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Organisation Environmental Footprint (OEF) Guide

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Authors: Nathan Pelletier, Karen Allacker, Simone Manfredi, Kirana Chomkhamsri, Danielle Maia de Souza

Project Leader and main reviewer: Rana Pant

Action Leader and reviewer: David Pennington

Approved by: Constantin Ciupagea

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Executive Summary

The Organisation Environmental Footprint (OEF) is a multi-criteria measure of the environmental performance of a goods/services-providing Organisation from a life cycle perspective. OEF studies are produced for the overarching purpose of seeking to reduce the environmental impacts associated with organisational activities, taking into account supply chain[1] activities (from extraction of raw materials, through production and use, to final waste management). The Organisations involved include companies, public administrative entities, non-profit organisations and other bodies. OEFs are complimentary to other instruments that focus on specific sites and thresholds.

This document provides guidance on how to calculate an OEF, as well as how to create sector-specific methodological requirements for use in Organisation Environmental Footprint Sector Rules (OEFSRs).

Context

This work relates to one of the building blocks of the Europe 2020 Strategy – "Roadmap to a Resource Efficient Europe"[2]. The document proposes ways to increase resource productivity and to decouple economic growth from both resource use and environmental impacts, taking a life cycle perspective (i.e. considering extraction of raw materials, production, use, final waste management and all necessary transport in an integrated approach). One of its aims is to: "*Establish a common methodological approach to enable Member States and the private sector to assess, display and benchmark the environmental performance of products, services and companies based on a comprehensive assessment of environmental impacts over the life cycle ('environmental footprint')*". In 2010, the European Council amongst others invited the Commission and Member States to optimise the use of methods such as Life-Cycle Analysis (LCA) of products, taking into account work done in the context of the ILCD (International Reference Life Cycle Data System).[3]. The Product and Organisation Environmental Footprint project was initiated with the aim of developing a harmonised European methodology for environmental footprint studies that can accommodate a broader suite of relevant environmental performance criteria using a life cycle approach.

A life-cycle approach takes into consideration the spectrum of resource flows and environmental interventions associated with a product or organisation from a supply-chain perspective. It includes all stages from raw material acquisition through processing, distribution, use, and end-of-life processes, and all relevant related environmental impacts, health effects, resource-related threats, burdens to society, and trade-offs. Such an approach is essential to effective management because important environmental effects may occur "upstream" or "downstream", and hence may not be immediately evident. This approach is also essential for making transparent any potential trade-offs between different types of environmental impacts associated with specific policy and management decisions and to help avoid unintended shifting of burdens.

Objectives and Target Audiences

OEF studies may be used for a variety of purposes, including: benchmarking and performance tracking; least environmental-cost sourcing (i.e. supply chain management); mitigation activities; and participation in

[1] Supply chain is often referred to as "value chain" in literature. However, the term "supply chain" was preferred here in order to avoid the economic connotation of "value chain".

[2] COM(2011) 571 final, http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:DKEY=615217:EN:NOT

[3] Council of the European Union: Council conclusions on sustainable materials management and sustainable production and consumption, 3061st ENVIRONMENT Council meeting, Brussels, 20 December 2010

voluntary or mandatory programmes. To the extent possible, the OEF should also be applicable within the context of Eco-management and Audit Schemes (EMAS).

This document aims to provide detailed and comprehensive technical guidance on how to conduct an OEF study in any sector. It is primarily aimed at technical experts such as engineers and environmental managers who are to develop an OEF study. Strong expertise in life cycle assessment is not a prerequisite to using this Guide in order to conduct an OEF study.

This Guide is not intended to directly support comparisons or comparative assertions (i.e. environmental claims regarding the superiority or equivalence of one organisation a competing organisation providing the same products (based on ISO 14040:2006)). This will require the development of additional OEFSRs in complement to the more general guidance in order to further increase methodological harmonisation, specificity, relevance and reproducibility for a given sector. OEFSRs will furthermore facilitate focusing on the most important parameters, thereby also reducing the time, efforts and costs involved in completing an OEF study. In addition to general guidance and requirements for OEF studies, this document also specifies the requirements for the development of OEFSRs.

Process and Results

Each requirement for OEF studies specified in this Guide has been chosen taking into consideration the recommendations of similar, widely accepted organisational environmental accounting methods and guidance documents. Specifically, the methodology guides considered were ISO 14064 (2006), ISO/WD TR 14069 (working draft, 2010), the ILCD Handbook (2011), the WRI/WBCSD Greenhouse Gas Protocol (2011a), Bilan Carbone® (version 5.0), DEFRA's Guidance on how to measure and report your greenhouse gas emissions (2009), the Carbon Disclosure project for Water (2010) and the Global Reporting Initiative - GRI (version 3.0).

The outcome of this analysis is summarised in Annex IX. A more detailed description of the analysed methods and of the outcome of the analysis can be found in "Analysis of Existing Environmental Footprint Methodologies for Products and Organizations: Recommendations, Rationale, and Alignment".[4] Although these documents align closely on much of the methodological guidance they provide, it is noteworthy that discrepancies and/or lack of clarity remain on a number of important decision points, which reduces the consistency and comparability of analytical outcomes. Whereas existing methods may provide several alternatives for a given methodological decision point, the intention of this OEF Guide is to provide additional guidance and (wherever feasible) to identify a single requirement for each decision point in order to support more consistent, robust and reproducible OEF studies. Thus, comparability is given priority over flexibility.

To the extent possible, this OEF Guide strives to align with existing or upcoming international methodological norms, including ISO 14069 (draft) and GHG Protocol Scope 3, as well as the Product Environmental Footprint Guide. Similarly, efforts have also been made to align insofar as possible with existing environmental management schemes (EMAS and ISO 14001). It should be noted, however, that in order to provide for multi-criteria environmental assessment at the organisational level using a life-cycle approach, the OEF Guide necessarily goes beyond existing guidance documents in important aspects.

[4] European Commission - Joint Research Centre - Institute for Environment and Sustainability (2011b). Analysis of Existing Environmental Footprint Methodologies for Products and Organizations: Recommendations, Rationale, and Alignment. http://ec.europa.eu/environment/eussd/corporate_footprint.htm

As elaborated before, OEFSRs are a necessary extension of and complement to the more general guidance for OEF studies provided in this document (i.e. in terms of comparability between different OEF studies). As they are developed, OEFSRs will play an important role in increasing the reproducibility, quality, consistency, and relevance of OEF studies.

Relationship to the Product Environmental Footprint Guide

Both the Product Environmental Footprint (PEF)[5] and the OEF provide a life cycle approach to quantifying environmental performance. Whereas the PEF method is specific to individual goods or services, the OEF method applies to organisational activities as a whole – in other words, to all activities associated with the goods and/or services the Organisation provides from a supply-chain perspective (from extraction of raw materials, through use, to final waste management). Organisation and Product Environmental Footprinting can therefore be viewed as complementary activities, each undertaken to support specific applications.

Calculating the OEF does not require that all individual products of the Organisation be analysed. The OEF is calculated using aggregate data representing the flows of resources and wastes that cross the defined Organisational boundary. Once the OEF is calculated, however, it may be disaggregated to the product level using appropriate allocation keys. In theory, the sum of the PEFs of the goods/services provided over a certain reporting interval (e.g. one year) by an Organisation should be equal to its OEF for the same reporting interval[6]. The methodologies have been purposely developed towards this end. Moreover, the OEF can help to identify areas of the Organisation's Product Portfolio where environmental impacts are most significant and, hence, where detailed, individual product-level analyses may be desirable.

Terminology: Shall, Should and May

This Guide uses precise terminology to indicate the requirements, the recommendations and permissible options available.

The term "shall" is used throughout this Guide to indicate what is required in order for an OEF study to be in conformance with this Guide.

The term "should" is used to indicate a recommendation, but not a requirement. Any deviation from a "should" requirement must be justified and made transparent.

The term "may" is used to indicate an option that is permissible.

[5] http://ec.europa.eu/environment/eussd/product_footprint.htm

[6] For example, a company produces 40,000 T-shirts and 20,000 trousers per year with a product environmental footprint of respectively X / T-shirt and Y / trousers. The OEF of the company equals Z / year. In theory, Z = 40,000 x X + 20,000 x Y.

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1. General Considerations for Organisation Environmental Footprint Studies

1.1 Approach and Applications

The Organisation Environmental Footprint (OEF) is a multi-criteria measure of the environmental performance of a goods/services-providing Organisation from a life cycle[7] perspective. This includes companies, public administrative entities, and other bodies. This document provides guidance on how to calculate an OEF, as well as how to create sector-specific methodological requirements for use in Organisation Environmental Footprint Sector Rules (OEFSRs). OEFSRs are a necessary extension of and complement to the more general guidance for OEF studies provided in this document. As they are developed, OEFSRs will play an important role in increasing the reproducibility, consistency, and relevance of OEF studies. OEFSRs will help focus on the most important parameters, thereby also possibly reducing the time, efforts, and costs involved in completing an OEF study.

Based on a life cycle approach, the OEF is a method for modelling and quantifying the physical environmental impacts of the flows of material/energy and resulting emissions and waste[8] streams associated with Organisational activities from a supply-chain[9] perspective (from extraction of raw materials, through use, to final waste management). A life cycle approach takes into consideration the spectrum of resource flows and environmental interventions associated with a product or organisation from a supply-chain perspective. It includes all stages of the product's life cycle, from raw material acquisition through processing, distribution, use, and end-of-life (EOL) processes, and all relevant related associated environmental impacts, health effects, resource-related threats, burdens to society, and trade-offs. This contrasts with the approach of focusing on site-level impacts only or on single environmental impacts in order to reduce the possibility of unintended burden shifting. Such burden shifting can, for example, involve the shifting of burdens from one life cycle stage in the supply chain to another, from one impact category to another, from one organisation to another, or from one country to another. The OEF is complementary to other assessments and instruments such as site-specific environmental impact assessments or chemical risk assessments.

The OEF is an environmental accounting model rather than a financial accounting model. Efforts have therefore been made to minimise the need for using financial information (for example, in defining Organisational boundaries) which may be poorly representative of the physical relationships pertinent to the systems modelled.

Each requirement specified in this OEF Guide has been chosen taking into consideration the recommendations of similar, widely accepted corporate environmental accounting methods and guidance documents. Specifically, the methodology guides considered were:

- ISO 14064 (2006): Greenhouse gases -- Part 1 and 3;
- ISO/WD TR 14069 (working draft, 2010): GHG -- Quantification and reporting of GHG emissions for organizations;

[7] The life cycle encompasses the consecutive and interlinked stages of a product system, from raw material to final disposal (ISO 14040:2006).
[8] Waste is defined as substances or objects which the holder intends or is required to dispose of (ISO 14040:2006).
[9] Supply chain is often referred to as "value chain" in the literature. However, the term "supply chain" was preferred here to avoid the economic connotation of "value chain".

- The ILCD (International Reference Life Cycle Data System) Handbook (2011);
- The Corporate Accounting and Reporting Standard of the Greenhouse Gas Protocol (WRI/ WBCSD) (2011a);
- Bilan Carbone® (version 5.0);
- DEFRA - Guidance on how to measure and report our greenhouse gas emissions (2009);
- The Carbon Disclosure Project for Water (2010);
- The Global Reporting Initiative (GRI) (version 3.0).

The outcome of this analysis is summarised in Annex IX. A more detailed description of the analysed methods and of the outcome of the analysis can be found in "Analysis of Existing Environmental Footprint Methodologies for Products and Organizations: Recommendations, Rationale, and Alignment".[10] Whereas existing methods may provide several alternatives for a given methodological decision point, this OEF Guide intends to provide additional guidance and to identify (wherever feasible) a single requirement for each decision point to support more consistent, robust and reproducible OEF studies.

The key requirements for OEF studies (elaborated in detail throughout this Guide) are slightly different depending on the application (Table 1):

- In-house applications may include support to environmental management, identification of environmental hotspots, and environmental improvement and performance tracking, and may implicitly include cost saving opportunities;
- External applications (e.g. communication to stakeholders or Business-to-Business (B2B) communication, relationships with public authorities or investors) cover a wide range of possibilities, including responding to investors' information requests, marketing, benchmarking, and responding to requirements posed in environmental policies at European level or at the level of the individual Member States.
- Benchmarking could for example include defining an average performing product (based on data provided by stakeholders or on generic data or on approximations) followed by a grading of other products according to their performance versus the benchmark.

[10] European Commission - Joint Research Centre - Institute for Environment and Sustainability (2011b). Analysis of Existing Environmental Footprint Methodologies for Products and Organizations: Recommendations, Rationale, and Alignment. http://ec.europa.eu/environment/eussd/corporate_footprint.htm

Table 1: Key requirements for OEF studies in relation to the intended application.

Intended applications		Goal & Scope definition	Screening exercise	Meeting data quality requirements	Multi-functionality hierarchy	Choice of impact assessment methods	Classification & Characterisation	Normalisation & Weighting	Interpretation of OEF results	Reporting elements	Critical review (1 person)	Critical review panel (3 persons)	Requires OEFSR
In-house (claiming to be in line with the OEF Guide)		M	R	R	M	M	M	O	M	O	M	O	O
External	Without comparisons / comparative assertions	M	R	M	M	M	M	O	M	M	M	R	R
	With comparisons / comparative assertions	M	R	M	M	M	M	O	M	M	/	M	M

"M" = mandatory

"R" = recommended (not mandatory)

"O" = optional (not mandatory)

"/" = not applicable

REQUIREMENTS FOR OEF STUDIES

An Organisation Environmental Footprint (OEF) study shall be based on a life-cycle approach.

1.2 How to Use this Guide

This Guide provides the information necessary to conduct an OEF study. The material in the Guide is presented in a sequential manner, in the order of the methodological phases that must be completed in calculating an OEF. Each section begins with a general description of the methodological phase, along with an overview of necessary considerations and supporting examples. "Requirements" specify the methodological norms that shall/should be satisfied in order to achieve an OEF-compliant study. These are positioned in text boxes with single solid-line borders following the general description sections. "Tips" describe non-mandatory but recommended best practices. These are positioned in shaded text boxes, also with single solid-line borders. Where additional requirements for creating OEFSRs are specified, these are positioned in text boxes with double solid-line borders at the end of each respective section.

1.3 Principles for Organisation Environmental Footprint Studies

Strict adherence to a core suite of analytical principles is required in order to achieve the objective of consistent, robust and reproducible OEF studies. These principles are intended to provide overarching guidance in the application of the OEF method. They shall be considered with respect to each phase of OEF studies, from the articulation of study goals and definition of the scope of the study, through data collection, environmental impact assessment, reporting, and verification of study outcomes.

REQUIREMENTS FOR OEF STUDIES

Users of this Guide shall observe the following principles in OEF studies:

(1) Relevance

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

(2) Completeness

Quantification of the OEF shall include attention to all environmentally significant[11] material/energy flows and other environmental interventions as required for adherence to the defined system boundaries, the data requirements, and the impact assessment methods employed.

(3) Consistency

Strict conformity with this Guide shall be observed in all steps of the OEF study so as to enhance internal consistency as well as comparability with similar analyses.

(4) Accuracy

All reasonable efforts shall be taken to reduce uncertainties both in modelling and 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.

Principles for OEFSRs

1. Relationship with the OEF Guide

The methodological requirements set out for OEFSRs shall apply to OEF studies in addition to the requirements of the OEF Guide. Where the OEFSRs provide more specific requirements than this OEF Guide, the specific requirements of the OEFSR shall be fulfilled.

2. Involvement of selected interested parties

The process of developing OEFSRs shall be open and transparent and should include a consultation with selected interested parties. Reasonable efforts should be made to achieve a consensus throughout the process (adapted from ISO 14020:2000, 4.9.1, Principle 8). The OEFSRs shall be peer reviewed.

3. Striving for comparability

The results of OEFs that have been conducted in line with the OEF Guide and the relevant OEFSR document may be used to support the comparison of the environmental performance of organisations in the same sector on a life cycle basis, as well as to support comparative assertions (intended to be disclosed to the public). Therefore, comparability of the results is crucial. The information provided for this comparison shall be transparent in order to allow the user to understand the limitations of comparability inherent in the calculated result (adapted from ISO 14025[12]).

[11] Environmentally significant is the adjective used to describe any process or activity that accounts for at least 90% of contributions to each environmental footprint impact category (see glossary for definition) considered.

[12] ISO. (2006a). ISO 14025. Environmental labels and declarations - Type III environmental declarations - Principles and procedures. International Organization for Standardization, Geneva.

1.4 Phases of an Organisation Environmental Footprint Study

A number of phases shall be completed in carrying out an OEF study in line with this Guide - i.e. Goal Definition, Scope Definition, Resource Use and Emissions Profile, Environmental Footprint Impact Assessment, and Environmental Footprint Interpretation and Reporting – see Figure 1.

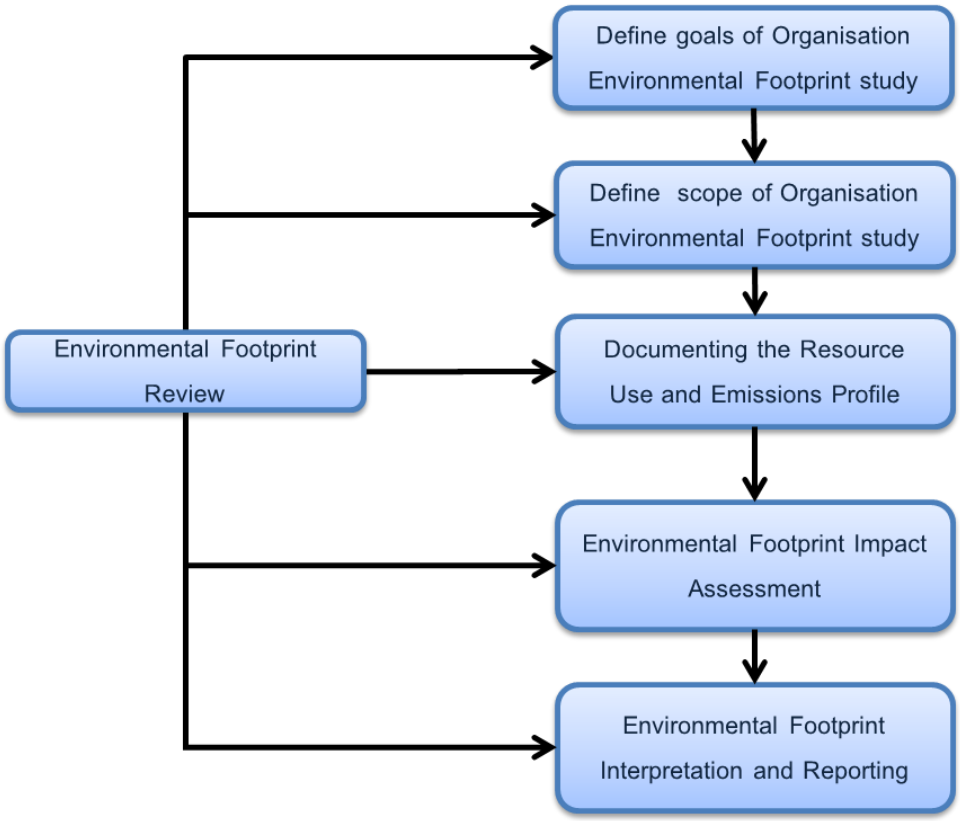

Figure 1: Phases of an Organisation Environmental Footprint study.

2. Role of Organisation Environmental Footprint Sector Rules (OEFSRs)

2.1 General

In addition to providing general guidance and requirements for OEF studies, this OEF Guide also specifies the requirements for developing OEFSRs. OEFSRs will play an important role in increasing the reproducibility, consistency (and therefore comparability between OEF calculations within organisations of the same sector), and relevance of OEF studies. OEFSRs will help focus on the most important parameters, thus also possibly reducing the time, efforts and costs involved in completing an OEF study.

The objective is to ensure that OEFSRs are developed according to the OEF Guide and that they provide the required further specifications to achieve comparability, increased reproducibility, consistency, relevance, focus and efficiency of OEF studies. OEFSRs should aim to focus OEF studies on those aspects and parameters that are most pertinent in determining the environmental performance of the sector. An OEFSR shall/should/may further specify requirements made in this OEF Guide and add new requirements where the more general OEF Guide gives several options.

This OEF Guide defines key areas to be covered in OEFSRs. These include, for example:

- Choice and description of system boundaries (Organisational boundaries and OEF boundaries);
- Defining the reporting interval and the time span of the use stage to be considered;
- Defining relevant/irrelevant environmental aspects[13];
- Description of the information to be included in the use and EOL stages, if considered in the analysis;
- How to compile the Product[14] Portfolio , including key related reference flow(s)[15];
- Choice of underlying data, indicating which data are to be directly collected (specific) and which may be generic[16], and providing guidance on possible data sources;
- Specific rules for solving the multi-functionality[17] issues of key processes/activities for the sector;
- Review requirements;
- Reporting requirements.

If the OEF studies are not to be used for comparative assertions intended to be disclosed to the public, they may be carried out without using OEFSRs.

REQUIREMENTS FOR OEF STUDIES
In the absence of OEFSRs for the reference sector, the key areas which would be covered by OEFSRs (as listed throughout this OEF Guide) shall be specified, justified and explicitly reported in the OEF study.

[13] An environmental aspect is an element of an organisation's activities or products that has or can have an impact on the environment (including human health).

[14] A product is any goods or service (ISO 14040:2006).

[15] The reference flow is a measure of the outputs from processes in a given system required to fulfil the function expressed by the unit of analysis (based on ISO 14040:2006).

[16] Generic Data – Refers to data that are not directly collected, measured, or estimated, but rather sourced from a third-party life-cycle inventory database or other source that complies with the data quality requirements of the OEF Guide. Synonymous with "secondary data."

[17] If a process or facility provides more than one function, i.e. it delivers several goods and/or services ("co-products"), it is "multi-functional". In these situations, all inputs and emissions linked to the process must be partitioned between the product of interest and the other co-products in a principled manner. Similarly, where a jointly owned and/or operated facility produces multiple products, it may be necessary to partition related inputs and emissions among the products within the defined Product Portfolios of different organisations. Organisations undertaking an OEF study may therefore have to address multi-functionality problems both at the product and facility level (see section 5.11 and Annex V).

