	0,80	3,5	0,51
f) **Cat 1/2 material and waste**	22,0	0,00	0,0	0,00

(1) Based on the PEF screening study (v 1.0, November 2015) of the pilot PEFCR on meat (bovine, pigs and sheep), available at https://webgate.ec.europa.eu/fpfis/wikis/pages/viewpage.action?pageId=81474527, ECAS registration needed to access the website.

(*) AR have been calculated as 'Economic allocation' divided by 'Mass fraction'

AR shall be used to calculate the environmental impact of a unit of product by using the equation below:

$$El_i = El_w * AR_i \quad \text{[Equation 18]}$$

Where, EI_i is the environmental impact per mass unit of product *i*, (*i* = a slaughterhouse output listed in **Table 17**), EI_w is the environmental impact of the whole animal divided by live weight mass of the animal and AR_i is the allocation ratio for product *i* (calculated as economic value of *i* divided by mass fraction of *i*).

EI_w shall include upstream impacts, slaughterhouse impacts that do not result from any specific product and impact from the management of slaughterhouse waste (cat. 1 and 2 material and waste in

Table 17). The default values for AR_i as shown in

Table 17 shall be used for the EF studies to represent the European average situation.

4.5.1.7 *Allocation within the slaughterhouse for pigs*

The default values in **Table 18** shall be used in OEF studies dealing with allocation within the slaughterhouse for pigs. Changing allocation factors based on company-specific data is not allowed.

Table 18

Economic allocation ratios for pigs [1]

	Mass fraction	Price	Economic allocation (EA)	Allocation ratio* (AR)
	%	€/kg	%	
a) **Fresh meat and edible offal**	67,0	1,08	98,67	1,54
b) **Food grade bones**	11,0	0,03	0,47	0,04
c) **Food grade fat**	3,0	0,02	0,09	0,03
d) **Category 3 slaughter by-products**	19,0	0,03	0,77	0,04
e) **Hides and skins (categorised in Category 3 products)**	0,0	0,00	0	0
Total	100,0		100,0	

[1] Based on the OEF screening study (v 1.0, November 2015) of the meat pilot, available at https://webgate.ec.europa.eu/fpfis/wikis/pages/viewpage.action?pageId=81474527

4.5.1.8 *Allocation within the slaughterhouse for sheep and goat*

The default values in Table **19** shall be used in OEF studies that deal with allocation within the slaughterhouse for sheep and goats. Changes to allocation factors based on company-specific data are not allowed. The same allocation factors used for sheep shall also be used for goats.

Table 19

Economic allocation ratios for sheep [1]

	Mass fraction	Price	Economic allocation (EA)	Allocation ratio* (AR)
	%	€/kg	%	
a) **Fresh meat and edible offal**	44,0	7	97,8[57]	2,22

b) **Food grade bones**	4,0	0,01	0,0127	0,0032
c) **Food grade fat**	6,0	0,01	0,0190	0,0032
d) **Category 3 slaughter by-products**	13,0	0,15	0,618	0,05
e) **Hides and skins (categorized in Category 3 products)**	14,0	0,35	1,6	0,11
f) **Category 1 and Category 2 material and waste**	19	0	0	0
Total	100		100	

([1]) Based on the OEF screening study (v 1.0, November 2015) of the meat pilot, available at https://webgate.ec.europa.eu/fpfis/wikis/pages/viewpage.action?pageId=81474527

4.6 *Data collection requirements and quality requirements*

4.6.1 Company-specific data

This Section describes company-specific LCI data, which are directly measured or collected at a specific facility or set of facilities, and representative of one or more activities or processes in the system boundary.

The data shall include all known inputs and outputs for the processes. Examples for inputs: use of energy, water, land, materials, etc. Examples of outputs: the products, co-products, emissions and waste generated. Emissions are divided into three compartments (emissions to air, to water and to soil).

There are several ways to collect company-specific emission, for example, they can be based on direct measurements or calculated using company-specific activity data and related emission factors (e.g. litre of fuel consumption and emission factors for combustion in a vehicle or boiler). Whenever the sector of the product in scope is covered by EU Emission Trade System (EU ETS) monitoring rules, the user of the OEF method should follow quantification requirements as set out in Regulation (EU) 2018/2066 for the processes and GHGs covered therein. For carbon capture and storage (CCS), the requirements of this Annex prevail. The data may need scaling, aggregation or other forms of mathematical treatment to bring them in line with the reporting unit.

Typical specific sources of company-specific data are:

(a) process- or plant-level consumption data;

(b) bills and stock/ inventory changes of consumables;

(c) emission measurements (amounts and concentrations of emissions from flue gas and wastewater);

(d) composition of products and waste;

(e) procurement and sale department(s)/ unit(s).

All new datasets created when conducting an OEF study shall be EF compliant.

All company-specific data shall be modelled in company-specific datasets.

4.6.2 Secondary data

Secondary data refer to data that are not based on direct measurements or on calculation of the respective processes in the system boundary. Secondary data are either sector-specific, i.e. specific to the sector being considered for the OEF study, or multi-sector. Examples of secondary data include:

(a) data from literature or scientific papers;

(b) industry average life-cycle data from LCI databases, industry association reports, government statistics, etc.

All secondary data shall be modelled in secondary datasets which shall fulfil the data hierarchy in Section 4.6.3 and the quality requirements specified in Section 4.6.5. The sources of these data used shall be clearly documented and reported in the OEF report.

4.6.3 Datasets to be used

OEF studies shall use secondary datasets that are EF compliant, when available. To develop secondary EF compliant datasets, the Guide for EF compliant datasets shall be followed ([53]). If an EF compliant secondary dataset does not exist or cannot be developed, the selection of the datasets to be used shall be done according to the following rules, provided in hierarchical order:

1. use an EF compliant proxy (if available); the use of proxy datasets shall be reported in the limitations section of the OEF report.

2. use an ILCD entry level (EL) compliant dataset as a proxy ([54]). A maximum of 10% of the single overall score may be derived from ILCD-EL compliant datasets .

3. if no EF compliant or ILCD-EL compliant dataset is available, then the process shall be excluded from the model. This shall be clearly stated in the in the 'limitations' section of the OEF report as a data gap and validated by the verifier.

4.6.4 Cut-off

Any cut-off shall be avoided, unless under the following rules:

Processes and elementary flows may be excluded up to 3.0% (cumulatively) based on material and energy flows and the level of environmental significance (single overall score). The processes subject to cut-off shall be made explicit and justified in the OEF report, in particular with reference to the environmental significance of the cut-off applied.

This cut-off has to be considered in addition to the cut-off already included in the background datasets. This rule is valid for both intermediate and final products.

The processes that in total (cumulatively) account for less than 3.0% of the material and energy flow as well as the environmental impact for each impact category may be excluded from OEF study.

A screening study is recommended to identify processes that may be subject to cut-off.

4.6.5 Data quality requirements

This Section describes how the data quality of EF compliant datasets shall be assessed. The data quality requirements are presented in Table 20.

— Two minimum requirements,

(i) completeness,

(ii) methodological appropriateness and consistency.

Once the processes and products are chosen, which represent the system analysed, and their LCIs are inventoried, the completeness criterion evaluates how much the LCI covers all the emissions and resources of the processes and products that are required to calculate all EF impact categories. Fulfilling the completeness criterion as well as being fully in line with the OEF method is a pre-requisite for EF compliant datasets. Therefore these two criteria are not qualitatively rated. The Guide for EF compliant data sets explains how they shall be reported in the data set ([55]) .

([53]) see https://eplca.jrc.ec.europa.eu/permalink/Guide_EF_DATA.pdf

([54]) In case an ILCD-EL compliant dataset is used, the nomenclature of the elementary flows shall be aligned with the EF reference package used by the EF compliant datasets in the rest of the model (available on the EF developer's page at the following link http://eplca.jrc.ec.europa.eu/LCDN/developerEF.xhtml).

([55]) https://eplca.jrc.ec.europa.eu/permalink/Guide_EF_DATA.pdf

— Four quality criteria: technological, geographical, time-related representativeness, and precision. These criteria shall be subject to a scoring procedure. The Guide for EF compliant data sets explains how they shall be reported in the data set ([56]) .

— Three quality aspects: documentation, nomenclature and review. These criteria are not included within the semi-quantitative assessment of the data quality. The Guide for EF compliant datasets ([57]) explains how the three quality aspects shall be performed and reported in the dataset(s).

Table 20

Data quality criteria, documentation, nomenclature and review ([58])

Minimum requirements	Completeness Methodological appropriateness and consistency ([1])
Data quality criteria (scored)	Technological Representativeness ([2]) (TeR) Geographical Representativeness ([3]) (GeR) Time-related Representativeness ([4]) (TiR) Precision ([5]) (P)
Documentation	Compliant with the ILCD format and with additional requirements on the metadata information available in the Guide for EF compliant datasets ([6])
Nomenclature	Compliant with the ILCD nomenclature structure (use of EF reference elementary flows for IT compatible inventories; see detailed requirements in Section 4.3)
Review	Review by 'Qualified reviewer' Separate review report

([1]) The term 'methodological appropriateness and consistency' used in relation to this procedure method is equivalent to 'consistency' used in EN ISO 14044:2006
([2]) The term "technological representativeness" used throughout this method is equivalent to "technological coverage" used in EN ISO 14044:2006.
([3]) The term "geographical representativeness" used throughout this method is equivalent to "geographical coverage" used in EN ISO 14044:2006.
([4]) The term "time-related representativeness" used throughout this method is equivalent to "time-related coverage" used in EN ISO 14044:2006.
([5]) The term "parameter uncertainty" used throughout this method is equivalent to "precision" used in EN ISO 14044:2006.
([6]) https://eplca.jrc.ec.europa.eu/permalink/Guide_EF_DATA.pdf

Each data quality criterion to be scored (TeR, GeR, TiR and P) is rated according to the five levels listed in Table 21.

Table 21

Data quality rating (DQR) and data quality levels of each data quality criterion

DQR of data quality criteria (TeR, GeR, TiR, P)	Data quality level
1	Excellent
2	Very Good
3	Good

([56]) https://eplca.jrc.ec.europa.eu/permalink/Guide_EF_DATA.pdf
([57]) https://eplca.jrc.ec.europa.eu/permalink/Guide_EF_DATA.pdf
([58]) Detailed requirements regarding documentation and review are provided http://eplca.jrc.ec.europa.eu/LCDN/developerEF.xhtml.

4	Fair
5	Poor

4.6.5.1 *DQR formula*

Within the EF context, the data quality of each new EF compliant dataset and of the total OEF study shall be calculated and reported. The DQR calculation shall be based on four data quality criteria:

$$\boldsymbol{DQR} = \frac{\boldsymbol{TeR+GeR+TiR+P}}{\boldsymbol{4}} \qquad \text{[Equation 19]}$$

where TeR is the Technological-Representativeness, GeR is the Geographical-Representativeness, TiR is the Time-Representativeness, and P is Precision.

The representativeness (technological, geographical and time-related) characterises the degree to which the processes and products selected depict the system analysed, while the precision indicates the way the data are derived and the related level of uncertainty.

Five quality levels (from excellent to poor) can be attained according to the Data Quality Rating (DQR), are summarised in Table 22.

Table 22

Overall data quality level of EF compliant datasets, according to the achieved data quality rating

Overall DQR	Overall data quality level
DQR ≤ 1.5	'Excellent quality'
1.5 < DQR ≤ 2.0	'Very good quality'
2.0 < DQR ≤ 3.0	'Good quality'
3 < DQR ≤ 4.0	'Fair quality'
DQR >4	'Poor quality'

The DQR formula is applicable to:

1. company-specific datasets: Section 4.6.5.2 describes the procedure for calculating the DQR of company-specific datasets;

2. secondary datasets: when using a secondary EF compliant dataset in an OEF study (procedure described in Section 4.6.5.3);

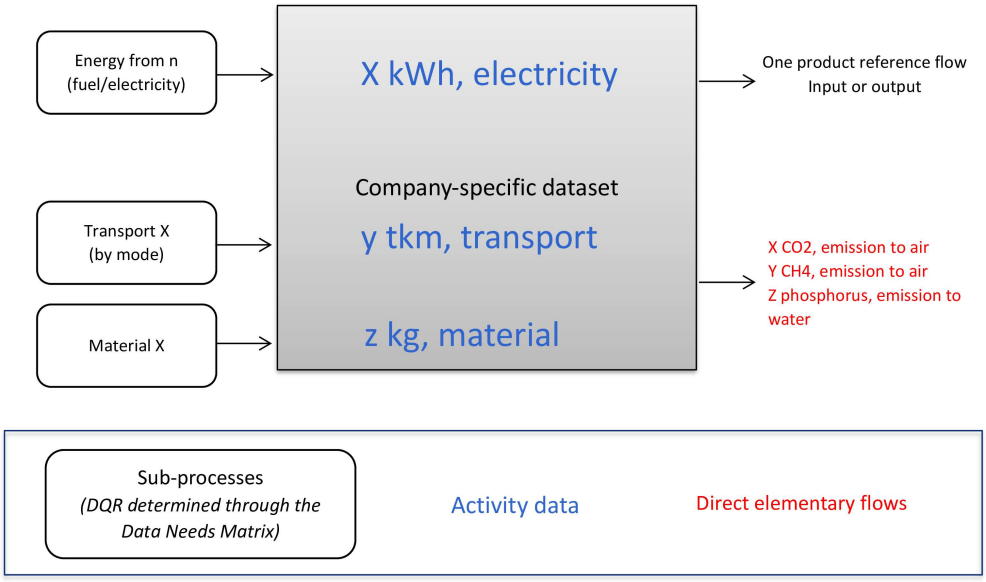
OEF study (procedure described in Section 4.6.5.8)

4.6.5.2 *DQR of company-specific datasets*

When creating a company-specific dataset, the data quality of i) the company-specific activity data and ii) the company-specific direct elementary flows (i.e. emission data) shall be assessed separately. The DQR of the sub-processes linked to the activity data (see Figure 9) is evaluated through the requirements provided in the Data Needs Matrix (Section 4.6.5.4).

Figure 9

Graphical representation of a company-specific dataset



A company-specific dataset is a partially disaggregated one: the DQR of the activity data and direct elementary flows shall be assessed. The DQR of the sub-processes shall be assessed through the Data Needs Matrix.

The DQR of the newly developed dataset shall be calculated as follows:

1. Select the most-relevant activity data and direct elementary flows: most-relevant activity data are those linked to sub-processes (i.e. secondary datasets) accounting for at least 80% of the total environmental impact of the company-specific dataset. List them in order, from those which contribute the most to those which contribute the least. Most-relevant direct elementary flows are defined as those which contribute cumulatively at least with 80% to the total impact of the direct elementary flows.

2. Calculate the DQR criteria - TeR, TiR, GeR and P - for each type of the most-relevant activity data and each type of most-relevant direct elementary flow using Table 23.

   a. Each most-relevant direct elementary flow consists of the amount and elementary flow naming (e.g. 40 g CO_2). For each most-relevant elementary flow, the 4 DQR criteria - TeR_{EF}, TiR_{EF}, GeR_{EF}, P_{EF} - shall be evaluated (e.g. the timing of the flow measured, for which technology the flow was measured and in which geographical area).

   b. For each most-relevant activity data, the 4 DQR criteria shall be evaluated (named TeR_{AD}, TiR_{AD}, GeR_{AD}, P_{AD}).

   c. Considering that both activity data and direct elementary flows shall be company specific, the score of P cannot be higher than 3 while the score for TiR, TeR, and GeR cannot be higher than 2 (the DQR score shall be ≤1.5).

3. Calculate as a percentage the environmental contribution of each most-relevant activity data (by linking to the appropriate sub-process) and direct elementary flow to the total sum of the environmental impact of all most-relevant activity data and direct elementary flows, (weighted, using all EF impact categories). For example, the newly developed dataset has only two most-relevant activity data, contributing to 80% of the total environmental impact of the dataset:

   Activity data 1 carries 30% of the total dataset environmental impact. This process contributes 37.5% (the weight to be used) to the total of 80%..

   Activity data 2 carries 50% of the total dataset environmental impact. This process contributes 62.5% (the weight to be used) to the toal of 80%.

4. Calculate the TeR, TiR, GeR and P criteria of the newly developed dataset as the weighted average of each criteria of the most-relevant activity data and direct elementary flows. The weight is the relative contribution (in %) of each most-relevant activity data and direct elementary flow calculated in step 3.

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

$$DQR = \frac{\overline{Te_R}+\overline{Ge_R}+\overline{Ti_R}+\overline{P}}{4} \qquad \text{[Equation 20]}$$

Table 23

How to assign the values to DQR criteria when using company-specific information. No criteria shall be modified.

Rating	P_{EF} and P_{AD}	TiR_{EF} and TiR_{AD}	TeR_{EF} and TeR_{AD}	GeR_{EF} and GeR_{AD}
1	Measured/calculated and externally verified	The data refers to the most recent annual administration period regarding the EF report publication date	The elementary flows and the activity data explicitly depict the technology of the newly developed dataset	The activity data and elementary flows reflect 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 of two annual administration periods regarding the EF report publication date	The elementary flows and the activity data are a proxy of the newly developed dataset's technology	The activity data and elementary flows) partly reflect 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 of three annual administration periods regarding the EF report publication date	Not applicable	Not applicable
4-5	Not applicable	Not applicable	Not applicable	Not applicable

P_{EF}: Precision for elementary flows; **P_{AD}**: Precision for activity data; **TiR_{EF}**: Time representativeness for elementary flows; **TiR_{AD}**: Time representativeness for activity data; **TeR_{EF}**: Technology representativeness for elementary flows; **TeR_{AD}**: Technology representativeness for activity data**; GeR_{EF}**: Geographical representativeness for elementary flows; **GeR_{AD}:** Geographical representativeness for activity data.

4.6.5.3 *DQR of secondary datasets used in OEF studies*

This Section describes the procedure for calculating the DQR of secondary datasets used in an OEF study. This involves re-calculating the DQR of the EF compliant secondary dataset (calculated by the data provider), when they are used in the modelling of most-relevant processes (see Section 4.6.5.4), to allow the user of the OEF method to assess the context-specific DQR criteria (i.e. TeR, TiR and GeR of most-relevant processes). The TeR, TiR and GeR criteria shall be re-evaluated based on Table 24. Modifying criteria is not allowed. The total DQR of the dataset shall be recalculated using Equation 19.

Table 24

How to assign the values to DQR criteria when using secondary datasets.

Rating	TiR	TeR	GeR
1	The EF report publication date is 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 for which the dataset is valid
2	The EF report publication date is 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) for which the dataset is valid for
3	The EF report publication date is 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 for which the dataset is valid for
4	The EF report publication date is 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) for which the dataset is valid, but it is estimated that there are sufficient similarities based on expert judgement.
5	The EF report publication date is more than 6 years after the time validity of the dataset, or the time validity is not specified	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

TiR: Time representativeness; **TeR**: Technology representativeness; **GeR:** Geographic representativeness.

4.6.5.4 *The Data Needs Matrix (DNM)*

The DNM shall be used to evaluate the data requirements of all processes required to model the product in scope (see

Table 25). It indicates for which processes company-specific data or secondary data shall or may be used, depending on how much influence the company has over the process. The following three cases are found in the DNM and explained below:

1. **Situation 1:** the process is run by the company conducting the OEF study.

2. **Situation 2:** the process is not run by the company conducting the OEF study, but this company has access to (company-)specific information.

3. **Situation 3:** the process is not run by the company conducting the OEF study and this company does not have access to (company-)specific information.

The user of the OEF method shall do the following:

1. Determine how much influence (Situation 1, 2 or 3) the company has over each process in its supply chain. This decision determines which of the options in

2. Table 25 is pertinent to each process;

3. Provide a table in the OEF report listing all processes and their situation according to the DNM;

4. Follow the data requirements indicated in Table 25;

5. Calculate/ re-evaluate the DQR values (for each criterion + total) for the datasets of most-relevant processes and the new ones created, as indicated in Sections 4.6.5.6 – 4.6.5.8.

Table 25

DNM – requirements for a company conducting an OEF study

The options indicated for each situation are not listed in hierarchical order

		Data requirements
Situation 1: process run by the company	**Option 1**	Provide company-specific data (both activity data and direct emissions) and create a company-specific dataset (DQR≤1.5). Calculate DQR of the dataset following the rules in Section 4.6.5.2.
Situation 2: process not run by the company but with access to company-specific information	**Option 1**	Provide company-specific data and create a company-specific dataset (DQR≤1.5). Calculate DQR of the dataset following the rules in Section 4.6.5.2.
	Option 1	Use an EF compliant secondary dataset and apply 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). Recalculate DQR of the dataset used (see Section 4.6.5.6).
Situation 3: process not run by the company and without access to company-specific information	**Option 1**	Use an EF compliant secondary dataset in aggregated form (DQR≤3.0). Recalculate DQR of the dataset if the process is most-relevant (see Section 4.6.5.7)

Note that for any EF compliant secondary dataset, an ILCD-EL compliant dataset may be used. This up to a maximum contribution of 10% of the single overall score of the product in scope (see Section 4.6.3). For these datasets the DQR shall not be recalculated.

4.6.5.5 *DNM, Situation 1*

For all processes run by the company and where the company performing the OEF study uses company-specific data, the DQR of the newly developed EF compliant dataset shall be evaluated as described in Section 4.6.5.2.

4.6.5.6 *DNM, Situation 2*

When a process takes place under Situation 2 (i.e. the company conducting the OEF study is not running the process but has access to company-specific data) there are two possible options:

1. The user of the OEF method has access to extensive supplier-specific information and wants to create a new EF compliant dataset (Option 1);

2. The company has some supplier-specific information and wants to make some minimum changes (Option 2);

Situation 2/Option 1

For all processes not run by the company and where the company conducting the OEF study uses company-specific data, the DQR of the newly developed EF compliant dataset shall be evaluated as described in Section 4.6.5.2.

Situation 2/Option 2

A disaggregated secondary EF compliant dataset is used for processes in Situation 2/Option 2. The company conducting the OEF study shall:

— use company-specific activity data for transport;

— substitute the sub-processes for the electricity mix and transport used in the disaggregated secondary EF compliant dataset with supply chain specific EF compliant datasets.

Company-specific R_1 values may be used. The user of the OEF method shall recalculate the DQR criteria for the processes in Situation 2/Option 2. It shall make the DQR context-specific by re-evaluating TeR and TiR using **Table 24**. The GeR criterion shall be lowered by 30% and the P criterion shall keep the original value.

4.6.5.7 *DNM, situation 3*

If a process takes place under Situation 3 (i.e. the company conducting the OEF study is not running the process and this company does not have access to company-specific data), the company conducting the OEF study shall use EF compliant secondary datasets.

In the case of a most-relevant process, following the procedure described in Section 7.3, the user of the OEF method shall make the DQR criteria context-specific by re-evaluating TeR, TiR and GeR using Table 24. The parameter P shall keep the original value.

For the non-most-relevant processes, following the procedure described in Section 7.3, the company conducting the OEF study shall take the DQR values from the original dataset.

4.6.5.8 *DQR of an OEF study*

To calculate the DQR of the OEF study, the user of the OEF method shall calculate the TeR, TiR, GeR and P separately. They shall be calculated as the weighted average of the DQR scores of all most-relevant processes, based on their relative environmental contribution to the single overall score, using Equation 20.

5. Environmental footprint impact assessment

Once the LCI has been compiled, the EF impact assessment ([59]) shall be carried out to calculate the environmental performance of the product, using all the EF impact categories and models. EF impact assessment includes four steps: classification, characterisation, normalisation and weighting. Results of an OEF study shall be calculated and reported in the OEF report as characterised, normalised and weighted results for each EF impact category and as a single overall score based on the weighting factors provided in Section 6.5.2.2. Results shall be reported for (i) the total life-cycle, and (ii) the total life-cycle excluding the use stage.

([59]) The EF Impact Assessment does not intend to replace other (regulatory) methods that have a different scope and objective such as (Environmental) Risk Assessment ((E)RA), site- specific Environmental Impact Assessment (EIA) or health and safety regulations at product level or related to safety at the workplace. In particular, the EF Impact Assessment does not have the objective of predicting if at any specific location at any specific time thresholds are exceeded and actual impacts occur. In contrast, it describes the existing pressures on the environment. Thus, the EF Impact Assessment is complementary to other well-proven tools, adding the life- cycle perspective

5.1. *Classification and characterisation*

5.1.1 Classification

Classification requires assigning the material/ energy inputs and outputs inventoried in the LCI to the relevant EF impact category. For example, during the classification phase, all inputs/ outputs that result in GHG emissions are assigned to the climate change category. Similarly, those that result in emissions of ozone-depleting substances are assigned to the ozone depletion category. In some cases, an input or output may contribute to more than one EF impact category (for example, chlorofluorocarbons (CFCs) contribute to both climate change and ozone depletion).

It is important to express the data in terms of the constituent substances for which characterisation factors (see next Section) are available. For example, data for a composite NPK fertiliser shall be disaggregated and classified according to its N, P, and K fractions, because each constituent element will contribute to different EF impact categories. In practice, much of the LCI data may be drawn from existing public or commercial LCI databases, where classification has already been implemented. In such cases, it must be assured, e.g. by the provider, that the classification and linked EF impact assessment pathways correspond to the requirements of the OEF method.

All inputs and outputs inventoried while the LCI is being compiled shall be assigned to the EF impact categories to which they contribute using the classification data made available by the European Commission JRC ([60]) .

As part of the classification of the LCI, data should be expressed in terms of constituent substances for which characterisation factors are available, as far as possible.

5.1.2 Characterisation

Characterisation refers to the calculating of the magnitude of the contribution of each classified input and output to their respective EF impact categories, and aggregating of the contributions within each category. This is carried out by multiplying the values in the LCI by the relevant characterisation factor for each EF impact category.

The characterisation factors are substance- or resource-specific. They represent the impact intensity of a substance relative to a common reference substance for an EF impact category (impact category indicator). For example, when calculating climate change impacts, all GHG emissions inventoried in the LCI are weighted in terms of their impact intensity relative to carbon dioxide, which is the reference substance for this category. This allows for the impact potentials and expression to be aggregated in terms of a single equivalent substance (in this case, CO_2 equivalents) for each EF impact category.

All classified inputs and outputs in each EF impact category shall be assigned characterisation factors representing the contribution per unit of input or output to the category, using the provided characterisation factors ([61]). EF impact assessment results shall subsequently be calculated for each EF impact category by multiplying the amount of each input/output by its characterisation factor and summing the contributions of all inputs/outputs within each category to obtain a single measure expressed in the appropriate reference units.

5.2. *Normalisation and weighting*

Following the steps of classification and characterisation, the EF impact assessment shall be complemented with normalisation and weighting.

5.2.1 Normalisation of environmental footprint impact assessment results

Normalisation is the step in which the LCIA results are divided by normalisation factors to calculate and compare the magnitude of their contributions to the EF impact categories relative to a reference unit. As a result, dimensionless, normalised results are obtained. These reflect the burdens that are attributed to a product relative to the reference unit. Within the OEF method the normalisation factors are expressed per capita based on a global value ([62]).

([60]) http://eplca.jrc.ec.europa.eu/LCDN/developerEF.xhtml
([61]) Available online at http://eplca.jrc.ec.europa.eu/LCDN/developerEF.xhtml
([62]) The EF normalisation factors to be used are available at http://eplca.jrc.ec.europa.eu/LCDN/developerEF.xhtml

Normalised environmental footprint results do not, however, indicate the severity or relevance of the respective impacts.

In OEF studies, normalised results shall not be aggregated as this implicitly applies weighting. Characterised results shall be reported alongside the normalised results.

5.2.2 Weighting of environmental footprint impact assessment results

Weighting is a mandatory step in OEF studies and it supports the interpretation and communication of the analysis results. In this step, normalised results are multiplied by a set of weighting factors (in %) which reflect the perceived relative importance of the life-cycle impact categories considered. Weighted results of different impact categories may then be compared to assess their relative importance. They may also be aggregated across life-cycle impact categories to obtain a single overall score, expressed in points.

The underpinning process to develop the weighting factors is reported in Sala et al. 2018. The weighting factors ([63]) that shall be used in OEF studies are provided online ([64]) ([65]).

The results of the EF impact assessment prior to weighting (i.e. characterised and normalised) shall be reported alongside weighted results in the OEF report.

6. **Interpretation of organisation environmental foootprint results**

6.1. *Introduction*

Interpretating of the results of the OEF study serves two purposes:

1. Firstly, to ensure that the performance of the OEF model corresponds to the study's goals and quality requirements. In this sense, life-cycle interpretation may inform iterative improvements of the OEF model until all goals and requirements are met;

2. Secondly, to derive robust conclusions and recommendations from the analysis, for example, in support of environmental improvements.

To meet these objectives, the interpretation phase shall include the steps outlined in this Section.

6.2. *Assessment of the robustness of the organisation environmental footprint model*

Assessing the robustness of the OEF model evaluates the extent to which methodological choices such as the system boundary, data sources, and allocation choices influence the analytical outcomes.

Tools that should be used to assess the OEF model's robustness include the following:

(a) **Completeness checks**: to assess the LCI data to ensure that it is complete relative to the defined goals, scope, system boundary and quality criteria. This includes completeness of process coverage (i.e. all processes at each supply chain stage considered have been included) and input/output coverage (i.e. all material or energy inputs and emissions associated with each process have been included).

(b) **Sensitivity checks**: to assess the extent to which the results are determined by specific methodological choices, and the impact of implementing alternative choices where these can be identified. It is useful to structure sensitivity checks for each phase of the OEF study, including goal and scope definition, the LCI, and the EF impact assessment.

(c) **Consistency checks**: to assess the extent to which assumptions, methods, and data quality considerations have been applied consistently throughout the OEF study.

([63]) For more information on existing weighting approaches in OEF, please refer to the reports developed by the JRC available online at http://ec.europa.eu/environment/eussd/smgp/documents/2018_JRC_Weighting_EF.pdf

([64]) http://eplca.jrc.ec.europa.eu/LCDN/developerEF.xhtml

([65]) Please note that the weighting factors are expressed in % and thus shall be divided by 100 before applying in the calculations.

Any issues flagged in this evaluation may be used to inform iterative improvements to the OEF study.

6.3. *Identification of hotspots: most-relevant impact categories, life-cycle stages, processes and elementary flows*

Once the user of the OEF method ensures that the OEF model is robust and conforms to all aspects defined in the goal and scope definition phases, the main contributing elements to the OEF results shall be identified. This step may also be referred to as 'hotspot' analysis. The user of the OEF method shall identify and list in the OEF report (together with the %) the most-relevant:

1. impact categories,
2. life cycle stages (mandatory if the PP is made of products. Optional if the PP includes services),
3. processes, and
4. elementary flows.

There is an important operational difference between most-relevant impact categories, and life-cycle stages on one hand and most-relevant processes, and elementary flows on the other. In particular, most-relevant impact categories and life-cycle stages may be mainly relevant in the context of communicating the results of an OEF study. They might serve to highlight environmental areas where the organisation 'should focus their attention.

Identifying the most-relevant processes and elementary flows is more important for the engineers and designers to identify actions for improving the overall footprint e.g. by-passing or changing a process, further optimising a process, or applying anti-pollution technology. This is particularly relevant for internal studies, to look deeper into how to improve the product's environmental performance. The procedure that shall be followed to identify the most-relevant impact categories, life-cycle stages, processes and elementary flows is described in the following Sections.

6.3.1 Procedure to identify the most-relevant impact categories

The identification of the most-relevant impact categories shall be based on the normalised and weighted results. The most-relevant impact categories shall be identified as all of those impact categories that together contribute to at least **80%** to the single overall score. This shall start from the largest to the smallest contributions.

At least three relevant impact categories shall be identified as most-relevant ones. The user of the OEF method may add more impact categories to the list of the most-relevant ones but none shall be deleted.

6.3.2 Procedure to identify the most-relevant life-cycle stages

The most-relevant life-cycle stages are those that together contribute to at least **80%** to any of the most-relevant impact categories identified. This shall start from the largest to the smallest contributions. The user of the OEF method may add more life-cycle stages to the list of the most-relevant ones but none shall be deleted. As a minimum, the life-cycle stages described at Section 4.2 shall be considered.

If the use stage accounts for more than 50% of the total impact of a most-relevant impact category, the procedure shall be re-run with the exclusion of the use stage. In this case, the list of most-relevant life-cycle stages shall be those selected through the latter procedure plus the use stage.

6.3.3 Procedure to identify the most-relevant processes

Each most-relevant impact category shall be further investigated by identifying the most-relevant processes used to model the product in scope. The most-relevant processes are those that collectively contribute to at least **80%** to any of the most-relevant impact categories identified. Identical processes ([66]) taking place in different life-cycle stages (e.g. transportation, electricity use) shall be accounted for separately. Identical processes taking place within the same life-cycle stage shall be accounted for together. The list of most-relevant processes shall be reported in the OEF report together with the respective life-cycle stage (or multiple life-cycle stages if relevant) and the table 26

([66]) Two processes are identical when they have the same UUID.

Table 26

Criteria to select at which life-cycle stage level to identify the most-relevant processes

Contribution of the use stage to the total impact of a most-relevant impact category	Most-relevant processes identified at the level of
≥ 50%	whole life-cycle excluding use stage, and use stage
< 50%	whole life-cycle

This analysis shall be reported separately for each most-relevant impact category. The user of the OEF method may add more processes to the list of the most-relevant ones but none shall be deleted.

6.3.4 Procedure to identify the most-relevant elementary flows

The most-relevant elementary flows are defined as those elementary flows that together contribute at least **80%** to the total impact of each most-relevant specific impact category for each most-relevant processes, starting from those that contribute the most to those that contribute the least. This analysis shall be reported separately for each most-relevant impact category.

Elementary flows belonging to the background system of a most-relevant process may dominate the impact. Therefore, if disaggregated datasets are available, the user of the OEF method should also identify the most-relevant direct elementary flows for each most-relevant process.

Most-relevant direct elementary flows are defined as those direct elementary flows that together contribute at least with **80%** to the total impact of the direct elementary flows of the process, for each most-relevant impact category. The analysis shall be limited to the direct emissions of the level-1 disaggregated datasets ([67]). This means that the 80% cumulative contribution shall be calculated against the impact caused by the direct emissions only, and not against the total impact of the process.

The user of the OEF method may add more elementary flows to the list of those that are most-relevant but none shall be deleted. The list of most-relevant elementary flows (or, if applicable, direct elementary flows) per most-relevant process shall be reported in the OEF report.

6.3.5 Dealing with negative numbers

When identifying the percentage impact contribution for any process or elementary flow, it is important that absolute values be used. This makes it possible to identify the relevance of any credits (e.g., from recycling). In case of processes or flows with a negative impact score, the following procedure shall be applied:

(a) consider the absolute values (i.e. impacts of processes or flows to have a plus sign, namely a positive score),

(b) the total impact score needs to be recalculated including the converted negative scores,

(c) the total impact score is set to 100%,

(d) the percentage impact contribution for any process or elementary flow is assessed to this new total.

This procedure does not apply to identify the most-relevant life-cycle stages.

6.3.6 Summary of requirements

Table 27 summarises the requirements to define most-relevant contributions.

([67]) See http://eplca.jrc.ec.europa.eu/LCDN/developerEF.xhtml) for description of level-1 disaggregated datasets

Table 27

Summary of requirements to define most-relevant contributions

Item	At what level does relevance need to be identified?	Threshold
Most-relevant impact categories	Single overall score	Impact categories that together contribute to at least **80%** of the single overall score
Most-relevant life-cycle stages	For each most-relevant impact category	All life-cycle stages that together contribute more than **80%** to that impact category. If the use stage accounts for more than 50% of the total impact of a most-relevant impact category, the procedure shall be re-run, excluding the use stage
Most-relevant processes	For each most-relevant impact category	All processes that together contribute (along the entire life-cycle) more than **80%** to that impact category, considering absolute values.
Most-relevant elementary flows	For each most-relevant process considering the most-relevant impact categories	All elementary flows that together contribute to at least 80% of the total impact of a most-relevant impact category for each most-relevant process. If disaggregated data are available: for each most-relevant process, all direct elementary flows that together contribute to at least to **80%** to that impact category (caused by the direct elementary flows only).

6.3.7 Example

Fictitious examples are provided below, which are not based on any specific OEF study results.

Most-relevant impact categories

Table 28

Contribution of different impact categories based on normalised and weighted results – example

Impact category	Contribution to the total impact (%)
Climate change	21,5
Ozone depletion	3,0
Human toxicity, cancer	6,0
Human toxicity, non-cancer	0,1
Particulate matter	14,9
Ionizing radiation, human health	0,5
Photochemical ozone formation, human health	2,4
Acidification	1,5

Eutrophication, terrestrial	1,0
Eutrophication, freshwater	1,0
Eutrophication, marine	0,1
Ecotoxicity, freshwater	0,1
Land use	14,3
Water use	18,6
Resource use, minerals and metals	6,7
Resource use, fossils	8,3
Total most-relevant impact categories (%)	**84,3**

Based on the normalised and weighted results, the most-relevant impact categories are: climate change, particulate matter, water use, land use, and resource use (minerals and metals and fossils) for a cumulative contribution of 84.3% of the total impact.

Most-relevant life-cycle stages

Table 29

Contribution of different life-cycle stages to the climate change impact category (based on the characterised inventory results) – example

Life-cycle stage	Contribution (%)
Raw material acquisition and pre-processing	46,3
Production of the main product	21,2
Product distribution and storage	16,5
Use stage	5,9
End of life	10,1
Total most-relevant life-cycle stages (%)	**88,0**

The three life-cycle stages in red will be the ones identified as 'most-relevant' for climate change as they are contributing to more than 80%. Ranking shall start from the highest contributors.

This procedure shall be repeated for all the selected most-relevant EF impact categories that are selected.

Most-relevant processes

Table 30

Contribution of different processes to the climate change impact category (based on the characterised inventory results) - example

Life-cycle stage	Unit process	Contribution (%)
Raw material acquisition and pre-processing	Process A	4,9
	Process B	41,4
Production of the main product	Process C	18,4
	Process D	2,8
Product distribution and storage	Process E	16,5

Use stage	Process F	5,9
EoL	Process G	10,1
Total most-relevant processes (%)		**86,4**

According to the proposed procedure the processes B, C, E and G shall be selected as the 'most-relevant'.

This procedure shall be repeated for all the selected most-relevant impact categories that are selected.

Dealing with negative numbers and identical processes in different life-cycle stages

Table 31

Example on how to deal with negative numbers and identical process in different life-cycle stages

Impact Category 1 (Characterised results)

1. Characterised results of a most relevant EF Impact Category

	LC stage 1	LC stage 2	LC stage 3	LC stage 4	LC stage 5	total per process	% per process
Process A	18	23				41	44%
Process B			13			13	14%
Process C	17				-9	8	9%
Process D	5			6		11	12%
Process E	4	4	4	4	4	20	22%
Total of LC						93	100%

2. Convert everything to absolute values

	LC stage 1	LC stage 2	LC stage 3	LC stage 4	LC stage 5	total per process	% per process
Process A	18	23				41	38%
Process B			10			10	9%
Process C	17				9	26	24%
Process D	5			6		11	10%
Process E	4	4	4	4	4	20	19%
Total of LC						108	100%

Most relevant processes

3. Calculate the % per process and life cycle stage

	LC stage 1	LC stage 2	LC stage 3	LC stage 4	LC stage 5	total per process (absolute values)	% per process
Process A	17%	21%				41	38%
Process B			9%			10	9%
Process C	16%				8%	26	24%
Process D	5%			6%		11	10%
Process E	4%	4%	4%	4%	4%	20	19%
Total of LC						108	100%

6.4. *Conclusions and recommendations*

The final part of the EF interpretation phase involves:

(a) drawing conclusions based on the analytical results;

(b) answering the questions posed at the outset of the OEF study, and

(c) advancing recommendations appropriate to the intended audience and context whilst explicitly taking into account any limitations as to the robustness and applicability of the results.

The OEF complements other assessments and instruments such as site-specific environmental impact assessments or chemical risk assessments.

Potential improvements should be identified, for example using cleaner technology or production techniques, changes in product design, applying environmental management systems (e.g. eco-management and audit scheme (EMAS) or EN ISO 14001:2015), or other systematic approaches.

Conclusions, recommendations and limitations shall be described in accordance with the defined goals and scope of the OEF study. The conclusions should include a summary of identified supply chain 'hotspots' and the potential improvements thanks to management interventions.

7. Organisation environmental footprint reports

7.1. *Introduction*

An OEF report complements the OEF study providing a relevant, comprehensive, consistent, accurate, and transparent summary of the OEF study. It reproduces the best possible information in such a way as to maximise its usefulness to intended current and future users, whilst transparently communicating the limitations. Effective OEF reporting requires that several criteria, both procedural (report quality) and substantive (report content), are met. An OEF report template is available in Part E of the Annex IV. This template includes the minimum information to be reported in an OEF report.

At a minimum, an OEF report consists of: a summary, the main report, the aggregated EF compliant dataset and an annex. Confidential and proprietary information may be documented in a fourth item - a complementary confidential report. Review reports are annexed.

7.1.1. Summary

The summary shall be able to stand alone without compromising the results and conclusions/recommendations (if included). The summary shall fulfil the same criteria about transparency, consistency, etc. as the detailed report. To the extent possible, the summary should be written targeting a non-technical audience.

7.1.2. Aggregated EF compliant dataset

For each product in scope of the OEF study, the user shall make an aggregated EF compliant dataset available

If the user of the OEF method or of the OEFSR publishes such an EF compliant dataset, the OEF report on the basis of which the dataset is generated shall also be made public.

7.1.3. Main report

The main report ([68]) shall, as a minimum, include the following components:

1. general information,
2. goal of the study,
3. scope of the study,
4. life-cycle inventory analysis,
5. life-cycle impact assessment results,
6. interpreting OEF results.

7.1.4. Validation statement

See Section 8.5.3

7.1.5. Annexes

The annexes serve to document supporting elements to the main report which are of a more technical nature (e.g detailed calculations for data quality assessment, alternative approach for nitrogen field model when an OEF study has agricultural modelling in scope, results of sensitivity analysis, assessment of the OEF model's robustness, bibliographic references).

([68]) The main report, as defined here, is insofar as possible in line with EN ISO 14044:2006 requirements on reporting for studies which do not contain comparative assertions to be disclosed to the public.

7.1.6. Confidential report

The confidential report is an optional. If used, it shall contain all data (including raw data) and information that are confidential or proprietary and may not be made externally available. The confidential report shall be made available for the verification and validation procedure of the OEF study (see Section 8.4.3).

8. Verification and validation of OEF studies, reports, and communication vehicles

If policies on implementing the OEF method define specific requirements as regards verification and validation of OEF studies, reports and communication vehicles, then these requirements in said policies shall prevail.

8.1. *Defining the scope of the verification*

The verification and validation of the OEF study is mandatory whenever the study, or part of the information therein, is used for any type of external communication (i.e. communication to any interested party other than the commissioner or the user of the OEF method of the study).

Verification means the conformity assessment process carried out by an environmental footprint verifier(s) to check whether the OEF study has been carried out in compliance with Annex III.

Validation means the confirmation by the environmental footprint verifier(s) who carried out the verification, that the information and data included in the OEF study, the OEF report and the communication vehicles available at the time of validation process are reliable, credible and correct.

The verification and validation shall cover the following three areas:

1. the OEF study (including, but not limited to the data collected, calculated, and estimated and the underlying model);
2. the OEF report;
3. the technical content of the communication vehicles, if applicable.

The verification of the OEF study shall ensure that the OEF study is conducted in compliance with Annex III or the applicable OEFSR.

The validation of information in the OEF study shall ensure that:

(a) the data and information used for the OEF study are consistent, reliable and traceable;

(b) the calculations performed do not include significant ([69]) mistakes.

The verification and validation of the OEF report shall ensure that:

(a) the OEF report is complete, consistent, and compliant with the OEF report template provided in Part E of Annex IV;

(b) the information and data included are consistent, reliable and traceable;

(c) the mandatory information and Sections are included and appropriately filled in;

(d) all the technical information that could be used for communication purposes, independently from the communication vehicle to be used, are included in the report.

Note: confidential information shall be validated, while it may be excluded from the OEF report.

The validation of the technical content of the communication vehicle content shall ensure that :

(a) the technical information and data included are reliable and consistent with the information included in the OEF study and in the OEF report;

(b) that the information is compliant with the requirements of the Unfair Commercial Practices Directive ([70]);

([69]) Mistakes are significant if they change the final result by more than 5% for any of the impact categories, or the identified most-relevant impact categories, life-cycle stages and processes.

([70]) Directive 2005/29/EC of the European Parliament and of the Council of 11 May 2005 concerning unfair business-to-consumer commercial practices in the internal market and amending Council Directive 84/450/EEC, Directives 97/7/EC, 98/27/EC and 2002/65/EC of the European Parliament and of the Council and Regulation (EC) No 2006/2004 of the European Parliament and of the Council ('Unfair Commercial Practices Directive')

(c) that the communication vehicle complies with the principles of transparency, availability and accessibility, reliability, completeness, comparability and clarity, as described in the Commission Communication on Building the Single Market for Green Products ([71]).

8.2. *Verification procedure*

The verification procedure covers the following steps:

1. The commissioner shall select the verifier(s) or verification team following the rules outlined in Section 9.3.1;

2. The verification shall take place following the verification process described in Section 9.4;

3. The verifier(s) shall communicate to the commissioner any misstatement, non-conformities and need for clarifications (Section 9.3.2), and draft the validation statement (Section 8.5.2);

4. The commissioner shall respond to the verifier's comments and introduce necessary corrections and changes (if needed) to ensure the final compliance of the OEF study, OEF report and technical content of OEF communication vehicles. If, in the verifier's judgement, the commissioner does not respond appropriately within a reasonable time period, the verifier shall issue a modified validation statement;

5. The final validation statement is provided, considering (if needed) the corrections and changes introduced by the commissioner.

6. Surveillance that the OEF report is available during the validity of the validation statement (as defined in Section 8.5.3).

If a matter comes to the verifier's attention that causes the verifier to believe in the existence of fraud or noncompliance with laws or regulations, the verifier shall communicate this immediately to the commissioner of the study.

8.3. *Verifier(s)*

This section is without prejudice to specific provisions of EU legislation.

The verification/ validation may be conducted by a single verifier or by a verification team. The independent verifier(s) shall be external to the organisation that conducted the OEF study.

In all cases the independence of the verifiers shall be guaranteed, i.e. they shall fulfil the intentions in the requirements of EN ISO/IEC 17020:2012 regarding a third party verifier, they shall not have conflicts of interests on concerned products.

The minimum requirements and score for the verifier(s) as specified below shall be fulfilled. If the verification/ validation is conducted by a single verifier, they shall satisfy all the minimum requirements and the minimum score (see Section 9.3.1); if the verification/validation is conducted by a team, the team as a whole shall satisfy all the minimum requirements and the minimum score. The documents proving the qualifications of the verifier(s) shall be provided as annex to the verification report or they shall be made available electronically.

In case a verification team is established, one of the members of the verification team shall be appointed as lead verifier.

8.3.1. Minimum requirements for verifier(s)

This section is without prejudice to specific provisions of EU legislation.

The assessment of the competences of verifier or verification team is based on a scoring system that takes into account (i) verification and validation experience, (ii) EF/LCA methodology and practice; and (iii) knowledge of relevant technologies, processes or other activities included in the product(s)/organisation(s) in scope of the study. Table 32 presents the scoring system for each relevant competence and experience topic.

([71]) https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52013DC0196

Unless otherwise specified in the context of the intended application, the verifier's self-declaration on the scoring system constitutes the minimum requirement. Verifier(s) shall provide a self-declaration of their qualifications (e. g. university diploma, working experience, certifications), stating how many points they achieved for each criterion and the total points achieved. This self-declaration shall form part of the OEF verification report.

A verification of an OEF study shall be conducted as per the requirements of the intended application. Unless otherwise specified, the minimum score necessary to qualify as a verifier or a verification team is six points, including at least one point for each of the three mandatory criteria (i.e. verification and validation practice, OEF/LCA methodology and practice, and knowledge of technologies or other activities relevant to the OEF study).

Table 32

Scoring system for each relevant competence and experience topic for the assessment of the competences of verifier(s)

			Score (points)				
	Topic	Criteria	0	1	2	3	4
Mandatory criteria	Verification and validation practice	Years of experience ([1])	<2	2 ≤ x < 4	4 ≤ x < 8	8≤ x < 14	≥14
		Number of verifications ([2])	≤5	5 < x ≤ 10	11 ≤ x ≤ 20	21 ≤ x ≤ 30	>30
	LCA method-logy and practice	Years of experience ([3])	<2	2 ≤ x < 4	4 ≤ x < 8	8≤ x < 14	≥14
		Number of LCA studies or reviews ([4])	≤5	5 < x ≤ 10	11 ≤ x ≤ 20	21 ≤ x ≤ 30	>30
	Knowledge of the specific sector	Years of experience ([5])	<1	1 ≤ x < 3	3 ≤ x < 6	6≤ x < 10	≥10
Additional criteria	Review, verification/ validation practice	Optional scores relating to verification/ validation	— 2 points: Accreditation as third party verifier for EMAS — 1 point: Accreditation as third party reviewer for at least one EPD scheme, EN ISO 14001:2015, or other EMS				

([1]) Years of experience in the field of environmental verifications and/or review of LCA/OEF/EPD studies.

([2]) Number of verifications for EMAS, EN ISO 14001:2015, international EPD scheme or other EMS.

([3]) Years of experience in the field of LCA modelling. Work done during master and bachelor degrees shall be excluded. Work done during a relevant Ph.D./Doctorate course shall be accounted for. Experience in LCA modelling includes, among others:
— LCA modelling in commercial and non-commercial software
— Datasets and database development

([4]) Studies compliant with one of the following standards/methods: EN ISO 14040:2006-44, EN ISO 14067:2018, ISO 14025:2010.

([5]) Years of experience in a sector related to the studied product(s). The experience in the sector may be gained through LCA studies or through other types of activities. The LCA studies shall be done on behalf of and with access to primary data of the producing/operating industry. The qualification of knowledge about technologies or other activities is assigned according to the classification of NACE codes (*Regulation (EC) No 1893/2006 of the European Parliament and of the Council of 20 December 2006 establishing the statistical classification of economic activities - NACE Revision 2*). Equivalent classifications of other international organisations may also be used. Experience gained with technologies or processes in a whole sector are considered valid for any of its sub-sectors.

8.3.2. Role of the lead verifier in the verification team

The lead verifier is a team member with additional tasks. The lead verifier shall:

— distribute the tasks to be fulfilled between the team members according to the specific roles and skills of the team members, to get the full coverage of the tasks to be done and to use in the best manner the specific competencies of the team members;

— coordinate the whole verification/validation process and ensure that all team members have a common understanding of the tasks they need to fulfil;

— assemble all comments and ensure they are communicated to the commissioner of the OEF study in a clear and understandable way;

— resolve any conflicting statements between team members;

— ensure that the verification report and validation statement are generated and are signed by each member of the verification team.

8.4. *Verification and validation requirements*

The verifier(s) shall present all the outcomes related to the verification of the OEF study and the validation of the OEF study, OEF report and OEF communication vehicles and give the commissioner of the OEF study the opportunity to improve the work, if necessary. Depending on the nature of the outcomes, additional iterations of comments and responses may be necessary. Any changes made in response to the verification or validation outcomes shall be documented and motivated in the verification or validation report. Such a summary may take the form of a table in the respective documents. The summary shall include the comment from the verifier(s), the commissioner's answer and the motivation for the changes.

Verification may take place after the OEF study has been concluded or in parallel (concurrent) to the study, while validation shall always take place after the study has been concluded.

The verification/validation shall combine document review and model validation.

— The document review includes the OEF report, the technical content of related communication vehicles available at the time of validation, and the data used in the calculations through requested underlying documents. Verifier(s) may organise the document review either as an 'at desk' or 'on-site' exercise, or as a mix of the two. The validation of the company-specific data shall always be organised through a visit to the production site(s) the data refer to.

— The validation of the model may take place at the production site of the commissioner of the study or be organised remotely. The verifier(s) shall access the model to verify its structure, the data used, and its consistency with the OEF report and OEF study. The commissioner of the OEF study and the verifier(s) shall agree on how the verifier(s) accesses the model.

— The validation of the OEF report shall be carried out by checking enough information to provide reasonable assurance that the content is in line with the modelling and results of the OEF study.

The verifier(s) shall ensure that data validation includes:

(a) coverage, precision, completeness, representativeness, consistency, reproducibility, sources and uncertainty;

(b) plausibility, quality and accuracy of the LCA-based data;

(c) quality and accuracy of additional environmental and technical information;

(d) quality and accuracy of the supporting information.

The verification and validation of the OEF study shall be carried out by following the minimum requirements listed in Section 8.4.1.

8.4.1. Minimum requirements for the verification and validation of the OEF study

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

— The verifier(s) shall check if the correct version of all impact assessment methods was used. For each of the most-relevant EF impact categories (ICs), at least 50% of the characterisation factors shall be verified, while all normalisation and weighting factors of all ICs shall be verified. In particular, the verifier(s) shall check that the characterisation factors correspond to those included in the EF impact assessment method the study declares compliance with ([72]). This may also be done indirectly, for example:

1) Export the EF-compliant datasets from the LCA software used to do the OEF study and run them in Look@LCI ([73]) to obtain LCIA results. If Look@LCI results are within a deviation of 1% from the results in the LCA software, the verifier(s) may assume that the implementation of the characterisation factors in the software used to do the OEF study was correct.

2) Compare the LCIA results of the most-relevant processes calculated with the software used to do the OEF study with the ones available in the metadata of the original dataset. If the compared results are within a deviation of 1%, the verifier(s) may assume that the implementation of the characterisation factors in the software used to do the OEF study was correct

— The verifier(s) shall check that the cut-off applied (if any) fulfils the requirements at Section 4.6.4.

— The verifier(s) shall check that all datasets used fulfill the data requirements (Section 4.6.3 and 4.6.5.).

— For at least 80% (in number) of the most-relevant processes (as defined in Section 6.3.3), the verifier(s) shall validate all related activity data and the datasets used to model these processes. If relevant, CFF parameters and datasets used to model them shall also be validated in the same way. The verifier(s) shall check that the most-relevant processes are identified as specified in Section 6.3.3;

— For at least 30% (in number) of all other processes (corresponding to 20% of the processes as defined in Section 6.3.3) the verifier(s) shall validate all related activity data and the datasets used to model these processes. If relevant, CFF parameters and datasets used to model them shall also be validated in the same way;

— The verifier(s) shall check that the datasets are correctly implemented in the software (i.e. LCIA results of the dataset in the software are within a deviation of 1% to the ones in the metadata). At least 50% (in number) of the datasets used to model most-relevant processes and 10% of those used to model other processes shall be checked.

The verifier(s) shall check if the aggregated EF compliant dataset representing the organisation in scope is made available to the European Commission ([74]). The commissioner of the OEF study may decide to make the dataset public.

Additional environmental and technical information fulfils the requirements at Section 3.2.4.1.

8.4.2. Verification and validation techniques

The verifier(s) shall assess and confirm whether the calculation methodologies applied are of acceptable accuracy, reliable, are appropriate and performed in line to this Annex. The verifier(s) shall confirm the correct application of conversion of measurement units.

The verifier(s) shall check if applied sampling procedures are in line with the sampling procedure defined in the OEF method as set out in Section 4.4.6. The data reported shall be checked against the source documentation in order to check their consistency.

The verifier(s) shall evaluate whether the methods for making estimates are appropriate and have been applied consistently.

The verifier(s) may assess alternatives to estimations or choices made, to determine whether a conservative choice has been selected.

The verifier(s) may identify uncertainties that are greater than expected and assess the effect of the identified uncertainty on the final OEF results.

([72]) Available at:
([73]) https://eplca.jrc.ec.europa.eu/LCDN/developer.xhtml
([74]) Please send your datasets to ENV-ENVIRONMENTAL-FOOTPRINT@ec.europa.eu

8.4.3. Data confidentiality

Data for validation shall be presented in a systematic and comprehensive way. all the project documentation supporting the validation of a OEF study shall be provided to the verifier(s), including the EF model, confidential information, data, and the OEF report. The verifier(s) shall treat all information and data undergoing verification/ validation as confidential and shall use them only during the verification/validation process.

The commissioner of the OEF study may exclude confidential data and information from the OEF report, provided that:

— only input information is excluded and all output information is included;

— the commissioner provides the verifier(s) with sufficient information of the nature of the data and information excluded as well as the reasoning for excluding them;

— the verifier(s) accept(s) the non-disclosure and includes in the verification and validation report the reasons for doing so; if the verifier(s) do(es) not accept the non-disclosure and the commissioner of the OEF study does not take corrective action, the verifier(s) shall include in the verification and validation report that the non-disclosure is not justified;

— the commissioner of the OEF study keeps a file of the non-disclosed information for possible future re-evaluation of the decision for non-disclosure.

Business data could be of confidential nature because of competition aspects, intellectual property rights or similar legal restrictions. Therefore, business data identified as confidential and provided during the validation process shall be kept confidential. Hence, verifier(s) shall not disseminate or otherwise retain for use, without the organisation'permission, any information disclosed to them during the course of the verification/validation process. The commissioner of the OEF study may ask the verifier(s) to sign a non-disclosure agreement (NDA).

8.5. *Outputs of the verification/ validation process*

8.5.1. Content of the verification and validation report

The verification and validation report ([75]) shall include all findings of the verification/ validation process, the actions taken by the commissioner to answer the comments of the verifier(s), and the final conclusion. The report is mandatory, but it may be confidential. Confidential information shall only be shared with the European Commission or the body overseeing the OEFSR development, and the review panel at their request.

The final conclusion may be of a different nature:

— 'compliant' if the document or on-site checks prove that the requirements of this Section are fulfilled.

— 'not compliant' if the document or on-site checks prove that the requirements of this Section are not fulfilled.

— 'complementary information needed' if the document or on-site checks do not allow the verifier(s) to conclude on compliance. This may happen if the information is not transparently or sufficiently documented or made available.

The verification and validation report shall clearly identify the specific OEF study under verification. To this purpose, it shall include the following information:

— title of the OEF study under verification/validation, together with the exact version of the OEF report to which the validation statement belongs;

— the commissioner of the OEF study;

— the user of the OEF method;

— the verifier(s) or, in the case of a verification team, the team members with the identification of the lead verifier;

— absence of conflicts of interest of the verifier(s) with respect to concerned product portfolio and the commissioner and any involvement in previous work (where relevant, consultancy work carried out for the user of the OEF method over the last three years);

([75]) The two aspects, validation and verification, are included in one report.