ADDITIONAL REQUIREMENTS FOR OEFSRs

OEFSRs should aim to focus OEF studies on those aspects and parameters which are most pertinent to determining the environmental performance of the sector.

An OEFSR shall/should/may further specify requirements made in this OEF Guide and add new requirements where the more general OEF Guide gives several options.

2.2 Defining the Sector that is Subject to the Organisation Environmental Footprint Sector Rules

The sector shall be defined with reference to the characteristic sectorial Product Portfolio[18] using NACE codes (i.e. in line with the Nomenclature générale des Activités Economiques dans les Communautés Européennes NACE Rev. 2). NACE is a system for statistically classifying economic activities in Europe. One NACE code is assigned to each unit recorded in statistical business registers, according to its principal economic activity. The principal activity is the activity which contributes most to the added value of the unit. As NACE is derived from the United Nations' International Standard Industrial Classification of All Economic Activities (ISIC), the two classification systems are very similar, but NACE is more detailed than ISIC.

The assignment of the NACE code is helped by the explanatory notes of NACE, decisions taken by the NACE management committee, correspondence tables and reference to Classification of Products by Activity (CPA). An activity as defined here "*may consist of one simple process (for example weaving), but may also cover a whole range of sub-processes, each mentioned in different categories of the classification (for example, the manufacturing of a car consists of specific activities such as casting, forging, welding, assembling, painting, etc.). If the production process is organised as an integrated series of elementary activities within the same statistical unit, the whole combination is regarded as one activity*"[19].

NACE consists of a hierarchical structure as follows[20]:

1. Headings identified by an alphabetical code (sections);
2. Headings identified by a two-digit numerical code (divisions);
3. Headings identified by a three-digit numerical code (groups);
4. Headings identified by a four-digit numerical code (classes).

ISIC and NACE have the same codes at the highest levels, but NACE is more detailed at the lower levels. As the NACE code in the context of this study applies to the sector level, at a minimum a 2-digit code (i.e. division level) shall be assigned[21]. This complies with the ISIC coding system. For multi-sector companies, all identifiable NACE codes related to their Product Portfolio shall be assigned.

[18] Suite and amount of goods/services provided over the reporting interval.
[19] (NACE Rev. 2 2008, page 15)
[20] (NACE Rev. 2 2008, page 15)
http://epp.eurostat.ec.europa.eu/portal/page/portal/product_details/publication?p_product_code=KS-RA-07-015
[21] The alphabetical section code does not appear in the digit code according to NACE and is therefore not relevant here.

Example:

A company manufacturing t-shirts and trousers belongs to the sector of manufacturers of wearing apparel. The NACE (and ISIC) code of the sector representing manufacturers of wearing apparel is 14. If the company does include processes for finishing of the textiles (e.g. bleaching of jeans), it also belongs to the sector representing manufacturers of textiles. The NACE (and ISIC) code related to the sector representing manufacturers of textile is 13. Both NACE codes 13 and 14 shall therefore be assigned to the company.

The sector should be defined so that it accommodates all relevant organisations in that sector. However, it must also be specific enough to facilitate the formulation of appropriately representative and prescriptive OEFSRs above and beyond those specified in the OEF Guide. The OEFSRs are, therefore, defined primarily with reference to the activities characteristic of the sector, as represented in a typical Product Portfolio.

To identify the set of activities by which organisations may be grouped under an OEFSR, several criteria should be considered:

- The organisations should provide similar goods/services;
- The relevant environmental impacts related to the activities of the organisations can be described by a similar set of environmental footprint impact categories, methods, and other indicators;
- The organisations should have similar Organisational boundaries and source a sufficiently similar profile of product inputs[22].

ADDITIONAL REQUIREMENTS FOR OEFSRs

The sector for which the OEFSR is to refer shall be defined using NACE codes. OEFSRs shall be based on at a minimum a two-digit code division of NACE codes (default option). However, OEFSRs may allow for (justified) deviations (e.g. allow for three-digits) if the complexity of the sector demands it. Where multiple production routes for similar Product Portfolios defined using alternative NACE codes are identifiable, the OEFSR shall accommodate all such NACE codes.

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

3. Defining the Goal(s) of the Organisation Environmental Footprint Study

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

An important element of the goal definition phase is to identify the intended applications of the study, and the associated necessary degree of analytical depth and rigor. In turn, this should be reflected in the defined study limitations (scope definition phase). For analyses geared towards e.g. least-environmental cost sourcing, product design, benchmarking or reporting, fully quantitative studies in conformance with the analytical requirements specified in this OEF Guide will be necessary. Combined approaches are also possible if only certain parts of the supply chain are subject to quantitative analysis and others to qualitative descriptions of potential environmental hotspots in a single OEF study (for example, a quantitative cradle-to-gate[23] analysis combined with qualitative descriptions of gate-to-grave[24] environmental considerations or with quantitative analyses of the use and EOL stages for selected representative product types).

Several reasons for carrying out an OEF study are possible, such as a need to understand the most significant environmental impacts of an Organisation's activities throughout its life cycle, to identify opportunities for reducing the environmental impacts focussing primarily on the identified 'hotspots', to support strategic decisions (e.g. on risk management in the supply chain), to address investors' and other stakeholders' enquiries regarding the Organisation's environmental performance, corporate sustainability reporting, reporting to stakeholders, etc.

Example: Environmental footprint of a company producing yeans and T-shirts: goal definition.

Aspects	Detail
Intended application(s):	Corporate sustainability reporting
Reasons for carrying out the study:	Demonstrate commitment to and practice of continuous improvement
Target audience:	Customers
Comparisons or comparative assertions intended to be disclosed to the public:	No, it will be publically available but it is not intended to be used for comparisons or comparative assertions.
Commissioner of the study:	G Company Ltd.
Review procedure:	Intended external reviewer, Mr. Y

[23] An assessment of a partial Organisation supply chain: from the extraction of raw materials (cradle) up to the manufacturer's "gate". The distribution, storage, use and EOL stages of the supply chain are omitted.

[24] An assessment of a partial Organisation supply chain, including only the processes within a specific organisation or site and the processes occurring along the supply chain such as distribution, storage, use, and disposal or recycling stages.

REQUIREMENTS FOR OEF STUDIES

The goal definition for an OEF study shall include:

- Intended application(s);
- Reasons for carrying out the study and decision context;
- Target audience;
- Whether for the purpose of comparisons and/or comparative assertions intended to be disclosed to the public;
- Commissioner of the study;
- Review Procedure (if applicable).

ADDITIONAL REQUIREMENTS FOR OEFSRs

The OEFSR shall specify the review requirements for OEF studies.

4. Defining the Scope of the Organisation Environmental Footprint Study

4.1 General

Defining the scope of the OEF study involves describing in detail the system to be evaluated along with the associated analytical specifications.

REQUIREMENTS FOR OEF STUDIES

The scope definition for an OEF study shall be in line with the defined study goals and the requirements of the OEF Guide. It shall identify and clearly describe (see following sections for a more detailed description):

- Definition of the Organisation (unit of analysis[25]) and the Product Portfolio (suite and amount of goods/services provided over the reporting interval);
- System boundaries (Organisational and OEF boundaries);
- Environmental Footprint impact categories;
- Assumptions and Limitations.

4.2 Defining the Organisation (Unit of Analysis)

The Organisation is the reference unit for the analysis, and (along with the Product Portfolio) the basis for defining the Organisational boundaries. It is parallel to the concept of "functional unit" in a traditional Life Cycle Assessment (LCA)[26]. 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 OEF study is intended to provide a measure of the potential environmental pressures related to the provision of products by the Organisation. Defining the Organisation with reference to the Product Portfolio therefore facilitates direct representation of the Organisation's physical exchanges with the environment.

REQUIREMENTS FOR OEF STUDIES

The Organisation (or clearly defined subset thereof subject to the OEF study) shall be defined according to the following:

- The name of the Organisation;
- The kinds of goods/services the Organisation produces (i.e. the sector);
- Locations of operation (i.e. countries);
- The NACE code(s).

[25] The unit of analysis defines the qualitative and quantitative aspects of the function(s) and/or service(s) that the Organisation being evaluated provides; the unit of analysis definition answers the questions "what?", "how much?", "how well?", and "for how long?".

[26] Life cycle assessment – compilation and evaluation of the inputs, outputs and the potential environmental impacts of a product system throughout its life cycle (ISO 14040:2006)

Example:

Aspect	Detail
Organisation:	Y Company Ltd.
Goods/Services Sector:	garment manufacturer
Location(s):	Paris, Berlin, Milan
NACE code(s):	14

4.3 Product Portfolio

The Product Portfolio refers to the amount and nature of goods and services provided by the Organisation over the reporting interval, which should be one year. It constitutes the basis for completing the Resource Use and Emissions Profile (inventory) for the Organisation, which equals the input and output[27] flows associated with the provision of the Organisation's Product Portfolio as per the defined system boundaries for the study.

The OEF may be limited to a clearly defined subset of the Product Portfolio of the Organisation. This can, for example, be the case if the Product Portfolio of a retailer consists of products produced in-house (own brands) and products which are provided by the Organisation without any transformation. The Product Portfolio for the cradle-to-grave analysis could then be limited to the in-house products, while a cradle-to-gate or gate-to-gate analysis is made for the other products. Another typical example is an organisation that is operating in various sectors and decides to restrict its analysis to one sector.

REQUIREMENTS FOR OEF STUDIES

A Product Portfolio shall be defined for the Organisation that represents the amount and nature of goods and services (or clearly defined subset thereof) provided by the Organisation over the reporting interval in terms of "what" and "how much". It shall be justified and reported if an OEF is limited to a subset of its Product Portfolio.

The reporting interval should be one year.

For modelling the use and EOL scenarios, information on "how well", and "for how long"[28] with respect to product performance shall also be provided. The quantitative input and output data collected in support of the analysis (to be carried out in a later phase of the OEF study) shall be calculated in relation to the specified Product Portfolio.

[27] Output flows are product, material or energy flows that leave a unit process. Products and materials include raw materials, intermediate products, co-products and releases (ISO 14040:2006).

[28] "How well" and "how much" are important characteristics which will determine the environmental footprint of the downstream processes occurring during the time span of the use stage.

Example: Product Portfolio:

Aspect	Detail
[WHAT]	T-shirts (average for size S, M, L) made from polyester, trousers (average for size S, M, L) made from polyester
[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 a water consumption of 6.9 litres/week.
[HOW LONG]	use stage of five years for both the T-shirts and the trousers
[YEAR]	2010
[REPORTING INTERVAL]	one year

ADDITIONAL REQUIREMENTS FOR OEFSRs

The OEFSR shall further specify how the Product Portfolio is defined, in particular with respect to "how well" and "for how long". It shall also define the reporting interval when this differs from one year, and justify the chosen interval.

4.4 System Boundaries for Organisation Environmental Footprint Studies

Organisational activities are ultimately embedded in networks of social, financial and physical relationships. It is therefore necessary to establish boundaries in order to formally define which of these relationships will be considered in the OEF, and which will be excluded. A key insight that has emerged from life cycle-based approaches to environmental accountancy is that resource use and emissions linked to processes upstream (i.e. goods and services purchased by the Organisation) or downstream (i.e. linked to the distribution, storage, use, and EOL of the goods/services the Organisation provides) can be key determinants of the overall environmental profile of the Organisation. Effective and efficient environmental management therefore requires attention to these upstream and downstream processes, and consideration of the extent to which they are or can be influenced by decision making at the organisational level.

Given the obviously important role that the choice of system boundaries will contribute to deciding the magnitude of the calculated OEF, these shall be established in a principled and consistent manner. The definition of the boundaries also directly determines the utility of the analytical outcomes for specific applications. For example, to generate results most suitable to informing environmental management of direct site-level impacts, Organisational boundaries related to the site are appropriate. To inform management of broader supply-chain impacts, system boundaries that encompass upstream and/or downstream processes are required. An OEF exercise that shows that the majority of environmental impacts occur upstream along the supply chain in association with specific processes provides the necessary basis for making improvements along the supply chain. An analysis that suggests that downstream impacts are most important may point towards opportunities for redesigning products or changing the composition of the Product Portfolio.

REQUIREMENTS FOR OEF STUDIES

The system boundaries shall include both Organisational boundaries (in relation to the defined Organisation) and OEF boundaries (that specify which aspects of the supply chain are included in the analysis).

4.4.1 Organisational Boundaries

In the interests of maximising the physical representativeness of the OEF model, it is most appropriate to define Organisational boundaries based on the Product Portfolio[29] as opposed to giving an economic definition. For this reason, Organisational boundaries of OEF studies are 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 Product Portfolio.[30] This corresponds to the "control" approach in that, in theory, the Organisation should be able to leverage direct access to specific data[31] for activities in which they have an operational or financial stake and should also be able to influence environmental management decisions for the facilities of concern based on the results of the OEF study. The activities and impacts linked to processes within the defined Organisational boundaries are considered "direct" activities and impacts.

For example, in the case of retailers, products produced by other organisations are not included in the Organisational boundaries 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 boundaries.

As some jointly owned/operated facilities may contribute to the provision both of the defined Product Portfolio of the organisation as well as of the Product Portfolio(s) of other organisations, it may be necessary to allocate inputs and outputs accordingly (see section 5.11).

REQUIREMENTS FOR OEF STUDIES

Organisational boundaries for calculating the OEF shall encompass all of the facilities/activities that the Organisation owns and/or operates (whether partially or in full) that contribute to providing the Product Portfolio during the reporting interval.

All activities and processes which occur within the Organisational boundaries but which are not necessary for the functioning of the Organisation shall be included in the analysis but reported separately. Examples of such processes/activities are gardening activities, food served by the company in the canteen, etc.

In the case of retailers, products produced or transformed by the retailer shall be included in the Organisational boundaries.

[29] Three approaches to defining Organisational boundaries can be distinguished. First is the equity share approach, where Organisational boundaries encompass all activities in which there is an ownership share. Second is the financial control approach, where organisations include within their defined boundaries only those activities over which they have financial control. Third is the operational control approach, where only those activities over which an organisation has operational control are included in the defined boundaries.

[30] The "control" approach is preferred to the "equity share" approach because it is better suited to environmental performance measurement and management, as explicitly recognised in existing guidance documents such as ISO 14069 and the GHG Protocol, Moreover, an inclusive interpretation of the control approach (i.e. defining Organisational boundaries taking into account **both** financial and operational control) is identified as necessary to ensuring maximally representative models that will support differentiation in the context of possible mandatory applications.

[31] Specific data refer to directly measured or collected data that is representative of activities at a specific facility or set of facilities. Synonymous with "primary data."

Example:

Facility	Status	Directly contributes to Product/Service Portfolio?	Included in System Boundary
Textile plant	Operated/not owned	Yes	Yes
Textile plant	Part owned/ operated	Yes	Yes
Factory (sewing)	Owned/ operated	Yes	Yes
Bottle factory	Minority share	No	No

ADDITIONAL REQUIREMENTS FOR OEFSRs

The OEFSR shall specify the characteristic processes, activities and facilities of the sector of concern to be included in the Organisational boundaries.

The OEFSR shall specify the characteristic processes and activities which occur within the Organisational boundaries but which are not necessary for the functioning of the Organisation. These shall be included in the analysis and reported separately.

4.4.2 Organisation Environmental Footprint Boundaries

Depending on the intended application, OEF studies may require system boundaries that are broader than the Organisational boundaries. Towards this end, OEF boundaries shall be defined in terms of indirect activities and associated impacts. Indirect activities and impacts are those that occur upstream or downstream along the supply chains linked to organisational activities, but that fall outside of the defined Organisational boundaries.

Figure 2 indicates the mandatory and optional processes/activities to be included in the OEF. For some organisations, downstream (indirect) activities may be excluded based on explicit justification. For example, organisations producing intermediate products[32] or products with an indeterminable fate for which the use stage is unknown (e.g. timber, sugar), the use stage may be excluded from the analysis. If retailers provide products produced by other organisations, the production processes shall be included as upstream processes.

[32] Intermediate product – Output from a unit process that is input to other unit processes that require further transformation within the system (ISO 14040:2006).

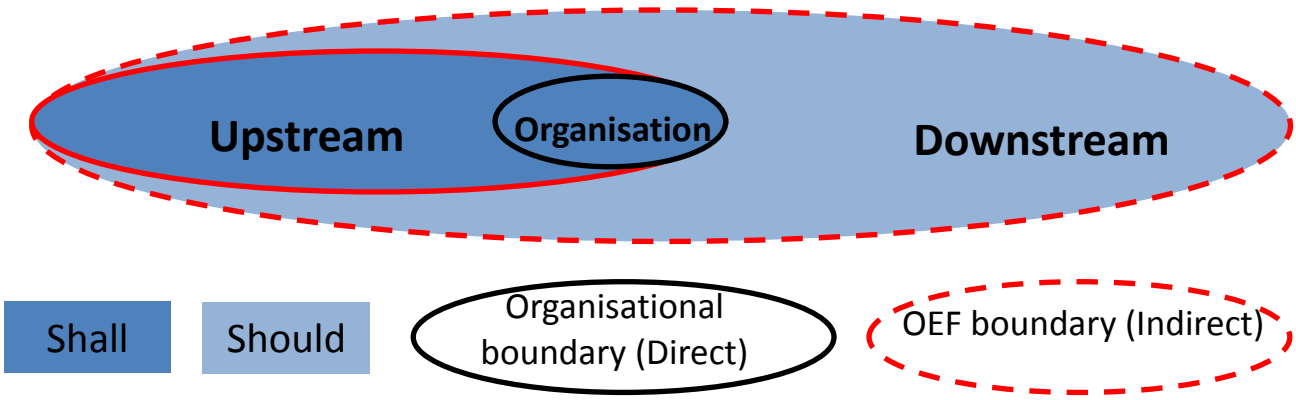

Figure 2: Organisational and OEF boundaries. Note: Any exclusion (e.g. downstream activities) shall be explicitly justified within the context of the study and the intended application.

Employee transport can occur either within the Organisational boundary (e.g. when employees commute using cars owned or operated by the employer, or use public transport paid for by the employer) or be an indirect process (e.g. when employees commute by private cars or public transport paid for by the employee). To ensure comparability between OEF studies, employee transport shall be included in the analysis, even if these are indirect activities.

As products within one sector may have a different life span (as specified in the description of the Product Portfolio under the term "how long" (see section 4.3)), the time span to be considered for the assessment of the downstream processes/activities needs to be defined to ensure comparability and consistency among OEF studies. If the life span of the product is shorter than the defined time span to be considered, necessary replacements shall be taken into account. These replacements are necessary to fulfil the defined time span and thus do not relate to reuse.

REQUIREMENTS FOR OEF STUDIES

The OEF boundaries shall be defined following general supply-chain logic. This shall include, at a minimum, site-level (direct) and upstream (indirect) activities associated with the Organisation's Product Portfolio. The OEF boundaries shall by default include all supply-chain stages from raw material[33] acquisition through processing, production, distribution, storage, use and EOL treatment of the Product Portfolio (i.e. cradle-to-grave). All processes within the defined OEF boundaries shall be considered. Explicit justification shall be provided if downstream (indirect) activities are excluded (e.g. use stage of intermediate products or products with an undeterminable fate).

Employee transport shall be included in the analysis, even if these are indirect activities.

If retailers provide products produced by other organisations, the production processes shall be included as upstream processes.

Replacements which are necessary to fulfil the defined time span (see OEFSRs in section 4.3) shall be taken into account. The number of replacements equals "time span/life span -1". As this assumes an average situation, the number of replacements does not need to be an integer. The future production processes for these replacements shall be assumed to be identical to the processes of the reporting year. If a fixed time span is not relevant for a certain sector (see OEFSRs in section 4.3), the use stage shall cover the life span of the products in the Product Portfolio of the Organisation (without replacements).

[33] Raw material – primary or secondary material that is used to produce a product (ISO 14040:2006).

Tip: The degree of robustness with which the full supply chain of the OEF can be assessed for an Organisation will depend strongly on the nature and variety of products the Organisation provides.

If the Organisation provides intermediate products and it is not feasible to establish robust end-use scenarios, modelling only direct and indirect upstream impacts may be preferred. The Organisation might also consider modelling the use and EOL stages for only a small, representative subset of products.

In all cases, system boundaries should be established and justified in relation to the defined goals and intended applications of the study.

ADDITIONAL REQUIREMENTS FOR OEFSRs

The OEFSR shall specify the OEF boundary, including specification of the supply-chain stages to be included; and the direct (gate-to-gate) and indirect (upstream and downstream) processes/activities to be included in the OEF study. Any deviation from the default cradle-to-grave approach shall be explicitly specified and justified, e.g. exclusion of the unknown use stage of intermediate products. The OEFSR shall also include justification for exclusions of processes/activities.

The OEFSR shall specify the time span and scenarios to be considered for the downstream activities. If a fixed time span is not appropriate or relevant for a certain sector (e.g. some consumable products), the OEFSR shall specify and justify why this is the case.

4.4.3 System Boundary Diagram

A system boundary diagram is a schematic representation of the analysed system. It details which parts of the Organisation supply chain are included or excluded from the analysis. A system boundary diagram may be a useful tool in defining the system boundary and organising subsequent data collection activities and therefore it should be included in the scope definition.

Tip: It is not mandatory to prepare a system boundary diagram, but it is highly recommended. The system boundary diagram will help the Organisation to define and structure the analysis.

REQUIREMENTS FOR OEF STUDIES

A system boundary diagram should be included in the scope definition.

4.4.4 How to Deal with Offsets in an OEF

The term “offset” is frequently used with reference to third-party greenhouse gas (GHG) mitigation activities. Offsets are GHG reductions obtained somewhere other than the source of the emission, used to compensate for (i.e. offset) emissions, 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 offset by the Clean Development Mechanism, carbon credits, and other offsets external to the system.

REQUIREMENTS FOR OEF STUDIES

Offsets shall not be included in an OEF study, but may be reported separately as "Additional Environmental Information."

4.5 Selecting Environmental Footprint Impact Categories and Assessment Methods

Environmental footprint (EF) impact categories[34] refer to specific categories of environmental impacts[35] considered in an OEF study. These generally relate to resource use (e.g. fossil fuels and mineral ores) or emissions of environmentally damaging substances (e.g. GHGs or toxic chemicals), which may affect human health. Impact assessment models are used for quantifying the causal relationships between the material/energy inputs and emissions associated with Organisational activities (as inventoried in the Resource Use and Emissions Profile) and each EF impact category considered (see Figure 1). Each EF impact category refers to a stand-alone EF impact assessment model and EF impact category indicator[36].

The EF impact assessment models used in the OEF are mid-point[37] models because these are considered scientifically best established.[38] Some impacts might seem to be left out of the EF impact assessment, but these are covered by mid-point indicators. For example, impacts on biodiversity (an end-point related to ecosystems) are not explicitly calculated for OEF studies, but are represented by several other mid-point indicators that affect biodiversity, predominantly ecotoxicity, eutrophication, acidification, land use, climate change and ozone depletion.

The purpose of the environmental footprint (EF) impact assessment[39] is to group and aggregate the inventoried Resource Use and Emissions Profile data according to the respective contributions to each EF impact category. This subsequently provides the necessary basis for interpretation of the OEF results relative to the goals of the study (for example, identification of supply chain "hotspots" and options for improvement). The selection of EF impact categories shall therefore be comprehensive as they cover all relevant environmental issues related to the activities of the Organisation.

This OEF Guide provides a default list of EF impact categories and related assessment models and indicators to be used in OEF studies (Table 2).[40] Further instructions on how to calculate these impacts are described in chapter 6. Chapter 6 also provides the data that are necessary to carry out the assessment.

[34] The term "EF impact category" is used throughout this Guide instead of the term "impact category" used in ISO 14044:2006.

[35] Environmental impacts according to this Guide include effects on human health and resources.

[36] The term "EF impact category indicator" is used throughout this Guide instead of the term "impact category indicator" used in ISO 14044:2006.

[37] A differentiation can be made between "mid-point" and "end-point" impact assessment methods. Mid-point methods assess the impacts earlier in the cause-effect chain. For example, midpoint methods express global warming as CO_2-equivalents while endpoint methods express it - for example - as Disability Adjusted Life Years (years of loss of (quality of) life due to illness or death due to climate change).

[38] European Commission - Joint Research Centre - Institute for Environment and Sustainability (2011a). International Reference Life Cycle Data System (ILCD) Handbook - Recommendations for Life Cycle Assessment in the European context - based on existing environmental impact assessment models and factors. ISBN 978-92-79-17451-3, doi: 10.278/33030. Publications Office of the European Union, Luxembourg.

[39] The term "EF impact assessment" is used throughout this Guide instead of the term "life cycle impact assessment" used in ISO 14044:2006. It is the phase of the OEF analysis aimed at understanding and evaluating the magnitude and significance of the potential environmental impacts for a system throughout the life cycle [based on ISO 14044:2006]. The employed EF impact assessment methods provide impact characterisation factors for elementary flows to aggregate the impact to a limited number of midpoint and/or damage indicators.

[40] For further information on specific EF impact assessment categories and models, reference is made to the ILCD Handbook "Framework and requirements for LCIA models and indicators"; "Analysis of existing environmental assessment methodologies for

Table 2: Default EF impact categories with their respective EF impact category indicators and EF impact assessment models for OEF studies.

EF Impact Category	EF Impact Assessment Model	EF Impact Category Indicator	Source
Climate Change	Bern model - Global Warming Potentials (GWP) over a 100 year time horizon.	Tonne CO_2 equivalent	Intergovernmental Panel on Climate Change, 2007
Ozone Depletion	EDIP model based on ODPs of the WMO over an infinite time horizon.	kg CFC-11 equivalent*	WMO, 1999
Ecotoxicity – fresh water[41]	USEtox model	CTUe (Comparative Toxic Unit for ecosystems)[42]	Rosenbaum et al., 2008
Human Toxicity - cancer effects	USEtox model	CTUh (Comparative Toxic Unit for humans)[43]	Rosenbaum et al., 2008
Human Toxicity – non-cancer effects	USEtox model	CTUh (Comparative Toxic Unit for humans)[12]	Rosenbaum et al., 2008
Particulate Matter/Respiratory Inorganics	RiskPoll model	kg $PM_{2.5}$ equivalent**	Humbert, 2009
Ionising Radiation – human health effects	Human Health effect model	kg U^{235} equivalent (to air)	Dreicer et al., 1995
Photochemical Ozone Formation	LOTOS-EUROS model	kg NMVOC equivalent***	Van Zelm et al., 2008 as applied in ReCiPe
Acidification	Accumulated Exceedance model	mol H+ equivalent	Seppälä et al., 2006; Posch et al, 2008
Eutrophication – terrestrial	Accumulated Exceedance model	mol N equivalent	Seppälä et al., 2006; Posch et al, 2008
Eutrophication – aquatic	EUTREND model	fresh water: kg P equivalent marine: kg N equivalent	Struijs et al., 2009 as implemented in ReCiPe
Resource Depletion – water	Swiss Ecoscarcity model	m^3 water use related to local scarcity of water[44]	Frischknecht et al., 2008
Resource Depletion – mineral, fossil	CML2002 model	kg Sb equivalent****	van Oers et al., 2002
Land Use	Soil Organic Matter (SOM) model	kg C (deficit)	Milà i Canals et al., 2007

* CFC-11 = Trichlorofluoromethane, also called freon-11 or R-11, is a chlorofluorocarbon.

** $PM_{2.5}$ = Particulate Matter with a diameter of 2.5 µm or less.

*** NMVOC = Non-Methane Volatile Organic Compounds

**** Sb = Antimony

use in LCA" and "Recommendations for life cycle impact assessment in the European context." (European Commission – JRC – IES 2010c, 2010e, 2011a). These are available online at http://lct.jrc.ec.europa.eu/.

[41] Direct emissions to marine water are not included in this impact assessment category, but shall be reported separately in the Additional Environmental Information (see section 4.6).

[42] CTUe provides an estimate of the potentially affected fraction of species (PAF) integrated over time and volume per unit mass of a chemical emitted (PAF m^3 day kg−1) (Rosenbaum et al. 2008, 538).

[43] CTUh provides an estimate of the increase in morbidity in the total human population per unit mass of a chemical emitted (cases per kilogram), assuming equal weighting between cancer and non-cancer due to a lack of more precise insights into this issue (Rosenbaum et al. 2008, 538).

[44] This refers to the consumed amount of water (not including rainwater or recovered grey water), or thus the net consumption of fresh water.

Depending on the nature of Organisation activities and the intended applications of the OEF study, users of this OEF Guide may opt for narrowing the suite of EF impact categories. Such justifications for exclusion(s) shall be supported by appropriate documents. Examples of sources of supporting documents are (non-exhaustive list):

- International consensus process;
- Independent external review (according to the requirements in chapter 9);
- Multi-stakeholder process;
- LCA studies which have been peer reviewed;
- Screening step (see section 5.2).

Example: Justification for exclusion of EF impact categories

EF Impact Categories Excluded	Justification
Particulate Matter/Respiratory Inorganics	Expert reviewer confirms that there are no significant impacts of Particulate Matter/Respiratory Inorganics based on the evidence provided.
Ionising Radiation	Previous sectorial studies (references) indicate no significant ionising radiation

REQUIREMENTS FOR OEF STUDIES

For an OEF study, all of the specified default EF impact categories and associated specified EF impact assessment models and indicators (see Table 2) shall be applied. Any exclusion shall be explicitly documented, justified and reported in the OEF report and supported by appropriate documents. The influence of any exclusion on the final results, especially related to limitations in terms of comparability to other OEF studies, shall be reported and discussed in the interpretation phase. Such exclusions are subject to review.

ADDITIONAL REQUIREMENTS FOR OEFSRs

The OEFSR shall specify and justify any exclusion of the default EF impact categories, especially related to aspects of comparability.

4.6 Selecting Additional Environmental Information to be Included in the OEF

Relevant potential environmental impacts of an organisation might go beyond the widely accepted life cycle-based EF impact assessment models. It is important to consider these environmental impacts whenever feasible. 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 EF impact categories beyond the default list provided in this OEF Guide, or even additional qualitative descriptions. Such additional methods are complementary to the default suite of EF impact categories. For example, a variety of developing

initiatives and schemes (such as the Global Reporting Initiative[45]) provide models for organisations to report qualitatively on their local biodiversity impacts.

Organisations which are located close to the sea might make emissions directly to marine water instead of to fresh water. As the default set of EF impact categories only include ecotoxicity due to emissions to fresh water, it is important to consider such emissions direct to marine water too as Additional Environmental Information. This shall be done at inventory level because no impact assessment model is currently available for such emissions.

In addition to the communication of absolute values for each EF impact category considered, intensity-based metrics may also be necessary. This is, for example, the case for the management of improved environmental performance as well as for making comparisons or comparative assertions. Examples of intensity-based metrics are impacts per unit of product, per employee, per gross sales and per value-added.

REQUIREMENTS FOR OEF STUDIES

If the default set of EF impact categories or the default EF impact assessment models do not properly cover the potential environmental impacts of the Organisation, all related relevant (qualitative/quantitative) environmental aspects shall be additionally included under Additional Environmental Information. Additional Environmental Information shall be reported separately from the default EF impact assessment results. These shall however not substitute the mandatory assessment models of the default EF impact categories. The supporting models of these additional categories with the corresponding indicators shall be clearly referenced and documented.

Additional Environmental Information shall be:

- Based on information that is substantiated and has been reviewed or verified (in accordance with the requirements of ISO 14020 and Clause 5 of ISO 14021:1999);
- Specific, accurate and not misleading;
- Relevant to the particular sector;
- Submitted to the review process;
- Clearly documented.

Emissions directly to marine water shall be included in the Additional Environmental Information (at inventory level).

If Additional Environmental Information is used to support the interpretation phase of an OEF study, then all data needed to produce such information shall meet the same or equivalent quality requirements established for the data used to calculate the OEF results (see section 5.6[46]).

Additional Environmental Information shall only be related to environmental issues. Information and instructions, e.g. organisation safety sheets that are unrelated to the environmental footprint of the Organisation, shall not be part of an OEF. Similarly, information related to legal requirements shall not be included.

[45] WRI and WBCSD 2011a, https://www.globalreporting.org

[46] Data Quality - Characteristics of data that relate to their ability to satisfy stated requirements (ISO 14040:2006). Data quality covers various aspects, such as technological, geographical and time-related representativeness, as well as completeness and precision of the inventory data.

ADDITIONAL REQUIREMENTS FOR OEFSRs

The OEFSR shall specify:

- Any Additional Environmental Information that shall be included in the OEF study or that is recommended to be presented as being relevant to the sector of concern. Such additional information shall be reported separately from the default EF impact assessment results (see Table 2). All models and assumptions of this Additional Environmental Information shall be supported by adequate documentation, clearly documented and submitted to the review process. Such Additional Environmental Information may include (non-exhaustive list):
    - Other relevant environmental impact categories for the sector;
    - Other relevant approaches for conducting characterisation of the flows from the Resource Use and Emissions Profile, when characterisation factors (CFs) in the default method are not available for certain flows (e.g. groups of chemicals);
    - Environmental indicators or product responsibility indicators (e.g. EMAS core indicators or the Global Reporting Initiative (GRI));
    - Life cycle energy consumption by primary energy source, separately accounting for "renewable" energy use;
    - Direct energy consumption by primary energy source, separately accounting for "renewable" energy use;
    - For gate-to-gate stages, number of IUCN Red List species and national conservation list species with habitats in areas affected by operations, by level of extinction risk;
    - Description of significant impacts of activities and products on biodiversity in protected areas and areas of high biodiversity value outside protected areas;
    - Total weight of waste by type and disposal method;
    - Weight of transported, imported, exported, or treated waste deemed hazardous under the terms of Annexes I, II, III, and VIII of the Basel Convention, and percentage of transported waste shipped internationally;
    - Information from environmental impact assessments (EIA) and chemical risk assessments.
- Justifications for inclusions/exclusions.

The OEFSRs shall furthermore define the appropriate unit for intensity-based metrics required for specific communication purposes.

4.7 Assumptions/Limitations

In OEF studies, several limitations to carrying out the analysis may occur and therefore assumptions need to be made. For example, generic data[47] that do not completely represent the reality of the Organisation may be adapted for better representation.

REQUIREMENTS FOR OEF STUDIES

All limitations and assumptions shall be transparently reported.

ADDITIONAL REQUIREMENTS FOR OEFSRs

The OEFSR shall report sector-specific limitations and define the assumptions necessary to overcome such limitations.

[47] Refers to data that are not directly collected, measured, or estimated, but rather sourced from a third-party life cycle inventory database or other source that complies with the data quality requirements of the OEF method.

5. Compiling and Recording the Resource Use and Emissions Profile (Inventory Phase)

5.1 General

An inventory (profile) of all material/energy resource inputs/outputs and emissions into air, water and soil shall be compiled as a basis for modelling the OEF. This is called the Resource Use and Emissions Profile, and is compiled in terms of the total of goods/services represented by the defined Product Portfolio of the Organisation. At the organisational level, this includes all inputs and outputs for owned and/or managed processes that contribute to the provision of the Product Portfolio within the Organisational boundary. At the analytical level, if upstream and downstream processes/flows are included in the OEF boundaries, this includes all processes/flows linked to all life-cycle stages of the Product Portfolio.

Ideally, the Organisation's activities should be described using facility- or product-specific data (i.e. modelling the exact life cycle depicting the supply chain, use, and EOL stages as appropriate). In practice, and as a general rule, for processes within the defined Organisational boundary, directly collected, facility-specific inventory data shall be used unless generic data are more representative or appropriate. For processes outside of the Organisational boundary, for which direct data access are not possible, generic data will typically be used. However, it is good practice to attempt to access directly collected data from suppliers when possible, in particular for environmentally significant processes. The use and collection requirements of specific and generic data are described in more detail in sections 5.7 and 5.8 respectively.

Generic data are data sourced from third-party life cycle inventory databases, government or industry association reports, statistical databases, peer-reviewed literature, or other sources. It is used when specific data are not available or relevant. All such data shall satisfy the quality requirements specified in this OEF Guide.

The Resource Use and Emissions Profile shall adopt the following classifications of the flows included:

- **Elementary flows,** which are (ISO 14040:2006, 3.12) "*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 are e.g. resources taken from the nature or emissions into air, water, soil that are directly linked to the characterization factors of the EF impact categories;
- **Non-elementary (or complex) flows**, which are all the remaining 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.

All non-elementary flows in the Resource Use and Emissions Profile shall be transformed into elementary flows. For example, waste flows shall not only be reported as kg of household waste or hazardous waste, but shall also include emissions into water, air and soil due to the treatment of the solid waste. This is necessary for the comparability of OEF studies. The compilation of the Resource Use and Emissions Profile is therefore completed when all flows are elementary flows.

Tip: Documenting the data collection process is useful for improving the data quality over time, preparing for critical review[48], and revising future Organisation inventories to reflect changes in Organisational activities. To ensure that all of the relevant information is documented, it may be helpful to establish a data management plan early in the inventory process (see Annex II).

The Resource Use and Emissions Profile in an OEF study may be compiled following a 2-step procedure: screening step and completing step. This is illustrated in Figure 4. The first step is not mandatory but is highly recommended.

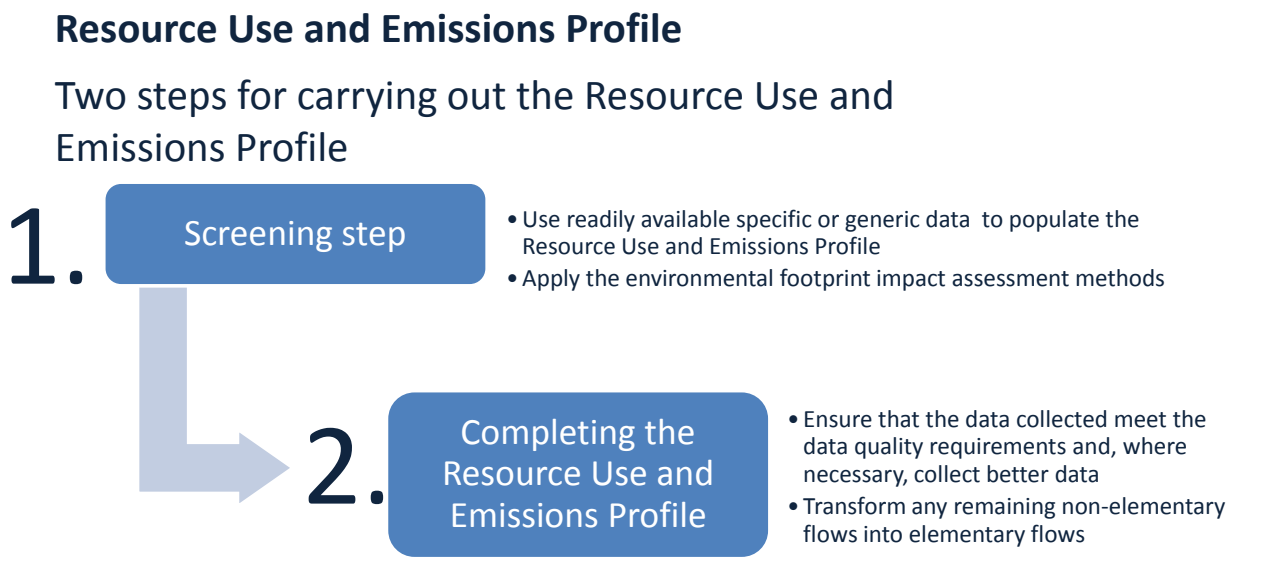

Figure 3: Two-step procedure to compile the Resource Use and Emissions Profile (the screening step is highly recommended, but not mandatory).

REQUIREMENTS FOR OEF STUDIES

All resource uses and emissions associated with the life cycle stages included in the defined system boundaries shall be included in the Resource Use and Emissions Profile. The flows shall be grouped into "elementary flows" and "non-elementary (i.e. complex) flows". All non-elementary flows in the Resource Use and Emissions Profile shall then be transformed into elementary flows.

5.2 Screening Step

An initial "screening-level" Resource Use and Emissions Profile and OEF Impact Assessment is highly recommended. This screening step helps to focus data-collection activities and data-quality priorities for completing the Resource Use and Emissions Profile.

[48] A critical review is a process intended to ensure consistency between an OEF study and the principles and requirements of this OEF guidance document and related OEFSRs (if available) (based on ISO 14040:2006).

REQUIREMENTS FOR OEF STUDIES

An initial "screening-level" Resource Use and Emissions Profile should be undertaken and is highly recommended. If a screening step is conducted, readily available specific and/or generic data shall be used fulfilling the data quality requirements as defined in section 5.6. Any exclusion of supply-chain stages shall be explicitly justified and submitted to the review process, and their influence on the final results shall be discussed.

For supply-chain stages for which a quantitative EF impact assessment is not intended (for example, the use stage of intermediate products in a cradle-to-gate OEF), the screening step shall refer to existing literature and other sources in order to develop qualitative descriptions of potentially environmentally significant processes. Such qualitative descriptions shall be included in the Additional Environmental Information.

In developing qualitative descriptions of potential environmental impacts, the following information sources should be considered:

- OEF and OEFSR-based studies of similar organisations;
- Product Environment Footprint and Product Environmental Footprint Category Rule-based studies for key products provided by the organisations;
- Previous, detailed studies of similar organisations;
- EMAS sectorial reference documents, where these exist for the sector;
- Organisation environmental reporting rules from other initiatives/ schemes;
- Environmental Impact of Products (EIPRO) and Environmental Improvement of Products (IMPRO) studies for products provided by the Organisation;
- Environmental Key Performance Indicators for sectors, as reported by DEFRA (http://archive.defra.gov.uk/environment/business/reporting/pdf/envkpi-guidelines.pdf);
- Other peer-reviewed literature.

ADDITIONAL REQUIREMENTS FOR OEFSRs

The OEFSR shall specify the processes to be included. The OEFSR shall also specify for which processes specific data are required, and for which the use of generic data is either permissible or required.

5.3 Data Management Plan (Optional)

While not required in the context of the OEF, a data management plan may be a valuable tool for managing data and for tracking the compilation of the Resource Use and Emissions Profile.

The data management plan can include:

- A description of data collection procedures for:
  - Processes/activities within the defined Organisational boundaries;
  - Processes/activities outside (upstream or downstream) the defined Organisational boundaries but within the OEF boundaries;
- Data sources;
- Calculation methodologies;

- Data transmission, storage and backup procedures;
- Quality control and review procedures for data collection, input and handling activities, data documentation and emissions calculations.

For additional guidance on possible approaches to formulating a data management plan, see Annex II.

5.4 Resource Use and Emissions Profile Data

REQUIREMENTS FOR OEF STUDIES

The Resource Use and Emissions Profile shall be the documented input and output flows associated with all activities and processes of all life cycle stages within the defined OEF boundaries.

The following elements shall be considered for inclusion in the Resource Use and Emissions Profile[49]:

- Direct activities and impacts of sources owned and/or operated by the Organisation;
- Indirectly attributable upstream activities;
- Indirectly attributable downstream activities.

Linear depreciation shall be used for the capital equipment.

ADDITIONAL REQUIREMENTS FOR OEFSRs

The OEFSR shall further specify sources, quality and review requirements for the data used in an OEF study.

The OEFSR should provide one or more examples for compiling the Resource Use and Emissions Profile, including specifications with respect to:

- Substance lists for activities/processes included;
- Units;
- Nomenclature for elementary flows.

These may apply to one or more supply-chain stages, processes or activities, for the purpose of ensuring standardised data collection and reporting. The OEFSR may specify more stringent data requirements for key upstream, gate-to-gate or downstream stages than those defined in this OEF Guide.

For modelling processes/activities within the defined Organisational boundary (i.e. gate-to-gate stage), the OEFSR shall also specify:

- Processes/activities included;
- Specifications for compiling data for key processes, including averaging data across facilities;
- Any site-specific data required for reporting as “Additional Environmental Information”;
- Specific data-quality requirements, e.g. for measuring specific activity data.

If the OEFSR requires/allows deviations from the default cradle-to-grave system boundary (e.g. if the OEFSR prescribes using a cradle-to-gate boundary), the OEFSR shall specify how material/energy balances in the Resource Use and Emissions Profile shall be accounted for.

[49] This section builds upon the Greenhouse Gas Protocol - A Corporate Accounting and Reporting Standard, chapter 4 (WRI and WBCSD 2004) and the Greenhouse Gas Protocol - Corporate Value Chain (Scope 3) Accounting and Reporting Standard, chapter 5 (WRI and WBCSD 2011a).