— a description of the objective of the verification/ validation;

— the actions taken by the commissioner to answer the comments of the verifier(s);

— a statement of the result (findings) of the verification /validation containing the final conclusion of the verification and validation reports;

— any limitations of the verification/ validation outcomes;

— date on which the validation statement has been issued;

— version of the underlying OEF method and, if applicable, of the underlying OEFSR;

— signature of the verifier(s).

8.5.2. Content of the validation statement

The validation statement is mandatory and shall always be provided as an annex to the OEF report.

The verifier(s) shall include at least the following elements and aspects in the validation statement:

— title of the OEF study under verification/validation, together with the exact version of the OEF report to which the validation statement belongs;

— the commissioner of the OEF study;

— the user of the OEF method;

— the verifier(s) or, in the case of a verification team, the team members with the identification of the lead verifier;

— absence of conflicts of interest of the verifier(s) with respect to concerned organisations and the commissioner and any involvement in previous work (where relevant, consultancy work carried out for the user of the OEF method over the last three years);

— a description of the objective of the verification/ validation;

— a statement of the result of the verification /validation containing the final conclusion of the verification and validation reports;

— any limitations of the verification/ validation outcomes;

— date in which the validation statement has been issued;

— version of the underlying OEF method and, if applicable, of the underlying OEFSR;

— signature of the verifier(s).

8.5.3. Validity of the verification and validation report and the validation statement

A verification and validation report, and a validation statement shall refer to one specific OEF report only. The verification and validation report and the validation statement shall clearly identify the specific OEF study under verification (i.e. by including the title, the commissioner of the OEF study, the user of the OEF method, etc. – see Sections 8.5.1 and 8.5.2), together with the explicit version of the final OEF report to which the verification and validation report and a validation statement apply (e.g. by including the report date, the version number, etc.).

Both the verification and validation report and the validation statement shall be completed based on the final OEF report, after the implementation of all the corrective actions requested by the verifier(s). They shall carry the handwritten or electronic signature of the verifier(s) in line with Regulation (EU) n° 910/2014 ([76]).

The maximum validity of the verification and validation report and of the validation statement shall not exceed three years starting from their issue date.

During the validity period of the verification, surveillance (follow-up) shall be agreed between the commissioner of the OEF study and the verifier(s) to evaluate if the content is still consistent with the current situation (the suggested periodicity for this follow-up is once per year, to be agreed between the OEF study commissioner and the verifier(s)).

([76]) Regulation N° 910/2014 of the European Parliament and of the Council of 23 July 2014 on electronic identification and trust services for electronic transactions in the internal market and repealing Directive 1999/93/EC, OJEU L 257, 28.8.2014, p. 73.

The periodic checks shall focus on the parameters that according to the verifier(s) might lead to relevant changes in the results of the OEF study. This means, that the results shall be recalculated considering the changes of the identified parameters. The list of such parameters includes:

— bill of material/ bill of components;

— energy mix used for processes in Situation 1 of the Data Needs Matrix;

— change of packaging;

— changes in the suppliers (materials/ geography);

— changes in the logistics;

— relevant technological changes in the processes in situation 1 of the Data Needs Matrix.

At the time of the periodic check the reasons for non-disclosure of information should also be reconsidered. The surveillance verification may be organised as a document check and/or through on-site inspections.

Regardless of the validity, the OEF study (and consequently the OEF report) shall be updated during the surveillance period if the results of one of the impact categories communicated has worsened by more than 10.0% compared to the verified data, or if the total aggregated score has worsened by more than 5.0% compared to the verified data.

If these changes also affect the content of the communication vehicle, it shall be updated accordingly.

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ANNEX IV

PART: A

REQUIREMENTS TO DEVELOP OEFSRS AND PERFORM OEF STUDIES IN COMPLIANCE WITH AN EXISTING ORGANISATION ENVIRONMENTAL FOOTPRINT SECTOR RULE

Organisation Environmental Footprint Sectorial Rules (OEFSRs) provide specific requirements for calculating the products' life-cycle potential environmental impacts. This Part A of Annex IV contains all methodological requirements for developing OEFSRs and performing OEF studies in compliance with an existing OEFSR.

An OEFSR shall be in line with all requirements of this document, shall include (as text) all requirements of this Annex and shall refer (without copying the corresponding text) to the requirements in the OEF method where relevant. It shall further specify those requirements where the OEF method leaves a choice, and may add new requirements, if relevant and in line with the OEF method. Further specified requirements in an OEFSR always prevail over those included in the OEF method.

The provisions of this annex are without prejudice of provisions to be included in future EU legislation.

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A.1 Introduction

Based on an analysis carried out by JRC in 2010 ([1]), the Commission came to the conclusion that existing life-cycle based standards do not provide sufficient specificity to ensure that the same assumptions, measurements and calculations are made to support comparability of environmental claims across organisations within the same sector. OEFSRs aim at increasing the reproducibility, relevance, focus, efficiency and consistency of OEF studies

An OEFSR should be developed and written in a format that persons with technical knowledge (in LCA as well as with regard to the considered product category) can understand and can use to conduct an OEF study.

Each OEFSR shall implement the materiality principle, meaning that an OEF study shall focus on those aspects and parameters that are the most-relevant for the environmental performance of a given product. By doing this the time, effort and cost of carrying out the analysis is reduced.

Each OEFSR shall specify the minimum list of processes (mandatory processes) that shall always be modelled with company-specific data. The purpose is to avoid that users of the OEFSR are able to perform an OEF study and communicate its results without having access to the relevant company-specific (primary) data and by using only default data. The OEFSR shall define this mandatory list of processes based on their relevance and the possibility to have access to company-specific data.

The definitions provided under the Annex III are applicable also for this Annex.

A.1.1. *Relationship between OEFSRs and PEFCRs*

Typically, OEFSRs tend to be wider in scope than PEFCRs (e.g. relationship between retail sector and one specific food product). Furthermore, OEFSRs are considering some aspects that are normally out of the boundaries of a PEF study compliant with a PEFCR (e.g. impacts related to company services, such as marketing).

At the same time, there is a need to ensure consistency between the methodological choices made in correlated OEFSRs and PEFCRs. In theory, the sum of the PEFs of the products provided by an organisation over a certain reporting interval (e.g. 1 year) should be close to its OEF for the same reporting interval.

The development of an OEFSR shall take into account existing PEFCRs: in case there is an existing PEFCR covering a product, material or component belonging to the Product Portfolio (PP), all the rules and assumptions used in the PEFCR, including the related EF-compliantdataset, shall be used for modelling that element in the PP. Exceptions to this rule shall be agreed with the EC.

([1]) Analysis of Existing Environmental Footprint Methodologies for Products and Organisations: Recommendations, Rationale, and Alignment (2010), available at: http://ec.europa.eu/environment/eussd/smgp/dev_methods.htm

A.1.2. *How to manage modularity*

In case the PP contains intermediate products, the PEFCR may become a "module" to be used when developing OEFSRs which include in their PP products further down the supply chain. This is equally applicable if the intermediate product can be used in different supply chains (e.g. metal sheets). The development of "modules" allows for a higher level of consistency among different supply chains that are using the same modules as part of their LCA.

The possibility to build such modules should always be considered also for final products, belonging to the PP, especially for those products that share part of the production chain and then differentiate due to different functions (e.g. detergents).

There are different scenarios that may require a modular approach:

(a) The PP includes a final product using in its BoM an intermediate product for which there is already an existing OEFSR (e.g. car production with leather upholstery) or a final product that becomes part of the life-cycle of another product (e.g. detergent used to wash a T-shirt);

(b) The PP includes a final product using a component or product that is already used as a component by another PEFCR/OEFSR (e.g. fittings to be used in piping systems, fertilisers).

For scenario (a), the new OEFSR shall define how to manage the product information based on the environmental relevance of the product and the DNM (see Section 4.4.4.4). This means that if the product is 'most-relevant' and it is under the company's control, company-specific data shall be requested, following the rules of the PEFCR having the module in its scope ([2]). If it is not under the company's operational control but amongst the 'most-relevant' processes, the user of the OEFSR may choose either to provide company-specific data, or to use the EF compliant secondary dataset ([3]) provided with the PEFCR that has the module in its scope.

In scenario (b), the Technical Secretariat (see the role and the membership in Section A.2.2.) shall assess the feasibility of implementing the same modelling assumptions and secondary datasets listed in the existing PEFCR/OEFSR. If feasible, the Technical Secretariat shall implement the same modelling assumptions and dataset to be used in its own OEFSR. If not feasible, the Technical Secretariat shall agree on a solution with the Commission.

A.2. **The process of developing and revising an OEFSR**

The provisions of this Section are without prejudice of provisions to be included in future EU legislation.

This Section includes the process for developing and revising an OEFSR. The following situations might occur:

Development of a new OEFSR;

(a) Full revision of an existing OEFSR;

(b) Partial revision of an existing OEFSR.

For cases (a) and (b) the procedure described in this Section (see figure A-1) shall be followed.

Case (c) is only allowed if the model of the Representative Organisation (RO), (see Section A.2.3.) is updated with corrected/new data or datasets and correction of obvious mistakes, and the results of the RO change with a certain maximum:

(i) LCIA results change <10% per impact category (characterized results), and

([2]) In case the already existing OEFSR used as a module is updated during the validity of the OEFSR relying on it, the old version prevails and stays valid for the duration of the validity of the newly developed OEFSR.

([3]) This is a mandatory deliverable for any representative organisation developed in a OEFSR.

(ii) LCIA results change <5% of the single overall score, and

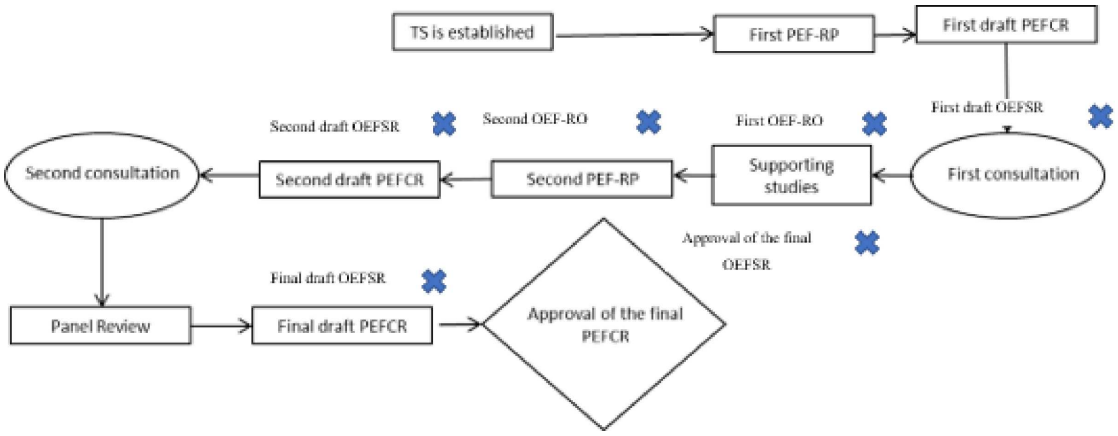
(iii) the list of most-relevant impact categories, life-cycle stages, processes, and direct elementary flows don't change.

If results of the RO change > 10% for at least one impact category (characterized results) or > 5% of the single overall score, case (c) is not applicable and a full revision of the OEFSR is required.

In case (c) the Technical Secretariat shall provide an updated OEFSR to the panel review and the last three steps of Figure A-1 shall be followed (i.e. panel review, final draft OEFSR, final approval of the OEFSR).

Figure J-1

Process flow to create/revise an OEFSR. OEF-RO: OEF study of the Representative organisation.



A.2.1. *Who can develop an OEFSR*

A Technical Secretariat shall be set up to develop an OEFSR. The Technical Secretariat shall represent at least 51% of the EU consumption market (sold) in terms of economic turnover. The Technical Secretariat shall achieve this market coverage directly by companies participating in it and/or indirectly, through the EU market coverage of members represented by a business association. The Technical Secretariat shall submit a confidential report proving market coverage to the Commission when establishing the Technical Secretariat.

A.2.2. *Role of the Technical Secretariat*

The Technical Secretariat (TS) is responsible for the following activities:

(a) Drafting the OEFSR in compliance with the rules included in Annex III and this Annex;

(b) Harmonisation with existing sectorial rules or PEFCRs ;

(c) Organising public consultations on draft versions of the documents, analysis of comments, and providing written feedback;

(d) Co-ordinating the supporting studies;

(e) Managing the public online platform for the respective OEFSR. This activity includes tasks such as the drafting of publicly available explanatory materials related to the OEFSR, online consultations on drafts and publishing of feedback on stakeholder comments;

(f) Ensuring the selection and appointment of competent independent OEFSR review panel members.

A.2.3. *Definition of the representative organisation(s)*

The Technical Secretariat shall develop a 'model' of the representative organisation (RO) present on the EU market and belonging to the sector. The RO shall reflect the current situation, at the time of developing the OEFSR. This means, for example, that future technologies, future transport scenarios or future end of life treatments shall be excluded. The data used shall reflect realistic market averages and be most recent (especially for fast developing technology products). Conservative values or estimates shall be avoided.

The RO may be a real or a virtual (non-existing) organisation. The virtual organisation should be calculated based on average European market sales-weighted characteristics of all existing technologies/production process/organisation types covered by the sector or sub-sector. Other weighting sets may be used, if justified..

When identifying the RO there is the risk that different technologies with very different market shares get mixed up and the ones with a relatively small market share might be overlooked. In such cases the Technical Secretariat shall include the missing technologies/production routes/ organisation types (if in scope) in the definition of the RO or provide written justification if this is not technically possible.

The RO is the basis for the OEF study of the representative organisation (OEF-RO). Section A.3.1 explains for when a RO shall be developed for sectors and subsectors.

The technical secretariat shall provide information about all the steps taken to define the 'model' of the RO and report the information gathered in an Annex to the OEFSR. The Technical Secretariat take the most appropriate measures to preserve the confidentiality of data, if applicable.

A.2.4. *First OEF study of the representative organisation(s)*

A first OEF study shall be carried out on each representative organisation (first OEF-RO). The first OEF-RO aims at:

1. Identifying the most-relevant impact categories;

2. Identifying the most-relevant life-cycle stages, processes and elementary flows;

3. Identifying data needs, data collection activities and data quality requirements.

The Technical Secretariat carries out the first OEF-RO on the 'model' of the RO(s). Lack of available data and low market shares shall not be an argument for exclusions of technologies or production processes.

The Technical Secretariat shall use EF compliant datasets for the OEF-RO, if available. If an EF compliant dataset does not exist, the following procedure shall be followed in hierarchical order:

1. If an EF compliant proxy can be found it shall be used;

2. If an ILCD-EL compliant dataset as proxy can be found: it shall be used but shall not be included in the list of default datasets of the first draft OEFSR. The proxy shall be listed in the limitations of the first draft OEFSR with the following text: 'This dataset is used as a proxy during the first OEF-RO only. However, the company performing the supporting study to test the first draft OEFSR shall apply an EF compliant dataset, if available (following the rules laid out in Section A.4.4.2 on which datasets to use). If this is not available, the company shall use the same proxy as used for calculating the first OEF-RO'

3. If no EF compliant or ILCD- EL compliant dataset can be found, another dataset may be used.

In the first OEF-RO no cut-off of processes, emissions to the environment and resources from the environment is allowed. All the life-cycle stages and processes shall be covered (including capital goods). However, activities like staff commuting, canteens at production sites, consumables not strictly related to production processes, marketing, business trips and R&D activities may be excluded. Cut-offs may only be included in the final OEFSR based on the rules included in the Annex III and this Annex.

A first OEF-RO report shall be provided (following template in part E of the Annex IV) and shall include the characterised, normalised and weighted results.

The first OEF-RO and its report shall be verified by the review panel and a public review report shall be provided as its annex.

A.2.5. *First draft OEFSR*

Based on the results of the first OEF-RO the Technical Secretariat shall produce a first draft OEFSR, used to carry out the OEFSR supporting studies. It shall be drafted according to the requirements included in this Annex and the template provided in part B of this Annex. It shall include all the requirements needed for the supporting studies, with particular reference to company-specific data collection tables and procedures.

A.2.6. *Supporting studies*

The goal of the supporting studies is to test the implementability of the first draft OEFSR and, to a lesser extent, provide indications about the suitability of the identified most-relevant impact categories, life-cycle stages, processes and direct elementary flows.

For each RO at least three OEF supporting studies shall be carried out.

The supporting studies shall be in compliance with all requirements included in the first draft OEFSR and the version of this Annex it refers to. The following additional rules shall be followed:

— No cut-off is allowed;

— Each study shall implement the hotspot analysis described in Section 6.3 of this Annex and A.6.1 of this Annex. Each study shall be carried out on real organisation as currently present in the European market;

— To better analyse the applicability of the first draft OEFSR, the studies shall be carried out on (i) organisation of different sizes, including at least one SME if present in the sector; (ii) organisations characterized by different production processes/ technologies; and (iii) organisations with the main production processes (i.e. the ones for which company-specific data are collected) located in different countries.

Each supporting study shall be carried out by an entity ([4]) that is neither involved in the drafting of the OEFSR nor is part of the review panel. Exceptions to this rule may exist but they have to be in agreement with the European Commission. No aggregated EF compliant dataset has to be made available to the European Commission

An OEF report shall complement each supporting study and provide a relevant, comprehensive, consistent, accurate, and transparent summary of the study. The OEF report template to be used for the supporting studies template is available in part E of this Annex. The template includes the minimum information to be reported. The supporting studies (and their related OEF report) are confidential. They shall only be shared with the European Commission or the body overseeing the OEFSR development, and the review panel. However, the company performing the supporting study may decide to grant access to other stakeholders.

A.2.7. *Second OEF study of the representative organisation*

Conducting the OEF study of the representative organization is an iterative process. Based on the information gathered through the first consultation and the supporting studies, the Technical Secretariat shall carry out a second OEF-RO. This second OEF-RO shall include new EF compliant datasets, updated default activity data and all assumptions that are at the basis of the requirements in the second draft OEFSR. Based on the second OEF-RO, the Technical Secretariat shall draft a second OEF-RO report.

([4]) Organization or business that has its own separate legal and financial existence

The Technical Secretariat shall use EF compliant datasets if available for free. In case EF compliant datasets are not available, the following rules shall be followed in hierarchical order:

— An EF compliant proxy is available for free: it shall be included in the list of default processes of the OEFSR and stated within the limitations Section of the second draft OEFSR.

— An ILCD-EL compliant dataset as proxy is available for free: A maximum of 10% of the single overall score may be derived from ILCD-EL compliant datasets.

— If no EF compliant or ILCD-EL compliant dataset is available for free: it shall be excluded from the model. This shall be clearly stated in the second draft OEFSR as a data gap and validated by the OEFSR verifiers.

The second OEF-RO shall determine all the requirements of the final OEFSR including, but not limited to, the final list of most-relevant impact categories, life-cycle stages, processes, direct elementary flows, cut-offs, etc.

A second OEF-RO report shall be provided (following the template in part E of this Annex) and shall include the characterised, normalised and weighted results.

The second OEF-RO and its report shall be reviewed by the review panel and a public review report shall be provided as its annex.

A.2.8. *The second draft OEFSR*

The Technical Secretariat shall draft the second draft OEFSR taking into consideration the results of the supporting studies and of the second OEF-RO. All the Sections in the OEFSR template (see part E of this annex) shall be filled in.

The OEFSR shall clarify that all the data gaps included in the OEFSR will remain data gaps for its entire validity. Therefore, data gaps are indirectly part of the system boundary of the OEFSR to allow a fair comparison among the organisations (if applicable)

A.2.9. *The OEFSR review*

A.2.9.1. Review panel

The TS shall set up an external independent third-party review panel for the OEFSR review.

The panel shall be composed of minimum three members (a chair and two members). In case a OEFSR entails more than five RO, the review panel could be enlarged with more members and additional co-chairs. The panel shall include one EF/LCA expert (with a background on sector under consideration and sector-related environmental aspects), one industry expert and, if possible, one representative from NGOs. One member shall be selected as the lead reviewer.

The reviewers shall be independent from each other from a legal entity point of view. The panel shall not include representatives of the members ([5]) of the TS or other entities involved in the work of the TS, or employees of the companies running the supporting studies. Exceptions to this rule are to be discussed and agreed with the European Commission.

A review team can change during the development of a OEFSR. Members can leave or join in between two reviews steps. However, it is the duty of the lead reviewer to ensure that the criteria for the review panel are fulfilled at each and every step of the OEFSR development process; the new members are updated by the lead reviewer about the previous steps and issues discussed.

([5]) If an industry association is member of a Technical Secretariat, an industry expert of one company belonging to that industry association can be in the review panel. On the contrary, experts on the payroll of the association shall not be members of the review panel.

Lead reviewer can change as long as one of the others takes his/her role and ensures continuity of the work. The review process will include milestones, e.g. 1) 1st OEF-RO + 1st draft OEFSR, 2) supporting studies + 2nd OEF-RO + 2nd draft OEFSR, 3) final draft OEFSR 4) final OEFSR. The continuity should be ensured within the same milestone. The previous requirement means that at least one member of the review team shall stay active in the project. If the requirements are not met, the review process shall start from the last milestone that fulfilled the requirements.

The assessment of the competences of the review panel is based on a scoring system that takes into account their experience, EF/LCA methodology and practice, and knowledge of relevant technologies, processes or other activities included in the organisation(s) in scope of the OEFSR. Table 32 of this Annex presents the scoring system for each relevant competence and experience topic.

The review panel members shall provide a self-declaration of their qualifications, stating how many points they achieved for each criterion and the total points achieved. This self-declaration shall be included in the OEFSR review report.

The minimum necessary score to qualify as a reviewer is six points, including at least one point for each of the three mandatory criteria (i.e. review practice, EF/LCA methodology and practice, and knowledge of technologies or other activities relevant to the EF study).

A.2.9.2 Review procedure

The TS shall agree on the review procedure with the review panel when signing the review contract. In particular, the TS shall agree the period available to the review panel for producing comments after each document is released by the TS and how to manage the comments received.

The review panel will be responsible for the independent review of the following documents (see figure 1):

— Any draft version of the OEFSR (first, second and final);

— First and second OEF-RO, including the RO model, data and OEF-RO reports;

— Supporting studies, including the related OEF model, data and OEF report;

If the second consultation or the OEFSR review affects the results of the second OEF-RO, the second OEF-RO shall be updated and the results shall be implemented in the final draft OEFSR. In this case, the final draft OEFSR and final OEFSR shall be reviewed by the review panel.

The panel shall send the review of each document to the TS for their analysis and discussion. The TS shall review the panel's comments and proposals, and it shall develop a response for each.

For all documents, the TS shall generate written responses through review reports that may include:

— Acceptance of the proposal: change the document to reflect proposal,

— Acceptance of the proposal: change the document with modification to the original proposal,

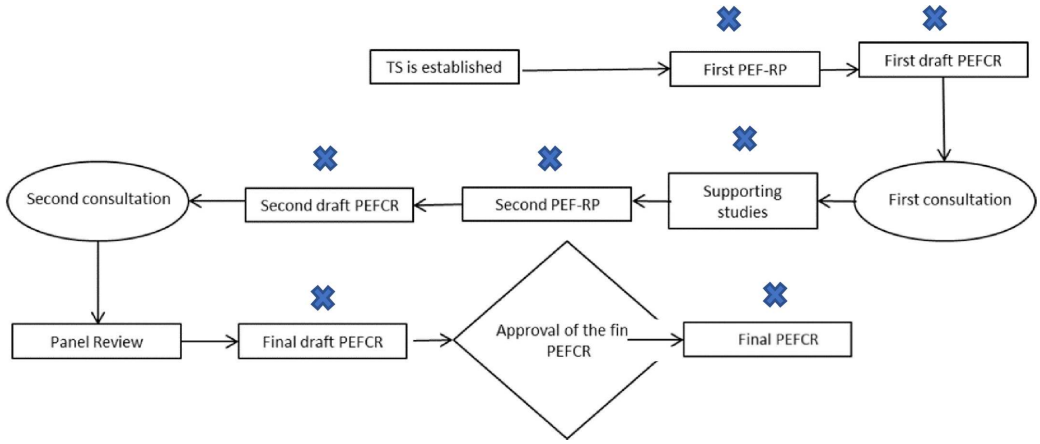
— Supporting comments on why the TS did not agree with the proposal,

Return to the review panel with further questions on the comments/proposal.

The documents that need to go through the review procedure are presented in Figure A-2 with a cross.

Figure A-2

OEFSR development process



A.2.9.2.1. *Review of the first OEF-RO*

The first OEF-RO and its related OEF-RO report shall be reviewed by the review panel, in accordance with the verification procedure as presented in Section 8.4 of the Annex III. However, on-site visits do not apply and if the RO is a virtual organisation, the reviewers shall agree with the technical secretariat on technique(s) to validate the activity data. If the OEFSR defines several ROs, the review shall check that all the ROs defined in the OEFSR are included in the scope of the different OEF-RO studies.

In addition to the guidelines provided in Section 8.4, the following review steps shall be made:

1. Assure that the instructions given in Sections A.2.4., A.3.2.7., A.4.2, A.4.3., A.4.4.3, A.6.1. and 4.4.9.4 are followed;

2. Evaluate whether the methods used to make estimates are appropriate and applied consistently;

3. Identify uncertainties that are greater than expected and assess the effects of the identified uncertainty on the final OEF results;

4. For intermediate products in the product portfolio validate if (i) the A value of the organisation in scope is set to 1 for the hotspot analysis and (ii) if this is documented in the OEFSR;

5. Check that the GHG emissions and removals are calculated and reported following the rules of Section A.4.2.9.

6. In case non EF compliant datasets are used to model the first OEF-RO, the steps related to checking the correct implementation in the software may be skipped

A.2.9.2.2. *Supporting study review*

The supporting studies and their OEF reports shall be reviewed by the review panel. At least three supporting studies per RO shall be reviewed by the review panel. The review panel shall assure that each supporting study is carried out by a company/consultant neither involved in the drafting of the OEFSR nor part of the review panel.

The supporting study review is very similar to the OEF study verification with some specificities, e.g. on-site visits do not apply. In addition to the guidelines provided in Section 8.4 in Annex III, the following review steps shall be made:

1. the supporting study is carried out on a real product-portfolio as currently sold in the European market;

2. the draft OEFSR has been applied correctly;

3. the supporting study follows the rules outlined in Section A.2.6.;

4. instructions given in Section A.4.2. and A.4.3. are followed;

5. the hotspot analysis described in Section A.6.1. is applied and reported upon correctly;

6. For intermediate products in the product portfolio validate if A value of the product portfolio in scope is set to 1 for the hotspot analysis.

A.2.9.2.3. *Review of the second OEF-RO study*

The second OEF-RO and its related OEF-RO report shall be reviewed by the review panel, in accordance with the verification procedure as presented in Section 8.4 of the Annex III. However, on-site visits do not apply.

In addition to the guidelines provided in Section 8.4 of Annex III, the following review steps shall be made:

1. that the review comments on the first OEF-RO and supporting studies are addressed, reasons for non implementation shall be provided;

2. that any new dataset, updated default activity data and all assumptions that are at the basis of the requirements in the second draft OEFSR are implemented correctly;

3. that the instructions given in Sections A.2.4., A.3.2.7., A.4.2, A.4.3., A.4.4.3, A.6.1. and 4.4.9.4 are followed;

4. that if the product portfolio contains intermediate products validate if (i) the A value of the organisation in scope is set to 1 for the hotspot analysis and (ii) if this is documented in the OEFSR;

5. that the GHG emissions and removals are calculated and reported following the rules of Section A.4.2.9.

A.2.9.3. Review criteria of the OEFSR document

The reviewers shall investigate whether the OEFSR (i) is developed in accordance with the requirements provided in Annex III, and (ii) supports the creation of credible, relevant, and consistent OEF profiles. In addition, the following review criteria shall also apply:

— The OEFSR scope and the representative organisation are adequately defined;

— The reporting unit, allocation and calculation rules are adequate for the sector category and sub-categories under consideration;

— Datasets used in the OEF-ROs and the supporting studies are relevant, representative, reliable, and in compliance with data quality requirements. The rules regarding which datasets to use are defined in Section A.2.4. for the first draft OEFSR and in Section A.4.4.2. for second draft and final OEFSR.

— For products protfolio with a life-cycle stage with a non-equal distribution throughout the EU and/or manufacturing outside the EU, default datasets used for that non-equally distributed life-cycle stage of the RO shall be checked on their geographic representativeness;

— The Data Needs Matrix of Section of A.4.4.4.4 is correctly implemented;

— The selected additional environmental information is appropriate for the product portfolio under consideration;

— The performance classes in the final OEFSR (where included) are plausible.

— The model of the RO(s) and corresponding benchmark(s) (if applicable) represent correctly the product portfolio;

— The datasets representing the RO(s) from the final OEFSR, are (i) provided in disaggregated and aggregated form and (ii) EF compliant following the rules in Section A.2.10.3.;

— The RO model (from final OEFSR) in its corresponding excel version is compliant with the rules outlined in Section A.2.10.1.