5.4.1 Direct Activities and Impacts

The direct impacts are impacts from sources that are owned and/or operated by the Organisation, i.e. from site-level activities, such as:

- Capital equipment when built/produced by the Organisation (e.g. machinery used in production processes, buildings, office equipment, transport vehicles, transportation infrastructure). Linear depreciation shall be applied for capital equipment;
- 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[50] (e.g. Hydrofluorocarbon (HFC) emissions during the use of air-conditioning equipment);
- Other site-specific activities.

5.4.2 Indirectly Attributable Upstream Activities

The indirect impacts of upstream activities refer to the use of materials, energy and emissions associated with goods/services sourced from upstream of the Organisational boundary in support of producing the Product Portfolio. These are resources and emissions from activities such as:

- Extraction of raw materials needed for the production of the Product Portfolio;
- Extraction, production and transportation of purchased[51] capital equipment (e.g. machinery used in production processes buildings, office equipment, transport vehicles, transportation infrastructure). Linear depreciation shall be applied for capital equipment;
- Extraction, production and transportation of purchased electricity, steam and heating/cooling energy;
- Extraction, production and transportation of purchased materials, fuels, goods and services;
- Generation of electricity consumed by upstream activities;
- Disposal and treatment of waste generated by upstream activities;

[50] Releases are emissions to air and discharges to water and soil. (ISO 14040:2006)

[51] Purchased is defined as purchased or otherwise brought into the Organisational boundary of the reporting company, including leased assets.

- 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);
- Any other upstream process/activity.

5.4.3 Indirectly Attributable Downstream Activities

The indirect impacts of downstream activities refer to the use of materials, energy and emissions associated with goods/services occurring downstream of the Organisational boundary in relation to the Product Portfolio. These are resources and emissions from activities such as:

- Transportation and distribution of goods/services provided to the client, where means of transport are not owned and/or operated by the Organisation;
- Processing of goods/services provided;
- Use of goods/services provided (see section 5.4.6 for more detailed specifications);
- EOL treatment of goods/services provided (see section 5.4.7 for more detailed specifications);
- Any other downstream process/activity.

5.4.4 Additional Resource Use and Emissions Profile Requirements

Accounting for Electricity Use (Including Use of Renewable Energy)

The electricity use from the grid consumed upstream or within the defined Organisational boundary 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.

REQUIREMENTS FOR OEF STUDIES

For electricity from the grid consumed upstream or within the defined Organisational boundary, supplier-specific data shall be used if available. If supplier-specific data is not available, country-specific consumption-mix data shall be used of the country in which the life cycle stages occur. For electricity consumed during the use stage of products, the energy mix shall reflect ratios of sales between countries or regions. Where such data are not available, the average EU consumption mix, or otherwise most representative mix, shall be used.

For renewable electricity from the grid consumed upstream or within the defined Organisational boundary, it shall be guaranteed that the renewable electricity (and associated impacts) is not double counted. A statement of the supplier shall be included as an annex to the OEF report, guaranteeing that the electricity supplied is effectively generated using renewable sources and is not sold to any other organisation, for example, by providing a Guarantee of Origin for production of renewable electricity[52].

[52] European Union 2009: Directive 2009/28/EC of the European Parliament and Council of 23 April 2009 on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC, Official Journal of the European Union.

Accounting for Renewable Energy Generation

Some organisations may produce energy from renewable sources in excess of the amount consumed. If excess renewable energy produced within the defined Organisational boundary is provided to a third party (e.g. put into the electricity grid), it may only be credited to the Organisation if the credit has not already been taken into account in other schemes. Documentation (e.g. Guarantee of Origin for production of renewable electricity[52]) is required to explain whether or not the credit is considered in the calculation.

REQUIREMENTS FOR OEF STUDIES

Credits associated with renewable energy generated by the Organisation shall be calculated with respect to the corrected (i.e. by subtracting the externally provided amount of renewable energy) average country-specific consumption-mix data of the country to which the electricity is provided. Where such data is not available, the corrected average EU consumption mix, or otherwise most representative mix shall be used. If no data are available on the calculation of corrected mixes, the uncorrected average mixes shall be used. It shall be transparently reported which energy mixes are assumed for the calculation of the benefits and whether or not these have been corrected.

Accounting for Temporary (Carbon) Storage and Delayed Emissions

REQUIREMENTS FOR OEF STUDIES

Credits associated with temporary (carbon) storage or delayed emissions shall not be considered in the calculation of the default EF impact categories. However, these may be included as "Additional Environmental Information". Moreover, these shall be reported as "Additional Environmental Information" if required by the OEFSRs.

Biogenic Carbon Removals and Emissions

Carbon is, for example, removed from the atmosphere due to the growth of wood (CF[53] of -1 CO_2 eq. for global warming), while it is released during the burning of wood (CF of +1 CO_2 eq. for global warming).

REQUIREMENTS FOR OEF STUDIES

Removals and emissions for biogenic carbon sources shall be identified separately in the Resource Use and Emissions Profile. [54]

Direct Land Use Change (Impact on Climate Change): the impact of land use change on climate change results basically from a change in carbon stocks in land. Direct Land Use Change occurs as the results of a transformation from one land use type into another, which takes place in a unique land cover, possibly incurring changes in the carbon stock of that specific land, but not leading to a change in another system. For details, see Annex VI.

[53] A characterisation factor (CF) is a factor derived from a characterisation model which is applied to convert an assigned Resource Use and Emissions Profile result to the common unit of the EF category indicator (based on ISO 14040:2006).

[54] A separate inventory of emissions/removals of biogenic carbon sources implies that the following CFs (see section 6.1.2) shall be assigned for the environmental footprint impact category Climate Change: "-1" for removals of a carbon dioxide biogenic substance; "+1" for emissions of a carbon dioxide biogenic substance; "+25" for methane emissions.

Indirect Land Use Change (Impact on Climate Change): the impact of land use change on climate change results basically from a change in carbon stocks in land. Indirect Land Use Change occurs when a certain change in land use induces changes outside the OEF boundaries, i.e. in other land use types.

REQUIREMENTS FOR OEF STUDIES

Greenhouse gas emissions from direct land use change shall be allocated to goods/services for 20 years following the land use change using the IPCC default values. For details see Annex VI. Greenhouse gas emissions from indirect land use change shall not be included.

5.4.5 Modelling Transport Scenarios

The modelling of transport across the life cycle of the products provided by the Organisation requires that scenarios be defined. The following parameters shall/should (case specific, see below) be taken into account:

1. **Transport mode:** the mode of transport shall be taken into account, e.g. by land (truck, rail, pipe), by water (boat, ferry, barge), or air (airplane);

2. **Vehicle type and fuel consumption:** the type of vehicle and the fuel consumption when fully loaded and empty shall be taken into account. An adjustment shall be applied to the consumption of a fully-loaded vehicle according to the load rate (example see below);

3. **Load rate[55]:** environmental impacts are directly linked to the actual load rate, therefore the load rate shall be considered.

4. **Number of empty returns**: the number of empty returns should be taken into account when applicable, 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. The kilometres travelled by the empty vehicle should also be allocated to the considered product. Specific values shall be developed by country and by type of transported product.

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

6. **Allocation[56] of impacts from transport:** where multiple goods are transported, it may be necessary to allocate a share of the transportation impacts to the Organisation based on the load-limiting factor. The following requirements apply:[57]
   - Goods transport: time or distance AND mass or volume (or in specific cases: pieces/pallets) of the transported good

     a) If the maximum authorised weight is reached before the vehicle has reached its maximum physical load: at 100% of its volume (high-density products), allocation shall be based on the mass of the transported products;

[55] The load rate is the ratio or capacity (i.e. mass or volume) that a vehicle carries per trip.

[56] Allocation is an approach to solving multi-functionality problems. It refers to partitioning the input flows of a process, a product system or facility between the system under study and one or more other systems (based on ISO 14040:2006).

[57] For more information on the consideration of transport-related aspects, see the International Reference Life Cycle Data System (ILCD) Handbook: General Guide for Life Cycle Assessment – detailed guidance, section 7.9.3.

b) If the vehicle is loaded at 100% of the volume but it does not reach the authorised maximum weight (low-density products), allocation shall be based on the volume of the transported products;

- Personal transport: time or distance;
- Staff business travel: time, distance or costs.

7. **Fuel production**: fuel production shall be taken into account. Default values for fuel production can be found e.g. in the European Reference Life Cycle Database (ELCD)[58];

8. **Infrastructure:** transport infrastructure, in particular for road, rail and boat transport, should be taken into account.

9. **Resources and tools:** the amount and type of additional resources and tools needed for logistic operations such as cranes and transporters should be taken into account.

REQUIREMENTS FOR OEF STUDIES

Transport parameters that shall be taken into account are: transport type, vehicle type and fuel consumption, load rate, number of empty returns when applicable and relevant, transport distance, allocation for goods transport based on load-limiting factor (i.e. mass for high-density products and volume for low-density products) and fuel production.

Transport parameters that should be taken into account are: transport infrastructure, additional resources and tools such as cranes and transporters, allocation for personal transport based on time or distance, allocation for business travel by staff based on time or distance or economic value.

The impacts due to transport shall be expressed in the default reference units, i.e. tkm for goods and person-km for passenger transport. Any deviation from these default reference units shall be reported and justified.

The environmental impact due to transport shall be calculated by multiplying the impact per reference unit for each of the vehicle types by a) for goods: the distance and load and b) for persons: the distance and number of persons based on the defined transport scenarios.

ADDITIONAL REQUIREMENTS FOR OEFSRs

The OEFSRs shall specify transport, distribution and storage scenarios to be included in the OEF study, if any.

5.4.6 Modelling Scenarios for the Use Stage

The use stage of the goods/services included in the Product Portfolio of the Organisation begins when the consumer or end user takes possession of the product and ends when the used product is discarded for transport to a recycling or waste-treatment facility. Use scenarios need to be defined. These should take into account published technical information, including:

[58] http://lca.jrc.ec.europa.eu/lcainfohub/datasetArea.vm

- Published international standards that specify guidance and requirements for the development of scenarios and service life for the use stage for the product being assessed;
- Published national guidelines that specify guidance for the development of scenarios and service life for the use stage for the product being assessed;
- Published industry guidelines that specify guidance for the development of scenarios and service life for the use stage for the product being assessed;
- Market surveys or other market data.

The use scenario also needs to reflect whether or not the use of analysed products might lead to changes in the systems in which they are used. For example, energy-using products might affect the energy needed for heating/cooling in a building, or the weight of a car battery might affect the fuel consumption of the car.

NOTE: 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) might 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 available.

REQUIREMENTS FOR OEF STUDIES

If downstream stages are to be included in the OEF, then use profiles (i.e. the related scenarios and assumed service life) shall be specified for representative goods/services for the sector. All relevant assumptions for the use stage shall be documented. Where no method for determining the use stage of products has been established in accordance with the techniques specified in this OEF Guide, the approach taken in determining the use stage of products shall be established by the Organisation carrying out the study. Documentation of methods and assumptions shall be provided. Relevant influences on other systems due to the use of the products shall be included.

ADDITIONAL REQUIREMENTS FOR OEFSRs

The OEFSR shall specify:

- The use scenario(s) to be included in the study, if any;
- The time span to be considered for the use stage.

Published technical information should be taken into account for the definition of the use-stage scenarios. Definition of the use profile should also take into account use/consumption patterns, location, time (day/night, summer/winter, week/weekend), and assumed service life for the use stage of products. The actual usage pattern of the products should be used if available.

5.4.7 Modelling End-of-Life Scenarios[59]

The EOL stage of the products included in the Product Portfolio of the Organisation begins when the used products are discarded by the user and ends when the products are returned to nature as a waste or enter other products' life cycles (i.e. as a recycled input). Examples of EOL processes that shall be included in the OEF study are:

[59] This section builds upon the Greenhouse Gas Protocol Product Life Cycle Accounting and Reporting Standard, 2011 – Section 7.3.1.

- Collection and transport of EOL products and packages;
- Dismantling of components from EOL products;
- Shredding and sorting;
- Conversion into recycled material;
- Avoided production due to recycling or reuse;
- Composting or other organic waste treatment methods;
- Littering;
- Incineration and disposal of bottom ash;
- Landfilling and landfill operation and maintenance;
- Transport required to EOL treatment facilities.

As there is often no information on exactly what will happen at the EOL of a product, EOL scenarios are to be defined.

REQUIREMENTS FOR OEF STUDIES

Waste flows arising from processes included in the system boundaries shall be modelled to the level of elementary flows.

ADDITIONAL REQUIREMENTS FOR OEFSRs

The OEFSR shall define the EOL scenario(s) to be included in the OEF study, if any. These scenarios shall be based on current (year of analysed time interval) practice, technology and data.

5.5 Nomenclature for the Resource Use and Emissions Profile

Using considerably different nomenclature and other conventions make Resource Use and Emissions Profiles incompatible on different levels, thereby strongly limiting the combined use of Resource Use and Emissions Profiles datasets from different sources or an efficient, electronic exchange of data among practitioners. This also hampers a clear unambiguous understanding and review of OEF reports. It is therefore important to use the same nomenclature in all OEF studies.

REQUIREMENTS FOR OEF STUDIES

All resource use and emissions associated with the life cycle stages included in the defined system boundaries shall be documented using the International Life Cycle Data System (ILCD) nomenclature and properties[60]. (Annex IV details the ILCD nomenclature rules and properties).

If nomenclature and properties for a given flow are not available in the ILCD, the practitioner shall create an appropriate nomenclature and document the flow properties.

[60] European Commission - Joint Research Centre - Institute for Environment and Sustainability (2010f). International Reference Life Cycle Data System (ILCD) Handbook –Nomenclature and other conventions. First edition. EUR 24384. Luxembourg Publications Office of the European Union. http://lct.jrc.ec.europa.eu/assessment/publications

5.6 Data Quality Requirements

Data quality indicators address how well the data fit the given process/activity in the Resource Use and Emissions Profile. This section describes the data quality requirements and how the data quality shall be assessed. Six quality criteria are adopted for OEF studies, of which five relate to the data and one to the method. These are summarised in

Table 3. Besides these criteria, three more aspects are included in the quality assessment, i.e. documentation (compliance with ILCD format), compliance with ILCD nomenclature, and review. The latter three are not included within the semi-quantitative assessment of the data quality as described in the subsequent paragraphs. These however shall be fulfilled.

Table 3: Data quality criteria, documentation, nomenclature and review

Data	• Technological representativeness61 • Geographical representativeness62 • Time-related representativeness63 • Completeness • Parameter uncertainty64
Method	• Methodological Appropriateness and Consistency[65] (The requirements as defined in Table 6 shall apply until end of 2015. From 2016 onwards, full compliance with the OEF methodology will be required.)
Documentation	• Compliant with ILCD format
Nomenclature	• Compliant with ILCD nomenclature document (e.g. use of ILCD reference elementary flows for IT-compatible inventories)
Review	• Review by a "qualified reviewer" (see chapter 9) • Separate review report

[61] "Technological representativeness" is used throughout this Guide instead of the term "technological coverage" used in ISO 14044.
[62] "Geographical representativeness" is used throughout this Guide instead of the term "geographical coverage" used in ISO 14044.
[63] "Time-related representativeness" is used throughout this Guide instead of the term "time-related coverage" used in ISO 14044.
[64] "Parameter uncertainty" is used throughout this Guide instead of the term "precision" used in ISO 14044.
[65] "Methodological Appropriateness and Consistency" is used throughout this Guide instead of the term "consistency" used in ISO 14044.

Table 4: Overview of requirements for data quality and the assessment of data quality

	Minimum data quality required	**Type of required data quality assessment**
Data covering at least 70% of contributions to each EF impact category	Overall "Good" data quality (DQR $\leq$ 3.0)	Semi-quantitative based on **Table 6.**
Data accounting for the subsequent 20% (i.e. from 70% to 90%) of contributions to each EF impact category	Overall "Fair" data quality	Qualitative expert judgement (**Table 6** can be used to support the expert judgement). No quantification required.
Data used for approximation and filling identified gaps (beyond 90% contribution to each EF impact category	Best available information	Qualitative expert judgement (**Table 6** can be used to support the expert judgement).

Semi-quantitative assessment of data quality

The following tables (**Table 5** and **Table 6**) and equation (**Formula 1**) describe the criteria to be used for a semi-quantitative assessment of data quality.

Table 5: Criteria for the semi-quantitative assessment of the data quality of the Life Cycle Inventory data used in the OEF study, based on EC–JRC–IE 2010d

Quality level	Quality rating (DQR)	Definition	Completeness	Methodological appropriateness and consistency	Time-related representativeness	Technological representativeness	Geographical representativeness	Parameter uncertainty
			To be judged with respect to the coverage of each environmental impact category and in comparison to a hypothetical ideal data quality.	The applied Life Cycle Inventory (LCI) methods[66] and methodological choices (e.g. allocation, substitution, etc.) are in line with the goal and scope, especially with the intended applications as support to decisions. The methods have been consistently applied across all data.[67]	Degree to which the dataset reflects the specific conditions of the system being considered regarding the time / age of the data and including background[68] process datasets, if any. Comment: i.e. of the given year (and - if applicable – of annual or daily differences).	Degree to which the dataset reflects the true population of interest regarding technology, including for included background process datasets, if any. Comment: i.e. of the technological characteristics including operating conditions.	Degree to which the dataset reflects the true population of interest regarding geography, including for included background process datasets, if any. Comment: i.e. of the given location / site, region, country, market, continent, etc.	Qualitative expert judgement or relative standard deviation as a % if a Monte Carlo simulation is used. Comment: The uncertainty assessment is only related to the Resource Use and Emissions Profile data, it does not cover the EF impact assessment.
Very good	1	Meets the criterion to a very high degree, without need for improvement.	Very good completeness (≥ 90 %)	Full compliance with all requirements of the OEF Guide	Case-specific[69]	Case-specific	Case-specific	**Very low uncertainty (≤ 10 %)**

[66] According to the OEF terms, the life cycle inventory equals the Resource Use and Emissions Profile.

[67] This requirement shall apply until the end of 2015. From 2016 onwards, full compliance with the OEF methodology will be required and can then be assumed to be of very good quality in order to calculate the DQR in formula 1 (i.e., M = 1).

[68] Refers to those processes of the organisation's supply chain for which no direct access to information is possible. For example, most of the upstream supply-chain processes and generally all processes further downstream will be considered part of the background system.

[69] Case specific means that the representativeness of data can differ depending on the organization. The OEFSR shall define the criteria for representativeness.

Quality level	Quality rating (DQR)	Definition	Completeness	Methodological appropriateness and consistency	Time-related representativeness	Technological representativeness	Geographical representativeness	Parameter uncertainty
Good	2	Meets the criterion to a high degree, with little significant need for improvement.	Good completeness ([80 % to 90 %)	Attributional[70] Process based approach AND: Following three method requirements of the OEF Guide met: • Dealing with multi-functionality; • EOL modelling; • System boundary.	Case-specific	Case-specific	Case-specific	**Low uncertainty (10 % to 20 %]**
Fair	3	Meets the criterion to an acceptable degree, but merits improvement.	Fair completeness ([70 % to 80 %)	Attributional Process based approach AND: Two of the following three method requirements of the OEF Guide met: • Dealing with multi-functionality; • EOL modelling; • System boundary.	Case-specific	Case-specific	Case-specific	**Fair uncertainty (20 % to 30 %]**
Poor	4	Does not meet the criterion to a sufficient	Poor completeness ([50 % to 70 %)	Attributional Process based approach AND:	Case-specific	Case-specific	Case-specific	**High uncertainty (30 % to 50 %]**

[70] Attributional - refers to process-based modelling intended to provide a static representation of average conditions.

Quality level	Quality rating (DQR)	Definition	Completeness	Methodological appropriateness and consistency	Time-related representativeness	Technological representativeness	Geographical representativeness	Parameter uncertainty
		degree, but rather requires improvement.		One of the following three method requirements of the OEF Guide met: • Dealing with multi-functionality; • EOL modelling; • System boundary.				
Very poor	5	Does not meet the criterion. Substantial improvement is necessary OR: This criterion was not judged / reviewed or its quality could not be verified / is unknown.	Very poor or unknown completeness (< 50 %)	Attributional Process based approach BUT: None of the following three method requirements of the OEF Guide met: • Dealing with multi-functionality; • EOL modelling; • System boundary.				**Very high uncertainty (> 50 %)**

The overall data quality shall be calculated by summing up the achieved quality rating (DQR) – as determined according to table 6 - for each of the quality criteria, divided by the total number of criteria (i.e. 6). Formula 1 provides the calculation provision (European Commission – JRC – IES 2010d, page 109). The Data Quality Rating (DQR) result is used to identify the corresponding quality level in **Table 6**.

Formula 1 $$DQR = \frac{TeR + GR + TiR + C + P + M}{6}$$

- *DQR* : *Data Quality Rating of the dataset*;
- *TeR: Technological Representativeness;*
- *GR: Geographical Representativeness;*
- *TiR: Time-related Representativeness;*
- *C: Completeness;*
- *P: Parameter uncertainty;*
- *M: Methodological Appropriateness and Consistency.*

Table 6: Overall data quality level according to the achieved data quality rating

Overall data quality rating (DQR)	**Overall data quality level**
≤ 1.6	“Excellent quality”
>1.6 to≤ 2.0	"Very good quality"
>2.0 to ≤3.0[71]	“Good quality”
>3 to ≤4.0	"Fair quality"
>4	“Poor quality”

[71] This means that not all data in the set shall achieve a ranking of “good quality" for the dataset to achieve an overall “good quality” rating. Rather, two may be ranked as "fair". If more than two are ranked as “fair” or one is ranked as “poor” and one as “fair”, the overall data quality of the dataset is downgraded to the next quality class, “fair”.

Table 7: Example of semi-quantitative assessment of data quality required for key Life Cycle Inventory datasets.

Process: dyeing process.

Quality level	Quality rating	Definition	Completeness	Methodological appropriateness and consistency	Time-related representativeness	Technological representativeness	Geographical representativeness	Parameter uncertainty
Very good	1	Meets the criterion to a very high degree, without need for improvement.	Very good completeness (≥ 90 %)	Full compliance with all requirements of the OEF Guide	2009-2012	Discontinuous with airflow dyeing machines	Central Europe mix	Very low uncertainty (≤ 10 %)
Good	2	Meets the criterion to a high degree, with little significant need for improvement.	Good completeness ([80 % to 90 %)	Attributional Process based approach AND: Following three method requirements of the OEF Guide met: • Dealing with multi-functionality; • EOL modelling; • System boundary.	2006-2008	e.g. "Consumption mix in EU: 30% Semi-continuous, 50% exhaust dyeing and 20% Continuous dyeing"	EU 27 mix; UK, DE; IT; FR	Low uncertainty (10 % to 20 %]
Fair	3	Meets the criterion to an acceptable degree, but merits improvement.	Fair completeness ([70 % to 80 %)	Attributional Process based approach AND: The following two method requirements of the OEF Guide met: • Dealing with multi-functionality; • EOL modelling. However, the following one method requirement of the	1999-2005	e.g. "Production mix in EU: 35% Semi-continuous, 40% exhaust dyeing and 25% Continuous dyeing"	Scandinavian Europe; other EU-27 countries	Fair uncertainty (20 % to 30 %]

Quality level	Quality rating	Definition	Completeness	Methodological appropriateness and consistency	Time-related representativeness	Technological representativeness	Geographical representativeness	Parameter uncertainty
				OEF Guide is not met: • System boundary				
Poor	4	Does not meet the criterion to a sufficient degree, but rather requires improvement.	Poor completeness ([50 % to 70 %)	Attributional Process based approach AND: The following one method requirement of the OEF Guide met: • Dealing with multi-functionality However, the following two method requirements of the OEF Guide are not met: • EOL modelling; • System boundary.	1990-1999	e.g. "Exhaust dyeing"	Middle east; US; JP	High uncertainty (30 % to 50 %]
Very poor	5	Does not meet the criterion. Substantial improvement is necessary OR: This criterion was not judged / reviewed or its quality could not be verified / is unknown.	Very poor or unknown completeness (< 50 %)	Attributional Process based approach BUT: None of the following three method requirements of the OEF Guide met: • Dealing with multi-functionality; • EOL modelling; • System boundary.	<1990; Unknown	Continuous dyeing; other; unknown	Other; Unknown	Very high uncertainty (> 50 %)

REQUIREMENTS FOR OEF STUDIES

Data quality requirements shall be met by an OEF study intended for external communication. For OEF studies (claiming to be in line with this OEF Guide) intended for in-house applications, the specified data quality requirements should be met (i.e., are recommended), but are not mandatory. Any deviations from the requirements shall be documented. Data quality requirements apply to both specific data and generic data.

The following 6 criteria shall be adopted for semi-quantitative assessment of data quality in OEF studies: technological representativeness, geographical representativeness, time-related representativeness, completeness, parameter uncertainty, methodological appropriateness and completeness.

In the optional screening step (if conducted) a minimum "fair" quality data rating is required for data contributing to at least 90% of the impact estimated for each EF impact category, as assessed via qualitative expert judgement.

In the final Resource Use and Emissions Profile, for the processes and/or activities accounting for at least 70% of contributions to each EF impact category, both specific and generic data shall achieve at least an overall "good quality" level[72]. A semi-quantitative assessment of data quality shall be performed and reported for these processes. At least 2/3 of the remaining 30% (i.e. 70% to 90%) shall be modelled with at least "fair quality" data, as assessed via qualitative expert judgement. Remaining data (used for approximation and filling identified gaps (beyond 90% contribution to environmental impacts)) shall be based on best available information. This is summarised in Table 4.

The data quality requirements for technological, geographical and time related representativeness shall be subject to review as part of the OEF study. The data quality requirements related to completeness, methodological appropriateness & consistency, and parameter uncertainty shall be met by sourcing generic data exclusively from data sources complying with the requirements of this OEF Guide.

With respect to the data quality criterion "methodological appropriateness and consistency", the requirements as defined in Table 6 shall apply until end 2015. From 2016 onwards, full compliance with the OEF methodology will be required.

With respect to the level at which assessment of data quality shall be conducted:

- For generic data: data quality shall be conducted at the level of the input flows, e.g. purchased paper used in a printing office;
- For specific data: data quality shall be conducted at the level of an individual process or aggregated processes, or at the level of individual input flows.

ADDITIONAL REQUIREMENTS FOR OEFSRs

The OEFSR shall provide further guidance on data quality assessment scoring with respect to time-related, geographical and technological representativeness. The OEFSR shall for example specify which data quality score related to time representativeness should be assigned to a dataset representing a given year.

[72] The 70% threshold is chosen to balance the goal of achieving a robust assessment with the need to keep it feasible and accessible.

The OEFSR may specify additional criteria for the assessment of data quality (compared to the default criteria).

The OEFSR may specify more stringent data quality requirements regarding e.g.:

- Foreground processes[73];
- Background processes (both upstream and downstream stages);
- Key supply chain processes/activities for the sector;
- Key EF impact categories for the sector.

Example for determining the data quality rating

Component	Achieved quality level	Corresponding quality rating
Technological representativeness (TeR)	good	2
Geographical representativeness (GR)	good	2
Time-related representativeness (TiR)	fair	3
Completeness (C)	good	2
Parameter uncertainty (P)	good	2
Methodological appropriateness and consistency (M)	good	2

$$DQR = \frac{TeR + GR + TiR + C + P + M}{6} = \frac{2+2+3+2+2+2}{6} = 2.2$$

DQR = 2.2 corresponds to an overall “good quality”.

5.7 Specific Data Collection

Specific data are data directly measured or collected representative of activities at a specific facility or set of facilities. The data should include all known inputs and outputs for the processes. Inputs are (for example) use of energy, water, materials, etc. Outputs are the products, co-products, emissions and waste. Emissions can be divided into three categories: emissions to air, to water and to soil. Specific data can be collected, measured or calculated using activity data and related emission factors. It should be noted that emission factors may be derived from generic data subject to the data quality requirements.

Data Collection - Measurements and Tailored Questionnaires

The most representative sources of data for specific processes are measurements directly performed on the process, or obtained from facility operators via interviews or questionnaires. The data may need scaling, aggregation or other forms of mathematical treatment to bring them in relation to the Product Portfolio.

[73] Foreground processes refer to those processes of the Organisation life cycle for which direct access to information is available. For example, the producer’s site and other processes operated by the organisation or contractors (e.g. goods transport, head-office services, etc.) belong to the foreground system.

Typical specific data sources include:

- Process or plant level consumption data;
- Bills and stock/inventory-changes of consumables;
- Emission declared/reported to authorities for legal purposes such as permits or fulfilling reporting requirements like according to the European Pollutant Release and Transfer Register (E-PRTR), or the predecessor European Pollutant Emission Register (EPER);
- Emission measurements (concentrations plus corresponding off-gas and wastewater amounts);
- Composition of waste and products;
- Procurement and sale department(s)/unit(s).

REQUIREMENTS FOR OEF STUDIES

Specific data[74] shall be obtained for all processes/activities within the defined Organisational boundary and for background processes/activities where appropriate[75]. However, if generic data are more representative or appropriate than specific data (to be reported and justified) for foreground processes, generic data shall also be used for the foreground processes.

ADDITIONAL REQUIREMENTS FOR OEFSRs

The OEFSR shall:

1. Specify for which processes specific data shall be collected;
2. Specify the requirements for the collection of specific data for each process/activity;
3. Define the data collection requirements for the following aspects for each site:
   - Target stage(s) and the data collection coverage;
   - Location of data collection (e.g. domestically, internationally, representative factories);
   - Term of data collection (e.g. year, season, month, etc.);
   - When the location or term of data collection shall be limited to a certain range, provide a justification and show that the collected data will serve as sufficient samples.

Note: The basic rule is that the location of data collection is all target areas and the term of data collection is one year or more.

5.8 Generic data collection

Generic data refer to data that are not based on direct measurements or calculation for the respective specific process(es). Generic data can be either sector-specific, i.e. specific to the sector being considered for the OEF study, or multi-sector. Examples of generic data include:

- Data from literature or scientific papers;
- Industry-average life cycle data from life cycle inventory databases, industry association reports, government statistics, etc.

[74] Including average data representing multiple sites. Average data refer to production weighted average of specific data.

[75] A definition of “foreground” and “background” processes is provided in the Glossary section.

Sourcing generic data

To ensure comparability, generic data shall fulfil the data quality requirements specified in this OEF Guide. Generic data should where available be sourced from the data sources specified in this OEF Guide (see below).

Remaining generic data should preferentially be sourced from:

- Databases provided by international governmental organisations (for example IEA, FAO, UNEP);
- National governmental LCI database projects (for data specific to the database host country);
- National governmental LCI database projects;
- Other third-party LCI databases;
- Peer-reviewed literature.

Potential sources of generic data can be found in e.g. the Resource Directory of the European Platform on LCA.[76] If the necessary data cannot be found in the above listed sources, other sources may be used.

REQUIREMENTS FOR OEF STUDIES

Generic data should be used only for processes and activities outside the defined Organisational boundary or for providing emission factors for activity data describing foreground processes. Moreover, for those processes and activities within the Organisational boundaries which are better represented by generic data, generic data shall be used (see previous requirement). When available, sector-specific generic data shall be used instead of multi-sector generic data. All generic data shall fulfil the data quality requirements specified in this OEF Guide. The sources of the data used shall be clearly documented and reported in the OEF report.

Generic data (provided they fulfil the data quality requirements specified in this OEF Guide) should, where available, be sourced from:

- Data developed in line with the requirements for the relevant OEFSRs;
- Data developed in line with the requirements for OEF studies;
- Data developed in line with the requirements for Product Environmental Footprint studies;
- International Reference Life Cycle Data System (ILCD) Data Network (giving preference to "ILCD-compliance" over "ILCD Data Network – entry level" datasets) [77];
- European Reference Life Cycle Database (ELCD)[77].

ADDITIONAL REQUIREMENTS FOR OEFSRs

The OEFSR shall specify:

- Where the use of generic data is permitted as an approximation for a substance for which specific data are not available;
- The level of required similarities between the actual substance and the generic substance;
- The combination of more than one generic dataset, if necessary.

5.9 Dealing with Remaining Data Gaps / Missing Data

Data gaps exist when there is no specific or generic data available that is sufficiently representative of the process/activity in question. For most processes/activities where data are missing, it should be possible to

[76] http://lca.jrc.ec.europa.eu/lcainfohub/datasetArea.vm
[77] http://lct.jrc.ec.europa.eu/assessment/data

obtain sufficient information to provide a reasonable estimate of the missing data. Therefore, there should be few, if any, data gaps in the final Resource Use and Emissions Profile. Missing information can be of different types and have different characteristics, each requiring separate approaches to resolve.

Data gaps may exist when:

- Data do not exist for a specific input/output, or
- Data exist for a similar process but:
    - The data have been generated in a different region;
    - The data have been generated using a different technology;
    - The data have been generated in a different time period.

REQUIREMENTS FOR OEF STUDIES

Any data gaps shall be filled using best available generic or extrapolated data[78]. The contribution of such data (including gaps in generic data) shall not account for more than 10% of the overall contribution to each EF impact category considered. This is reflected in the data quality requirements, according to which 10% of the data can be chosen from the best available data (without any further data quality requirements).

ADDITIONAL REQUIREMENTS FOR OEFSRs

The OEFSR shall address potential data gaps and provide detailed guidance for filling these gaps.

5.10 Data Gathering Related to the Next Methodological Phases in an Organisation Environmental Footprint Study.

Figure 4 focuses on the data collection step to be taken when developing an OEF study. The "shall/should/may" requirements are summarised for both specific and generic data. The figure moreover indicates the link between the data collection step and the development of the Resource Use and Emissions Profile and subsequent EF impact assessment.

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

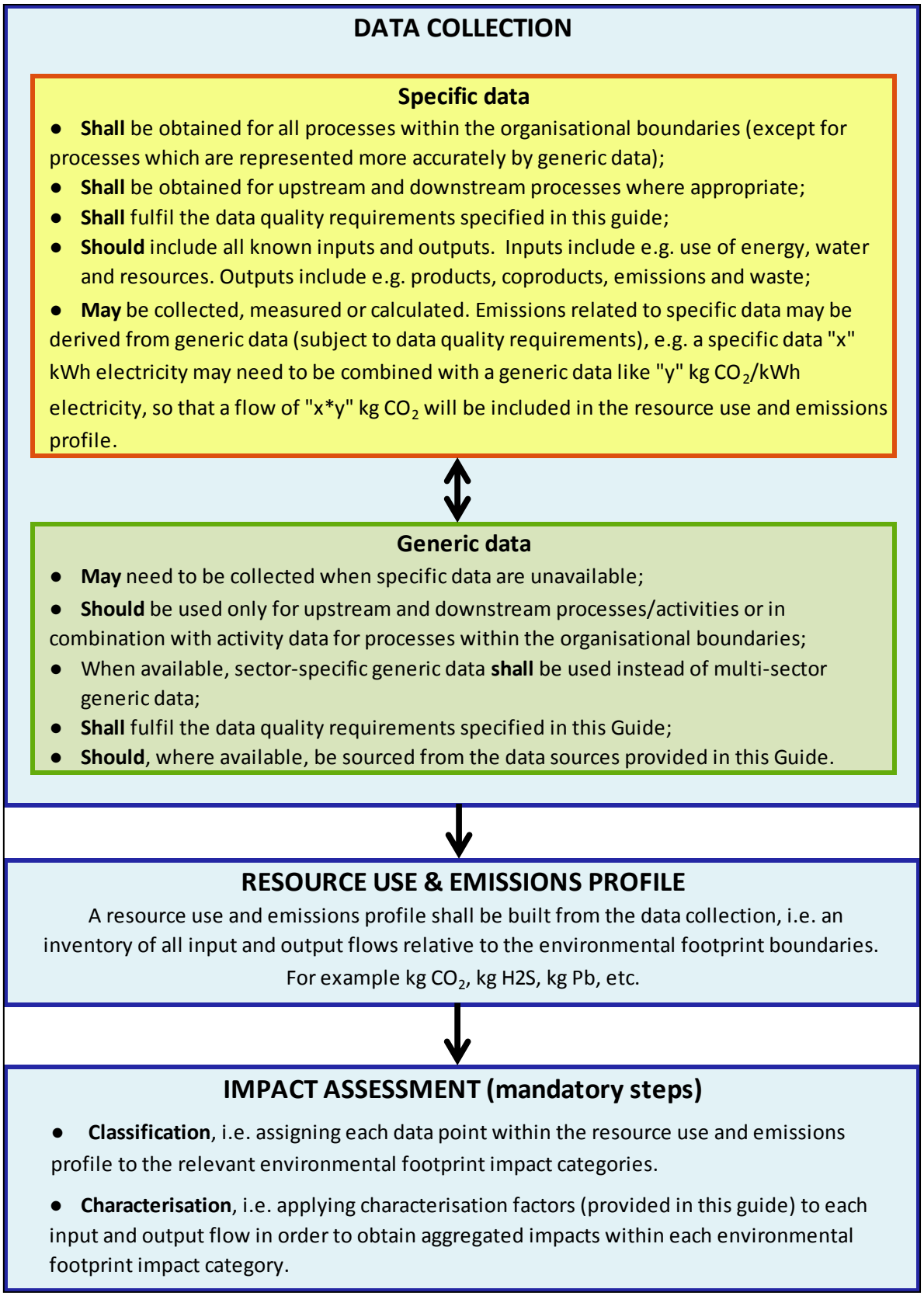

Figure 4: Relationship between data collection, Resource Use and Emissions Profile and EF impact assessment

5.11 Handling Multi-Functional Processes and Facilities

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 must be partitioned between the product of interest and the other co-products in a principled manner. Similarly, where a jointly owned and/or operated facility produces multiple products, it may be necessary to partition related inputs and emissions among the products within the defined Product Portfolios of different organisations, or when heat and electricity are simultaneously produced via co-generation. However, in case a process contributes to multiple products of the Product Portfolio of an Organisation and the OEF study covers the full Product Portfolio of that Organisation, allocation between the products is not required.

Systems involving multi-functionality of processes shall be modelled in accordance with the following decision hierarchy, with additional guidance at the sectorial level provided by OEFSRs if available. Figure 5 provides a decision tree for handling multi-functional processes.

"Some outputs may be partly co-products and partly waste. In such cases, it is necessary to identify the ratio between co-products and waste since the inputs and outputs shall be allocated to the co-products part only.

Allocation procedures shall be uniformly applied to similar inputs and outputs of the system under consideration." (ISO 14044:2006, 14)

Decision Hierarchy

I) Subdivision or system Expansion

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 the analysed process can be subdivided or expanded. Where subdivision is possible, inventory data should be collected only for those unit processes[79] directly attributable[80] to the goods/services of concern. Or if the system can 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.

II) Allocation Based on a Relevant Underlying Physical Relationship

Where subdivision or system expansion cannot be applied, 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. (ISO 14044:2006, 14)

Allocation based on a relevant underlying physical relationship refers to partitioning the input and output flows of a multi-functional process or facility in accordance 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

[79] A unit process is the smallest element considered in the Resource Use and Emissions Profile for which input and output data are quantified. (based on ISO 14040:2006)

[80] Directly attributable refers to a process, activity or impact occurring within the defined Organisational boundary.

on a physical relationship can be modelled using direct substitution if a product can be identified that is directly substituted[81].

Can a direct substitution-effect be robustly modelled? This can be demonstrated by proving that (1) there is a direct, empirically demonstrable substitution effect, AND (2) the substitute product can be modelled and the inventory subtracted in a directly representative manner:

- If yes (i.e. both conditions are verified), model the substitution effect.

Or

Can input/output flows be allocated based on some other relevant underlying physical relationship that relates the inputs and outputs to the function provided by the system? This can be demonstrated by proving that a relevant physical relationship can be defined by which to allocate the flows attributable to the provision of the defined function of the product system[82]:

- If yes, allocate based on this physical relationship.

III 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 at which the co-products are produced. Allocation based on economic value shall only be applied when (I and II) are not possible. In any case, a clear justification shall be provided, with reference to ensuring the physical representativeness of the OEF results.

Allocation based on some other relationship can be approached in one of the following alternative ways:

Can an indirect substitution[83] effect be identified? 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.

Or

Can the inputs between the products and functions be allocated on the basis of some other relationship (e.g. the relative economic value of the co-products)?

- If yes, allocate products and functions on the basis of the identified relationship

Dealing with multi-functionality of products is particularly challenging when recycling or energy recovery of one (or more) of these products is involved as the systems tend to get rather complex. Annex V provides an approach that shall be used to estimate the overall emissions associated to a certain process involving recycling and/or energy recovery. The equation described in Annex V shall be applied for EOL. These moreover also relate to waste flows generated within the system boundaries. The decision hierarchy described in this section also applies for product recycling.

[81] See below for an example of direct substitution.

[82] A product system is the collection of unit processes with elementary and product flows, performing one or more defined functions, and which models the life cycle of a product (ISO 14040:2006)

[83] Indirect substitution occurs when a product is substituted but you don't know by which products exactly.

Examples of direct and indirect substitution

Direct Substitution:	Direct substitution may be modelled as a form of allocation based on an underlying physical relationship when a direct, empirically-demonstrable substitution effect can be identified. For example, when manure nitrogen is applied to agricultural land, directly substituting for an equivalent amount of the specific fertilizer nitrogen that the farmer would otherwise have applied, the animal husbandry system from which the manure is derived is credited for the displaced fertilizer production (taking into account differences in transportation, handling, and emissions).
Indirect Substitution:	Indirect substitution may be modelled as a form of "allocation based on some other relationship" when a co-product is assumed to displace a marginal market-equivalent product or an average market-equivalent product via market-mediated processes. For example, when animal manure is packaged and sold for use in home gardening, the animal husbandry system from which the manure is derived is credited for the market-average home gardening fertilizer that is assumed to have been displaced (taking into account differences in transportation, handling, and emissions).

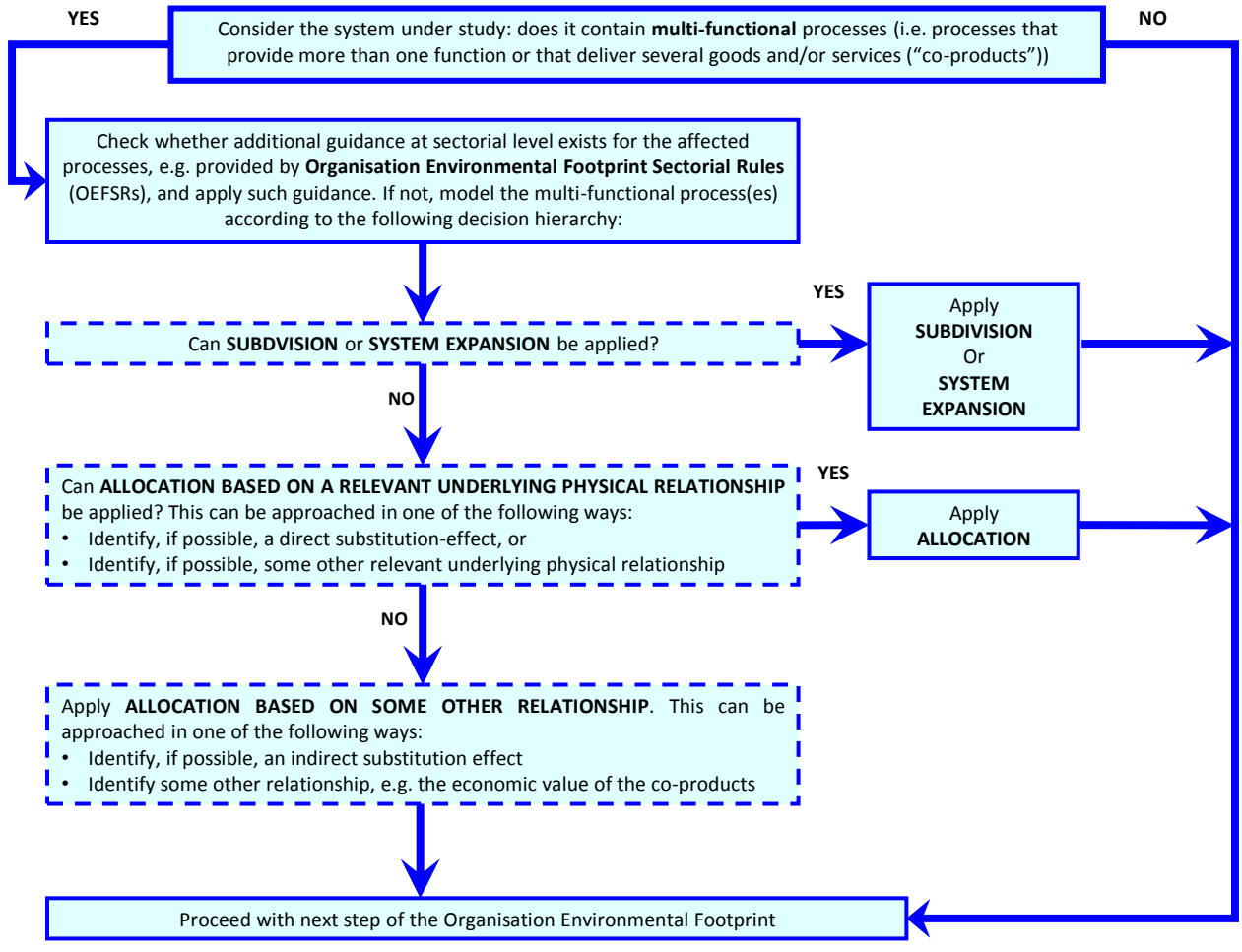

Figure 5: Decision tree for handling multi-functional processes

REQUIREMENTS FOR OEF STUDIES

The OEF multi-functionality decision hierarchy shall be applied for resolving all multi-functionality problems at both process and facility-level: (1) subdivision or system expansion; (2) allocation based on a relevant underlying physical relationship (including (a) direct substitution or (b) some relevant underlying physical relationship); (3) allocation based on some other relationship (including (a) indirect substation or (b) some other relevant underlying relationship).