A.2.9.4. Review report/ statements

The review panel shall produce:

For each OEF-RO: A public review report as Annex to the OEF-RO report. The public review report shall include the public review statement, all relevant information concerning the review process, the comments raised by the reviewers with the replies provided by the TS, and the outcome.

1. For each supporting study report, OEF-RO report and OEFSR: A public validation statement. The validation statement shall be in line with the rules outlined in Section 8.5.2.

2. For minimum 3 (three) supporting studies: A confidential review report. This review report shall be shared with the EC or the body overseeing the OEFSR development, and the review panel. The company performing the supporting study may decide to grant access to other stakeholders.

3. For the final OEFSR: A public and a confidential review report.

   — The public review report shall include the public review statement (as provided in the OEFSR template), all relevant (non confidential) information concerning the review process, the comments raised by the reviewers with the replies provided by the TS, and the outcome.

   — The confidential review report shall include all comments raised by the reviewers during the development of the OEFSR and the replies provided by the TS. Any other relevant information concerning the review process and outcomes shall also be included. This review report shall be made available to the EC.

The final OEFSR shall include the following annexes: (i) its public review report, (ii) the review reports of each OEF-RO and (iii) the public validation statements of each reviewed supporting study.

A.2.10. *Final draft OEFSR*

Once the drafting work is finalised the Technical Secretariat shall send to the Commission the following documents:

1. the final draft OEFSR (including all annexes);

2. confidential review report of the OEFSR;

3. public review report of the OEFSR;

4. second OEF-RO report (including its public review report);

5. public review statements on the supporting studies;

6. all EF and ILCD-EL compliant datasets used for the modelling (both aggregated and disaggregated at level-1; see details in Section A.2.10.2);

7. the model(s) of the RO(s) in excel format (see details in Section A.2.10.1);

8. an EF compliant dataset of each RO (aggregated and disaggregated, see details in Section A.2.10.3).

A.2.10.1. Excel model(s) of the representative organisation(s)

The 'model' of the RO shall be made available in MS Excel format. In case the model of the RO is built on multiple sub-models (e.g. very different technologies), for each of these sub-models a separate excel file shall be provided in addition to the one of the overall model. The excel file shall be built in accordance with the template provided at JRC website ([6]).

A.2.10.2 Datasets listed in the OEFSR

All EF and ILCD-EL compliant datasets used in the OEFSR shall be available on a node of the Life-cycle Data Network ([7]), in aggregated and disaggregated (level-1) form.

A.2.10.3. EF compliant datasets representing the representative organisation(s)

The EF compliant dataset(s) representing the RO(s) shall be provided in aggregated and disaggregated form. The latter shall be disaggregated at the level coherent with the respective OEFSR. Data may be aggregated to protect confidential information.

The list of technical requirements to be fulfilled by the dataset to be EF compliant are available at http://eplca.jrc.ec.europa.eu/LCDN/developerEF.xhtml.

A.3. **Defining the scope of the OEFSRs**

A.3.1. *Sector and sub-sectors*

Organisations having similar PPs should be grouped within the same OEFSR. The scope of the OEFSR shall be selected in a way that it is sufficiently wide to cover different applications and/or technologies. In some cases, to fulfil this requirement, a sector may be split into multiple sub-sectors. The Technical Secretariat shall decide if sub-sectors are necessary to achieve the primary objective of the OEFSR and therefore to avoid the risk that the hotspot results from different technologies get mixed up or the results of the ones with a small market share are overlooked[91]. It is important to be as specific as possible when defining the sector and sub-sectors to ensure the reproducibility and comparability (if applicable) of results.

The OEFSR shall be structured with a Section including the "horizontal" rules that are common to all organisations in scope of the OEFSR, and then a sub-section for each sub-sector including the specific "vertical" rules applicable only to that sub-sector (Figure A-2).

As a general principle, the horizontal rules prevail over the vertical ones; however, specific derogations from this principle may be allowed if properly justified. This structure will make it easier to widen the scope of an existing OEFSR by adding more sub-sectors.

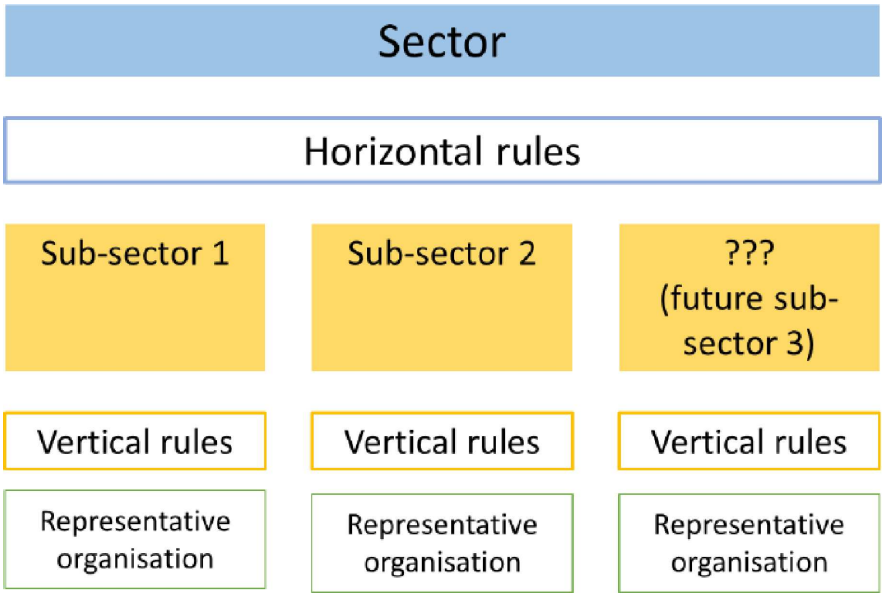
Each sub-sector shall be clearly described in the scope definition of the OEFSR, each sub-sector shall have its own RO together with its selection of most-relevant processes, life-cycle stages and impact categories

([6]) http://eplca.jrc.ec.europa.eu/LCDN/developerEF.xhtml

([7]) All EF and ILCD-EL compliant datasets used for modelling the RO shall be made available at the same terms and conditions as provided in the EF compliant data guide (available at http://eplca.jrc.ec.europa.eu/LCDN/developerEF.xhtml).

Figure K-2

Example of an OEFSR structure with sector specific horizontal rules, various sub-sectors and sub-sectors specific vertical rules.



Comparisons shall be allowed if there is a single sector in the OEFSR or within the sub-sectors. The Technical Secretariat shall specify under which conditions the OEFSR enables comparisons of organisations belonging to the same sector and/or sub-sector. The Technical Secretariat shall specify if cross-comparison of organisations belonging to two or more different sub-sectors is allowed.

Table GG-1

Summary of requirements for OEFSRs covering one single sector and for OEFSRs covering sub-sector.

	Single sector in OEFSR	Sector and sub-sector in OEFSR	
		Within the category	*Within the sub-category*
Definition of a RO	Shall	May	Shall
Provision of rules in the OEFSR to enable comparisons and comparative assertions among organisations	Shall	May The technical secretariat decides if and in which cases comparison among organisations in different sub-sectors is allowed.	Shall

All requirements in Annex IV apply to sectors and sub-sectors (if applicable).

A.3.2. *Scope of the OEFSR*

The scope Section of the OEFSR shall contain a description of the Product Portfolio and provide the NACE codes applicable to the sector in scope. The OEFSR shall specify the processes to be included in the organisational boundaries (direct activities). It shall also specify the OEF boundary, including specification of the supply chain stages to be included and all the indirect (upstream and downstream) activities, and give justification if downstream (indirect) activities are excluded (e.g. use stage of intermediate products or products with an undeterminable fate included in the product portfolio).

The OEFSR shall define the time span to be considered for the assessment

The scope Section of the OEFSR shall contain, as a minimum, the following information:

1. General description of the scope of the OEFSR:
   a. Description of the product category;
   b. List and description of sub-categories included in the OEFSR (if any);
   c. Description of the product(s) and technical performance;
2. NACE codes;
3. Description of the Representative organisation(s) and how it has been derived;
4. Reporting unit and definition of the product portfolio;
5. System boundary description and diagram, including organisational and OEF boundaries;
6. List of EF impact categories;
7. Additional environmental information and additional technical information;
8. Limitations.

A.3.2.1. General description of the scope of the OEFSR

The OEFSR scope definition shall include a general description of the product category, including the granularity of scope, the product sub-categories included (if any), a description of the product/services belonging to the PP an dtheir technical performance. If products are excluded from the PP, this omission shall be justified (e.g. they do not belong to the typical PP of an organisation in the sector.)

A.3.2.2. Use of NACE codes

The NACE codes applicable to the sector in scope shall be listed in the OEFSR.

A.3.2.3. Definition of the representative organisation (RO)

The OEFSR shall include in the scope a short description of the RO(s).

The Technical Secretariat shall provide information about all the steps taken to define the 'model' of the RO and report the information gathered in an Annex to the OEFSR. Should any piece of confidential information be included in the Annex, it should only be made available for reviewing (by the EC, market surveillance authorities or reviewers).

A.3.2.4. Reporting unit (RU)

The Section of the RU of an OEFSR shall require to define the organisation specifying i) the name of the organisation, ii) the kind of goods/ services the organisation produces, iii) locations of operation (e.g. country cities).

Furthermore, the OEFSR shall provide a description of the product portfolio according to the four aspects provided in Table A-2 and the reporting interval (justification shall be provided if the reporting interval differs from one year). The OEFSR shall require the user of the OEFSR to define its own PP, including the reference year and the reporting interval.

In case applicable standards exist, they shall be used and cited in the OEFSR.

The OEFSR shall explain and document any exclusion of products/ services from the PP.

Table HH-2

Four aspects of the product portfolio

Elements of the RU	Non-food products
1. The function(s)/service(s) provided: 'what'	OEFSR specific
2. The extent of the function or service: 'how much'	OEFSR specific
3. The expected level of quality: 'how well'	OEFSR specific, where possible.
4. The duration/life time of the product: 'how long'	Shall be quantified if technical standards or agreed procedures at sectoral level exist or can be developed.

In case calculation parameters are needed related to the OEFSR mandatory company-specific information, the OEFSR shall provide a calculation example.

A.3.2.5. System boundary

The OEFSR shall identify and provide a short description of the the processes and life-cycle stages that are included in the sector/subsector.

The OEFSR shall identify the processes that shall be excluded based on the cut-off rule (see Section A.4.3.3.), or specify that no cut-off is applicable.

The OEFSR shall provide a system diagram indicating the processes for which mandatory company-specific data are required and the processes excluded from the system boundary.

The OEFSR shall identify in the system diagram the organisational boundaries and the OEF boundaries.

A.3.2.6. List of EF impact categories

The OEFSR shall list the 16 EF impact categories to be used to calculate the OEF profile, as listed in Table 2 of the Annex III. Out of the 16 impact categories, the OEFSR shall list those that are most-relevant for the sector or sub-sector(s) in scope (see Section A.6.1.1 of this Annex).

The OEFSR shall specify if the user of the OEFSR shall calculate and report separately the sub-indicators for climate change (see Section A.4.2.9).

The OEFSR shall specify the version of the EF reference package to be used ([8]).

A.3.2.7. Additional information

A.3.2.7.1. *Additional environmental information*

The OEFSR shall specify which additional environmental information to report, and whether these are mandatory or recommended additional environmental information. The use of 'should' requirements should be avoided. Additional environmental information may be included only if the OEFSR specifies the method that shall be used for its calculation.

Biodiversity

When developing an OEFSR, biodiversity shall be addressed under additional environmental information through the procedure below:

([8]) Available at http://eplca.jrc.ec.europa.eu/LCDN/developer.xhtm

(a) When performing the first and second OEF-RO study, the Technical Secretariat shall make an assessment about the relevance of biodiversity for the sector/ sub-sector(s) in scope of the OEFSR. This assessment may be based on expert judgement, be LCA-based, or be derived through other means already put in place within the sector. The assessment shall be clearly explained in a dedicated Section of the first and second OEF-RO report.

(b) Based on the above, the OEFSR shall clearly explain whether biodiversity is considered relevant or not. If the Technical Secretariat determines that there are significant impacts on biodiversity, then they shall describe how the user of the OEFSR shall assess and report biodiversity impacts, as additional environmental information.

While the Technical Secretariat may determine how biodiversity shall be assessed and reported in the OEFSR (if relevant), the following suggestions are available:

1. To express the (avoided) impact on biodiversity as the percentage of material that comes from ecosystems that have been managed to maintain or enhance conditions for biodiversity. This shall then be demonstrated by a regular monitoring and reporting of biodiversity levels, gains or losses (e.g. less than 15% loss of species richness due to disturbance, but the Technical Secretariat may set their own level provided this is well justified). The assessment should refer to materials that end up in the final products and to materials that have been used during the production process. For example, charcoal that is used in steel production processes, or soy that is used to feed cows that produce dairy etc.

2. To report additionally the percentage of such materials for which no chain of custody or traceability information can be found.

3. To use a certification system as a proxy. The Technical Secretariat shall determine which certification schemes provide sufficient evidence for ensuring biodiversity maintenance and describe the criteria used ([9]).

A.3.2.7.2. *Additional technical information*

The OEFSR shall list the additional technical information that shall/ should/ may be reported.

If the products belonging to the PP in scope are an intermediate product, the OEFSR shall request the following additional technical information:

1. The biogenic carbon content at factory gate (physical content) shall be reported in the OEF study. If derived from a native forest, the OEFSR shall require that the corresponding carbon emissions shall be modelled with the elementary flow '(land use change)';

2. The recycled content (R1) shall be reported;

3. Results with application-specific A-values of the circular footprint formula, if relevant.

A.3.2.8. Assumptions and limitations

The OEFSR shall include the list of limitations an OEF study is subject to, even if carried out in accordance with the OEFSR.

The technical secretariat shall specify under which conditions the OEFSR enables comparisons of organisations belonging to the same sector and/or sub-sector (e.g. through normalisation of the OEF profile against the yearly turnover of the organisation).

The OEFSR shall list the ILCD-EL compliant datasets used when modelling the representative organisation(s) and the data gaps.

([9]) A useful overview of standards can be found on http://www.standardsmap.org/

A.4. **Life-cycle Inventory**

A.4.1. *Direct and indirect activities and life-cycle stages*

The OEFSR shall identify the processes expected to belong to direct activities and the ones expected to belong to indirect activities.

If the PP includes mainly products, the OEFSR shall list all processes for each life-cycle stage. This step is optional if the PP includes mainly services, in this case it is up to the Technical Secretariat to evaluate the applicability of life-cycle stages to the sector in scope (see Section 4.2 of Annex III, which describes the applicability of life-cycle stages to OEF studies).

The default life-cycle stages are listed in Section 4.2 of Annex III and further detailed in Sections 4.2.1-4.2.5 of Annex III.

For each process, the OEFSR shall include the default secondary datasets that the user of the OEFSR shall apply, unless the process is covered by mandatory company-specific data.

A.4.2. *Modelling requirements*

A.4.2.1. Agricultural production

For agricultural activities, the modelling guidelines of Section 4.4.1 of the Annex III shall be followed for the ROs and included in the OEFSRs. Any exception shall be agreed upon with the Commission before being implemented.

A.4.2.1.1. *Fertilisers*

For nitrogen-based fertilisers, the Tier 1 emissions factors of table 2-4 of IPCC (2006) should be used, as presented in Table 3 of the Annex III.

The nitrogen field model presented in Table 3 of the Annex III has some limitations and should be improved in the future. Therefore, OEFSRs which have agricultural modelling in scope shall test (as minimum) the following alternative approach within the OEF-ROs.

The N-balance is calculated using the parameters in Table II-3 and the formula below. The total NO_3-N emission to water is considered a variable and its total inventory shall be calculated as:

'Total NO_3-N emission to water' = 'NO_3^- base loss' + 'additional NO_3-N emissions to water', with

'Additional NO_3-N emissions to water' = 'N input with all fertilisers' + 'N_2 fixation by crop' – 'N-removal with the harvest' – 'NH_3 emissions to air' – 'N_2O emissions to air' – 'N_2 emissions to air' -'NO_3- base loss'.

If in certain low-input schemes the value for 'additional NO_3-N emissions to water' is negative, the value shall be set to '0'. Moreover, in such cases the absolute value of the calculated 'additional NO_3-N emissions to water' is to be inventoried as additional N-fertiliser input into the system, using the same combination of N-fertilisers as employed to the analysed crop. This serves to avoid regarding fertility-depleting schemes by capturing the N-depletion by the analysed crop that is assumed to lead to the need for additional fertiliser later on to keep the same soil fertility level.

Table II-3

Alternative approach to nitrogen modelling

Emission	Compartment	Value to be applied
NO_3^- base loss (synthetic fertiliser and manure)	Water	kg NO_3^-= kg N*FracLEACH = 1*0.1*(62/14) = 0.44 kg NO_3^-/ kg N applied
N_2O (synthetic fertiliser and manure; direct and indirect)	Air	0.022 kg N_2O/ kg N fertilizer applied
NH_3 - Urea (synthetic fertiliser)	Air	kg NH_3= kg N * FracGASF= 1*0.15* (17/14)= 0.18 kg NH_3/ kg N fertilizer applied
NH_3 - Ammonium nitrate (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 - others (synthetic fertiliser)	Air	kg NH_3= kg N * FracGASF= 1*0.02* (17/14)= 0.024 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
N_2-fixation by crop		For crops with symbiotic N_2-fixation: the fixed amount is assumed to be identical to the N-content in the harvested crop
N_2	Air	0.09 kg N_2 / kg N applied

The Technical Secretariat may decide to include the above approach for N-based modelling in their OEFSR, instead of the one provided in the Annex III. Both approaches shall be tested in the supporting studies, and based on the evidences gathered, the Technical Secretariat is free to decide which of the two to apply. This shall be validated by the review panel of the OEFSR.

As a second alternative, in case better data is available, a more comprehensive nitrogen field model may be used in the OEFSR, provided (i) it covers at least the emissions requested in Table 3 of the Annex III, (ii) N shall be balanced in inputs and outputs and (iii) it shall be described in a transparent way.

A.4.2.2. Electricity use

The requirements in Section 4.4.2 of the Annex III shall be applied, unless the OEFSR covers electricity as main product (e.g., photovoltaic systems).

A.4.2.2.1. *Electricity modelling for representative organisations*

When modelling the RO the following electricity mix shall be used in hierarchical order:

(i) Sector specific information on the use of green electricity shall be used if:

  (a) available, and

  (b) the set of minimum criteria to ensure the contractual instruments are reliable is met.This may be combined with the remaining electricity to be modelled with the residual grid mix.

(ii) In case no sector specific information is available, the consumption grid mix shall be used.

In case the RO is situated in different locations and/or the products in the PP are sold in different countries, the electricity mix shall reflect the ratios of production or ratios of sales between EU countries/regions. To determine the ratio, a physical unit shall be used (e.g. number of pieces or kg of product). Where such data are not available, the average EU mix (EU+EFTA), or region representative mix shall be used.

A.4.2.3. Transport and logistics

The OEFSR shall provide default transport scenarios to be used, in case these data are not listed as mandatory company-specific information (see Section A.4.4.1) and supply-chain specific information is not available. The default transport scenarios shall reflect the European average transport, including all different transport options within the current product category (e.g. including home delivery, if applicable).

In case no OEFSR-specific data ([10]) is available, the default scenarios and values outlined in Section 4.4.3 of the Annex III shall be used. Replacement of the default values provided in Section 4.4.3 with OEFSR-specific values shall be clearly mentioned and justified in the OEFSR.

The (final and intermediate) client of the products belonging to the PP shall be defined in the OEFSR ([11]). The final client may be a consumer (i.e. any natural person who is acting for purposes which are outside his trade, business, craft or profession) or a company that uses the product for final use, such as restaurants, professional painters, or a construction site. For the purposes of this Section, re-sellers and importers are intermediate clients and not final clients.

A.4.2.3.1. *Allocation of impacts from transport – truck transport*

The OEFSR shall specify the utilisation ratio to be used for each truck transport modelled, and it shall clearly indicate whether the utilisation ratio includes empty return trips.

— If the load is mass-limited: a default utilisation ratio of 64% ([12]) shall be used. This utilisation ratio includes empty return trips. Therefore, empty returns shall not be modelled separately. The OEFSR shall list the truck dataset to be used, together with the utilisation factor to be used (64%). The OEFSR shall clearly indicate that the user shall check and adapt the utilisation ratio to the default value provided in the OEFSR.

— If the load is volume-limited and the full volume is used: the OEFSR shall indicate the company-specific utilisation ratio calculated as the kg real load/kg payload of the dataset and indicate how empty returns shall be modelled.

— If the load is delicate (e.g. flowers): it is likely that the full truck volume cannot be used. The OEFSR shall evaluate the most appropriate utilisation ratio to be applied.

— Bulk transport (e.g., gravel transport from mining pit to concrete plant) shall be modelled with a default utilisation ratio of 50% (100% loaded outbound and 0% loaded inbound).

— Reusable products and packaging shall be modelled with OEFSR-specific utilisation ratios. The default value of 64% (including empty return) cannot be used because the return transport is modelled separately for reusable products.

A.4.2.3.2. *Allocation of impacts from transport – consumer transport*

The OEFSR shall prescribe the default allocation value to be used for consumer transport, if applicable.

A.4.2.3.3. *Default scenarios – from supplier to factory*

The OEFSR shall specify default transport distances, transport modes (specific dataset) and truck load factors to be used for the transport of products from supplier to factory. If no OEFSR specific data are available, then the default data provided in Section 4.4.3.4 of the Annex III shall be prescribed in the OEFSR.

([10]) Product category specific data, defined by the TS and representing the European average for the products in scope.

([11]) A clear definition of the final client facilitates a correct inteprretation of the OEFSR by practitioners which will enhance the comparability of results.

([12]) Eurostat 2015 indicates that 21% of the kms truck transport are driven with empty load and 79% are driven loaded (with an unknown load). In Germany only, the average truck load is 64%.

A.4.2.3.4. *Default scenarios – from factory to final client*

The transport from factory to final client (including consumer transport) shall be described in the distribution stage of the OEFSR. This helps fair comparisons between products delivered through traditional shops as well as delivered at home.

In case no OEFSR-specific transport scenario is available, the default scenario outlined in Section 4.4.3.5 of the Annex III shall be used as a basis, together with a number of OEFSR-specific values:

1. Ratio between products sold through retail, distribution centre (DC) and directly to the final client;

2. For factory to final client: Ratio between local, intracontinental and international supply chains;

3. For factory to retail: distribution between intracontinental and international supply chains.

For reusable products the return transport from retail/DC to factory shall be modelled in addition to the transport needed to go to retail/DC. The same transport distances as from product factory to final client shall be used (see Section 4.4.3.5 of the Annex I), however the truck utilisation ratio might be volume-limited depending on the type of product. The OEFSR shall indicate the utilisation ratio that shall be used for the return transport.

A.4.2.4. Capital goods – infrastructure and equipment

During the execution of the OEF-RO studies all processes shall be included in the modelling without applying any cut-off, the modelling assumptions and secondary datasets used shall be clearly documented.

The OEFSR shall identify if, based on the results of the OEF-RO study, capital goods are subject to cut-off or not. If capital goods are included in the OEFSR, clear rules for their calculation shall be provided.

A.4.2.5. Sampling procedure

In some cases, a sampling procedure is needed by the user of an OEFSR to limit the data collection only to a representative sample of plants/ farms etc. Examples of cases when the sampling procedure may be needed are in case multiple production sites are involved in the production of the same Stock Keeping Unit (SKU); e.g., in case the same raw material/ input material comes from multiple sites or in case the same process is outsourced to more than one subcontractor/ supplier.

For OEFSRs a stratified sample shall be used, i.e. one that ensures that sub-populations (strata) of a given population are each adequately represented within the whole sample of a research study. With this type of sampling, it is guaranteed that subjects from each sub-population are included in the final sample, whereas simple random sampling does not ensure that sub-populations are represented equally or proportionately within the sample.

The Technical Secretariat shall decide if sampling is allowed or not allowed in its OEFSR. The Technical Secretariat may explicitly prohibit the use of sampling procedures in the OEFSR. In this case sampling will not be allowed in OEF studies and the user of the OEFSR shall collect data from all plants or farms. If the Technical Secretariat allows sampling, the OEFSR shall contain the following sentence: 'In case sampling is needed, it shall be conducted as specified in this OEFSR. However, sampling is not mandatory and any user of this OEFSR may decide to collect the data from all the plants or farms, without performing any sampling.'

In case the OEFSR allows the use of sampling, the OEFSR shall define the requirements for reporting by the user of the OEFSR. The population and the selected sample used for the OEF study shall be clearly described in the OEF report (e.g., the % of the total production or % of number of sites, following the requirements stated in the OEFSR).

A.4.2.5.1. *How to define homogeneous sub-populations (stratification)*

The OEF method requires aspects to be taken into consideration in the identification of the sub-populations (see Section 4.4.6.1of the Annex I):

1. Geographical distribution of sites;

2. Technologies/ farming practices involved;

3. Production capacity of the companies/ sites taken into consideration.

The OEFSR may list additional aspects to be taken into consideration within a specific product category.

In case additional aspects are taken into account, the number of sub-populations is calculated using the formula (equation 1) provided in Section 4.4.6.1 of the Annex III 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).

A.4.2.5.2. *How to define sub-sample size at sub-population level*

The OEFSR shall specify the approach chosen among the two available in Section 4.4.6.2 of the Annex III. The same approach shall be used for all the sub-populations selected.

In case the first approach is chosen the OEFSR shall establish the unit of measure for the production (e.g., t, m^3, m^2 or value in €). The OEFSR shall identify the percentage of production to be covered by each sub-population, which shall not be lower than 50%, expressed in the relevant unit. This percentage determines the sample size within the sub-population.

A.4.2.6. Use stage

A.4.2.6.1. *Main function approach or delta approach*

The OEFSR shall describe which approach shall be applied (main function approach or delta approach, Section 4.4.7.1 of the Annex III).

In case the delta approach is used, the OEFSR shall specify a reference consumption to be defined for each associated product (e.g. of energy and materials). The reference consumption refers to the minimum consumption that is essential for providing the function. The consumption above this reference (the delta) will then be allocated to the product. To define the reference situation, the following shall be considered, if available:

1. Regulations applicable to the product category;

2. Standards or harmonised standards;

3. Recommendations from manufacturers or manufacturers' organisations;

4. Use agreements established by consensus in sector-specific working groups.

A.4.2.6.2. *Modelling the use stage*

For all processes belonging to the use stage (both most-relevant and the others):

1. The OEFSR shall indicate which use stage processes are product dependent and product independent (as described in the Annex III, Section 4.4.7). In case of large product portfolios, this information may be provided as an Annex to the OEFSR

2. The OEFSR shall identify for which processes default data shall be provided by following the modelling guidelines in Table JJ-4. In case modelling is optional, the Technical Secretariat shall decide whether this is included in the system boundary of the OEFSR calculation model.

3. Per process to be modelled, the Technical Secretariat shall decide and describe in the OEFSR whether the main function approach or delta approach shall be applied:

4. Main function approach: The default datasets presented in the OEFSR shall reflect as much as possible the reality of market situations.

5. Delta approach: the OEFSR shall provide the reference consumption to be used.

6. The OEFSR shall follow the modelling and reporting guidelines in Table JJ-4. This table shall be filled in by the Technical Secretariat and included in the first and second OEF-RO reports.

Table JJ-4

OEFSR guidelines for the use stage

The specific use stage process is:		Actions to be taken by the TS	
Product dependent?	**Most-relevant?**	**Modelling guidelines**	**Where to report**
Yes	Yes	To be included in the OEFSR system boundary. Provide default data	Mandatory: OEF report,
	No	Optional: May be included in the OEFSR system boundary when the uncertainty can be quantified (provide default data)	Optional: OEF report,
No	Yes/No	Excluded from the OEFSR system boundary	Optional: qualitative information

Part D of Annex IV provides default data to be used by the Technical Secretariat to model use stage activities that might be cross-cutting for several product groups. It shall be used to fill in the data gaps and ensure consistency among OEFSRs. Better data may be used but shall be justified in the OEFSR.

Example: pasta

This is a simplified example on how the environmental footprint of the use stage can be modelled and reported for the product '1 kg dry pasta' (adapted from the final OEFSR for dry pasta ([13]).

Table LL-6 presents the processes used for modelling the use stage of 1kg dry pasta (boiling time according to instructions, for instance 10 minutes; amount of water, according to the instructions, for instance 10 litres). Among the four processes, electricity and heat use are the most-relevant ones. Within this example, all four processes are product dependent. The amount of water use and cooking time is in general indicated on the packaging. The manufacturer can change the recipe in order to increase or reduce the cooking time, and therefore the energy use. Within the OEFSR, default data is provided on all four processes, as indicated in Table LL-6 (activity data + LCI dataset to be used). Following the reporting guidelines, the EF of the total of all four processes is reported as separate information.

Table KK-5

Example activity data and secondary datasets used

Materials/fuels	Value	Unit
Tap water; technology mix; at user; per kg water	10	kg
Electricity mix, AC, consumption mix, at consumer, <1kV	0,5	kWh
Thermal energy, from resid. heating systems from NG, consumption mix, at consumer, temperature of 55C	2,3	kWh
Waste to treatment	Value	Unit
Waste water treatment, domestic waste water according to the Directive 91/271/EEC concerning urban waste water treatment	10	kg

([13]) Available at http://ec.europa.eu/environment/eussd/smgp/OEFSR_OEFSR_en.htm

Table LL-6

Processes of the use stage of dry pasta (adapted from the final PEFCR for dry pasta). The most-relevant processes are indicated in the green box

Is the use stage process …?		Pasta processes	Actions taken by the Technical Secretariat:	
(ii) **Product dependent?**	(iii) **Most-relevant?**		**Modelling**	**Reporting**
Yes	Yes	Electricity and Heat	Modelled as main function approach. Default data provided (total energy use).	In the OEF report, reported separately
	No	Tap water Waste water	Modelled as main function approach. Default data provided (total water use).	In the OEF report, reported separately
No	Yes/No		Excluded from the EF calculation (impact categories)	Optional: qualitative information

A.4.2.7. End of life modelling

OEFSR shall prescribe the use of the CFF formula and provide default values for all parameters to be used (see also Section 4.4.8 of the Annex III).

A.4.2.7.1. *The A factor*

The A values to be used shall be clearly listed in the OEFSR, with a reference to Part C of Annex IV. When developing an OEFSR the following procedure shall be applied to select the value of A to be included in the OEFSR:

1. Check in Part C of Annex IV the availability of an application-specific A value which fits the OEFSR,

2. If an application specific A value is not available, the material-specific A value in Part C of Annex IV shall be used,

3. If a material-specific A value is not available, the A value shall be set equal to 0.5.

A.4.2.7.2. *The B factor*

The B value shall always be equal to 0 as default unless another appropriate value is available in the part C of the Annex IV. The B value to be used shall be clearly stated in the OEFSR.

A.4.2.7.3. *The quality ratios:* Qs_{in}/Q_p *and* Qs_{out}/Q_p

The quality ratios shall be determined at the point of substitution and per application or material. The quality ratios are OEFSR specific. For packaging, each OEFSR should use the default values provided in Part C of Annex IV. The Technical Secretariat may decide to change the default values in the OEFSR to product or sector specific ones. In this case, the justification for the change shall be included in the OEFSR.

All quality ratios to be used shall be clearly stated in the OEFSR. Alternatively, clear guidance shall be provided by the OEFSR on how to determine quality ratios to be used.

The quantification of the quality ratios shall be based on:

— Economic aspects: i.e. price ratio of secondary compared to primary materials at the point of substitution. In case the price of secondary materials is higher than that of the primary ones, the quality ratios shall be equal to 1.

— If economic aspects are less relevant than physical aspects, the latter may be used.

A.4.2.7.4. *Recycled content (R_1)*

The OEFSR shall provide the list of default R1 values, which shall be used by the user of the OEFSR in case no company-specific values are available. For this, the Technical Secretariat shall select the appropriate application-specific R1 values available in Part C of Annex IV. In case no application-specific values are available, R1 shall be set equal to 0. Material-specific values based on supply market statistics shall not be used as a proxy. All possible geographic regions shall be provided. The applied R1 values shall be subject to the OEFSR review (if applicable) or OEF study verification (if applicable).

New R1 values may be developed by the Technical Secretariat (based on new statistics) and provided to the Commission for implementation in Part C of Annex IV. Newly proposed R1 values shall be provided together with a report indicating the sources and calculations, and reviewed by an external independent third party. The Commission will take the decision if the new values are acceptable and can be implemented in an updated version of Part C of Annex IV. Once the new R1 values are integrated in Part C of Annex IV, they can be used by any OEFSR.The choice for 'default R_1 values' or 'company-specific R_1 values' shall be based on the rules of the DNM (see Table A-7).

This means that company-specific values shall be used when:

(a) the process is identified in the OEFSR as being most-relevant and is run by the company using the OEFSR, or the company is not running the process but has access to company-specific information,

or

(b) the process is listed by the OEFSR as mandatory company-specific data.

In other cases 'default secondary R_1 values' shall be used for example, when R_1 is in situation 2, option 2 of the DNM. In this case company-specific data is not mandatory and default secondary R_1 values provided in the OEFSR shall be used by the company.

Table A-7

Requirements regarding R_1 values in relation with the DNM

		Most-relevant process	Other process
Situation 1: process run by the organisation in scope of the OEF study	**Option 1**	Supply-chain specific R_1 value	
	Option 2		Default (application-specific) R1 value
Situation 2: process not run by the organisation in scope of the OEF study, but with access to (company-)specific information	**Option 1**	Supply-chain specific R_1 value	
	Option 2	Default (application-specific) or supply-chain specific R_1 value	
	Option 3		Default (application-specific) or supply-chain specific R_1 value
Situation 3: process not run by the organisation in scope of the OEF study and without access to (company)-specific information	**Option 1**	Default (application-specific) R_1 value	
	Option 2		Default (application-specific) R_1 value

A.4.2.7.5. *Guidelines on how to deal with pre-consumer scrap*

Two options are described in the OEF method (Section 4.4.8.8 of Annex III): the OEFSR shall specify which option shall be used when modelling pre-consumer scrap.

A.4.2.7.6. *Recycling output rate (R_2)*

The OEFSR shall provide the list of default R2 values to be used by the user of the OEFSR in case no company-specific values are available. For this, the Technical Secretariat shall select the appropriate application-specific R2 values available in part C of Annex IV. In case no application-specific values are available in part C of Annex IV, the OEFSR shall select the R2 values of the material (e.g. materials average) to be used as default. In case no R2 values are available, R2 shall be set equal to 0. All possible geographic regions shall be provided.

New R2 values may be developed by the Technical Secretariat (based on new statistics) and provided to the Commission for implementation in part C of Annex IV. Newly proposed R2 values shall be provided together with a study report indicating the sources and calculations, and reviewed by an external independent third party. The Commission will take the decision if the new values are acceptable and can be implemented in an updated version of part C of Annex IV. Once the new R2 values are integrated in part C of Annex IV, they can be used by any OEFSR.To select the right R_2 value the following procedure shall be followed by the user of the OEFSR and described in the OEFSR:

Company-specific values shall be used if available.

1. If no company-specific values are available and the criteria for evaluation of recyclability are fulfilled (see Section 4.4.8.9 of Annex I), application-specific R_2 values shall be used as listed in the OEFSR,

   a. If an R_2 value is not available for a specific country, then the European average shall be used.

   b. If an R_2 value is not available for a specific application, the R_2 values of the material shall be used (e.g. material's average).

   c. In case no R_2 values are available, R_2 shall be 0 or new statistics may be generated to assign an R_2 value in the specific situation.

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

A.4.2.7.7. *The R_3 value*

The OEFSR shall provide the list of default R_3 values, which shall be used by the user of the OEFSR in case no company-specific values are available . For this, the Technical Secretariat shall select the appropriate R_3 values available in part C of Annex IV. In case no value is available in part C of Annex IV or in the case that such values are outdated with more recent ones from the same data source ([14]), the Technical Secretariat shall provide own developed values or provide guidance for the user of the OEFSR on how to derive the necessary values. The applied R_3 values shall be subject to the OEFSR review (if applicable) or OEF study verification (if applicable).

New R_3 values may be developed by the Technical Secretariat (based on new statistics) and provided to the Commission for implementation in part C of Annex IV. Newly proposed R_3 values shall be provided together with a study report indicating the sources and calculations, and reviewed by an external independent third party. The Commission will take the decision if the new values are acceptable and can be implemented in an updated version of part C of Annex IV. Once the new R_3 values are integrated in part C of Annex IV, they can be used by any OEFSR.

The choice for 'default R_3 values' or 'company-specific R_3 values' shall be based on the logic of the DNM. This means that supply chain specific values shall be used when:

1. the process is identified in the OEFSR as being most-relevant and is run by the company using the OEFSR, or the company is not running the process but has access to company-specific information,

([14]) For example, part C of Annex IV reports data from Eurostat 2013 but more updated data were published by Eurostat in a more recent year.

or

2. the process is listed by the OEFSR as mandatory company-specific data.

In all other cases 'default secondary R_3 values' shall be used for example, when R_3 is in situation 2, option 2 of the DNM. In this case company-specific data is not mandatory and default secondary R_3 values provided in the OEFSR shall be used by the company.

A.4.2.7.7. *$E_{recycled}$ and $E_{recyclingEoL}$*

The OEFSR shall list the default datasets that the user of the OEFSR shall apply to model E_{rec} and E_{recEoL}.

A.4.2.7.8. *The E*v*

The OEFSR shall list the default datasets that the user of the OEFSR shall apply to model E*v.

A.4.2.7.9. *How to apply the formula when the product portfolio includes intermediate products*

In this case, the parameters related to the end-of-life of the specific product in the PP (i.e. recyclability at end-of-life, energy recovery and disposal) shall not be accounted for, unless the OEFSR requires to calculate additional information for the EoL stage.

If the formula is applied in OEF studies for intermediate products (cradle-to-gate studies), the OEFSR shall prescribe:

1. The use of the CFF;

2. To exclude the EoL by setting the parameters R2, R3, and Ed to 0 for the products included in the PP;

3. Use A=1 for the intermediate products in the PP.

When developing the OEFSR, the A value of the product in the PP shall be set to 1 for the hotspot analysis in the OEF-RO study to allow to focus the analysis on the actual system. This shall be documented in the OEFSR.

A.4.2.8. Extended product lifetime

In situation 1 described in Section 4.4.9 of the Annex III, the OEFSR shall describe how reuse or refurbishment is included in the calculations of the reference flow and full life-cycle model, taking into account the 'how long' of the PP Default values for extended lifetime shall be provided in the OEFSR or shall be listed as mandatory company-specific information.

A.4.2.8.1. *How to apply 'reuse rate' (situation 1)*

At point 2) of Section 4.4.9.2 of Annex III, the OEFSR shall further specify and provide one-way transport distances.

A.4.2.8.2. *Average reuse rates for company owned pools*

The average reuse rates available in Section 4.4.9.4 of Annex III shall be used within the OEF-RO studies, unless data of better quality is available.

If the Technical Secretariat decides to use other values within their OEF-RO study, it shall provide a justification and provide the data source. In case a specific packaging type is not present in the list above, sector-specific data shall be used. New values shall be subject to the OEFSR review.

The OEFSR shall prescribe the use of mandatory company-specific reuse rates for company owned packaging pools.

A.4.2.8.3. *Average reuse rates for third party operated pools*

The average reuse rates available in Section 4.4.9.5 of Annex III shall be used by those OEFSRs that have third party operated reusable packaging pools in scope, unless data of better quality is available.

If the Technical Secretariat decides to use other values within their final OEFSR, it shall clearly justify why and provide the data source. In case a specific packaging type is not present in the list of Section 4.4.9.5 of the Annex I, sector-specific data shall be collected and included in the OEFSR. New values shall be subject to the OEFSR review.

A.4.2.9. Greenhouse gas emissions and removals

To provide all necessary information for developing the OEFSR, the OEF-RO study shall always calculate the three climate change sub-categories separately. If climate change is identified as a most-relevant impact category, the OEFSR shall (i) request to report the total climate change as the sum of the three sub-categories, and (ii) request the reporting of the sub-categories 'climate change -fossil', 'climate change – biogenic' and 'climate change - land use and land use change', separately if the OEF-RO study shows a contribution of more than 5% ([15]) each to the total score.

A.4.2.9.1. *Sub-category 2: Climate change – biogenic*

The OEFSR shall specify if a simplified modelling approach shall be used when modelling the foreground emissions.

In the case a simplified modelling approach is chosen, the OEFSR shall include the following text: 'Only the emission 'methane (biogenic)' is modelled, while no further biogenic emissions and uptakes from the 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.'

In the case a simplified modelling approach is not chosen, the OEFSR shall include the following text: 'All biogenic carbon emissions and removals shall be modelled separately. However, note that the corresponding characterisation factors for biogenic CO_2 uptakes and emissions within the EF impact assessment method are set to zero'.

A.4.2.9.2. *Sub-category 3: Climate change – land use and land use change (LULUC)*

The Technical Secretariat may decide to include soil carbon storage in the OEFSR as additional environmental information. In case of inclusion, the OEFSR shall specify how this shall be modeled and calculated, and which proof shall be provided. If legislation provides specific modelling requirements for the sector, it shall be modelled according to this legislation.

A.4.2.10. Packaging

European average packaging datasets shall be used in case the OEFSR does not request the use of company-specific data, no supplier-specific information is available or the packaging is not relevant. Although the default secondary datasets shall be listed in the OEFSR, for some multi-material packaging the OEFSR shall provide additional information to allow the user to perform a correct modelling. This is for example the case for beverage cartons and bag-in-box packaging:

— Beverage cartons are made out of LDPE granulates and liquid packaging board, with or without aluminium foil. The amount of LDPE granulates, board and foil (also called the bill of material of beverage cartons) depends on the application of the beverage carton and shall be defined in the OEFSR if applicable (e.g. wine cartons, milk cartons). Beverage cartons shall be modelled by combining the OEFSR prescribed amounts of material datasets with the beverage carton conversion dataset.

— Bag in box is made out of corrugated board and packaging film. If applicable, the OEFSR should define the amount of corrugated board, as well as the amount and type of packaging film. If this is not prescribed by the OEFSR, the user of the OEFSR shall use the default dataset for bag-in-box.

([15]) For example, if 'Climate change - biogenic' contributes with 7% (using absolute values) to the total climate change impact and 'Climate change – land use and land use change' contributes with 3% to the total climate change impact. In that case, the total climate change impact and the 'Climate change – biogenic' shall be reported. The Technical Secretariat may decide where and how to report the latter ('Climate change – biogenic').

A.4.3. *Handling multi-functional processes*

Systems involving multi-functionality of processes shall be modelled in accordance with the decision hierarchy provided in Section 4.5 of Annex I.

The OEFSR shall further specify multi-functionality solutions within the defined system boundary and, where appropriate, for upstream and downstream stages. If applicable, the OEFSR shall further provide specific factors to be used in the case of allocation solutions. All such multi-functionality solutions specified in the OEFSR shall be clearly justified with reference to the OEF multi-functionality solution hierarchy:

(a) Where subdivision is applied, the OEFSR shall specify which processes are to be sub-divided and the principles that such subdivision should adhere to.

(b) Where allocation by physical relationship is applied, the OEFSR shall specify the relevant underlying physical relationships that shall be considered and list the specific allocation values that shall be fixed for all studies using the OEFSR.

(c) Where allocation by some other relationship is applied, the OEFSR shall specify this relationship and list the specific allocation values that shall be fixed for all studies using the OEFSR.

A.4.3.1. Animal husbandry

A.4.3.1.1. *Allocation within the farm module*

Default values for each type of animal shall be provided in the OEFSR and used by OEF studies. The default values available in Sections 4.5.1.2-4.5.1.4 of Annex III should be used, unless more sector-specific data are available.

A.4.3.1.2. *Allocation within the slaughterhouse*

Default values for prices and mass fractions are provided in the Annex III for cattle, pigs and small ruminants (sheep, goat) and these default values shall be included in relevant OEFSRs and used by OEF studies, OEF supporting studies and OEF-RO studies. No change of allocation factors is allowed in OEF studies.

A.4.3.1.3. *Allocation within the slaughterhouse for cattle*

If allocation factors to subdivide the impact of the carcass among the different cuts are desired, they shall be defined in the relevant OEFSR.

A.4.4. *Data collection requirements and quality requirements*

The materiality principle

One of the main features of the OEF method is the 'materiality' approach, i.e. focusing where it really matters. In the OEF context, the materiality approach is developed around two main areas:

Impact categories, life-cycle stages, processes and direct elementary flows: the OEFSR shall identify the most-relevant ones. These are the environmental contributions on which companies, stakeholders, consumers, and policy makers should focus (see Section 7.3 of the Annex III);

Data requirements: as the most-relevant processes are those driving the environmental profile of an organisation, these shall be assessed by using data of higher quality compared to the less relevant processes, independently from where these processes happen within the OEF boundaries.

Once the model(s) for the representative organisation(s) is developed, the Technical Secretariat shall address the following two questions with the OEF-RO studies:

1. Which are the processes for which company-specific information is mandatory?

2. Which are the processes that are driving the environmental profile of the organisation (most-relevant processes)?

A.4.4.1. List of mandatory company-specific data

The list of mandatory company-specific data refers to the activity data, direct elementary flows and (unit) processes for which company-specific data shall be collected. This list defines the minimum data requirements to be fulfilled by the users of the OEFSR. The purpose is to avoid that a user without access to the relevant company-specific data is able to perform an OEF study and communicate its results by only applying default data and datasets. The OEFSR shall define the list of mandatory company-specific data

For the selection of the mandatory company-specific data, the Technical Secretariat shall consider its relevance within the EF profile, the level of effort needed to collect these data (especially for SMEs) and the overall quantity of data / time required to collect all mandatory company-specific data and existing legal requirements defined in EU law on measuring certain emissions. For instance, in case specific EU ETS monitoring rules exist for the sector to which the product in scope of the OEFSR belongs, the OEFSR should refer to EU ETS quantification requirements as set out in Regulation (EU) 2018/2066 for the processes and GHGs covered therein. In case of carbon capture and storage (CC), the requirements of the Annex III prevail.

This decision has, in particular, two consequences: (i) companies may perform an OEF study by only searching for these data and using default data for everything outside this list, while (ii) companies that don't have company-specific data for any of the listed data cannot calculate an OEFSR-compliant OEF profile for an organisation on the sector concerned.

For each process for which company-specific data is mandatory the OEFSR shall provide the following information:

1. the list of the company-specific activity data to be declared by the user of the OEFSR together with the default secondary datasets to be used. The list of activity data shall be as specific as possible in terms of units of measure and any other characteristics that could help the user in implementing the OEFSR;

2. the list of direct (i.e. foreground) elementary flows to be measured by the user of the OEFSR. This is the list of most-relevant direct emissions and resources. For each emission and resource, the OEFSR shall specify the frequency of measurements, the measurement methods and any other technical information necessary to ensure that OEF profiles are comparable. Note that the direct elementary flows listed shall be aligned with the nomenclature used by the most recent version of the EF reference package ([16]) .

Considering that the data for these processes shall be company-specific, the score of P cannot be higher than 3, the score for TiR, TeR, and GeR cannot be higher than 2, and the DQR score shall be equal or lower than 1.5 (≤1.5). To assess the DQR, follow the requirements of Table 23 of Annex III. The developed datasets shall be EF compliant.

For processes selected to be modelled mandatorily with company-specific data, the OEFSR shall follow the requirements set out in this Section. For all other processes, the user of the OEFSR shall apply the Data Needs Matrix as explained in Section 4.4.4.4 of this Annex.

A.4.4.2. Datasets to be used

When developing the final OEFSR, EF compliant datasets ([17]) shall be used. In case EF compliant datasets are not available, the following rules shall be followed in hierarchical order:

1. An EF compliant proxy is available for free: it shall be included in the list of default processes of the OEFSR and stated within the limitations Section of the OEFSR.

2. An ILCD-EL compliant dataset as proxy is available for free: A maximum of 10% of the single overall score may be derived from ILCD-EL compliant datasets.

([16]) Available at http://eplca.jrc.ec.europa.eu/LCDN/developerEF.xhtml
([17]) http://eplca.jrc.ec.europa.eu/LCDN/contactListEF.xhtml)

3. If no EF compliant or ILCD-EL compliant dataset is available for free: it shall be excluded from the model. This shall be clearly stated in the OEFSR as a data gap and validated by the OEFSR reviewers.

For the user of the OEFSR, the secondary datasets listed in the OEFSR shall be used. Whenever a dataset needed to calculate the OEF profile is not among those listed, the following rules shall be followed in hierarchical order:

1. Use an EF compliant dataset available on one of the nodes of the Life-cycle Data Network ([18]) ;

2. Use an EF compliant dataset available in a free or commercial source;

3. Use another EF compliant dataset considered to be a good proxy. In this case, this information shall be included in the 'limitations' Section of the Annex I.

4. Use an ILCD-EL compliant dataset as proxy. In such cases, these datasets shall be included in the 'limitations' Section of the Annex I. This up to a maximum contribution of 10% of the single overall score of the product in scope

5. If no EF compliant or ILCD-EL compliant dataset is available: it shall be excluded from the OEF study. This shall be clearly stated in the OEF report as a data gap and validated by the OEF study and OEF report verifiers.

Whenever an EF or ILCD-EL compliant dataset is used, the nomenclature of the elementary flows shall be aligned with the EF reference package used in the rest of the model ([19]) .

A.4.4.3. Cut-off

Any cut-off shall be avoided in the first OEF-RO study and supporting studies.

Based on the results of the first OEF-RO study and if confirmed by the supporting study results, the second OEF-RO study and OEFSR may exclude processes from the RO system boundaries by applying the following rule:

(a) In case processes are excluded from the model, this shall be done based on a 3% cut-off considering their environmental impact for all impact categories, additionally to the cut-off already included in the background datasets. This rule is valid for both intermediate and final products. The processes that in total (cumulatively) account less than 3% of the environmental impact for each impact category may be excluded from the RO. In case the Technical Secretariat decides to apply the cut-off rule, second OEF-RO shall exclude the processes and the OEFSR shall list the processes that shall be excluded based on the cut-off.

(b) In case the processes identified for cut-off from the first OEF-RO study are not confirmed by the supporting studies, the decision about their exclusion or inclusion shall be left to the review panel and reported explicitly in the review report to be annexed to the OEFSR.

The OEFSR shall list the processes that shall be excluded from the modelling based on the cut-off rule and indicate that no additional cut-offs are allowed by the user of the OEFSR. In case the Technical Secretariat decides that no cut-off is allowed, this requirement shall be explicitly mentioned in the OEFSR.

A.4.4.4. Data quality requirements

A.4.4.4.1. *The DQR formula*

The OEFSR shall provide tables with the criteria to be used for the semi-quantitative assessment of each data quality criteria. The OEFSR may specify more stringent or specify additional data quality requirements if appropriate for the sector in question.

([18]) http://eplca.jrc.ec.europa.eu/LCDN/
([19]) http://eplca.jrc.ec.europa.eu/LCDN/developerEF.xhtml

A.4.4.4.2. *The DQR of company-specific datasets*

When creating a company-specific dataset, the data quality of i) the company-specific activity data and ii) the company-specific direct elementary flows (i.e. emission data) shall be assessed separately by the user of the OEFSR. To allow the evaluation of the DQR of data sets with company-specific data, the OEFSR shall include at least one table on how to assess the value of the DQR criteria for these processes. The table(s) to be included in the OEFSR shall be based on Table 23 of Annex III: only the reference years criteria ($Ti_{R\text{-}EF}$, $Ti_{R\text{-}AD}$) may be adapted by the Technical Secretariat.

The DQR of the sub-processes linked to the activity data (see Figure 9 of the Annex I) are evaluated through the requirements provided in the DNM (Section 4.4.4.4 of this Annex).

The DQR of the newly developed dataset shall be calculated as follows:

1. Select the most-relevant activity data and direct elementary flows: most-relevant activity data are the ones linked to sub-processes (i.e. secondary datasets) that account for at least 80% of the total environmental impact of the company-specific dataset, listing them from the most contributing to the least contributing one. Most-relevant direct elementary flows are defined as those direct elementary flows contributing cumulatively at least with 80% to the total impact of the direct elementary flows.

2. Calculate the DQR criteria TeR, TiR, GeR and P for each most-relevant activity data and each most-relevant direct elementary flow. The values of each criteria shall be assigned based on the table on how to assess the value of the DQR criteria provided in the OEFSR.

   a. Each most-relevant direct elementary flow consists of the amount and elementary flow naming (e.g. 40 g carbon dioxide). For each most-relevant elementary flow, the user of the OEFSR shall evaluate the 4 DQR criteria named $TeR_{\text{-}EF}$, $TiR_{\text{-}EF}$, $GeR_{\text{-}EF}$, OEF. Examples of elements to be evaluated include the timing of the flow measured, the technology for which the flow was measured and in which geographical area the measurement was made.

   b. For each most-relevant activity data, the 4 DQR criteria shall be evaluated (named $TeR_{\text{-}AD}$,$TiR_{\text{-}AD}$, $P_{AD,}$ $GeR_{\text{-}AD}$,) by the user of the OEFSR.

   c. Considering that the data for the mandatory processes shall be company-specific, the score of P cannot be higher than 3 while the score for TiR, TeR, and GeR cannot be higher than 2 (The DQR score shall be ≤1.5).

3. Calculate the environmental contribution of each most-relevant activity data (through linking to the appropriate sub-process) and each most-relevant direct elementary flow to the total sum of the environmental impact of all most-relevant activity data and direct elementary flows, in % (weighted, using all EF impact categories). For example, the newly developed dataset has only two most-relevant activity data, contributing in total to 80% of the total environmental impact of the dataset:

   a. Activity data 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).

   b. Activity data 2 carries 50% of the total dataset environmental impact. The contribution of this process to the total of 80% is 62.5% (the latter is the weight to be used).

4. Calculate the TeR, TiR, GeR and P criteria of the newly developed dataset as the weighted average of each criterion of the most-relevant activity data and direct elementary flows. The weight is the relative contribution (in %) of each most-relevant activity data and direct elementary flow calculated in step (3).

5. The user of the OEFSR shall calculate the total DQR of the newly developed dataset using Equation 20 of the Annex I, where $\overline{Te_R}, \overline{Ge_R}, \overline{Ti_R}, \overline{P}$ are the weighted averages calculated as specified in point (4).

A.4.4.4.3. *The DQR of secondary datasets used in an OEF study*

To allow the user to assess the context-specific DQR criteria TeR, TiR and GeR of most-relevant processes, the OEFSR shall include at least one table on how to assess the criteria. The assessment of the TeR, TiR and GeR criteria shall be based on Table 24 of Annex I. The Technical Secretariat may only adapt the reference years for the criterion TiR. It is not allowed to modify the text for the other criteria.

A.4.4.4.4. *The Data Needs Matrix*

All processes required to model the product and that are not on the list of mandatory company-specific data shall be evaluated using the Data Needs Matrix (see Table MM-8).

Rules to be followed when developing an OEFSR

The OEFSR shall include the following information for all processes that are not on the list of mandatory company-specific data:

(1) provide the list of default secondary datasets to be used within the scope of the OEFSR (dataset name, together with the UUID of the aggregated version ([20]), the web address of the node, and the data stocks). For each dataset the aggregated and disaggregated (level-1) form shall be available;

(2) report the default DQR values (for each criterion) as provided in their meta data, for all default EF datasets listed;

(3) indicate the most-relevant processes;

(4) provide one or more DQR table(s) for the most-relevant processes;

(5) indicate the processes expected to be in situation 1;

(6) for those processes expected to be in situation 1, explicitly list the activity data and direct elementary flows (resources and emissions) to be measured by the user of the OEFSR as a minimum ([21]). This list shall be as specific as possible in terms of unit of measurement, how to measure or average data, and any other characteristics that could help the user in implementing the OEFSR.

Rules for the user of the OEFSR

The user of the OEFSR shall apply the DNM to evaluate which data is needed. It shall be used within the modelling of its OEF study, depending on the level of influence the user (company) has on the specific process. The following three cases are found in the DNM:

(1) **Situation 1**: the process is run by the organisation in scope of the OEF study;

(2) **Situation 2**: the process is not run by the organisation in scope of the OEF study but the company has access to company-specific information;

(3) **Situation 3**: the process is not run by the organisation in scope of the OEF study and this company does not have access to company-specific information.

The user of the OEFSR shall:

(1) determine the level of influence (Situation 1, 2 or 3 described below) the company has over each process in its supply chain. This decision determines which of the options in Table MM-8 is pertinent for each process;

(2) follow the rules of Table MM-8 for the most-relevant processes and for the other processes. The DQR value mentioned in brackets is the maximum DQR value allowed.

(3) Calculate or re-evaluate the DQR values (for each criterion + total) for all the datasets used for the most-relevant processes and the new ones created. For all remaining 'other processes' the DQR values provided in the OEFSR shall be used.

([20]) Each EF compliant dataset tendered by the Commission is available in both an aggregated and disaggregated (at level-1) form.

([21]) Note that the direct elementary flows listed shall be aligned with the nomenclature used by the most recent version of the EF reference package (available at http://eplca.jrc.ec.europa.eu/LCDN/developerEF.xhtml).

(4) If one or more processes are not included in the list of default processes in the OEFSR, the user shall identify a suitable dataset according to requirements provided in Section A.4.4.2 of this Annex.

Table MM-8

Data Needs Matrix (DNM) – Requirements for the user of the OEFSR. The options indicated for each situation are not listed in hierarchical order. See Table A-7 to determine the R_1 value to be used.

		Most-relevant process	Other process
Situation 1: process run by the organisation in scope of the OEF study	**Option 1**	Provide company-specific data (as requested in the OEFSR) and create a company-specific dataset, in aggregated form (DQR≤1.5) ([1]) Calculate the DQR values (for each criterion + total)	
	Option 2		Use default secondary dataset in OEFSR, in aggregated form (DQR≤3.0) Use the default DQR values
Situation 2: process not run by the organisation in scope of the OEF study with access to company-specific information	**Option 1**	Provide company-specific data (as requested in the OEFSR) and create a company-specific dataset, in aggregated form (DQR≤1.5) 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 organisation in scope of the OEF study 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

([1]) Company-specific datasets shall be made available to the Commission.