All choices made in this context shall be reported and justified with respect to the overarching goal of ensuring physically representative, environmentally relevant results.

If co-products are partly co-products and partly waste, all inputs and outputs shall be allocated to the co-products only.

Allocation procedures shall be uniformly applied to similar inputs and outputs.

For multi-functionality problems including recycling or energy recovery at EOL or for waste flows within the system boundaries, the equation described in Annex V shall be applied.

ADDITIONAL REQUIREMENTS FOR OEFSRs

The OEFSR shall further specify multi-functionality solutions for application within the defined Organisational boundaries and, where appropriate, for upstream and downstream stages. If feasible/appropriate, the OEFSR may further provide specific substitution scenarios or factors to be used in 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.

Where sub-division is applied, the OEFSR shall specify which processes are to be sub-divided and according to what principles.

Where allocation by physical relationship is to be applied, the OEFSR shall specify the relevant underlying physical relationships to be considered, and establish the relevant allocation factors.

Where allocation by some other relationship is to be applied, the OEFSR shall specify the relationship and establish the relevant allocation factors. For example, in the case of economic allocation, the OEFSR shall specify the rules for determining the economic values of co-products.

For multi-functionality in EOL situations, the OEFSR shall specify how to calculate the different parts within the provided mandatory formula.

6. Organisation Environmental Footprint Impact Assessment

Once the Resource Use and Emissions Profile has been compiled, the EF impact assessment shall be undertaken to calculate the environmental footprint of the Organisation using the selected EF impact categories and models. EF impact assessment includes two mandatory and two optional steps. The EF Impact Assessment does not intend to replace other (regulatory) tools 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. Especially, the EF Impact Assessment has not the objective to predict 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.

6.1 Mandatory Steps: Classification and Characterisation

REQUIREMENTS FOR OEF STUDIES

The EF impact assessment shall include:

- Classification;
- Characterisation.

6.1.1 Classification of Environmental Footprint Flows

Classification requires assigning the material/energy inputs and outputs inventoried in the Resource Use and Emissions Profile to the relevant EF impact category. For example, during the classification phase, all inputs/outputs that result in greenhouse gas emissions are assigned to the Climate Change category. Similarly, those that result in emissions of ozone depleting substances are classified accordingly. In some cases, an input/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 constituent substances for which characterisation factors (CFs) (see next section) are available. For example, data for a composite NPK fertiliser should be disaggregated and classified according to its N, P, and K fractions, because each constituent element will contribute to different EF impact categories.

REQUIREMENTS FOR OEF STUDIES

All inputs/outputs inventoried during the compilation of the Resource Use and Emissions Profile shall be assigned to the EF impact categories to which they contribute (“classification”) using the classification scheme as provided at http://lct.jrc.ec.europa.eu/assessment/projects.

As part of the classification of the Resource Use and Emissions Profile, data should be expressed in terms of constituent substances for which CFs are available.

If the Resource Use and Emissions Profile data are drawn from existing public or commercial life cycle inventory databases - where classification has already been implemented - it shall be assured that the classification and linked EF impact assessment pathways correspond to the requirements of this OEF Guide.

Example: classification step in the EF impact assessment

Classification of data in the climate change impact category	
CO_2	Yes
CH_4	Yes
SO_2	No
NO_x	No
Classification of data in the acidification impact category	
CO_2	No
CH_4	No
SO_2	Yes
NO_x	Yes

6.1.2 Characterisation of Environmental Footprint Flows

Characterisation refers to the calculation of the magnitude of the contribution of each classified input/output to their respective EF impact categories, and aggregation of the contributions within each category. This is carried out by multiplying the values in the Resource Use and Emissions Profile by the relevant CFs for each EF impact category.

The CFs 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, in the case of calculating climate change impacts, all greenhouse gas emissions inventoried in the Resource Use and Emissions Profile are weighted in terms of their impact intensity relative to carbon dioxide, which is the reference substance for this category. This allows for the aggregation of impact potentials and expression in terms of a single equivalent substance (in this case, CO_2-equivalents) for each EF impact category. For example, the CFs expressed as global warming potential for methane equals 25 CO_2 – equivalents compared to the 1 CO_2 equivalent of 1 CO_2.

REQUIREMENTS FOR OEF STUDIES

All classified inputs/outputs in each EF impact category shall be assigned CFs representing the contribution per unit of input/output to the category, using the provided CFs (available online at http://lct.jrc.ec.europa.eu/assessment/projects). EF impact assessment results shall subsequently be calculated for each EF impact category by multiplying the amount of each input/output by its CF and summing the contributions of all inputs/outputs within each category to a single measure expressed in terms of an appropriate reference unit.

If CFs from the default method are not available for certain flows (e.g. a group of chemicals) of the Resource Use and Emissions Profile, then other approaches may be used for characterising these flows. In such circumstances, this shall be reported under "Additional Environmental Information". The characterisation models shall be scientifically and technically valid, and based upon distinct, identifiable environmental mechanisms[84] or reproducible empirical observations.

[84] An environmental mechanism is defined as a system of physical, chemical and biological processes for a given EF impact category linking the Resource Use and Emissions Profile results to EF category indicators. (based on ISO 14040:2006)

Example: characterisation step in the EF Impact Assessment

Climate Change:

	Amount (kg)		CF		CO_2-equivalents (metric tonnes)
CO_2	5,132	x	1	=	5.132 t CO_2-eq.
CH_4	8.2	x	25	=	0.205 t CO_2-eq.
SO_2	3.9	x	0	=	0 t CO_2-eq.
NO_2	26.8	x	0	=	0 t CO_2-eq.
			Total	=	5.337 t CO_2-eq.

Acidification:

	Amount (kg)		CF		Mol H+ equivalents
CO_2	5,132	x	0	=	0 Mol H+ eq.
CH_4	8.2	x	0	=	0 Mol H+ eq.
SO_2	3.9	x	1.31	=	5.109 Mol H+ eq.
NO_2	26.8	x	0.74	=	19.832 Mol H+ eq.
			Total	=	29.941 Mol H+ eq.

6.2 Optional Steps: Normalisation and Weighting

Following the two mandatory steps of classification and characterisation, the EF impact assessment may be complemented with normalisation and weighting, which are optional steps.

6.2.1 Normalisation of Environmental Footprint Impact Assessment Results

Normalisation is an optional step in which the EF impact assessment results are multiplied by normalisation factors in order to calculate and compare the magnitude of their contributions to the EF impact categories relative to a reference unit (typically the pressure related to that category caused by a whole country or an average citizen over one year). As a result, dimensionless normalised OEF results are obtained. These reflect the burdens attributable to a product relative to the reference unit, such as per capita for a given year and region. This allows the relevance of the contributions made by organisational processes/activities to be compared to the reference unit of the EF impact categories considered.

Normalised OEF results do not, however, indicate the severity/relevance of the respective impacts, nor can they be aggregated across EF impact categories.

REQUIREMENTS FOR OEF STUDIES

Normalisation is not a required step for OEF studies. If it is applied, the normalised OEF results shall be reported under “Additional Environmental Information”, with all methods and assumptions documented. The normalised results shall not be aggregated as this implicitly applies weighting. Results of the EF impact assessment prior to normalisation shall be reported alongside the normalised results.

6.2.2 Weighting of Environmental Footprint Impact Assessment Results

Weighting is an additional, but not required, step that may support the interpretation and communication of the results of the analysis. In this step, (normalised) environmental footprint results are multiplied by a set of weighting factors which reflect the perceived relative importance of the EF impact categories considered. Weighted OEF results can then be compared to assess their relative importance. They can also be aggregated across EF impact categories to obtain several aggregated values or a single overall impact indicator.

Weighting requires making value judgements as to the respective importance of the EF impact categories considered. These judgements may be based on expert opinion, cultural/political view points, or economic considerations.[85]

REQUIREMENTS FOR OEF STUDIES

Weighting is not a required step for OEF studies. If weighting is applied, the results shall be reported as "Additional Environmental Information", with all methods and assumption documented. Results of the EF impact assessment prior to weighting shall be reported alongside the weighted results.

The application of normalisation and weighting steps in OEF studies shall be consistent with the defined goals and scope of the study, including the intended applications.[86]

[85] For more information on existing weighting approaches in Life Cycle Impact Assessment, please refer to the reports developed by the JRC and CML entitled "*Background review of existing weighting approaches in LCIA*" and "*Evaluation of weighting methods for measuring the EU-27 overall environmental impact*". These are available online at http://lct.jrc.ec.europa.eu/assessment/publications

[86] It should be noted that ISO 14040 (ISO 2006b) and 14044 (ISO 2006c) do not permit the use of weighting in support of comparative assertions disclosed to the public.

7. Organisation Environmental Footprint Interpretation

7.1 General

Interpretation of the results of the OEF[87] study serves two purposes:

- The first is to ensure that the OEF model corresponds to the goals and quality requirements of the study. In this sense, OEF interpretation may inform iterative improvements of the OEF model until all goals and requirements are met;
- The second purpose is to derive robust conclusions and recommendations from the analysis, for example in support of environmental improvements.

REQUIREMENTS FOR OEF STUDIES

The interpretation phase of an OEF study shall include the following steps: “assessment of the robustness of the OEF model”; “Identification of hotspots”; “estimation of uncertainty”; and “conclusions, limitations and recommendations”.

7.2 Assessment of the Robustness of the Organisation Environmental Footprint Model

This shall include an assessment of the extent to which methodological influence the analytical outcomes. Tools that should be used to assess the robustness of the OEF model include:

- **Completeness checks**: assess the Resource Use and Emissions Profile data to ensure that it is complete relative to the defined goals, scope, system boundaries and quality criteria. This includes completeness of process coverage (i.e. all relevant processes at each supply chain stage considered have been included) and input/output coverage (i.e. material or energy inputs and emissions associated with each process have been included);
- **Sensitivity checks**: assess the extent to which the results are determined by specific methodological choices and the impact of implementing alternative choices where these are identifiable. It is useful to structure sensitivity checks for each phase of the OEF study, including goal and scope definition, the Resource Use and Emissions Profile, and the EF impact assessment;
- **Consistency checks:** assess the extent to which assumptions, methods, and data quality considerations have been applied consistently throughout the OEF study.

REQUIREMENTS FOR OEF STUDIES

The assessment of the robustness of the OEF model shall include an assessment of the extent to which methodological choices such as system boundaries, data sources, allocation choices and coverage of EF impact categories influence the results. These choices shall correspond to the requirements specified in this OEF Guide and shall be appropriate to the context. Tools that should be used to assess the robustness of the PEF model are completeness checks, sensitivity checks and consistency checks. Any issues flagged in this evaluation should be used to inform iterative improvements to the OEF study.

[87] The term “environmental footprint interpretation” is used throughout this OEF Guide instead of the term “life cycle interpretation” used in ISO 14044:2006. A mapping of the terminology used in this OEF Guide with ISO terminology is included in annex VII.

7.3 Identification of Hotspots (Significant Issues)

Once it has been ensured that the OEF model (e.g. choice of system boundaries, data sources and allocation choices) is robust and conforms to all aspects defined in the goal and scope definition phases, the next step is to identify the main contributing elements to the OEF results. This step may also be referred to as "hotspot" or "weak point" analysis. Contributing elements may be specific elements of the Product Portfolio, life cycle stages, processes, or individual material/energy inputs/outputs associated with a given stage or process in the Organisation supply chain. These are identified by systematically reviewing the OEF study results. Graphical tools may be particularly useful in this context. Such analyses provide the necessary basis to identify improvement potentials associated with specific management interventions.

REQUIREMENTS FOR OEF STUDIES

OEF results shall be evaluated to assess the effect of supply-chain hotspots/weak points at the level of the input/output, process, and supply chain stage and to assess potential for improvements.

ADDITIONAL REQUIREMENTS FOR OEFSR

The OEFSR shall identify the most relevant EF impact categories for the sector. Normalisation and weighting may be used to achieve such prioritisation.

7.4 Estimation of Uncertainty

Estimating the uncertainties of the final OEF results supports iterative improvement of OEF studies. It also helps the target audience to assess the robustness and applicability of the OEF study results.

There are two key sources of uncertainty in OEF studies:

(1) Stochastic uncertainties (both parameter and model) for "Resource Use and Emissions Profile" data

In practice, it may be difficult to access estimates of uncertainty for all data used in an OEF study. At a minimum, efforts to accurately characterise stochastic uncertainty and its impact on modelling outcomes should focus on those processes identified as environmentally significant in the EF impact assessment and interpretation phases.

(2) Choice-related uncertainties

Choices-related uncertainties arise from methodological choices including modelling principles, system boundaries, choice of EF impact assessment models, and other assumptions related to time, technology, geography, etc. These are not readily amenable to statistical description, but rather can only be characterised via scenario model assessments (e.g. modelling worst and best-case scenarios for significant processes) and sensitivity analyses.

REQUIREMENTS FOR OEF STUDIES

At least a qualitative description of the uncertainties of the final OEF results shall be provided for both data and choice related uncertainties separately, in order to facilitate an overall appreciation of the uncertainties of the study results.

ADDITIONAL REQUIREMENTS FOR OEFSRs

The OEFSR shall describe the uncertainties common to the sector and should identify the range in which results could be seen as not being significantly different in comparisons or comparative assertions.

TIP: Quantitative uncertainty assessments may be calculated for variance associated with the "Resource Use and Emissions Profile" data using, for example, Monte Carlo simulations or other appropriate tools. The influence of choice-related uncertainties should be estimated at the upper and lower bounds through sensitivity analyses based on using scenario assessments. These should be clearly documented and reported.

7.5 Conclusions, Recommendations and Limitations

The final aspect of the interpretation phase is to draw conclusions based on the results, answer the questions posed at the outset of the OEF study, and advance recommendations appropriate to the intended audience and context whilst explicitly taking into account any limitations to the robustness and applicability of the results. The OEF needs to be seen as complementary to other assessments and instruments such as site specific environmental impact assessments or chemical risk assessments.

Potential improvements should be identified such as, for example, cleaner technology techniques, changes in product design, supply chain management, environmental management systems (e.g., Eco-Management and Audit Scheme (EMAS) or ISO 14001), or other systematic approaches.

REQUIREMENTS FOR OEF STUDIES

Conclusions, recommendations and limitations shall be described in accordance with the defined goals and scope of the OEF study. OEF studies to support comparative assertions[88] intended to be disclosed to the public shall be based both on this OEF Guide AND related OEFSRs.

As required by ISO 14044:2006, for any comparative assertions intended to be disclosed to the public, it shall be carefully considered whether any differences in data quality and methodological choices used to model the compared organisations may influence the comparability of the outcomes. Any inconsistencies in defining system boundaries, inventory data quality, or EF impact assessment shall be considered and documented/reported.

Conclusions derived from the OEF study should include a summary of identified supply chain "hotspots" and the potential improvements associated with management interventions.

[88] Comparative assertions are an environmental claim regarding the superiority or equivalence of an organisation versus a competing organisation providing the same products, based on the results of an OEF study and supporting OEFSRs. (based on ISO 14040:2006).

8. Organisation Environmental Footprint Reports

8.1 General

An OEF report shall provide a relevant, comprehensive, consistent, accurate, and transparent account of the study and of the calculated environmental impacts associated with the Organisation. It reflects the best possible information in such a way as to maximise its usefulness to intended current and future users, whilst honestly and transparently communicating limitations. Effective OEF reporting requires that several criteria, both procedural (report quality) and substantive (report content), are met.

8.2 Reporting elements

An OEF report consists of at least three elements: the Main Report, a Summary and an Annex. Confidential and proprietary information can be documented in a fourth element, a complementary Confidential Report. Review reports are either annexed or referenced.

8.2.1 First Element: 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 main report.

The summary shall, at a minimum, include:

- Key elements of the goal and scope of the study with relevant limitations and assumptions;
- A description of the system boundaries;
- The main results from the Resource Use and Emission Profile, and the EF impact assessment components: these shall be presented in such a way as to ensure the proper use of the information;
- If applicable, environmental improvements compared to previous periods;
- Relevant statements about data quality, assumptions and value judgements;
- A description of what has been achieved by the study, the recommendations made and conclusions drawn;
- Overall appreciation of the uncertainties of the results.

8.2.2 Second Element: Main Report

The Main Report[89] shall, at a minimum, include the following components:

- **Goal of the study:**
  The goal shall, as a minimum, include clear and concise statements with respect to the following aspects:
  - Intended application(s);
  - Methodological or EF impact category limitations;
  - Reasons for carrying out the study;
  - Target audience;

[89] The Main Report, as defined here, is insofar as possible in line with ISO 14044:2006 requirements on reporting for studies which do not contain comparative assertions to be disclosed to the public.

- Whether the study is intended for comparisons or for comparative assertions to be disclosed to the public (requiring an OEFSR);
- Reference OEFSRs;
- Commissioner of the study.

- **Scope of the study:**
  The Scope of the study shall identify the Organisation in detail and address the overall approach used to establish the system boundaries. The Scope of the study shall also address the data quality requirements. Finally, the Scope shall include a description of the methods applied for assessing potential environmental impacts and which EF impact categories, methods, normalisation and weighting sets are included.

  Mandatory reporting elements include, as a minimum:
  - Description of the Organisation and defined Product Portfolio;
  - System boundaries (Organisational and OEF boundaries);
  - The reasons for and potential significance of any exclusions;
  - All assumptions and value judgements, along with justifications for the assumptions made;
  - Data representativeness, appropriateness of data, and types/sources of required data and information;
  - EF impact categories, models and indicators, normalisation and weighting factors (if used);
  - Treatment of any multi-functionality issues encountered in the modelling.

- **Compiling and recording the Resource Use and Emissions Profile:**
  Mandatory reporting elements include, as a minimum:
  - Description and documentation of all specific data collected;
  - Data collection procedures;
  - Sources of published literature;
  - Information on any use and EOL scenarios considered in downstream stages;
  - Calculation procedures;
  - Validation of data, including documentation and justification of allocation procedures;
  - Description and results of the sensitivity analysis[90], if conducted.

- **Calculating OEF impact assessment results:**
  Mandatory reporting elements include:
  - The EF impact assessment procedure, calculations and results for the foreground, upstream and downstream processes separately, including all assumptions and limitations;
  - The relationship of the EF impact assessment results to the defined goal and scope;
  - If any exclusion from the default EF impact categories has been made, the justification for the exclusion(s) shall be reported;
  - If any deviation from the default EF impact categories and/or models has been made (which shall be justified and included under Additional Environmental Information), then the mandatory reporting elements shall also include:
    - EF impact categories and EF impact category indicators considered, including a rationale for their selection and a reference to their source;

[90] Sensitivity analyses are systematic procedures for estimating the effects of the choices made regarding methods and data on the outcome of an OEF study. (based on ISO 14040: 2006)

  - Descriptions of or reference to all characterisation models, CFs and methods used, including all assumptions and limitations;
  - Descriptions of or reference to all value-choices used in relation to the EF impact categories, characterisation models, CFs, normalisation, grouping, weighting and, a justification for their use and their influence on the results, conclusions and recommendations;
  - A statement and justification of any grouping of the EF impact categories;
  - Any analysis of the indicator results, for example sensitivity and uncertainty analysis or the use of environmental data, including any implication for the results.
- Additional Environmental Information, if any;
- Information on carbon storage in products;
- Information on delayed emissions;
- Data and indicator results prior to any normalisation and weighting;
- If included, normalisation and weighting factors and results.

- **Interpretation of the OEF results:**
  Mandatory reporting elements include:
  - Assessment of data quality;
  - Full transparency of value choices, rationale and expert judgements;
  - Overall appreciation of the uncertainty (at least a qualitative description);
  - Conclusions;
  - Identification of environmental hotspots;
  - Recommendations, limitations and potential improvements.

8.2.3 Third Element: Annex

The Annex serves to document supporting elements to the main report, which are of a more technical nature. It shall include:

- Descriptions of all assumptions, including those assumptions that have been shown to be irrelevant;
- Questionnaire / data collection check-list (see annex III of this OEF Guide) and raw data (optional if considered sensitive and communicated separately in the Confidential Report);
- Resource Use and Emissions Profile (optional if considered sensitive and communicated separately in the Confidential Report, see below);
- Critical review report (if conducted), including (where applicable) the name and affiliation of the reviewer or reviewer team, responses to the review report (if any);
- Reviewer's self-declaration of their qualification, stating how many points they achieved for each criterion defined in section 9.3 of this OEF Guide.

8.2.4 Fourth Element: Confidential Report

The Confidential Report should (optional reporting element) contain all those data (including raw data) and information that are confidential or proprietary and cannot be made externally available. It shall be made available confidentially to the critical reviewers.