Note that for any EF compliant secondary dataset, an ILCD-EL compliant dataset may be used. This up to a maximum contribution of 10% of the single overall score of the product in scope (see Section 4.6.3 of Annex III). For these datasets the DQR shall not be recalculated."

A.4.4.4.5. *DNM 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 OEFSR or is not in the list of most-relevant processes, 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 using the OEFSR uses company-specific data, the DQR of the newly developed dataset shall be evaluated as described in Section A.4.4.4.2 while using the OEFSR-specific DQR tables.

Situation 1/ Option 2

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

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

A.4.4.4.6. *DNM situation 2*

If a process is in situation 2 (i.e. the user of the OEFSR is not running the process but has access to company-specific data) there are three possible options:

— The user of the OEFSR has access to extensive supplier-specific information and wants to create a new EF compliant dataset (Option 1);

— The user of the OEFSR has some supplier-specific information and wants to make some minimum changes (Option 2);

— The process is not in the list of most-relevant processes, still the company wants to make some minimum changes (Option 3).

Situation 2/ Option 1

For all processes not run by the company and where the user of the OEFSR applies company-specific data. The DQR of the newly developed dataset shall be evaluated as described in Section 4.6.5.2 of Annex III while using the OEFSR-specific DQR tables.

Situation 2/ Option 2

The user of the OEFSR applies company-specific activity data for transport and substitutes the sub-processes used for the electricity mix and transport with supply chain specific EF compliant datasets starting from the default secondary dataset provided in the OEFSR.

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

For the most-relevant processes, the user of the OEFSR shall make the DQR context-specific by re-evaluating TeR and TiR using the table(s) provided in the OEFSR (adapted from Table 24 of Annex I). The criteria GeR shall be lowered by 30% ([22]) and the criteria P shall keep the original value.

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

Situation 2/ Option 3

The user of the OEFSR applies company-specific activity data for transport and substitutes the sub-processes used for the electricity mix and transport with supply chain specific EF compliant datasets starting from the default secondary dataset provided in the OEFSR.

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

In this case, the user of the OEFSR shall apply the default DQR values. If the default dataset to be used for the process is not listed in the OEFSR, the user of the OEFSR shall take the DQR values from the original dataset.

A.4.4.4.7. *DNM situation 3*

If a process is in situation 3 (i.e. the company using the OEFSR is not running the process and this company does not have access to company-specific data), there are two possible options:

— It is on the list of most-relevant processes (situation 3, option 1);

— It is not on the list of most-relevant processes (situation 3, option 2).

Situation 3/ Option 1

In this case, the user of the OEFSR shall make the DQR context-specific by re-evaluating TeR, TiR and GeR using the table(s) provided in the OEFSR (adapted from Table 24 of Annex I). The criterion P shall keep the original value.

Situation 3/ Option 2

The user of the OEFSR shall apply the corresponding secondary dataset listed in the OEFSR together with its DQR values. If the default dataset to be used for the process is not listed in the OEFSR, the user of the OEFSR shall take the DQR values from the original dataset.

A.4.4.4.8. *DQR of an OEF study*

The OEFSR shall require the delivery of an EF compliant dataset of the product in scope (meaning, the OEF study). The DQR of this dataset shall be calculated and the OEF report shall report it. To calculate the DQR of the OEF study, the OEFSR shall specify that the user of the OEFSR shall follow the DQR calculation rules of Section 4.6.5.8 of Annex III.

A.5. **OEF results**

The OEFSR shall require the user of the OEFSR to calculate results the OEF study as i) characterised, ii) normalised and iii) weighted results for each EF impact category and iv) as a single overall score based on the weighting factors provided in Section 5.2.2 of Annex III

A.6. **Interpretation of Organisation Environmental Footprint results**

A.6.1. *Identification of hotspots*

The identification of most-relevant impact categories, life-cycle stages, processes and direct elementary flows shall be based on the first and second OEF-RO study. The second OEF-RO study determines the identification that will be required in the OEFSR. The identification of the most-relevant processes and direct elementary flows has a key role in the process to identify data-related requirements (see previous Sections on data quality requirements for further information).

A.6.1.1. Procedure to identify the most-relevant impact categories

The identification of the most-relevant impact categories shall follow the requirements at Section 6.3.1 of Annex III. The OEFSR may add more impact categories to the list of the most-relevant ones but none shall be deleted.

A.6.1.2. Procedure to identify the most-relevant life-cycle stages

The identification of the most-relevant life-cycle stages shall follow the requirements in Section 6.3.2 of Annex III. The Technical Secretariat may decide to split or add additional life-cycle stages if there are good reasons for it. This shall be justified in the OEFSR. E.g., the life-cycle stage 'Raw material acquisition and pre-processing' may be split into 'Raw material acquisition', 'pre-processing', and 'raw materials supplier transport'. The TS shall evaluate if this step is applicable to OEFSR where the PP covers mainly services

A.6.1.3. Procedure to identify the most-relevant processes

The identification of the most-relevant processes shall follow the requirements in Section 6.3.3. of Annex III. The OEFSR may add more processes to the list of the most-relevant ones but none shall be deleted.

In most cases, vertically aggregated datasets may be identified as representing relevant processes. In such cases, it may not be obvious which process is responsible for contributing to an impact category. The Technical Secretariat may decide whether to seek further disaggregated data or to treat the aggregated dataset as a process for the purposes of identifying relevance.

A.6.1.4. Procedure to identify the most-relevant direct elementary flows

The identification of the most-relevant direct elementary flows shall follow the requirements at Section 6.3.4 of Annex III. The Technical Secretariat may add more elementary flows to the list of the most-relevant ones but none shall be deleted. For each most-relevant process, the identification of the most-relevant direct elementary flows is important to define which direct emissions or resource use should be requested as company-specific data (i.e. the foreground elementary flows within the processes listed in the OEFSR as mandatory company-specific data).

A.7. **Organisation Environmental Footprint reports**

General requirements regarding OEF reports are available in Annex III (Section 8). Any OEF study (including OEF-RO studies and supporting studies) shall include an OEF report. An OEF report provides a relevant, comprehensive, consistent, accurate, and transparent account of the study and of the calculated environmental impacts associated with the organisation.

An OEF report template is available in part E of this annex. The template includes the detailed information to be provided in an OEF report. The Technical Secretariat may decide to require further information to be provided in the OEF report, in addition to the ones listed in part E of this annex.

A.8. **Verification and validation of OEF studies, reports, and communication vehicles**

A.8.1. *Defining the scope of the verification*

The verification of the OEF study shall ensure that the OEF study is conducted in compliance with the OEFSR it refers to.

A.8.2. *Verifier(s)*

The independence of the verifiers shall be guaranteed (i.e. they shall fulfil the intentions in the requirements of EN ISO/IEC 17020:2012 regarding a 3rd party verifier, they shall not have conflicts of interests on concerned products and cannot include members of the Technical Secretariat or of the consultants involved in previous part of the work - OEF-RO studies, supporting studies, OEFSR review, etc.).

A.8.3. *Verification/Validation requirements: requirements for the verification/validation when an OEFSR is available*

The verifier(s) shall verify that the OEF report, OEF communication (if any) and OEF study is in compliance with the following documents:

(a) most recent version of the OEFSR applicable for the specific product in scope;

(b) conformance with Annex III

The verification and validation of the OEF study shall be carried out following the minimum requirements listed in Section 8.4.1 of the Annex III and Section A.2.3 of this annex and the additional OEFSR-specific requirements specified by the Technical Secretariat and documented in the OEFSR Section 'Verification'.

A.8.3.1. Minimum requirements for the verification and validation of the OEF study

In addition to the requirements specified in the OEF method, for all processes used in the OEF study that are to be validated, the verifier(s) shall check if the DQR satisfies the minimum DQR as specified in the OEFSR.

The OEFSR may specify additional requirements for the validation that shall be added to the minimum requirements stated in this document. The verifier(s) shall check that all the minimum and additional requirements are satisfied during the verification process.

A.8.3.2. Verification and validation techniques

In addition to the requirements specified in the OEF method, the verifier shall check if the applied sampling procedures are in accordance with the sampling procedure defined in the OEFSR. The data reported shall be checked against the source documentation to check their consistency.

A.8.3.3. Content of the validation statement

In addition to the requirements specified in the OEF method (Section 8.5.2 of Annex III), the following element shall be included in the validation statement: absence of conflict of interest of the verifier(s) with respect to concerned products and any involvement in previous work (OEFSR development, OEF-RO studies, supporting studies, Technical Secretariat membership and consultancy work carried out for the user of the OEFSR during the last three years).

PART B:

OEFSR TEMPLATE

Note: the text included in *italics* in each Section shall not be modified when drafting the OEFSR, except for references to tables, figures and equations. References shall be revised and linked correctly. Further text may be added if relevant.

In case of conflicting requirements between the ones in this Annex and Annex I, the latter prevail

The text included in [] are instructions for the OEFSR developers.

The order of Sections and their titles shall not be modified.

[The first page shall include at least the following information:

— The product category for which the OEFSR is valid

— Version number

— Date of publication

— Time validity]

Table of contents

Acronyms

[List in this Section all the acronyms used in the OEFSR. Those already included in Annex III or the part A of Annex IV shall be copied in their original form. The acronyms shall be provided in alphabetical order.]

Definitions

[List in this Section all the definitions that are relevant for the OEFSR. Those already included in Annex III or in part A of Annex IV shall be copied in their original form. The definitions shall be provided in alphabetical order.]

B.1. Introduction

The Organisation Environmental Footprint (OEF) method provides detailed and comprehensive technical rules on how to conduct OEF studies that are more reproducible, consistent, robust, verifiable and comparable. Results of OEF studies are the basis for the provision of EF information and they may be used in a diverse number of potential fields of applications, including in-house management and participation in voluntary or mandatory programmes.

For all requirements not specified in this OEFSR the user of the OEFSR shall refer to the documents this OEFSR is in conformance with (see Section B.7*).*

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

Terminology: shall, should and may

This OEFSR uses precise terminology to indicate the requirements, the recommendations and options that could be chosen when an OEF study is conducted.

The term "shall" is used to indicate what is required in order for an OEF study to be in conformance with this OEFSR.

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 OEF study and made transparent.

The term "may" is used to indicate an option that is permissible. Whenever options are available, the OEF study shall include adequate argumentation to justify the chosen option.

B.2. General information about the OEFSR

B.2.1. *Technical Secretariat*

[The list of the organisations in the Technical Secretariat at the time of approval of the final OEFSR shall be provided. For each one, the type of organisation shall be reported (industry, academia, NGO, consultant, etc.), as well as the starting date of participation. The Technical Secretariat may decide to include also the names of the members of the persons involved for each organisation]

Name of the organisation	*Type of organisation*	*Name of the members (not mandatory)*

B.2.2. *Consultations and stakeholders*

[For each public consultation the following information shall be provided:

— Opening and closing date of the public consultation

— Number of comments received

— Names of organisations that have provided comments

— Link to the online platform]

B.2.3. *Review panel and review requirements of the OEFSR*

[This Section shall include the names and affiliations of the members of the review panel. The member that is chairing the review panel shall be identified.]

Name of the member	*Affiliation*	*Role*

The reviewers have verified that the following requirements are fulfilled:

— The OEFSR has been developed in accordance with the requirements provided in Annex III and Annex IV;

— The OEFSR supports the creation of credible, relevant and consistent OEF profiles;

— The OEFSR scope and the representative organisations are adequately defined;

— The Reporting unit, allocation and calculation rules are adequate for the sector under consideration;

— Datasets used in the OEF-ROs and the supporting studies are relevant, representative, reliable, and in compliance with data quality requirements;

— The selected additional environmental and technical information are appropriate for the product category under consideration and the selection is done in accordance with the requirements stated in Annex III,

— The model of the RO represent correctly the product category or sub-category;

— The RO model, disaggregated in line with the OEFSR and aggregated in ILCD format, are EF compliant following the rules available at http://eplca.jrc.ec.europa.eu/LCDN/developerEF.xhtml;

— The RO model in its corresponding excel version is compliant with the rules outlined in Section A.2.3 of Annex IV;

— The Data Needs Matrix is correctly implemented;

[The Technical Secretariat may add additional review criteria as appropriate]

The public review reports are provided in Annex 3 of this OEFSR.

[The review panel shall produce: i) a public review report for each OEF-RO, ii) a public review report for the final OEFSR].

B.2.4. *Review statement*

This OEFSR was developed in compliance with the OEF Method adopted by the Commission on [indicate the date of approval of the latest version available].

The representative organisation(s) correctly describe the average organisation(s) active in Europe (EU+EFTA) for the sector/ sub-sector(s) in scope of this OEFSR.

OEF studies carried out in compliance with this OEFSR 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 Section on limitations).

[The review statement shall be completed by the reviewer.]

B.2.5. *Geographic validity*

This OEFSR is valid for products in scope sold or consumed in the EU+EFTA.

Each OEF study shall identify its geographical validity listing all the countries where the organisation's activities take place, together with the relative market share.

B.2.6. *Language*

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

B.2.7. *Conformance to other documents*

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

Organisation Environmental Footprint (OEF) method

….

[The OEFSR shall list additional documents, if any, with which the OEFSR is in conformance with.]

B.3. **OEFSR scope**

[This Section shall i) include a description of the scope of the OEFSR, ii) list and describe the sub-categories included in the OEFSR (if any), describe the product portfolio in scope and the technical performance]

B.3.1. *The sector*

[The OEFSR shall include a sector definition.]

The NACE codes for the sectors included in this OEFSR are:

[Based on the sector, provide the corresponding statistical classification of economic activities in the European community, NACE. Identify the sub-sectors not covered by the NACE, if any.]

B.3.2. *Representative organisation(s)*

[The OEFSR shall include a description of the representative organisation(s) and how it has been derived. The Technical Secretariat shall provide in an Annex to the OEFSR information about all the steps taken to define the 'model' of the RO(s) and report the information gathered].

The OEF study of the representative organisation(s) (OEF-RO) is available upon request to the TS coordinator that has the responsibility of distributing it with an adequate disclaimer about its limitations.

B.3.3. *Reporting unit and reference flow*

The Reporting unit (RU) is … [to be filled in].

Table B. **1** *defines the key aspects used to define the RU.*

Table B. 1.

Key aspects of the product portfolio

What?	[to be filled in. Note that in case the OEFSR uses the term 'inedible parts' a definition shall be provided by the TS]
How much?	[to be filled in]
How well?	[to be filled in]
How long?	[to be filled in]
Reference year	[to be filled in]
Reporting interval	[to be filled in]

[The OEFSR shall specify the product portfolio (PP) and how it is defined, in particular with respect to 'how well' and 'how long'. It shall be defined the reporting interval. If this differs from 1 year, the technical secretariat shall justify the chosen interval. In case calculation parameters are needed the OEFSR shall provide default values or shall request these parameters in the list of mandatory company-specific information. A calculation example shall be provided].

B.3.4. *System boundary*

[This Section shall include a system diagram clearly indicating the processes and life-cycle stages that are included in the product category/sub-category. A short description of the processes and life-cycle stages shall be provided. The diagram shall include an indication of the processes for which company-specific data are required and the processes excluded from the system boundary.

The system diagram shall clearly indicate the organisational boundary and the OEF boundary. A short description of the processes included in the organisational boundary and OEF boundary shall be provided.]

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

Table B. 2.

Life-cycle stages

Life-cycle stage	Short description of the processes included

According to this OEFSR, the following processes may be excluded based on the cut-off rule: [include the list of processes that shall be excluded based on the cut off rule]. *No additional cut-off is allowed.* OR *According to this OEFSR, no cut-off is applicable.*

Each OEF study done in accordance with this OEFSR shall provide a diagram indicating the activities falling in situation 1, 2 or 3 of the data needs matrix. Each OEF study shall describe the activities taking place within the organisational boundary and the OEF boundary.

B.3.5. *List of EF impact categories*

Each OEF study carried out in compliance with this OEFSR shall calculate the OEF-profile including all EF impact categories listed in the Table below. [The Technical Secretariat shall indicate in the table if the sub-categories for climate change shall be calculated separately. In case one or both sub-categories are not reported on, the Technical Secretariat shall include a footnote explaining the reasons, e.g.: '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 total score, is less than 5% each.']

Table B. 3.

List of the impact categories to be used to calculate the OEF profile

EF Impact category	Impact category Indicator	Unit	Characterization model	Robust-ness
Climate change, total ([1])	Global warming potential (GWP100)	kg $CO_{2\ eq}$	Bern model - Global Warming Potentials (GWP) over a 100 year time horizon (based on IPCC 2013)	I

Ozone depletion	Ozone Depletion Potential (ODP)	kg CFC-11 $_{eq}$	EDIP model based on the ODPs of the World Meteorological Organisation (WMO) over an infinite time horizon (WMO 2014 + integrations)	I
Human toxicity, cancer	Comparative Toxic Unit for humans (CTU_h)	CTUh	based on USEtox2.1 model (Fantke et al. 2017), adapted as in Saouter et al., 2018	III
Human toxicity, non-cancer	Comparative Toxic Unit for humans (CTU_h)	CTUh	based on USEtox2.1 model (Fantke et al. 2017), adapted as in Saouter et al., 2018	III
Particulate matter	Impact on human health	disease incidence	PM model (Fantke et al., 2016 in UNEP 2016)	I
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)	II
Photochemical ozone formation, human health	Tropospheric ozone concentration increase	kg NMVOC $_{eq}$	LOTOS-EUROS model (Van Zelm et al, 2008) as applied in ReCiPe 2008	II
Acidification	Accumulated Exceedance (AE)	mol H^+ $_{eq}$	Accumulated Exceedance (Seppälä et al. 2006, Posch et al, 2008)	II
Eutrophication, terrestrial	Accumulated Exceedance (AE)	mol N $_{eq}$	Accumulated Exceedance (Seppälä et al. 2006, Posch et al, 2008)	II
Eutrophication, freshwater	Fraction of nutrients reaching freshwater end compartment (P)	kg P $_{eq}$	EUTREND model (Struijs et al, 2009) as applied in ReCiPe	II
Eutrophication, marine	Fraction of nutrients reaching marine end compartment (N)	kg N $_{eq}$	EUTREND model (Struijs et al, 2009) as applied in ReCiPe	II
Ecotoxicity, freshwater	Comparative Toxic Unit for ecosystems (CTU_e)	CTUe	based on USEtox2.1 model (Fantke et al. 2017), adapted as in Saouter et al., 2018	III
Land use [2]	Soil quality index [3]	Dimensionless (pt)	Soil quality index based on LANCA model (De Laurentiis et al. 2019) and on the LANCA CF version 2.5 (Horn and Maier, 2018)	III
Water use	User deprivation potential (deprivation-weighted water consumption)	m^3 water eq of deprived water	Available WAter REmaining (AWARE) model (Boulay et al., 2018; UNEP 2016)	III

Resource use ([4]), **minerals and metals**	Abiotic resource depletion (ADP ultimate reserves)	kg Sb_{eq}	van Oers et al., 2002 as in CML 2002 method, v.4.8	III
Resource use, fossils	Abiotic resource depletion – fossil fuels (ADP-fossil) ([5])	MJ	van Oers et al., 2002 as in CML 2002 method, v.4.8	III

([1]) The indicator "Climate Change, total" is constituted by three sub-indicators: Climate Change, fossil; Climate Change, biogenic; Climate Change, land use and land use change. The sub-indicators are further described in Section 4.4.10. The sub-categories 'Climate change –fossil', 'Climate change – biogenic' and 'Climate change - land use and land use change', shall be reported separately if they show a contribution of more than 5% each to the total score of climate change.

([2]) Refers to occupation and transformation

([3]) This index is the result of the aggregation, performed by JRC, of 4 indicators (biotic production, erosion resistance, mechanical filtration, and groundwater replenishment) provided by the LANCA model for assessing impacts due to land use as reported in De Laurentiis et al, 2019.

([4]) The results of this impact category shall be interpreted with caution, because the results of ADP after normalization may be overestimated. The European Commission intends to develop a new method moving from depletion to dissipation model to better quantify the potential for conservation of resources

([5]) rm

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 is available at this link http://eplca.jrc.ec.europa.eu/LCDN/developerEF.xhtml. [The Technical Secretariat shall specify the EF reference package that shall be used.]

B.3.6. *Additional technical information*

[The Technical Secretariat shall list the additional technical information to be reported]:

…

B.3.7. *Additional environmental information*

[Specify which additional environmental information shall/should be reported (provide units). Avoid if possible the use of should. Reference all methods used to report additional information.]

[Please choose the correct statement]

Biodiversity is considered as relevant for this OEFSR.

OR

Biodiversity is not considered as relevant for this OEFSR.

[If biodiversity is relevant, the OEFSR shall describe how biodiversity impacts shall be assessed by the user of the OEFSR.]

B.3.8. *Limitations*

[This Section shall include the list of limitations an OEF study will have, even if carried out in accordance with this OEFSR.]

B.3.8.1. Comparisons and comparative assertions

[This Section shall include the conditions under which a comparison or comparative assertion may be made.]

B.3.8.2. Data gaps and proxies

[This Section shall include:

1. The list of data gaps on the company-specific data to be collected that most frequently are encountered by companies in the specific sectors and how these data gaps may be solved in the context of the OEF study;
2. The list of processes excluded from the OEFSR due to missing datasets that shall not be filled in by the user of the OEFSR;
3. The list of processes for which the user of the OEFSR shall apply ILCD-EL compliant datasets.

The Technical Secretariat may decide to indicate in the LCI excel file (see Section B.5 of this Annex) for which processes no datasets are available and therefore are considered data gaps and for which processes proxies shall be used.]

B.4. Most-relevant impact categories, life-cycle stages, processes and elementary flows

B.4.1. *Most-relevant EF impact categories*

[In case the OEFSR has no sub-categories] *The most-relevant impact categories for the product category in scope of this OEFSR are the following:*

[list the most-relevant impact categories per sector].

[In case the OEFSR has sub-categories] *The most-relevant impact categories for the sub-category [name] in scope of this OEFSR are the following:*

[list the most-relevant impact categories per each sub-sector].

B.4.2. *Most-relevant life-cycle stages*

[In case the OEFSR has no sub-categories] *The most-relevant life-cycle stages for the product category in scope of this OEFSR are the following:*

[list the most-relevant life-cycle stages per sector]

[In case the OEFSR has sub-categories] *The most-relevant life-cycle stages for the sub-category [name] in scope of this OEFSR are the following:*

[list the most-relevant life-cycle stages per each sub-sector]

B.4.3. *Most-relevant processes*

The most-relevant processes for the sector in scope of this OEFSR are the following [this table shall be filled in based on the final results of the OEF studies of the representative organisation(s). Provide one table per sub-sector, if appropriate.]

Table B. 4.

List of the most-relevant processes

Impact category	Processes
Most-relevant impact category 1	Process A (from life-cycle stage X)
	Process B (from life-cycle stage Y)
Most-relevant impact category 2	Process A (from life-cycle stage X)
	Process B (from life-cycle stage X)
Most-relevant impact category n	Process A (from life-cycle stage X)
	Process B (from life-cycle stage X)

B.4.4. *Most-relevant direct elementary flows*

The most-relevant direct elementary flows for the sectorin scope of this OEFSR are the following [the list shall be provided based on the final results of the OEF studies of the representative organisation(s). Provide one list per sub-sector, if appropriate.]

B.5. **Life-cycle inventory**

All newly created datasets shall be EF or ILCD-EL compliant (see rules in Section B 5.5).

[The OEFSR shall indicate if sampling is allowed. If the Technical Secretariat allows sampling, the OEFSR shall describe the sampling procedure as described in the OEF method and contain the following sentence:] *In case sampling is needed, it shall be conducted as specified in this OEFSR. However, sampling is not mandatory and any user of this OEFSR may decide to collect the data from all the plants or farms, without performing any sampling.*

B.5.1. *List of mandatory company-specific data*

[The Technical Secretariat shall here list the processes to be modelled with mandatory company-specific data (i. e. activity data and direct elementary flows). Note that the direct elementary flows listed shall be aligned with the nomenclature used by the most recent version of the EF reference package ([23]) .

Process a

[Provide a short description of process A. List all the activity data and direct elementary flows that shall be collected and the default datasets of the sub-processes linked to the activity data within process A. Use the table below to introduce minimum one example in the OEFSR. In case not all processes are introduced here, the full list of all processes shall be include in an excel file.]

Table B. 5.

Data collection requirements for mandatory process A

Requirements for data collection purposes			Requirements for modelling purposes								Remarks
Activity data to be collected	*Specific requirements (e.g. frequency, measurement standard, etc.)*	*Unit of measure*	*Default dataset to be used*	*Dataset source (i.e. node)*	*UUID*	*TiR*	*TeR*	*GeR*	*P*	*DQR*	
Inputs:											
[E.g.: yearly electricity use]	[E.g.: 3 year average]	[E.g. kWh/year]	[E.g.: Electricity grid mix 1kV-60kV/EU28 +3]	[Link to appropriate node of the Life-cycle Data Network. The 'data stock' shall also be specified]	[E.g.: 0af0a6-a8-aebc-4eeb-99f8-5cc-f2304-b99d]	[E.g 1.6]					

([23]) Available at http://eplca.jrc.ec.europa.eu/LCDN/developerEF.xhtml

Outputs:

…	…	…	…	…	…	…					

[List all the emissions and resources that shall be modelled with company-specific information (most-relevant foreground elementary flows) within process A.]

Table B. 6.

Direct elementary flow collection requirements for mandatory process A

Emissions/ resources	Elementary flow	UUID	Frequency of measurement	Default measurement method (1)	Remarks

(1) Unless specific measurements/methods are foreseen in a country-specific legislation.

See excel file named '[Name OEFSR_version number] - *Life-cycle inventory' for the list of all company-specific data to be collected.*

B.5.2. *List of processes expected to be run by the company*

[The processes listed in this Section shall be additional to the ones listed as mandatory company-specific data. No repetition of processes or data is allowed. In case there are no further processes expected to be run by the company, please state *'There are no further processes expected to be run by the company in addition to those listed as mandatory company-specific data.'*]

The following processes are expected to be run by the user of the OEFSR:

Process X

Process Y

…

Process X:

[Provide a short description of process 'x'. List the activity data and direct elementary flows that shall be collected as a minimum, and the datasets of the sub-processes linked to the activity data within process 'x'. Indicate the unit of measurement, how to measure and any other characteristic that could help de user. Note that the direct elementary flows listed shall be aligned with the nomenclature used by the most recent version of the EF reference package (24) . Use the table below to introduce minimum one example in the OEFSR. In case not all processes are introduced here, the full list of all processes shall be include in an excel file.]

(24) Available at http://eplca.jrc.ec.europa.eu/LCDN/developerEF.xhtml

Table B. 7.

Data collection requirements for process X

Requirements for data collection purposes			Requirements for modelling purposes								Remarks
Activity data to be collected	*Specific requirements (e.g. frequency, measurement standard, etc.)*	*Unit of measure*	*Default dataset to be used*	*Dataset source (i.e. node and data stock)*	*UUID*	*TiR*	*TeR*	*GeR*	*P*	*DQR*	
Inputs:											
[E.g.: yearly electricity use]	[E.g.: 3 year average]	[E.g. kWh/year]	[E.g.: Electricity grid mix 1kV-60kV/EU28 +3]	[Link to appropriate node of the Life-cycle Data Network. The 'data stock' shall also be specified]	[E.g.: 0af0a6-a8-aebc-4eeb-99f8-5cc-f2304-b99d]	[E.g 1.6]					

Requirements for data collection purposes			Requirements for modelling purposes								Remarks
Outputs:											
…	…	…	…	…	…	…					

Table B. 8.

Direct elementary flow collection requirements for process X

Emissions/ resources	Elementary flow	UUID	Frequency of measurement	Default measurement method [1]	Remarks

[1] Unless specific measurements/methods are foreseen in a country-specific legislation.

See excel file named '[Name OEFSR_version number] - *Life-cycle inventory' for the list of all processes expected to be in situation 1.*

B.5.3. *Data quality requirements*

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

$$DQR = \frac{TeR+GeR+TiR+P}{4} \quad \text{[Equation B.1]}$$

where TeR is technological representativeness, GeR is geographical representativeness, TiR is time representativeness, and P is precision. The representativeness (technological, geographical and time-related) characterises to what degree the processes and products selected are depicting the system analysed, while the precision indicates the way the data is derived and related level of uncertainty.

The next Sections provide tables with the criteria to be used for the semi-quantitative assessment of each criterion.

[The OEFSR may specify more stringent data quality requirements and specify additional criteria for the assessment of data quality. The OEFSR shall report the formulas to be used for assessing the DQR of i) company-specific data (equation 20 of Annex III), ii) secondary datasets (equation 19 of Annex III), iii) OEF study (equation 20 of Annex III).]