REQUIREMENTS FOR OEF STUDIES

Any OEF study intended for external communications shall include an OEF study report, which shall provide a relevant, comprehensive, consistent, accurate, and transparent account of the study and of the calculated environmental impacts associated with the Organisation. The reported information shall also provide a robust basis for assessing, tracking, and seeking to improve the environmental performance of the Organisation over time. The OEF report shall include, at a minimum, a Summary, a Main Report and an Annex. These shall contain all the reporting elements specified in this chapter.

ADDITIONAL REQUIREMENTS FOR OEFSRs

The OEFSR shall specify and justify any deviations from the default reporting requirements and any additional reporting requirements and/or differentiate reporting requirements that depend on, for example, the type of applications of the OEF study and, the type of organisation being assessed. The OEFSRs shall specify whether the OEF results shall be reported separately for each of the selected life cycle stages.

9. Organisation Environmental Footprint Critical Review

9.1 General[91]

A critical review is essential to ensuring the reliability of the OEF results and to improving the quality of the OEF study.

REQUIREMENTS FOR OEF STUDIES

Any OEF study intended for external communication shall be critically reviewed in order to ensure that:

- The methods used to carry out the OEF study are consistent with this OEF Guide;
- The methods used to carry out the OEF study are scientifically and technically valid;
- The data used are appropriate, reasonable and meet the defined data quality requirements;
- The interpretation of the results reflects the limitations identified;
- The study report is transparent, accurate and consistent.

9.2 Review Type

The most suitable review type that provides the required minimum guarantee of quality assurance is an independent external review. The type of review conducted should be informed by the goals and intended applications of the OEF study.

REQUIREMENTS FOR OEF STUDIES

Unless otherwise specified in relevant policy instruments, any OEF study intended for external communication shall be critically reviewed by at least one independent and qualified external reviewer (or review team). An OEF study to support a comparative assertion intended to be disclosed to the public shall be based on relevant OEFSRs and critically reviewed by at least three independent qualified external reviewers.

The type of review conducted should be informed by the goals and intended applications of the OEF study.

ADDITIONAL REQUIREMENTS FOR OEFSRs

The OEFSR shall specify the review requirements for OEF studies to be used for comparative assertions intended to be disclosed to the public (e.g. whether a review by at least three independent qualified external reviewers is sufficient).

9.3 Reviewer Qualification

The assessment of the appropriateness of potential reviewers is based on a scoring system that takes into account review and audit experience, EF and/or LCA methodology and practice, and knowledge of relevant technologies, processes or other activities represented by the Organisation and its Product Portfolio. Table 8 presents the scoring system for each relevant competence and experience topic.

[91] This section builds upon the Greenhouse Gas Protocol Product Life Cycle Accounting and Reporting Standard, 2011 - Section 12.3

If one reviewer alone does not fulfil the necessary requirements for reviewers specified below, the review framework allows for having more than one reviewer to jointly fulfil the requirements, forming a "review team".

Table 8: Scoring system for eligible reviewers and review teams.

Topic		Criteria	Score (points) 0	1	2	3	4
Manda-tory criteria	Review verification and audit practice						
		Years of experience[1]	0-2	3 – 4	5 –8	9 – 14	> 14
		Number of reviews[2]	0-2	3 – 5	6 –15	16 – 30	> 30
	EF or LCA methodology and practice	**Years of experience[3]**	0-2	3 – 4	5 – 8	9 – 14	> 14
		"Experiences" of participation in EF or LCA work	0-4	5 – 8	9 – 15	16 – 30	> 30
	Technologies or other activities relevant to the OEF study	**Years of experience[4*] in private or public sector**	0-2 (within the last 10 years)	3 –5 (within the last 10 years)	6 – 10 (within the last 20 years)	11 – 20	> 20
Other[6]	Review verification and audit practice	Optional scores relating to audit	▪ 2 points: Accreditation as third party reviewer for at least one EPD Scheme, ISO 14001, or other EMS. ▪ 1 point: Attended courses on environmental audits (at least 40 hours). ▪ 1 point: Chair of at least one review panel (for EF, LCA studies or other environmental applications). ▪ 1 point: Qualified trainer in environmental audit course.				

Notes:

1) Years of experience in the field of environmental review and auditing.

2) Number of reviews for ISO 14040/14044 compliance, ISO 14025 compliance (Environmental Organisation Declarations (EPD)), or LCI datasets.

3) Years of experience in the field of EF or LCA work, starting from University degree or Bachelor degree.

4) Years of experience in a sector related to the Organisation(s). 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 can also be used. Experience gained with technologies or processes in any sub-sector are considered valid for the whole sector.

5) Years of experience in the public sector, e.g. research centre, university, government institution relating to the Organisation(s)

* Candidate must calculate years of experience based on employment contracts. For example, Prof A works in University B part-time from Jan 2005 until Dec 2010 and part-time at a refinery organisation. Prof A can count years of experience in the private sector as 3 years and 3 years for the public sector (university).

6) The additional scores are complementary.

REQUIREMENTS FOR OEF STUDIES

A critical review of the OEF study shall be conducted as per the requirements of the intended application. Unless otherwise specified, the minimum necessary score to qualify as a reviewer or a review team is six points, including at least one point for each of the three mandatory criteria (i.e. verification and audit practice, EF and/or LCA methodology and practice, and knowledge of technologies or other activities relevant to the OEF study). Score points per criteria shall be achieved by individuals, while score points may be summed across criteria at the team level. Reviewers or review teams shall provide a self-declaration of their qualifications, stating how many points they achieved for each criteria and the total points achieved. This self-declaration shall be part of the mandatory annex of the OEF report.

10. Acronyms and Abbreviations

ADEME	Agence de l'Environnement et de la Maîtrise de l'Energie
B2B	Business to Business
B2C	Business to Consumer
BSI	British Standards Institution
CDP	Carbon disclosure project
CF	Characterisation Factor
CFCs	Chlorofluorocarbons
CFC-11	Trichlorofluoromethane
CPA	Classification of Product Activity
DQR	Data Quality Rating
EIA	Environmental Impact Assessment
ELCD	European Reference Life Cycle Database
EF	Environmental Footprint
EIPRO	Environmental Impact of Products
EMAS	Eco-management and Audit Schemes
EMS	Environmental Management Schemes
EOL	End-of-life
GHG	Greenhouse Gas
GRI	Global Reporting Initiative
ILCD	International Reference Life Cycle Data System
IMPRO	Environmental Improvement of Products
IPCC	Intergovernmental Panel on Climate Change
ISIC	International Standard Industrial Classification
ISO	International Organization for Standardization
IUCN	International Union for Conservation of Nature and Natural Resources

LCA	Life Cycle Assessment
LCI	Life Cycle Inventory
LCT	Life Cycle Thinking
NACE	Nomenclature générale des Activités Economiques dans les Communautés Européennes
NMVOC	non-methane volatile organic compounds
ODP	Ozone Depletion Potential
OEF	Organisation Environmental Footprint
OEFSR	Organisation Environmental Footprint Sector Rules
PEF	Product Environmental Footprint
PM2.5	Particulate Matter with a diameter of 2.5 µm or less
Sb	Antimony
WRI	World Resources Institute
WBCSD	World Business Council for Sustainable Development

11. Glossary

Additional Environmental Information – Environmental footprint impact categories and other environmental indicators that are calculated and communicated alongside OEF results.

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 lakes acidification.

Allocation – An approach to solving multi-functionality problems. It refers to partitioning the input or output flows of a process, a product system or a facility between the system under study and one or more other systems" (based on ISO 14040:2006).

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

Average Data – Refers to a production-weighted average of specific data.

Background Process – Refers to those processes of the Organisations supply chain for which no direct access to information is possible. For example, most of the upstream supply-chain processes and generally all processes further downstream will be considered part of the background process.

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

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

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", CO_2 is chosen as the reference substance and Tonne CO_2-equivalents as the reference unit.

Characterisation factor – Factor derived from a characterisation model which is applied to convert an assigned Resource Use and Emissions Profile result to the common unit of the EF category indicator. (based on ISO 14040:2006)

Classification - Assigning the material/energy inputs and outputs inventoried in the Resource and Emissions Profile to EF impact categories according to each substance's potential to contribute to each of the EF impact categories considered.

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

Comparative Assertion – An environmental claim regarding the superiority or equivalence of an organisation versus a competing organisation providing the same products, based on the results of an OEF study and supporting OEFSRs. (based on ISO 14040:2006).

Comparison – A comparison (graphically or otherwise) of two or more organisations regarding the results of their OEF, taking into account the OEFSRs, not including a comparative assertion.

Co-product – Any of two or more products resulting from the same unit process or product system. (ISO 14044:2006)

Cradle to Cradle - A specific kind of cradle-to-grave assessment, where the end-of-life disposal step for the product is a recycling process.

Cradle to Gate - An assessment of a partial Organisation supply chain, from the extraction of raw materials (cradle) up to the manufacturer's "gate". The distribution, storage, use stage and end-of-life stage of the supply chain are omitted.

Cradle to Grave - An assessment, including 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 OEF study and the principles and requirements of this OEF Guide and related OEFSRs (if available). (based on ISO 14040:2006)

Data Quality - Characteristics of data that relate to their ability to satisfy stated requirements. (ISO 14040:2006) Data quality covers various aspects, such as technological, geographical and time-related representativeness, as well as completeness and precision of the inventory data.

Direct Land Use Changes (dLUC) – The transformations from one land use type into another take which takes place in a unique land area, possibly incurring changes in the carbon stock of that specific land, and does not drive to a change in another system.

Directly attributable – Refers to a process, activity or impact occurring within the defined Organisational Boundary.

Downstream – Occurring along a product supply chain after exiting the Organisational Boundary.

Ecological footprint - Refers to "*the area of productive land and water ecosystems required to produce the resources that the population consumes and assimilate the wastes that the population produces, wherever on Earth the land and water is located*" (Wackernagel and Rees 1996). The environmental footprint according to this OEF Guide is not equal to the ecological footprint of Wackernagel and Rees: the main differences are highlighted in annex X of the PEF Guide. (EC-JRC-IES, 2012)

Ecotoxicity – 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.

Elementary flows - In the Resource Use and Emissions Profile, elementary flows include (ISO 14040, p.3) "*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 - An element of an Organisation's activities or products that has or can have an impact on the environment (including human health). (EMAS regulation)

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 system throughout the life cycle (ISO 14044:2006). The EF impact assessment methods provide impact characterisation factors for elementary flows to aggregate the impact to a limited number of midpoint and/or damage indicators.

Environmental Footprint (EF) Impact Assessment Method – Protocol for quantitative translation of Resource Use and Emissions Profile data into contributions to an environmental impact of concern.

Environmental Footprint (EF) Impact Category – Class of resource use or environmental impact to which the Resource Use and Emissions Profile data are related.

Environmental Footprint (EF) impact Category indicatory - Quantifiable representation of an EF impact category. (based on ISO 14044:2006)

Environmental impact - Any change to the environment, whether adverse or beneficial, that wholly or partially result from an Organisation's activities or products. [EMAS regulation]

Environmental mechanism – System of physical, chemical and biological processes for a given EF impact category linking the Resource Use and Emissions Profile results to EF category indicators. (based on ISO 14040:2006)

Environmentally significant – Any process or activity accounting for at least 90% of contributions to each EF impact category considered.

Eutrophication - Nutrients (mainly nitrogen and phosphorus) from sewage outfalls and fertilised farmland 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 emission of substances into a common measure expressed as the oxygen required for the degradation of dead biomass.

Extrapolated Data – Refers to 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 modelled system (foreground systems and links to background system), and all major inputs and outputs.

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

Gate to Gate – An assessment of a partial Organisation supply chain including only the processes within a specific Organisation or site.

Gate to Grave – An assessment of a partial Organisation supply chain, including only the processes within a specific Organisation or site and the processes occurring along the supply chain such as distribution, storage, use, and disposal or recycling stages.

Generic Data – Refers to data that is not directly collected, measured, or estimated, but rather sourced from a third-party life cycle inventory database or other source that complies with the data quality requirements of the OEF Guide. Synonymous with "secondary data." Example: An organisation operating a facility that purchases acetylsalicylic acid from a number of regional firms on a least-cost basis as an input to their production process sources generic data from a life cycle inventory database to represent average acetylsalicylic acid production conditions in the region of interest.

Global Warming Potential – Capacity of a greenhouse gas to influence radiative forcing, 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)**.** It relates to the capacity to influence changes in the global, average surface-air temperature and subsequent change in various climate parameters and their effects, such as storm frequency and intensity, rainfall intensity and frequency of flooding, etc.

Human Toxicity –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 inso far 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 inso far as they are related to non-cancer effects that are not caused by particulate matter/respiratory inorganics or ionising radiation.

Indirect Land Use Changes (iLUC) - Occur when a demand for a certain land use leads to changes outside the system boundaries, i.e. in other land use type. These indirect effects can be mainly accessed by means of economic modelling of the demand for land or by modelling the relocation of activities on a global scale. The main drawbacks of such models are their reliance on trends, which might not reflect future developments. They are commonly used as the basis for political decisions.

Indirectly attributable – Refers to a process, activity or impact occurring outside of the defined Organisational boundary but within the defined OEF boundary (i.e. upstream or downstream).

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

Intermediate product – Output from a unit process that is input to other unit processes that require further transformation within the system (ISO 14040:2006)

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, 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 quality multiplied by area and duration). Land transformation considers the extent of changes in land properties and the area affected (changes in quality multiplied by the area).

Life cycle – Consecutive and interlinked stages of a product system, from raw material acquisition or generation from natural resources to final disposal. (ISO 14040:2006)

Life Cycle Approach - Takes into consideration the spectrum of resource flows and environmental interventions associated with a product or organisation 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 (ISO 14040:2006)

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 (ISO 14040:2006). The LCIA methods used provide impact characterisation factors for elementary flows to aggregate the impact to a limited number of midpoint and/or damage indicators.

Load rate - Ratio or capacity (i.e. mass or volume) that a vehicle carries per trip.

Multi-functionality - If a process or facility provides more than one function, i.e. it delivers several goods and/or services ("co-products"), it is “multi-functional”. In these situations, all inputs and emissions linked to the process must be partitioned between the product of interest and the other co-products in a principled manner. Similarly, where a jointly owned and/or operated facility produces multiple products, it may be necessary to partition related inputs and emissions among the products within the defined Product Portfolios of different organisations. Organisations undertaking an OEF study may therefore have to address multi-functionality problems both at the product and facility level.

Non-elementary (or complex) flows – Remaining inputs and outputs which are not elementary flows and need further modelling efforts to be transformed into elementary flows. Examples of non-elementary inputs are electricity, materials, transport processes and examples of non-elementary outputs are waste and by-products.

Normalisation – After the characterisation step, normalisation is an optional step in which the EF impact assessment results are multiplied by normalisation factors that represent the overall inventory of a reference unit (e.g., a whole country or an average citizen). Normalised EF 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. When displaying the normalised EF impact assessment results of the different impact topics next to each other, it becomes evident which EF impact categories are affected most and least by the analysed system. Normalised EF 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 Sector Rules (OEFSRs) – Are sector-specific, life cycle based rules that complement general methodological guidance for OEF studies by providing further specification at the sectorial level. OFCRs can help shifting the focus of the OEF study towards those aspects and parameters that matter the most, and hence contribute to increased relevance, reproducibility and consistency.

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

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. CFCs, HCFCs, Halons).

Particulate Matter/Respiratory Inorganics – EF impact category that accounts for the adverse health 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 through reaction with organic materials.

Product - Any goods or service. (ISO 14040:2006)

Product category - Group of products that can fulfil equivalent functions. (ISO 14025:2006)

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

Product flow – Products entering from or leaving to another product system. (ISO 14040:2006)

Product system – Collection of unit processes with elementary and product flows, performing one or more defined functions, and which models the life cycle of a product (ISO 14040:2006)

Raw material – Primary or secondary material that is used to produce a product (ISO 14040:2006)

Reference flow – Measure of the outputs from processes in a given system required to fulfil the function expressed by the unit of analysis. (based on ISO 14040:2006)

Releases – Emissions to air and discharges to water and soil. (ISO 14040:2006)

Resource Depletion – EF impact category that addresses use of natural resources, either renewable or non-renewable, biotic or abiotic.

Resource Use and Emissions Profile – Refers to the inventory of data collected to represent the inputs and outputs associated with each stage of the Organisation supply chain being studied. The compilation of the Resource Use and Emissions Profile is completed when non-elementary (i.e. complex) flows are transformed into elementary flows.

Resource Use and Emissions Profile results – Outcome of a Resource Use and Emissions Profile that catalogues the flows crossing the OEF boundary and provides the starting point for the EF impact assessment.

Sensitivity analysis – Systematic procedures for estimating the effects of the choices made regarding methods and data on the outcome of an OEF study. (based on ISO 14040: 2006)

Soil Organic Matter (SOM) – Is the measure of the content of organic material in soil. This derives from plants and animals and comprises all of the organic matter in the soil exclusive of the matter that has not decayed.

Specific Data – Refers to directly measured or collected data representative of activities at a specific facility or set of facilities. Synonymous with “primary data.”
Example: A pharmaceutical organisation compiles data from internal inventory records to represent the material and energy inputs and emissions from a factory producing acetylsalicylic acid.

Subdivision - Subdivision refers to 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 the it can be subdivided. Where subdivision is possible, inventory data should be collected only for those unit processes directly attributable to the products/services of concern.

System Boundary – Definition of aspects included or excluded from the study. For example, for a "cradle-to-grave" environmental footprint analysis, the system boundary should include all activities from the extraction of raw materials through the processing, manufacturing, use, repair and maintenance processes as well as transport, waste treatment and other purchased services such as e.g. cleaning and legal services, marketing, production and decommissioning of capital goods, operation of premises such as retail, storage, administration offices, staff commuting, business travel, and end-of-life processes.

System Boundary diagram - Schematic representation of the analysed system. It details which parts of the Organisation supply chain are included or excluded from the analysis.

Uncertainty analysis– Procedure to assess the uncertainty introduced into the results of a PEF study due to data variability and choice-related uncertainty.

Unit of analysis - The unit of analysis defines the qualitative and quantitative aspects of the function(s) and/or service(s) provided by the Organisation being evaluated; the unit of analysis definition answers the questions "what?", "how much?", "how well?", and "for how long?".

Unit process – Smallest element considered in the Resource Use and Emissions Profile for which input and output data are quantified. (based on ISO 14040:2006)

Upstream – Occurring along the supply chain of purchased goods/services prior to entering the Organisational Boundary.

Waste – Substances or objects which the holder intends or is required to dispose of. (ISO 14040:2006)

Weighting - Weighting is an additional, but not mandatory, step that may support the interpretation and communication of the results of the analysis. (Normalised) OEF results are multiplied by a set of weighting factors, which reflect the perceived relative importance of the impact categories considered. Weighted environmental footprint results can be directly compared across impact categories, and also summed across impact categories to obtain a single-value overall impact indicator. Weighting requires making value judgements as to the respective importance of the EF impact categories considered. These judgements may be based on expert opinion, social science methods, cultural/political view points, or economic considerations.

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Annex I Summary of Key Mandatory Requirements for Organisation Environmental Footprint Studies and for Developing Organisation Environmental Footprint Sector Rules

This Annex gives an overview of the key mandatory requirements ("shall") for OEF studies. The mandatory requirements for the OEF and the additional requirements for the development of OEFSRs are summarised in table 2, in column 3 and 4 respectively. The requirements relate to different criteria which are mentioned in the second column and which are further elaborated in separate chapters and sections (as indicated in the first column).

Table 9: Summary of key mandatory requirements for OEF studies and additional requirements for developing OEFSRs.

Chapter/section	Criteria	Organisation Environmental Footprint (OEF) Requirements	Additional requirements for Developing Organisation Environmental Footprint Sector Rule (OEFSRs)
1.1	General Approach	An OEF study shall be based on a life cycle approach.	
1.3	Principles	Users of this Guide shall observe the following principles in OEF studies: 1. Relevance; 2. Completeness; 3. Consistency; 4. Accuracy; 5. Transparency.	Principles for OEFSRs: 1. Relationship with the OEF Guide; 2. Involvement of selected interested parties; 3. Striving for comparability.
2.1	Role of OEFSRs	In the absence of OEFSRs for the reference sector, the key areas which would be covered in OEFSRs (as listed throughout this OEF Guide) shall be specified, justified and explicitly reported in the OEF study.	OEFSRs should aim to focus OEF studies on those aspects and parameters which are most pertinent in determining the environmental performance of the sector. An OEFSR shall/should/may further specify requirements made in this OEF Guide and add new requirements where the more general OEF Guide gives several options.
2.2	Defining the Sector		OEFSRs shall be based on at a mimimum a two-digit code division of NACE codes (default option). However, OEFSRs may allow for (justified) deviations (e.g. allow for three-digits) if the complexity of the sector demands it. Where

			multiple production routes for similar Product Portfolios defined using alternative NACE codes are identifiable, the OEFSR shall accommodate all such NACE codes.
3	Goal Definition	The goal definition for an OEF study shall include: • Intended application(s); • Reasons for carrying out the study and decision context; • Target audience; • Whether for the purpose of comparisons and/or comparative assertions intended to be disclosed to the public; • Commissioner of the study; • Review Procedure (if applicable).	The OEFSR shall specify the review requirements for OEF studies.
4	Scope Definition	The scope definition for an OEF study shall be in line with the defined study goals and the requirements of the OEF Guide. It shall identify and clearly describe (see following sections for a more detailed description): • Definition of the Organisation (unit of analysis[92]) and the Product Portfolio (suite and amount of goods/services provided over the reporting interval); • System boundaries (Organisational and OEF boundaries); • EF impact categories; • Assumptions and limitations.	
4.2	Defining the Organisation (unit of analysis)	The Organisation (or clearly defined subset thereof subject to the OEF study) shall be defined according to the following: • The name of the Organisation; • The kinds of goods/services the Organisation produces (i.e. the sector); • Locations of operation (i.e. countries); • The NACE code(s).	
4.3	Product Portfolio	A Product Portfolio shall be defined for the Organisation that represents the amount and nature of goods and services (or clearly defined subset thereof) provided by the Organisation over the reporting interval in terms of “what” and “how much”. It shall be justified and reported if an OEF is limited to a subset of its Product	The OEFSR shall further specify how the Product Portfolio is defined, in particular with respect to “how well” and “for how long.” It shall also define the reporting interval when this differs from one year, and justify the chosen interval.

[92] The term “unit of analysis” is used throughout this Guide instead of the term “functional unit” used in ISO 14044.