B.5.3.1. Company-specific datasets

The DQR shall be calculated at the level-1 disaggregation, before any aggregation of sub-processes or elementary flows is performed. The DQR of company-specific datasets shall be calculated as following:

1) *Select the most-relevant activity data and direct elementary flows: most-relevant activity data are the ones linked to sub-processes (i.e. secondary datasets) that account for at least 80% of the total environmental impact of the company-specific dataset, listing them from the most contributing to the least contributing one. Most-relevant direct elementary flows are defined as those direct elementary flows contributing cumulatively at least with 80% to the total impact of the direct elementary flows.*

2) *Calculate the DQR criteria TeR, TiR, GeR and P for each most-relevant activity data and each most-relevant direct elementary flow. The values of each criterion shall be assigned based on Table B.9.*

   a. *Each most-relevant direct elementary flow consists of the amount and elementary flow naming (e.g. 40 g carbon dioxide). For each most-relevant elementary flow, the user of the OEFSR shall evaluate the 4 DQR criteria named* TeR_{EF}, TiR_{EF}, GeR_{EF}, P_{EF}. *For example, the user of the OEFSR shall evaluate the timing of the flow measured, for which technology the flow was measured and in which geographical area.*

   b. *For each most-relevant activity data, the 4 DQR criteria shall be evaluated (named* T_eR_{AD} TiR_{AD}, GeR_{AD}, P_{AD} *)by the user of the OEFSR.*

   c. *Considering that the data for the mandatory processes shall be company-specific, the score of P cannot be higher than 3, while the score for TiR, TeR, and GeR cannot be higher than 2 (The DQR score shall be ≤1.5).*

3) *Calculate the environmental contribution of each most-relevant activity data (through linking to the appropriate sub-process) and each most relevant direct elementary flow to the total sum of the environmental impact of all most-relevant activity data and direct elementary flows, in % (weighted, using all EF impact categories). For example, the newly developed dataset has only two most-relevant activity data, contributing in total to 80% of the total environmental impact of the dataset:*

   a. *Activity data 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).*

   b. *Activity data 2 carries 50% of the total dataset environmental impact. The contribution of this process to the total of 80% is 62.5% (the latter is the weight to be used).*

4) *Calculate the TeR, TiR, GeR and P criteria of the newly developed dataset as the weighted average of each criteria of the most-relevant activity data and direct elementary flows. The weight is the relative contribution (in %) of each most-relevant activity data and direct elementary flow calculated in step 3.*

5) *The user of the OEFSR shall calculate the total DQR of the newly developed dataset using Equation B.2, where* $\overline{TeR}$ *,* $\overline{TiR}$ *,* $\overline{GeR}$ *, P are the weighted average calculated as specified in point (4).*

$$DQR = \frac{\overline{Te_R} + \overline{Ge_R} + \overline{Ti_R} + \overline{P}}{4} \qquad \text{[Equation B.2]}$$

Table B. 9.

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

[Note that the reference years for criterion TiR may be adapted by the TS; more than one table may be included in the OEFSR].

Rating	P_{EF} and P_{AD}	TiR_{EF} and TiR_{AD}	TeR_{EF} and TeR_{AD}	GeR_{EF} and GeR_{AD}
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 elementary flows and the activity data explicitly depict the technology of the newly developed dataset	The activity data and elementary flows reflect 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 elementary flows and the activity data are a proxy of the technology of the newly developed dataset	The activity data and elementary flows partly reflect 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
4-5	Not applicable	Not applicable	Not applicable	Not applicable

P_{EF}: Precision for elementary flows; **P_{AD}**: Precision for activity data; **TiR_{EF}**: Time Representativeness for elementary flows; **TiR_{AD}**: Time representativeness for activity data; **TeR_{EF}**: Technology representativeness for elementary flows; **TeR_{AD}**: Technology representativeness for activity data**; GeR_{EF}**: Geographical representativeness for elementary flows; **GeR_{AD}:** Geographical representativeness for activity data.

B.5.4. *Data needs matrix (DNM)*

All processes required to model the product and outside the list of mandatory company-specific data (listed in Section B.5.1) shall be evaluated using the Data Needs Matrix (see Table B.10). The user of the OEFSR shall apply the DNM to evaluate which data is needed and shall be used within the modelling of its OEF, depending on the level of influence the user of the OEFSR (company) has on the specific process. The following three cases are found in the DNM and are explained below:

1. ***Situation 1:*** *the process is run by the company applying the OEFSR;*

2. ***Situation 2:*** *the process is not run by the company applying the OEFSR but the company has access to (company-) specific information;*

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

Table B. 10.

Data Needs Matrix (DNM) ([25]). ***Disaggregated datasets shall be used.**

		Most-relevant process	Other process
Situation 1: process run by the organisation in the scope of the OEF study	Option 1	Provide company-specific data (as requested in the OEFSR) and create a company-specific dataset, in aggregated form (DQR≤1.5) ([1]) Calculate the DQR values (for each criterion + total)	
	Option 2		Use default secondary dataset in OEFSR, in aggregated form (DQR≤3.0) Use the default DQR values
Situation 2: process not run by the the organisation in the scope of the OEF study but with access to company-specific information	Option 1	Provide company-specific data (as requested in the OEFSR) and create a company-specific dataset, in aggregated form (DQR≤1.5) 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.

([25]) The options described in the DNM are not listed in order of preference.

Situation 3: process not run by the the organisation in the scope of the OEF study 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

([1]) Company-specific datasets shall be made available to the Commission.

B.5.4.1. Processes in situation 1

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

1. The process is in the list of most-relevant processes as specified in the OEFSR or is not in the list of most-relevant process, but still the company wants to provide company-specific data (option 1);

2. 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 user of the OEFSR applies company-specific data. The DQR of the newly developed dataset shall be evaluated as described in Section B.5.3.1.

Situation 1/Option 2

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

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

B.5.4.2. Processes in situation 2

When a process is not run by the user of the OEFSR, but there is access to company-specific data, then there are three possible options:

1. The user of the OEFSR has access to extensive supplier-specific information and wants to create a new EF compliant dataset (Option 1);

2. The company has some supplier-specific information and want to make some minimum changes (Option 2);

3. The process is not in the list of most-relevant processes and the company wants to make some minimum changes (Option 3).

Situation 2/Option 1

For all processes not run by the company and where the user of the OEFSR applies company-specific data, the DQR of the newly developed dataset shall be evaluated as described in Section B.5.3.1

Situation 2/Option 2

The user of the OEFSR shall use company-specific activity data for transport and shall substitute the sub-processes used for electricity mix and transport with supply-chain specific OEF compliant datasets, starting from the default secondary dataset provided in the OEFSR.

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

The user of the OEFSR shall make the DQR context-specific by re-evaluating TeR and TiR using the table(s) B.11. The criteria GeR shall be lowered by 30% ([26]) and the criteria P shall keep the original value.

Situation 2/Option 3

The user of the OEFSR shall apply company-specific activity data for transport and shall substitute the sub-processes used for electricity mix and transport with supply-chain specific EF compliant datasets, starting from the default secondary dataset provided in the OEFSR.

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

In this case, the user of the OEFSR shall use the default DQR values. If the default dataset to be used for the process is not listed in the OEFSR, the user of the OEFSR shall take the DQR values from the original dataset.

Table B. 11.

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

[More than one table may be included in the OEFSR and entered in the Section on life-cycle stages]

	TiR	*TeR*	*GeR*
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 are 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.*

([26]) In situation 2, option 2 it is proposed to lower the parameter GeR by 30% in order to incentivise 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.

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*

B.5.4.3. Processes in situation 3

If a process is not run by the company using the OEFSR and the company does not have access to company-specific data, there are two possible options:

(a) It is in the list of most-relevant processes (situation 3, option 1);

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

Situation 3/Option 1

In this case, the user of the OEFSR shall make the DQR values of the dataset used context-specific by re-evaluating TeR, TiR and GeR, using the table(s) provided. The criteria P shall keep the original value.

Situation 3/Option 2

For the non-most-relevant processes, the user of the OEFSR shall apply the corresponding secondary dataset listed in the OEFSR together with its DQR values.

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

B.5.5. *Datasets to be used*

This OEFSR lists the secondary datasets to be applied by the user of the OEFSR. Whenever a dataset needed to calculate the OEF profile is not among those listed in this OEFSR, then the user shall choose between the following options (in hierarchical order):

1. Use an EF compliant dataset available on one of the nodes of the Life-cycle Data Network ([27]);
2. Use an EF compliant dataset available in a free or commercial source
3. Use another EF compliant dataset considered to be a good proxy. In such case this information shall be included in the 'limitations' Section of the OEF report
4. Use an ILCD-EL compliant dataset as proxy. These datasets shall be included in the 'limitations' Section of the OEF report. A maximum of 10% of the single overall score may be derived from ILCD-EL compliant datasets. The nomenclature of the elementary flows of the dataset shall be aligned with the EF reference package used in the rest of the model ([28]) .
5. If no EF compliant or ILCD-EL compliant dataset is available, it shall be excluded from the OEF study. This shall be clearly stated in the OEF report as a data gap and validated by the OEF study and OEF report verifiers.

B.5.6. *How to calculate the average DQR of the study*

To calculate the average DQR of the OEF study, the user of the OEFSR shall calculate separately the TeR, TiR, GeR and P for the OEF study as the weighted average of all most-relevant processes, based on their relative environmental contribution to the total single overall score. The calculation rules explained in Section 4.6.5.8 of Annex III shall be used.

B.5.7. *Allocation rules*

[The OEFSR shall define which allocation rules shall be applied by the user of the OEFSR and how the modelling/ calculations shall be made. In case economic allocation is used, the calculation method on how to derive the allocation factors shall be fixed and prescribed in the OEFSR. The following template shall be used:]

([27]) http://eplca.jrc.ec.europa.eu/LCDN/
([28]) http://eplca.jrc.ec.europa.eu/LCDN/developerEF.xhtml

Table B. 12.

Allocation rules

Process	Allocation rule	Modelling instructions	Allocation factor
[Example: Process A]	[Example: Physical allocation]	[Example: The mass of the different outputs shall be used.]	[Example: 0.2]
…	…		

B.5.8. *Electricity modelling*

The following electricity mix shall be used in hierarchical order:

(a) *Supplier-specific electricity product shall be used if for a country there is a 100% tracking system in place, or if :*

(i) *available, and*

(ii) *the set of minimum criteria to ensure the contractual instruments are reliable is met.*

(b) *The supplier-specific total electricity mix shall be used if:*

(i) *available, and*

(ii) *the set of minimum criteria to ensure the contractual instruments are reliable is met.*

(c) *The 'country-specific residual grid mix, consumption mix' shall be used. Country-specific means the country in which the life-cycle stage or activity occurs. This may be an EU country or non-EU country. The residual grid mix prevents double counting with the use of supplier-specific electricity mixes in (a) and (b).*

(d) *As a last option, the average EU residual grid mix, consumption mix (EU+EFTA), or region representative residual grid mix, consumption mix, shall be used.*

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

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

Set of minimum criteria to ensure contractual instruments from suppliers

A supplier-specific electricity product/ mix may only be used if the user of the OEF method ensures that the contractual instrument meets the criteria specified below. If contractual instruments do not meet the criteria, then country-specific residual electricity consumption-mix shall be used in the modelling.

The list of criteria below is based on the criteria of the GHG Protocol Scope 2 Guidance ([29])*–. A contractual instrument used for electricity modelling shall:*

Criterion 1 – Convey attributes

1. Convey the energy type mix associated with the unit of electricity produced.

([29]) World Resources Institute (WRI) and World Business Council for Sustainable Development WBCSD (2015): GHG Protocol Scope 2 Guidance. An amendment to the GHG Protocol. Corporate Standard

2. The energy type mix shall be calculated based on delivered electricity, incorporating certificates sourced and retired (obtained or acquired or withdrawn) 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.

Criterion 2 – Be a unique claim

1. Be the only instrument that carries the environmental attribute claim associated with that quantity of electricity generated.

2. 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).

Criterion 3 – Be as close as possible to the period to which the contractual instrument is applied

[The Technical Secretariat may provide more information following the OEF method]

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

Datasets for residual grid mix, consumption mix, per energy type, per country and per voltage are made available by data providers.

If no suitable dataset is available, the following approach should 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 combine them with LCI datasets per energy type and country/region (e.g. LCI dataset for the production of 1MWh hydro energy in Switzerland):

1. Activity data related to non-EU country consumption mix per detailed energy type shall be determined based on:

2. Domestic production mix per production technologies;

3. Import quantity and from which neighbouring countries;

4. Transmission losses;

5. Distribution losses;

6. 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 (www.iea.org).

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

2. fuel supply (share of resources used, by import and/ or domestic supply);

3. energy carrier properties (e.g. element and energy contents);

4. technology standards of power plants regarding efficiency, firing technology, flue-gas desulphurisation, NOx removal and de-dusting.

Allocation rules:

[The OEFSR shall define which physical relationship shall be used by OEF studies: (i) to subdivide the electricity consumption among multiple products for each process (e.g. mass, number of pieces, volume…) and (ii) 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. Where such data are not available, the average EU mix (EU +EFTA), or region representative mix, shall be used. The following template shall be used:]

Table B. 13.

Allocation rules for electricity

Process	Physical relationship	Modelling instructions
Process A	*Mass*	
Process B	*N of pieces*	
…	…	

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) *If 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) *If 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) *If all the products produced in the specific plant are supplied with a publically available OEF study, the company wanting to make the claim shall make all OEF studies available. The allocation rule applied shall be described in the OEF study, consistently applied in all OEF 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:

1. No contractual instruments have been sold to a third party: the own electricity mix (combined with LCI datasets) shall be modelled.

2. 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 may be seen as a multifunctional situation. The system will provide two functions (e.g. product + electricity) and the following rules shall be followed:

1. If possible, apply subdivision. Subdivision applies both to separate electricity productions or to a common electricity production where you may 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 windmill on its production site and exports 30% of the produced electricity, emissions related to 70% of produced electricity should be accounted in the OEF study).

2. If not possible, direct substitution shall be used. The country-specific residual consumption electricity mix shall be used as substitution ([30]).

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

B.5.9. *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.*

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

2. ***Climate change – biogenic:*** *This sub-category covers carbon emissions to air (CO2, CO and CH4) 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 ([31]) shall be modelled under sub-category 3 (incl. connected soil emissions, derived products, residues). The emission flows ending with '(biogenic)' shall be used.*

[Choose the right statement]

A simplified modelling approach shall be used when modelling foreground emissions.

[OR]

A simplified modelling approach shall not be used when modelling foreground emissions.

[If a simplified modelling approach is used, include in the text: '*Only the emission 'methane (biogenic)' is modelled, while no further biogenic emissions and uptakes from atmosphere are included. If methane emissions can be both fossil or biogenic, the release of biogenic methane shall be modelled first and then the remaining fossil methane.*']

[If no simplified modelling is used, include the text: '*All biogenic carbon emissions and removals shall be modelled separately.*']

[For intermediate products only:]

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

3. ***Climate change – land use and land use change****: This sub-category accounts for carbon uptakes and emissions (CO2, CO and CH4) originating from carbon stock changes caused by land use change and land use. This sub-category includes biogenic carbon exchanges from deforestation, road construction or other soil activities (including 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 ([32]) and residues), while their CO_2 uptake is excluded. The emission flows ending with '(land use change)' shall be used.*

For land use change, all carbon emissions and removals shall be modelled following the modelling guidelines of PAS 2050:2011 (BSI 2011) and the supplementary document PAS2050-1:2012 (BSI 2012) for horticultural products. PAS 2050:2011 (BSI 2011): 'Large emissions of GHGs can result as a consequence of land use change. Removals as a direct result of land use change (and not as a result of long-term management practices) do not usually occur, although it is recognized that this could happen in specific circumstances. Examples of direct land use change are the conversion of land used for growing crops to industrial use or conversion from forestland to cropland. All forms of land use change that result in emissions or removals are to be included. Indirect land use change refers to such conversions of land use as a consequence of changes in land use elsewhere. While GHG emissions also arise from indirect land use change, the methods and data requirements for calculating these emissions are not fully developed. Therefore, the assessment of emissions arising from indirect land use change is not included.

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

([31]) Native forests – represents native or long-term, non-degraded forests. Definition adapted from Table 8 in the Annex of Commission Decision C(2010)3751 on guidelines for the calculation of land carbon stocks for the purpose of Annex V of Directive 2009/28/EC.

([32]) Following the instantaneous oxidation approach in IPCC 2013 (Section 2).

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 ([33]).

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:*

    1. the earliest year in which it can be demonstrated that the land use change had occurred; or

    2. 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.' [end of quote from PAS 2050:2011]

[Choose the right statement]

Soil carbon storage shall be modelled, calculated and reported as additional environmental information.

[OR]

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

[If it shall be modelled, the OEFSR shall specify which proof needs to be provided and include the modelling rules.]

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

[If climate change is selected as a relevant impact category, the OEFSR shall (i) always request to report the total climate change as the sum of the three sub-indicators, and (ii) for the sub-indicators 'Climate change – fossil', 'Climate change – biogenic' and 'Climate change - land use and land use change', request separate reporting for those contributing more than 5% each to the total score.]

[Choose the right statement]

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

[OR]

The sub-category 'Climate change-biogenic' shall not be reported separately.

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

The sub-category 'Climate change-land use and land transformation' shall be reported separately.

[OR]

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

B.5.10. *Modelling of end of life and recycled content*

The end of life 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 provides rules on how to model the end of life of products as well as the recycled content.

The circular footprint formula (CFF) 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 OEF 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.*
E_{ER}:	*specific emissions and resources consumed (per functional unit) arising from the energy recovery process (e.g. incineration with energy recovery, landfill with energy recovery, etc.).*
$E_{SE,heat}$ 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.*

[Within the respective Sections, the following parameters shall be provided in the OEFSR:

1. All A values to be used shall be listed in the OEFSR, together with a reference to the OEF method and part C of Annex IV. In case specific A values cannot be determined by the OEFSR, the OEFSR shall prescribe the following procedure for its users:

   a. Check in part C of Annex IV the availability of an application-specific A value which fits the OEFSR,

   b. If an application-specific A value is not available, the material-specific A value in part C of Annex IV shall be used,

   c. If a material-specific A value is not available, the A value shall be set equal to 0.5.

2. All quality ratios (Qs_{in}, Qs_{out}/Q_p) to be used.

3. Default R_1 values for all default material datasets (in case no company-specific values are available), together with a reference to the OEF method and part C of Annex IV. They shall be set to 0% when no application-specific data is available.

4. Default R_2 values to be used in case no company-specific values are available, together with a reference to the OEF method and part C of Annex IV.

5. All datasets to be used for $E_{re}c$, E_{recEoL}, E_v, E^*_v, E_{ER}, $E_{SE,heat}$ and $E_{SE,elec}$, E_D]

[Default values for all parameters shall be listed in a table in the Section of the appropriate life-cycle stage. Furthermore, the OEFSR shall clearly describe for each parameter if only defaults can be used or also company-specific data, following the overview in Section A.4.2.7. of Annex IV]

Modelling recycled content (if applicable)

[If applicable the following text shall be included:]

The following part of the circular footprint formula is used to model the recycled content:

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

The R_1 values applied shall be supply-chain specific or default as provided in the table above [TS to provide a table]*, in relation with the DNM. Material-specific values based on supply market statistics are not accepted as a proxy and therefore shall not be used. The applied R_1 values shall be subject to OEF study verification.*

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

1. The supplier information (through e.g., statement of conformity or delivery note) shall be maintained during all stages of production and delivery at the converter;

2. Once the material is delivered to the converter for production of the end products, the converter shall handle information through their regular administrative procedures;

3. The converter for production of the end products claiming recycled content shall demonstrate through its management system the [%] of recycled input material into the respective end product(s).

4. The latter demonstration shall be transferred upon request to the user of the end product. In case an OEF profile is calculated and reported, this shall be stated as additional technical information of the OEF profile.

5. Company-owned traceability systems may be applied as long as they cover the general guidelines outlined above.

[Industry systems may be applied as long as they cover the general guidelines outlined above. In that case, the text above may be replaced by those industry specific rules. If not, they shall be supplemented with the general guidelines above.]

[For intermediate products only:]

The OEF profile shall be calculated and reported using A equal to 1 for the product in scope.

Under additional technical information the results shall be reported for different applications/materials with the following A values:

Application/material	*A value to be used*

B.6. **Life-cycle stages**

B.6.1. *Raw material acquisition and pre-processing*

[The OEFSR shall list all technical requirements and assumptions to be applied by the user of the OEFSR. Furthermore, it shall list all processes taking place in this life-cycle stage (according to the model of the RO), following the table provided below (transport in separate table). The table may be adapted by the TS as appropriate (e.g. by including relevant parameters of the circular footprint formula).]

Table B. 14.

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

*Process name**	*Unit of measurement (output)*	*Default*				*UUID*	*Default DQR*				*Most-relevant process [Y/N]*
		R_1	*Amount per FU*	*Dataset*	*Dataset source (Node and data stock)*		*P*	*TiR*	*GeR*	*TeR*	

[Please write in CAPITAL LETTERS the name of those processes expected to be run by the company]

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

[Packaging shall be modelled as part of the raw material acquisition stage of the life-cycle.]

[OEFSRs that include the use of beverage cartons or bag-in-box packaging shall provide information on the amounts of input materials (also called the bill of material) and state that the packaging shall be modelled by combining the prescribed amounts of the material datasets with the prescribed conversion dataset.]

[OEFSRs that include reusable packaging from third party operated pools shall provide default reuse rates. OEFSRs with company-owned packaging pools shall specify that the reuse rate shall be calculated using supply-chain-specific data only. The two different modelling approaches as presented in Annex III shall be used and copied in the OEFSR. The OEFSR shall include the following: *'The raw material consumption of reusable packaging shall be calculated by dividing the actual weight of the packaging by the reuse rate.'*]

[For the different ingredients transported from supplier to factory, the user of the OEFSR needs data on (i) transport mode, (ii) distance per transport mode, (iii) utilisation ratios for truck transport and (iv) empty return modelling for truck transport. The OEFSR shall provide default data for these or request these data in the list of mandatory company-specific information. The default values provided in Annex III shall be applied unless OEFSR-specific data is available.]

Table B. 15.

Transport (capitals indicate those processes expected to be run by the company)

Process name (*)	*Unit of measurement (output)*	*Default (per FU)*			*De-fault data-set*	*Data-set source*	*UUID*	*Default DQR*				*Most-relevant [Y/N]*
		Dis-tance	*Utilisa-tion ratio (*)*	*Empty return*				*P*	*TiR*	*GeR*	*TeR*	

(*) *The user of the OEFSR shall always check the utilisation ratio applied in the default dataset and adapt it accordingly.*

[Please write in CAPITAL LETTERS the name of processes expected to be run by the company.]

[OEFSRs that include reusable packaging shall include the following: *'The reuse rate affects the quantity of transport 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.'*]

B.6.2. *Agricultural modelling [to be included only if applicable]*

[In case agricultural production is part of the scope of the OEFSR the following text shall be included. Sections that are not relevant may be removed.]

Handling multi-functional processes: The rules described in the LEAP guidelines shall be followed: 'Environmental performance of animal feeds supply chains (pages 36-43), FAO 2015, available at http://www.fao.org/partnerships/leap/publications/en/'.

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:

1. 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, etc.). 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 another 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.

2. For perennial plants (including entire plants and edible portions of perennial plants) a steady state situation (i.e. where all development stages are proportionally represented in the studied time period) shall be assumed and a three-year period shall be used to estimate the inputs and outputs ([34]).

3. 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.

4. For crops that are grown and harvested in less than one year (e.g. lettuce 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 may best be done by first gathering annual data and calculating the life-cycle inventory per year and then determining the three years average.

Pesticide emissions shall be modelled as specific active ingredients. As a default approach, 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:

1. NH_3, to air (from N-fertiliser application)

2. N_2O, to air (direct and indirect) (from N-fertiliser application)

3. CO_2, to air (from lime, urea and urea-compounds application)

4. NO_3, to water unspecified (leaching from N-fertiliser application)

5. PO_4, to water unspecified or freshwater (leaching and run-off of soluble phosphate from P-fertiliser application)

6. 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).

([34]) The underlying assumption in the cradle-to-gate life-cycle inventory assessment of horticultural products is that the inputs and outputs of the cultivation are in a 'steady state', which means that all development stages of perennial crops (with different quantities of inputs and outputs) shall be proportionally represented in the time period of cultivation that is studied. This approach gives the advantage that inputs and outputs of a relatively short period can be used for calculating the cradle-to-gate life-cycle inventory from the perennial crop product. Studying all development stages of a horticultural perennial crop can have a lifespan of 30 years and more (e.g. in case of fruit and nut trees).

[For nitrogen based fertilisers, the OEFSR shall describe the LCI model to be used. The Tier 1 emission factors of IPCC (2006) should be used. A more comprehensive nitrogen field model may be used by the OEFSR provided (i) it covers at least the emissions requested above, (ii) N is balanced in inputs and outputs and (iii) it is described in a transparent way.]

Table B. 16.

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*

FracGASF: fraction of synthetic fertiliser N applied to soils that volatilises as NH_3 and NO_x. FracLEACH: fraction of synthetic fertiliser and manure lost to leaching and runoff as NO3-.

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 TS shall select one of the two modelling approaches to be used]

1. 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.

2. The final fate (emission compartment) of the heavy metal elementary flows is considered within the system boundary: the inventory does account for the final emissions (release) of the heavy metals in the environment and therefore shall also account for the uptake of heavy metals by the crop. For example, heavy metals in agricultural crops cultivated for feed will mainly end up in the animal digestion and used as manure back on the field where the metals are released in the environment and their impacts are captured by the impact assessment methods. Therefore, the inventory of the agricultural stage shall account for the uptake of heavy metals by the crop. A limited amount ends up in the animal, which may be neglected for simplification.

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 [The TS shall select what shall be included]:

1. Input of seed material (kg/ha)

2. Input of peat to soil (kg/ha + C/N ratio)

3. Input of lime (kg $CaCO_3$/ha, type)

4. Machine use (hours, type) (to be included if there is high level of mechanisation)

5. Input N from crop residues that stay on the field or are burned (kg residue + N content/ha)

6. Crop yield (kg/ha)

7. Drying and storage of products

8. Field operations through …[to be filled in]

B.6.3. *Manufacturing*

[The OEFSR shall list all technical requirements and assumptions to be applied by the user of the OEFSR. Furthermore, it shall list all processes taking place in this life-cycle stage, according to the table provided below. The table may be adapted by the TS as appropriate (e.g. by including relevant parameters of the circular footprint formula).]

Table B. 17.

Manufacturing (capitals indicate those processes expected to be run by the company)

Name of the process	*Unit of measure-ment (output)*	*Default amount per FU*	*Default dataset to be used*	*Dataset source (Node and data stock)*	*UUID*	*Default DQR*				*Most-relevant process [Y/N]*
						P	*TiR*	*GeR*	*TeR*	

[Please write in CAPITAL LETTERS the name of those processes expected to be run by the company]

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

[OEFSRs that include reusable packaging shall account for the additional energy and resource used for cleaning, repairing or refilling.]

The waste of products used during the manufacturing shall be included in the modelling. [Default loss rates per type of product and how these shall be included in the reference flow shall be described.]

B.6.4. *Distribution stage [to be included if applicable]*

Transport from factory to final client (including consumer transport) shall be modelled within this life-cycle stage. The final client is defined as … [to be filled in].

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

[A default transport scenario shall be provided by the TS in the PEFCR. In case no PEFCR-specific transport scenario is available, the transport scenario provided in the PEF method shall be used as a basis together with (i) a number of PEFCR-specific ratios, (ii) PEFCR-specific utilisation ratios for truck transport, and (iii) PEFCR-specific allocation factor for consumer transport. For reusable products, the return transport from retail/DC to

factory shall be added in the transport scenario. For cooled or frozen products, the default truck/van transport processes should be changed. The PEFCR shall list all processes taking place in scenario (according to the model of the RP) using the table below. The table may be adapted by the TS as appropriate]

Table B. 18.

Distribution (capitals indicate those processes expected to be run by the company)

*Process name**	*Unit of measurement (output)*	*Default (per FU)*			*Default dataset*	*Dataset source*	*UUID*	*Default DQR*				*Most relevant [Y/N]*
		Distance	*Utilisation ratio*	*Empty return*				*P*	*TiR*	*GeR*	*TeR*	

[Please write in CAPITAL LETTERS the name of those processes expected to be run by the company.]

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

The waste of products during distribution and retail shall be included in the modelling. [Default loss rates per type of product and how these shall be included in the reference flow shall be described. The OEFSR shall follow the part F of this Annex in case no OEFSR-specific information is available.]

B.6.5. *Use stage [to be included if applicable]*

[The OEFSR shall provide a clear description of the use stage and list all processes taking place therein (according to the model of the RO) according to the table provided below. The table may be adapted by the TS as appropriate.]

Table B. 19.

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*	*TeR*	*GeR*	

[Please write in CAPITAL LETTERS the name of those processes expected to be run by the company.]

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

[In this Section the OEFSR shall also list all technical requirements and assumptions that the user of the OEFSR shall apply. The OEFSR shall state if a delta approach is used for certain processes. In case the delta approach is used, the OEFSR shall state the minimum consumption (reference) to be used when calculating the additional consumption allocated to the product.]

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

The waste of products during the use stage shall be included in the modelling. [Default loss rates per type of product and how these shall be included in the reference flow shall be described. The OEFSR shall follow part E of this Annex in case no OEFSR-specific information is available.]

B.6.6. *End of life [to be included if applicable]*

The end of life stage begins when the product in scope and its packaging is discarded by the user and ends when the product is returned to nature as a waste product or enters another product's life-cycle (i.e. as a recycled input). In general, it includes the waste of the product in scope, such as the food waste, and primary packaging.

Other waste (different from the product in scope) generated during the manufacturing, distribution, retail, use stage or after use shall be included in the life-cycle of the product and modelled at the life-cycle stage where it occurs.

[The OEFSR shall list all technical requirements and assumptions that the user of the OEFSR shall apply. Furthermore, it shall list all processes taking place in this life-cycle stage (according to the model of the RO) according to the table provided below. The table may be adapted by the TS as appropriate (e.g. by including relevant parameters of the circular footprint formula). Please note that the transport from collection place to EoL treatment may be included in the landfill, incineration and recycling datasets: the TS shall check if it is included in the default datasets provided. However, there might be some cases, where additional default transport data is needed and thus shall be included here. The OEF method provides default values to be used in case no better data is available.]

Table B. 20.

End of life (capitals indicate those processes expected to be run by the company)

*Name of the process**	*Unit of measure-ment (output)*	*Default amount per FU*	*Default dataset to be used*	*Dataset source*	*UUID*	*Default DQR*				*Most-relevant process [Y/N]*
						P	*TiR*	*Ter*	*GeR*	

[Please write in CAPITAL LETTERS the name of those processes expected to be run by the company.]

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

The end of life shall be modelled using the circular footprint formula and rules provided in Section 'End of life modelling' of this OEFSR and in the OEF method, together with the default parameters listed in the table [Table number].

Before selecting the appropriate R_2 value, the user of the OEFSR shall carry out an evaluation for recyclability of the material. The OEF study shall include a statement on the recyclability of the materials/ products. The statement on recyclability shall be provided together with an evaluation for recyclability that includes evidence for the following three criteria (as described by EN ISO 14021:2016, 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 ([35]).

Following the evaluation for recyclability, the appropriate R_2 values (supply-chain specific or default) shall be used. If one criterion is not fulfilled or the sector-specific recyclability guidelines indicate 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, if available. If no company-specific values are available and the criteria for the evaluation of recyclability are fulfilled (see below), application-specific R_2 values shall be used as listed in the table below.

1. If an R_2 value is not available for a specific country, the European average shall be used.

2. 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).

3. 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 OEF study verification.

[The OEFSR shall list in a table all the parameters to be used by the user to implement the CFF, distinguishing between those that have a fixed value (to be provided in the same Table; from the OEF method or OEFSR-specific) and those that are OEF study-specific (e.g. R_2, etc.). Furthermore, the OEFSR shall include additional modelling rules derived from the OEF method, if applicable. Within this table, the B value shall be equal to 0 as default.]

[OEFSRs that include reusable packaging shall include the following: *'The reuse rate determines the quantity of packaging material (per product sold) to be treated at the end of life. The amount of packaging treated at the end of life shall be calculated by dividing the actual weight of the packaging by the number of times this packaging was reused.'*]

B.7. **OEF results – The OEF profile**

The user of the OEFSR shall calculate the OEF profile of its product in compliance with all requirements included in this OEFSR. The following information shall be included in the OEF report:

1. full life-cycle inventory;

2. characterised results in absolute values, for all impact categories (as a table);

3. normalised results in absolute values, for all impact categories (as a table);

4. weighted result in absolute values, for all impact categories (as a table);

5. the aggregated single overall score in absolute values.

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

Together with the OEF report, the user of the OEFSR shall develop an aggregated EF compliant dataset of its product in scope. This dataset shall be made available to the European Commission and may be made public. The disaggregated version may remain confidential.

B.8. **Verification**

The verification of an OEF study/ report carried out in compliance with this OEFSR shall be done according to all the general requirements included in Section 9 of the Annex III, including part A of this Annex and the requirements listed below.

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

In case policies implementing the OEF method define specific requirements regarding verification and validation of OEF studies, reports and communication vehicles, the requirements in said policies shall prevail.

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:

1. the verifier(s) shall check if the correct version of all impact assessment methods was used. For each of the most-relevant EF impact categories (ICs), at least 50% of the characterisation factors shall be verified, while all normalisation and weighting factors of all ICs shall be verified. In particular, the verifier(s) shall check that the characterisation factors correspond to those included in the EF impact assessment method the study declares compliance with ([36]) . This may also be done indirectly, for example:

2. Export the EF-compliant datasets from the LCA software used to do the OEF study and run them in Look@LCI ([37]) to obtain LCIA results. If Look@LCI results are within a deviation of 1% from the results in the LCA software, the verifier(s) may assume that the implementation of the characterisation factors in the software used to do the OEF study was correct.

3. Compare the LCIA results of the most-relevant processes calculated with the software used to do the OEF study with the ones available in the metadata of the original dataset. If the compared results are within a deviation of 1%, the verifier(s) may assume that the implementation of the characterisation factors in the software used to do the OEF study was correct

4. cut-off applied (if any) fulfils the requirements at Section 4.6.4 of Annex III.

5. all datasets used shall be checked against the data requirements (Sections 4.6.3 and 4.6.5. of Annex III).

6. For at least 80% (in number) of the most-relevant processes (as defined in Section 6.3.3 of Annex III), the verifier(s) shall validate all related activity data and the datasets used to model these processes. If relevant, CFF parameters and datasets used to model them shall also be validated in the same way. The verifier(s) shall check that the most-relevant processes are identified as specified in Section 6.3.3 of Annex III;

7. For at least 30% (in number) of all other processes (corresponding to 20% of the processes as defined in Section 6.3.3 of Annex III) the verifier(s) shall validate all related activity data and the datasets used to model these processes. If relevant, CFF parameters and datasets used to model them shall also be validated in the same way;

8. The verifier(s) shall check that the datasets are correctly implemented in the software (i.e. LCIA results of the dataset in the software are within a deviation of 1% to the ones in the metadata). At least 50% (in number) of the datasets used to model most-relevant processes and 10% of those used to model other processes shall be checked.

In particular, verifier(s) shall verify if the DQR of the process satisfies the minimum DQR as specified in the DNM for the selected processes.

([36]) Available at: http://eplca.jrc.ec.europa.eu/LCDN/developer.xhtml
([37]) https://eplca.jrc.ec.europa.eu/LCDN/developer.xhtml

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

The verification of the OEF report shall be carried out by randomly checking enough information to provide reasonable assurance that the OEF report fulfils all the conditions listed in Section 8 of Annex III, including part A of this Annex.

[The OEFSR may specify additional requirements for the verification that should be added to the minimum requirements stated in this document].

References

[List the references used in the OEFSR.]

Annexes

ANNEX B1 – List of EF normalisation and weighting factors

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

[The TS shall provide the list of normalisation and weighting factors that the user of the OEFSR shall apply. Normalisation and weighting factors are available at: http://eplca.jrc.ec.europa.eu/LCDN/developerEF.xhtml ([38])]

ANNEX B2 – OEF study template

[The OEFSR shall provide as an annex a checklist listing all the items that shall be included in OEF studies, using the OEF study template available as part E of this Annex of this document. The items already included are mandatory for every OEFSR. In addition, each technical secretariat may decide to add additional points to the template.]

ANNEX B3 – Review reports of the OEFSR and OEF-RO(s)

[Insert here the critical review panel reports of the OEFSR and OEF-RO(s), including all findings of the review process and the actions taken by the technical secretariat to answer the comments of the reviewers.]

ANNEX B4 – Other annexes

[The TS may decide to add other Annexes that are considered important. Such as, an example on the application of the DNM or DQR calculations, and explanations on decisions taking during the OEFSR development.].

PART C

LIST OF DEFAULT CFF PARAMETERS

Part C of Annex IV is available at http://eplca.jrc.ec.europa.eu/LCDN/developerEF.xhtml.

The list of values in part C of Annex IV is periodically reviewed and updated by the European Commission; users of the OEF method are invited to check and use the most updated values provided in the Annex.

([38]) Please note that the weighting factors are expressed in % and thus shall be divided by 100 before applying in the calculations.

PART D

DEFAULT DATA FOR MODELLING THE USE STAGE

The following tables shall be used in OEF studies and when developing OEFSRs unless better data is available. The data provided is based on assumptions, except if specified otherwise.

Product	Use stage assumptions per product category
Meat, fish, eggs	*Chilled storage. Cooking: 10 minutes in frying pan (75% on gas and 25% electricity), 5 gram sunflower oil (incl. its life-cycle) per kg product. Dishwashing of frying pan.*
Milk	*Chilled storage, drunk cold in 200 ml glass (i.e., 5 glasses per L milk), incl. glass life-cycle and dishwashing.*
Pasta	*Per kg pasta cooked in pot with 10 kg water, 10 min boiling (75% on gas and 25% electricity). Boiling phase: 0.18 kWh per kg of water, Cooking phase: 0.05 kWh per minute of cooking.*
Frozen dishes	*Frozen storage. Cooked in oven 15 minutes at 200°C (incl. a fraction of a stove, a fraction of a baking sheet). Baking sheet rinsing: 5 L water.*
Roast and ground coffee	*7 g roast and ground coffee per cup* *Filter coffee preparation in a filter coffee machine: machine production and end-of-life (1.2 kg, 4 380 uses, with 2 cups/use), paper filter (2 g/use), electricity consumption (33 Wh/cup) and water consumption (120 ml/cup).* *Machine rinsing/washing: 1 L cold water per use, 2 L hot water per 7 uses, decanter dishwashing (every 7 uses)* *Cup (mug) production and end-of-life and dishwashing* *Source: based on PEFCR Coffee (draft as of Feb 1, 2015* ([1]))
Beer	*Cooling, drunk in 33 cl glass (i.e., 3 glasses per L beer), glass production, end-of-life and dishwashing. See also PEFCR of beer* ([2]).
Bottled water	*Chilled storage. Storage duration: 1 day. 2.7 glasses per L water drunk, 260 gram glass production, end-of-life and dishwashing.*
Pet food	*Pet food dish production, end-of-life and dishwashing*
Goldfish	*Electricity and water use and treatment for the aquarium (43 kWh and 468 L per year). Goldfish feed production (1 g/day, assumed 50% fish meal, 50% soybean meal). Lifetime of the goldfish assumed to be 7.5 years.*
T-shirt	*Washing machine, tumble dryer use and ironing. 52 washing at 41 degree, 5.2 tumble drying (10%) and 30 times ironing per T-shirt.* *Washing machine: 70 kg, 50% steel, 35% plastic, 5% glass, 5% aluminium, 4% copper, 1% electronics, 1 560 cycles (=loads) within its lifetime. 179 kWh and 8 700 L water for 220 cycles at 8 kg load (based on http://www.bosch-home.com/ch/fr/produits/laver-et-s%C3%A9cher/lave-linge/WAQ28320FF.html?source=browse) being 0.81 kWh and 39.5 L/cycle, as well as 70 ml laundry detergent/cycle.* *Tumble dryer: 56 kg, same composition share and lifetime as for washing machine assumed. 2.07 kWh/cycle for 8 kg clothes load.*
Paint	*Paint brush production, sand paper, … (see PEFCR of decorative paints* ([3])).
Cell phone	*2 kWh/year for the charge, 2 years lifetime.*

Laundry detergent	*Use of a washing machine (see T-shirt data for washing machine model). 70 ml laundry detergent assumed per cycle, i.e., 14 cycles per kg detergent.*
Automotive oil	*10% losses during use assessed as hydrocarbons emissions to water.*

([1]) https://webgate.ec.europa.eu/fpfis/wikis/display/EUENVFP/OEFSR+Pilot%3A+Coffee ECAS registration is needed to access this website
([2]) http://ec.europa.eu/environment/eussd/smgp/pdf/Beer%20OEFSR%20June%202018%20final.pdf
([3]) http://ec.europa.eu/environment/eussd/smgp/documents/PEFFCR_decorative_paints.pdf

Default assumptions for storage (always based on assumptions, except if specified otherwise).

Product	Assumptions common to several product categories
Ambient storage (at home)	*Ambient storage at home is considered, for the sake of simplification, as having no impact.*
Chilled storage (in a fridge, at home)	*Storage time: product dependent. As default 7 days storage in fridge (ANIA and ADEME 201 ([1])).* *Storage volume: assumed to be 3x the actual product volume* *Energy consumption: 0.0037 kWh/L (i.e., 'the storage volume') - day (ANIA and ADEME 2012).* *Fridge production and end-of-life considered (assuming 15 years of lifetime).*
Chilled storage (at the pub/restaurant)	*The fridge at the pub is assumed to consume 1 400 kWh/ yr (Heineken green cooling expert, 2015). 100% of this energy consumption is assumed to be for the cooling of beer. The throughput of the fridge is assumed to be 40hl/ yr. This means 0.035 kWh/ l for pub / supermarket cooling for the full storage time.* *Fridge production and end-of-life considered (assuming 15 years of lifetime).*
Frozen storage (in a freezer, at home)	*Storage time: 30 days in freezer (based on ANIA and ADEME 2012).* *Storage volume: assumed to be 2x the actual product volume.* *Energy consumption: 0.0049 kWh/L (i.e., 'the storage volume') - day (ANIA and ADEME 2012).* *Freezer production and end-of-life considered (assuming 15 years of lifetime): assumed similar to fridge.*
Cooking (at home)	*Cooking: 1 kWh/h use (derived from consumptions for induction stove (0.588 kWh/h), ceramic stove (0.999 kWh/h) and electric stove (1.161 kWh/h) all from (ANIA and ADEME 2012).* *Backing in oven: electricity considered: 1.23 kWh/h (ANIA and ADEME 2012).*
Dishwashing (at home)	*Dishwasher use: 15 L water, 10 g soap and 1.2 kWh per washing cycle (Kaenzig and Jolliet 2006).* *Dishwasher production and end-of-life considered (assuming 1 500 cycle per lifetime).* *When dishwashing is done by hand, one assumes an equivalent of 0.5 L of water and 1 g of soap for the value above of 2.5% (with a scaling in terms of water use and soap, using the % above). The water is assumed to be warmed by natural gas, considering a delta T of 40 °C and an efficiency of energy from natural gas heating to water heat of 1/1.25 (meaning that to heat the 0.5 L of water one needs to use 1.25 * 0.5 * 4 186 * 40 = 0.1 MJ of 'Heat, natural gas, at boiler').*

([1]) ANIA and ADEME. (2012). Projet de référentiel transversal d'évaluation de l'impact environnemental des produits alimentaires (mainly annexe 4) (« GT1 »), 23/04/12.

PART E

OEF REPORT TEMPLATE

This part of the Annex presents the OEF report template that shall be applied for all types of OEF studies (e.g., including OEF-ROs or supporting studies of OEFSRs). The template presents the mandatory report structure to be followed and the information to be reported as a non-exhaustive list. All items required to be reported by the OEF method shall be included, even if they are not explicitly mentioned in this template.

Organisation Environmental Footprint

Report

[Insert name of the organisation here]

Table of contents

Acronyms

[List in this Section all the acronyms used in the OEF study. Those already included in the latest version of the OEF method shall be copied in their original form. The acronyms shall be provided in alphabetical order.]

Definitions

[List in this Section all the definitions that are relevant for the OEF study. Those already included in the latest version of the OEF method shall be copied in their original form. The definitions shall be provided in alphabetical order.]

E.1 **Summary**

[The summary shall include as a minimum the following elements:

1. The goal and scope of the study, including relevant limitations and assumptions;
2. A short description of the system boundary;
3. Relevant statements about data quality,
4. The main results of the LCIA: these shall be presented showing the results of all EF impact categories (characterized, normalized, weighted);
5. A description of what has been achieved by the study, any recommendation made and conclusions drawn;

To the extent possible, the summary should be written with a non-technical audience in mind and should not be longer than 3-4 pages.]

E.2. **General**

[The information below should ideally be placed on the front-page of the study:

1. Name of the organisation
2. Product portfolio,
3. NACE codes,
4. Company presentation (name, geographic location),
5. Date of publication of the OEF study (the date shall be written in extended format, e.g. 25 June 2015, to avoid confusion over the date format),
6. Geographic validity of the OEF study (countries where the product portfolio is produced/consumed/sold),
7. Compliance with the OEF method,
8. Conformance to other documents, additional to the OEF method,
9. Name and affiliation of the verifier(s)]

E.3. **Goal of the study**

[Mandatory reporting elements include, as a minimum:

1. Intended application(s);
2. Methodological limitations;
3. Reasons for carrying out the study;
4. Target audience;
5. Commissioner of the study;
6. Identification of the verifier]

E.4. **Scope of the study**

[The scope of the study shall identify the analysed system in detail and address the overall approach used to establish: i) Reporting unit and product portfolio, ii) system boundary (including the identification of the organisational and OEF boundary), iii) list of EF impact categories, iv) additional information (environmental and technical) iv) assumptions and limitations.]

E.4.1. *Functional/declared unit and reference flow*

[Provide the Reporting unit, defining the organisation and the product portfolio (PP):

Definition of the organisation:

Name of the organisation

The kinds of good/services the organisation produces (i.e. sector);

Locations of operation (e.g. countries, cities)

Definition of the product portfolio:

The good(s)/service(s) provided: 'what';

The extent of the good or service: 'how much';

The expected level of quality: 'how well';

The duration/lifetime of the good(s)/service(s)t: 'how long';

The reference year;

The reporting interval.]

E.4.2. *System boundary*

[This Section shall include as a minimum:

1. Identification and description of the i) organisational boundary and ii) OEF boundary;
2. List all attributable life-cycle stages (if applicable) that are part of the system boundary. In case the naming of the default life-cycle stages has changed, the user shall specify to which default life-cycle stage it corresponds. Document and justify if life-cycle stages were split and/or new ones were added.
3. The main processes covered, if applicable, with reference to each life-cycle stage (details are in the LCI Section A.5). The products not included in the PP and waste streams of the at least the foreground system shall be clearly identified. .
4. The reason for and potential significance of any exclusion.
5. A system boundary diagram with the processes that are included and those excluded, highlight those activities which falls respectively under situation 1, 2, and 3 of the Data Needs Matrix, and highlight where company-specific data are used.]

E.4.3. *Environmental Footprint impact categories*

[Provide a table with the list of EF impact categories, units, and EF reference package used (see http://eplca.jrc.ec.europa.eu/LCDN/developerEF.xhtml for further details).

For climate change, specify if the results of the three sub-indicators are reported separately in the results Section.]

E.4.4. *Additional information*

[Describe any additional environmental information and additional technical information included in the OEF study. Provide references and exact calculations rules adopted.

Explain if biodiversity is relevant/not relevant for the product in scope.

E.4.5. *Assumptions and limitations*

[Describe all limitations and assumptions. Provide list of data gaps, if any, and the way in which these gaps were filled. Provide list of proxy datasets used.]

E.5. **Life-cycle inventory analysis**

[This Section shall describe the compilation of the LCI and include:

1. Screening step, if performed,
2. List and description of life-cycle stages (if applicable),
3. Description of modelling choices,
4. Description of allocation approaches applied,
5. Description and documentation of data used and sources,
6. Data quality requirements and rating]

E.5.1. *Screening step [if applicable]*

[Provide a description of the screening step, including relevant information regarding data collection, data used (e.g. list of secondary data sets, activity data, direct elementary flows), cut-off, and results of the life-cycle impact assessment phase.

Document main findings and any refinement of the initial scope settings (if any).]

E.5.2. *Modelling choices*

[Describe all modelling choices for the applicable aspects listed below (more can be added, when relevant):

1. Agricultural production (OEF studies which have agricultural modelling in scope and have tested the alternative approach described in Section 4.4.1.5 and Table 4 of Annex III, shall report the results in an Annex of the OEF report);
2. Transport and logistics: all data used shall be provided in the report (e.g. transportation distance, payload, re-use rate for packaging, etc.). If default scenarios were not used in the modelling, provide documentation of all specific data used;
3. Capital goods: if capital goods are included, the OEF report shall include a clear and extensive explanation, reporting all assumptions made;
4. Storage and retail;
5. Use stage: Product dependent processes shall be included in the system boundary of the OEF study. Product independent processes shall be excluded from the system boundary and qualitative information may be provided, see Section 4.4.7 of Annex III. Describe the approach taken to model the use stage (main function approach or delta approach);
6. End of life modelling, including values of parameters of the circular footprint formula (A, B, R_1, R_2, Q_s/Q_p, R_3, LHV, $X_{ER,heat}$, $X_{ER,elec}$), list of processes and datasets used (E_v, E_{rec}, E_{recEoL}, E^*_v, E_d, E_{Er}, $E_{SE,heat}$, $E_{SE,elec}$) with reference to part C of Annex IV;
7. Extended product lifetime;
8. Electricity use;
9. Sampling procedure (report if a sampling procedure was applied and indicate the approach taken);

10. GHG emissions and removals (report if a simplified approach was not used to model biogenic carbon flows);
11. Offsets (if reported as additional environmental information).]

E.5.3. *Handling multi-functional processes*

[Describe the allocation rules used in the OEF study and how the modelling/calculations were made. Provide the list of all allocation factors used for each process and the detailed list of processes and datasets used, in case substitution is applied.]

E.5.4. *Data collection*

[This Section shall include as a minimum:

1. Description and documentation of all company-specific data collected:
   - — list of processes covered by company-specific data indicating to which life-cycle stage they belong (if life-cycle stages are applicable);
   - — list of resource use and emissions (i.e. direct elementary flows);
   - — list of activity data used;
   - — link to detailed components/materials/ingredients, including substance names, units and quantities, including information on grades/ purities and other technically and/or environmentally relevant characterisation of these;
   - — company-specific data collection/estimation/calculation procedures;
2. List of all secondary datasets used (process name, UUID, dataset source (node on Life-cycle Data Network, data stock) and compliance with the EF reference package);
3. Modelling parameters;
4. Cut-off applied, if any;
5. Sources of published literature;
6. Validation of data, including documentation;
7. If a sensitivity analysis has been conducted, this shall be reported.]

E.5.5. *Data quality requirements and rating*

[Provide a table listing all processes and their situation according to the Data Needs Matrix (DNM).

Provide the DQR of the OEF study.]

E.6. **Impact assessment results [confidential, if relevant]**

E.6.1. *OEF results*

[This Section shall include as a minimum:

1. Characterised results of all EF impact categories shall be calculated and reported as absolute values in the OEF report. The sub-categories 'climate change –fossil', 'climate change – biogenic' and 'climate change - land use and land use change', shall be reported separately if they show a contribution of more than 5% each to the total score of climate change);
2. Normalised and weighted results as absolute values;
3. Weighted results as single score;]

E.6.2. *Additional information*

[This Section shall include:

1. Results of the additional environmental information;
2. Results of the additional technical information.]

E.7. **Inteprreting OEF results**

[This Section shall include as a minimum:

1. Assessment of the robustness of the OEF study;

2. List of most-relevant impact categories, life-cycle stages, processes and elementary flows (see tables below);

3. Limitations and relationship of the EF results relative to the defined goal and scope of the OEF study,

4. Conclusions, recommendations, limitations and improvement potentials)].

Item	At what level does relevance need to be identified?	Threshold
Most-relevant impact categories	Single overall score	Impact categories cumulatively contributing at least **80%** of the single overall score
Most-relevant life-cycle stages	For each most-relevant impact category	All life-cycle stages contributing cumulatively more than **80%** to that impact category. If the use stage accounts for more than 50% of the total impact of a most-relevant impact category, the procedure shall be re-run with the exclusion of the use stage
Most-relevant processes	For each most-relevant impact category	All processes contributing cumulatively (along the entire life-cycle) more than **80%** to that impact category, considering absolute values.
Most-relevant elementary flows	For each most-relevant process considering the most-relevant impact categories	All elementary flows contributing cumulatively to at least 80% of the total impact of a most-relevant impact category for each most-relevant process. If disaggregated data are available: for each most-relevant process, all direct elementary flows contributing cumulatively at least to **80%** to that impact category (caused by the direct elementary flows only)

Example:

Most-relevant impact category	[%]	Most-relevant life-cycle stages	[%]	Most-relevant processes	[%]	Most-relevant elementary flows	[%]
IC 1		End of life		Process 1		el. flow 1	
						el. flow 2	
				Process 2		el. flow 2	
		Raw material acquisition and p.p.		Process 4		el. flow 1	

Most-relevant impact category	[%]	Most-relevant life-cycle stages	[%]	Most-relevant processes	[%]	Most-relevant elementary flows	[%]
IC 2		Manufacturing		Process 1		el. flow 2	
						el. flow 3	
IC 3		Manufacturing		Process 1		el. flow 2	
						el. flow 3	

E.8. **Validation statement**

[The validation statement is mandatory and shall always be provided as public annex of the public OEF report.

The following elements and aspects shall be included in the validation statement, as a minimum:

1. title of the OEF study under verification/validation, together with the exact version of the report to which the validation statement belongs;
2. the commissioner of the OEF study;
3. the user of the OEF method;
4. the verifier(s) or, in the case of a verification team, the team members with the identification of the lead verifier;
5. absence of conflicts of interest of the verifier(s) with respect to concerned products and any involvement in previous work (where relevant, OEFSR development, Technical Secretariat membership, consultancy work carried out for the user of the OEF method or of the OEFSR during the last three years);
6. a description of the objective of the verification/validation;
7. a statement of the result of the verification/validation;
8. any limitations of the verification/validation outcomes;
9. date in which the validation statement has been issued;
10. signature by the verifier(s).]

ANNEX I of the validation statement

[The Annex serves to document supporting elements to the main report which are of a more technical nature. It could include:

1. Bibliographic references;
2. Detailed life-cycle inventory analysis (optional if considered sensitive and communicated separately in the confidential annex, see below)
3. Detailed assessment of data quality: Provide i) Data Quality Rating per process in accordance with the OEF Method and ii) Data Quality Rating for the newly created EF compliant datasets. In case information is confidential, it shall be included in Annex II.]

ANNEX II of the validation statement – CONFIDENTIAL REPORT

[The Confidential annex is an optional Section that shall contain all those data (including raw data) and information that are confidential or proprietary and cannot be made externally available.]

ANNEX III of the validation statement – EF COMPLIANT DATASET

[The aggregated EF compliant dataset of the product in scope shall be made available to the European Commission.]

PART F

DEFAULT LOSS RATES PER TYPE OF PRODUCT

Default loss rates per type of product during distribution and at consumer (including restaurant, etc.) (assumptions if not specified otherwise). For simplification purposes, the values for restaurant are considered the same as for consumer at home.

Retail trade sector	*Category*	*Loss rate (incl. broken products but not products returned to the manufacturer) during distribution (overall consolidated value for transportation, storage and retail place)*	*Loss rate at consumer (including restaurant, etc.)*
Food	*Fruits and vegetables*	*10% (FAO 2011)*	*19% (FAO 2011)*
	Meat and meat alternatives	*4% (FAO 2011)*	*11% (FAO 2011)*
	Dairy products	*0,5% (FAO 2011)*	*7% (FAO 2011)*
	Grain products	*2% (FAO 2011)*	*25% (FAO 2011)*
	Oils and fats	*1% (FAO 2011)*	*4% (FAO 2011)*
	Prepared/processed meals (ambient)	*10%*	*10%*
	Prepared/processed meals (chilled)	*5%*	*5%*
	Prepared/processed meals (frozen)	*0,6% (primary data based on Picard – oral communication from Arnaud Brulaire)*	*0,5% (primary data based on Picard – oral communication from Arnaud Brulaire)*
	Confectionery	*5%*	*2%*
	Other foods	*1%*	*2%*
Beverages	*Coffee and tea*	*1%*	*5%*
	Alcoholic beverages	*1%*	*5%*
	Other beverages	*1%*	*5%*
Tobacco		*0%*	*0%*
Pet food		*5%*	*5%*
Live animals		*0%*	*0%*
Clothing and textile		*10%*	*0%*
Footwear and leather goods		*0%*	*0%*
Personal accessories	*Personal accessories*	*0%*	*0%*
Home and professional supplies	*Home hardware supplies*	*1%*	*0%*
	Furniture, furnishings and decor	*0%*	*0%*
	Electrical household appliances	*1%*	*0%*

Retail trade sector	*Category*	*Loss rate (incl. broken products but not products returned to the manufacturer) during distribution (overall consolidated value for transportation, storage and retail place)*	*Loss rate at consumer (including restaurant, etc.)*
	Kitchen utensils	*0%*	*0%*
	Information and communication equipment	*1%*	*0%*
	Office machinery and supplies	*1%*	*0%*
Cultural and recreational goods	*Books, newspapers and paper/paper supplies*	*1%*	*0%*
	Music and videos	*1%*	*0%*
	Sporting equipment and gadgets	*0%*	*0%*
	Other cultural and recreational goods	*1%*	*0%*
Healthcare		*5%*	*5%*
Cleaning/hygiene products, cosmetics and toiletries		*5%*	*5%*
Fuels, gases, lubricants and oils		*1%*	*0%*
Batteries and power		*0%*	*0%*
Plants and garden supplies	*Flowers, plants and seeds*	*10%*	*0%*
	Other garden supplies	*1%*	*0%*
Other goods		*0%*	*0%*
Gas station	*Gas station products*	*1%*	*0%*

Food losses at the distribution center, during transport and at retail place, and at home: assumed to be 50% trashed (i.e., incinerated and landfilled), 25% composted and 25% methanised.

Product losses (excluding food losses) and packing/repacking/unpacking at distribution center, during transport and at retail place: assumed to be 100% recycled.

Other waste generated at the distribution center, during transport and at the retailer (except food and product losses) such as repacking/unpacking are assumed to follow the same EoL treatment as for home waste.

Liquid food wastes (as for instance milk) at consumer (including restaurant, etc.) are assumed to be poured in the sink and therefore treated in the wastewater treatment plant.

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