		Portfolio. For modelling the use and EOL scenarios, information on "how well", and "for how long" with respect to product performance shall also be provided. The quantitative input and output data collected in support of the analysis (to be carried out in a later phase of the OEF study) shall be calculated in relation to the specified Product Portfolio.	
4.4	System Boundaries	The system boundaries shall include both Organisational boundaries (in relation to the defined Organisation) and OEF boundaries (that specify which aspects of the supply chain are included in the analysis).	
4.4.1	Organisational Boundaries	Organisational boundaries for calculating the OEF shall encompass all of the facilities/activities that the Organisation owns and/or operates (whether partially or in full) that contribute to providing the Product Portfolio during the reporting interval. All activities and processes which occur within the Organisational boundaries but which are not necessary for the functioning of the Organisation shall be included in the analysis but reported separately. Examples of such processes/activities are gardening activities, food served by the company in the canteen, etc. In the case of retailers, products produced or transformed by the retailer shall be included in the Organisational boundaries.	The OEFSR shall specify the characteristic processes, activities and facilities of the sector of concern to be included in the Organisational boundaries. The OEFSR shall specify the characteristic processes and activities which occur within the Organisational boundaries but which are not necessary for the functioning of the Organisation. These shall be included in the analysis and reported separately.
4.4.2	Organisation Environmental Footprint Boundaries	The OEF boundaries shall be defined following general supply-chain logic. This shall include, at a minimum, site-level (direct) and upstream (indirect) activities associated with the Organisation's Product Portfolio. The OEF boundaries shall by default include all supply chain stages from raw material acquisition through processing production, distribution, storage, use and EOL treatment of the Product Portfolio (i.e. cradle-to-grave). All processes within the defined OEF boundaries shall be considered. Explicit justification shall be provided if downstream (indirect) activities are excluded (e.g. use stage of intermediate products or products with an undeterminable fate). Employee transport shall be included in the analysis, even if these are indirect activities.	The OEFSR shall specify the OEF boundary, including specification of the supply chain stages to be included; and the direct (gate-to-gate) and indirect (upstream and downstream) processes/activities to be included in the OEF study. Any deviation from the default cradle-to-grave approach shall be explicitly specified and justified. The OEFSR shall also include justification for exclusions of processes/activities. The OEFSR shall specify the time span and scenarios to be considered for the downstream activities. If a fixed time span is not appropriate or relevant for a certain sector (e.g. some consumable products), the OEFSR shall specify

		If retailers provide products produced by other organisations, the production processes shall be included as upstream processes. Replacements which are necessary to fulfil the defined time span (see OEFSRs in section 4.3) shall be taken into account. The number of replacements equals "time span/life span -1". As this assumes an average situation, the number of replacements does not need to be an integer. The future production processes for these replacements shall be assumed to be identical to the processes of the reporting year. If a fixed time span is not relevant for a certain sector (see OEFSRs in section 4.3), the use stage shall cover the life span of the products in the Product Portfolio of the Organisation (without replacements).	and justify why this is the case.
4.4.4	Offsets	Offsets shall not be included in an OEF study.	
4.5	Selection of EF Impact Categories	For an OEF study, all of the specified default EF impact categories and associated specified EF impact assessment models and indicators (see Table 2) shall be applied. Any exclusion shall be explicitly documented, justified and reported in the OEF report and supported by appropriate documents. The influence of any exclusion on the final results, especially related to limitations in terms of comparability to other OEF studies, shall be reported and discussed in the interpretation phase. Such exclusions are subject to review.	The OEFSR shall specify and justify any exclusion of the default EF impact categories, especially related to aspects of comparability.
4.6	Selecting Additional Environmental Information	If the default set of EF impact categories or the default EF impact assessment models do not properly cover the potential environmental impacts of the Organisation, all related relevant (qualitative/quantitative) environmental aspects shall be additionally included under Additional Environmental Information. Additional Environmental Information shall be reported separately from the default EF impact assessment results. These shall however not substitute the mandatory assessment models of the default EF impact categories. The supporting models of these additional categories with the corresponding indicators shall be clearly referenced and documented. Additional relevant environmental shall be: • Based on information that is substantiated and has been	The OEFSR shall specify : • Any Additional Environmental Information that shall be included in the OEF study. Such additional information shall be reported separately from the default EF impact assessment results (see Table 2). All models and assumptions of this Additional Environmental Information shall be supported by adequate documentation, clearly documented and submitted to the review process. Such Additional Environmental Information may include (non-exhaustive list) ○ Other relevant environmental impact categories for the sector;

		reviewed or verified (in accordance with the requirements of ISO 14020 and Clause 5 of ISO 14021:1999); • Specific, accurate and not misleading; • Relevant to the particular sector; • Submitted to the review process; • Clearly documented. Emissions directly to marine water shall be included in the Additional Environmental Information (at inventory level). If Additional Environmental Information is used to support the interpretation phase of an OEF study, then all data needed to produce such information shall meet the same or equivalent quality requirements established for the data used to calculate the OEF results. Additional Environmental Information shall only be related to environmental issues. Information and instructions, e.g. organisation safety sheets that are unrelated to the environmental footprint of the Organisation shall not be part of an OEF. Similarly, information related to legal requirements shall not be included.	○ Other relevant approaches for conducting characterisation of the flows from the Resource Use and Emissions Profile, when characterisation factors (CFs) in the default method are not available for certain flows (e.g. groups of chemicals); ○ Environmental indicators or Product responsibility indicators (e.g. EMAS core indicators or the Global Reporting Initiative (GRI)); ○ Life cycle energy consumption by primary energy source, separately accounting for "renewable" energy use; ○ Direct energy consumption by primary energy source, separately accounting for "renewable" energy use; ○ For gate-to-gate stages, number of IUCN Red List species and national conservation list species with habitats in areas affected by operations, by level of extinction risk; ○ Description of significant impacts of activities and products on biodiversity in protected areas and areas of high biodiversity value outside protected areas; ○ Total weight of waste by type and disposal method; ○ Weight of transported, imported, exported, or treated waste deemed hazardous under the terms of Annexes I, II, III, and VIII of the Basel Convention, and percentage of transported waste shipped internationally; ○ Information from environmental impact assessments (EIA) and chemical risk assessments. • justifications for inclusions/exclusions. The OEFSRs shall furthermore define the appropriate unit for intensity-based metrics,

			required for specific communication purposes.
4.7	Assumptions/limitations	All limitations and assumptions shall be transparently reported.	The OEFSR shall report sector specific limitations and define the assumptions necessary to overcome such limitations.
5	Resource Use and Emissions Profile	All resource use and emissions associated with the life cycle stages included in the defined system boundaries shall be included in the Resource Use and Emissions Profile. This flows shall be grouped into "elementary flows" and "non-elementary (i.e. complex) flows". All non-elementary flows in the Resource Use and Emissions Profile shall then be transformed into elementary flows.	
5.2	Resource Use and Emissions Profile – screening step	If a screening step is conducted (highly recommended), readily available specific and/or generic data shall be used, fulfilling the data quality requirements as defined in section 5.6. Any exclusion of supply chain stages shall explicitly be justified and submitted to the review process, and their influence on the final results shall be discussed. For supply chain stages for which a quantitative EF impact assessment is not intended, the screening step shall refer to existing literature and other sources in order to develop qualitative descriptions of potentially environmentally significant processes. Such qualitative descriptions shall be included in the Additional Environmental Information.	The OEFSR shall specify the processes to be included. The OEFSR shall also specify for which processes specific data are required, and for which the use of generic data is either permissible or required.
5.4	Resource Use and Emissions Profile - data	The Resource Use and Emissions Profile shall be the documented input and output flows associated with all activities and processes within the defined OEF boundaries. The following elements shall be considered for inclusion in the Resource Use and Emissions Profile: • Direct activities and impacts of sources owned and/or operated by the Organisation; • Indirectly attributable upstream activities; • Indirectly attributable downstream activities. Linear depreciation shall be used for capital equipment.	The OEFSR shall further specify sources, quality and review requirements for the data used in an OEF study. The OEFSR should provide one or more examples for compiling the Resource Use and Emissions Profile, including specifications with respect to: • Substance lists for activities/processes included; • Units; • Nomenclature for elementary flows. These may apply to one or more supply-chain stages, processes or activities, for the purpose of ensuring standardised data collection and reporting.

			The OEFSR may specify more stringent data requirements for key upstream, gate-to-gate or downstream stages than those defined in this OEF Guide. For modelling processes/activities within the defined Organisational boundary (i.e. gate-to-gate stage), the OEFSR shall also specify: • Processes/activities included; • Specifications for compiling data for key processes, including averaging data across facilities; • Any site-specific data required for reporting as "Additional Environmental Information"; • Specific data quality requirements, e.g. for measuring specific activity data. If the OEFSR requires/allows deviations from the default cradle-to-grave system boundary (e.g. if the OEFSR prescribes using cradle-to-gate boundary), the OEFSR shall specify how material/energy balances in the Resource Use and Emissions Profile shall be accounted for.
5.4.4	Accounting for electricity use (including use of renewable energy)	For electricity from the grid consumed upstream or within the defined Organisational boundary, supplier-specific data shall be used if available. If supplier-specific data is not available, country-specific consumption-mix data shall be used of the country in which the life cycle stages occur. For electricity consumed during the use stage of products, the energy mix shall reflect ratios of sales between countries or regions. Where such data are not available, the average EU consumption mix, or otherwise most representative mix, shall be used. For renewable electricity from the grid consumed upstream or within the defined Organisational boundary, it shall be guaranteed that the renewable electricity (and associated impacts) is not double counted. A statement of the supplier shall be included as annex to the OEF report, guaranteeing that the electricity supplied	

		is effectively generated using renewable sources and is not sold to any other organisation.	
5.4.4	Biogenic carbon emissions	Removals and emissions for biogenic carbon sources shall be identified separately in the Resource Use and Emissions Profile.	
5.4.4	Renewable energy generation	Credits associated with renewable energy generated by the Organisation shall be calculated with respect to the corrected (i.e. by subtracting the externally provided amount of renewable energy) average country-specific consumption-mix data of the country to which the electricity is provided. Where such data is not available, the corrected average EU consumption mix, or otherwise most representative mix shall be used. If no data are available on the calculation of corrected mixes, the uncorrected average mixes shall be used. It shall be transparently reported which energy mixes are assumed for the calculation of the benefits and whether or not these have been corrected.	
5.4.4	Temporary (carbon)storage and delayed emissions	Credits associated with temporary (carbon) storage or delayed emissions shall not be considered in the calculation of the default EF impact categories. These shall be reported in the Additional Environmental Information if required by the OEFSRs.	
5.4.4	Direct land use change (impact for climate change)	Greenhouse gas emissions from direct land use change shall be allocated to goods/services for 20 years following the land use change using the IPCC default values. For details see annex VI. Greenhouse gas emissions from indirect land use change shall not be included.	
5.4.4	Indirect land use change (impact for climate change)	Greenhouse gas emissions from indirect land use change shall not be included.	
5.4.5	Modelling transport scenarios	Transport parameters that shall be taken into account are: transport type, vehicle type and fuel consumption, load rate, number of empty returns when applicable and relevant, transport distance, allocation for goods transport based on load-limiting factor (i.e. mass for high-density products and volume for low-density products) and fuel production. The impacts due to transport shall be expressed in the default reference units, i.e. tkm for goods and person-km for passenger transport. Any deviation from these default reference units shall be	The OEFSR shall specify transport, distribution and storage scenarios to be included in the study, if any.

		reported and justified. The environmental impact due to transport shall be calculated by multiplying the impact per reference unit for each of the vehicle types by a) for goods: the distance and load and b) for persons: the distance and number of persons based on the defined transport scenarios.	
5.4.6	Modelling use stage scenarios	If downstream stages are to be included in the OEF, then use profiles (i.e. the related scenarios and assumed service life) shall be specified for representative goods/services for the sector. All relevant assumptions for the use stage shall be documented. Where no method for determining the use stage of products has been established in accordance with the techniques specified in this Guide, the approach taken in determining the use stage of products shall be established by the Organisation carrying out the study. Documentation of methods and assumptions shall be provided. Relevant influences on other systems due to the use of the products shall be included.	The OEFSR shall specify: • The use scenario(s) to be included in the study, if any; • The time span to be considered for the use stage. Published technical information should be taken into account for the definition of the use-stage scenarios. Definition of the use profile should also take into account use/consumption patterns, location, time (day/night, summer/winter, week/weekend), and assumed service life for the use stage of products. The actual usage pattern of the products should be used if available.
5.4.7	Modelling EOL scenarios	Waste flows arising from processes included in the system boundaries shall be modelled to the level of elementary flows.	The OEFSR shall define the EOL scenario(s) to be included in the OEF study, if any. These scenarios shall be based on current (year of analysed time interval) practice, technology and data.
5.5	Nomenclature	All resource use and emissions associated with the life cycle stages included in the defined system boundaries shall be documented using the International Life Cycle Data system (ILCD) nomenclature and properties. If nomenclature and properties for a given flow are not available in the ILCD, the practitioner shall create an appropriate nomenclature and document the flow properties.	
5.6	Data quality requirements	Data quality requirements shall be met by an OEF study intended for external communication. Data quality requirements apply to both specific data and generic data.	The OEFSR shall provide further guidance on data quality assessment scoring with respect to time-related, geographical and technological representativeness. The OEFSR shall for example

		The following 6 criteria shall be adopted for semi-quantitative assessment of data quality in OEF studies: • Technological representativeness; • Geographical representativeness; • Time-related representativeness; • Completeness; • Parameter uncertainty; • Methodological appropriateness and completeness. In the optional screening step (if conducted) a minimum "fair" quality data rating is required for data contributing to at least 90% of the impact estimated for each EF impact category, as assessed via qualitative expert judgement. In the final Resource Use and Emissions Profile, for the processes and/or activities accounting for at least 70% of contributions to each EF impact category, both specific and generic data shall achieve at least an overall "good quality" level. A semi-quantitative assessment of data quality shall be performed and reported for these processes. At least 2/3 of the remaining 30% (i.e. 70% to 90%) shall be modelled with at least "fair quality" data, as assessed via qualitative expert judgement. Remaining data (used for approximation and filling identified gaps (beyond 90% contribution to environmental impacts)) shall be based on best available information. The data quality requirements for technological, geographical and time related representativeness shall be subject to review as part of the OEF study. The data quality requirements related to completeness, methodological appropriateness and consistency, and parameter uncertainty shall be met by sourcing generic data exclusively from data sources complying with the requirements of the OEF Guide. With respect to the data quality criterion "methodological appropriateness and consistency", the requirements as defined in Table 6 shall apply until end 2015. From 2016 onwards, full compliance with the OEF methodology will be required.	specify which data quality score related to time representativeness should be assigned to a dataset representing a given year. The OEFSR may specify additional criteria for the assessment of data quality (compared to the default criteria). The OEFSR may specify more stringent data quality requirements regarding e.g.: • Foreground processes; • Background processes (both upstream and downstream stages); • Key supply chain processes/activities for the sector; • Key EF impact categories for the sector.

		With respect to the level at which assessment of data quality shall be conducted: • For generic data, at the level of the input flows; • For specific data, at the level of an individual process or aggregated processes, or at the level on individual input flows.	
5.7	Specific Data Collection	Specific data shall be obtained for all foreground processes/activities and for background processes/activities, where appropriate. However, if generic data are more representative or appropriate than specific data (to be reported and justified) for foreground processes, generic data shall also be used for the foreground processes.	The OEFSRs shall specify: 1. For which processes specific data shall be collected; 2. The requirements for collection of specific data for each process/activity; 3. The data collection requirements for the following aspects for each site: • Target stage(s) and the data collection coverage; • Location of data collection (e.g. domestically, internationally, representative factories); • Term of data collection (e.g. year, season, month, etc.); • When the location or term of data collection shall be limited to a certain range, provide a justification and show that the collected data will serve as sufficient samples. Note: The basic rule is that the location of data collection is all target areas and the term of data collection is one year or more.
5.8	Generic Data Collection	When available, sector-specific generic data shall be used instead of multi-sector generic data. All generic data shall fulfil the data quality requirements specified. The sources of the data used shall be clearly documented and reported in the OEF report.	The OEFSR shall specify: • Where the use of generic data is permitted as an approximation for a substance for which specific data are not available; • The level of required similarities between the actual substance and the generic substance; • The combination of more than one generic dataset, if necessary.

5.9	Data Gaps	Any data gaps shall be filled using best available generic or extrapolated data[93]. The contribution of such data (including gaps in generic data) shall not account for more than 10% of the overall contribution to each EF impact category considered. This is reflected in the data quality requirements, according to which 10% of the data can be chosen from the best available data (without any further data quality requirements).	The OEFSR shall specify potential data gaps and provide detailed guidance for filling data gaps.
5.11	Handling Multi-functionality	The OEF multi-functionality decision hierarchy shall be applied for resolving all multi-functionality problems at both process and facility-level: (1) subdivision or system expansion; (2) allocation based on a relevant underlying physical relationship (including (a) direct substitution or (b) some relevant underlying physical relationship); (3) allocation based on some other relationship (including (a) indirect substation or (b) some other relevant underlying relationship). All choices made in this context shall be reported and justified with respect to the overarching goal of ensuring physically representative, environmentally relevant results. If co-products are partly co-products and partly waste, all inputs and outputs shall be allocated to the co-products only. Allocation procedures shall be uniformly applied to similar inputs and outputs. For multi-functionality problems including recycling or energy recovery at EOL or for waste flows within the system boundaries, the equation described in Annex V shall be applied.	The OEFSR shall further specify multi-functionality solutions for application within the defined Organisational boundaries and, where appropriate, for upstream and downstream stages. If feasible/appropriate, the OEFSR may further provide specific substitution scenarios or factors to be used in 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. Where sub-division is applied, the OEFSR shall specify which processes are to be sub-divided and according to what principles. Where allocation by physical relationship is to be applied, the OEFSR shall specify the relevant underlying physical relationship to be considered and establish the relevant allocation factors. Where allocation by some other relationship is to be applied, the OEFSR shall specify the relationship and establish the relevant allocation factors. For example, in the case of economic allocation, the OEFSR shall specify the rules for determining the

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

			economic values of co-products. For multi-functionality in EOL situations, the OEFSR shall specify how to calculate the different parts within the provided mandatory formula.
6	Environmental Footprint Impact Assessment	The EF impact assessment shall include: • Classification; • Characterisation.	
6.1.1	Classification	All inputs/outputs inventoried during the compilation of the Resource Use and Emissions Profile shall be assigned to the EF impact categories to which they contribute ("classification") using the classification scheme as provided at http://lct.jrc.ec.europa.eu/assessment/projects. If the Resource Use and Emissions Profile data are drawn from existing public or commercial life cycle inventory databases - where classification has already been implemented - it shall be assured that the classification and linked EF impact assessment pathways correspond to the requirements of this OEF Guide.	
6.1.2	Characterisation	All classified inputs/outputs in each EF impact category shall be assigned CFs representing the contribution per unit of input/output to the category, using the provided CFs (available online at http://lct.jrc.ec.europa.eu/assessment/projects). EF impact assessment results shall subsequently be calculated for each EF impact category by multiplying the amount of each input/output by its CF and summing contributions of all inputs/outputs within each category to a single measure expressed in terms of an appropriate reference unit. If CFs from the default methods are not available for certain flows (e.g. a group of chemicals) of the Resource Use and Emissions Profile, then other approaches may be used for characterising these flows. In such circumstances, this shall be reported under "Additional Environmental Information". The characterisation models shall be scientifically and technically valid, and based upon distinct, identifiable environmental mechanisms or reproducible empirical observations.	

6.2.1	Normalisation (if applied)	Normalisation is not a required step for OEF studies. If it is applied, the normalised OEF results shall be reported under "Additional Environmental Information", with all methods and assumptions documented. The normalised results shall not be aggregated as this implicitly applies weighting. Results of the EF impact assessment prior to normalisation shall be reported alongside the normalised results.	
6.2.2	Weighting (if applied)	Weighting is not a required step for OEF studies. If weighting is applied, the weighted results shall be reported as "Additional Environmental Information", with all methods and assumption documented. Results of the EF impact assessment prior to weighting shall be reported alongside weighted results. The application of normalisation and weighting steps in OEF studies shall be consistent with the defined goals and scope of the study, including the intended applications.	
7	Interpretation of results	The interpretation phase of an OEF study shall include the following steps: assessment of the robustness of the OEF model; identification of hotspots; estimation of uncertainty; and conclusions, limitations and recommendations.	
7.2	Model robustness	The assessment of the robustness of the OEF model shall include an assessment of the extent to which methodological choices such as system boundaries, data sources, allocation choices and coverage of EF impact categories influence the results. These choices shall correspond to the requirements specified in this Guide and shall be appropriate to the context.	
7.3	Hotspots	OEF results shall be evaluated to assess supply-chain hotspots/weak points at the level of the input/output, process, and supply chain stage and to assess potential for improvements.	The OEFSR shall identify the most relevant EF impact categories for the sector. Normalisation and weighting may be used to achieve such prioritisation.
7.4	Estimation of Uncertainty	At least a qualitative description of the uncertainties of the final OEF results shall be provided for both data and choice related uncertainties separately, in order to facilitate an overall appreciation of the uncertainties of the study results.	The OEFSR shall describe the uncertainties common to the sector and should identify the range in which results could be seen as not being significantly different in comparisons or comparative assertions.
7.5	Conclusions, Recommendations, and Limitations	Conclusions, recommendations and limitations shall be described in accordance with the defined goals and scope of the OEF study. OEF studies to support comparative assertions intended to be disclosed	

		to the public shall be based both on this OEF Guide and related OEFSRs. As required by ISO 14044:2006, for any comparative assertions intended to be disclosed to the public it shall be carefully considered whether any differences in data quality and methodological choices used to model the compared organisations may influence the comparability of the outcomes. Any inconsistencies in defining system boundaries, inventory data quality, or EF impact assessment shall be considered and documented/reported.	
8	Reporting	Any OEF study intended for external communications shall include an OEF study report, which shall provide a relevant, comprehensive, consistent, accurate, and transparent account of the study and of the calculated environmental impacts associated with the Organisation. The reported information shall also provide a robust basis for assessing, tracking, and seeking to improve the environmental performance of the Organisation over time. The OEF report shall include, at a minimum, a Summary, a Main Report, and an Annex. These shall contain all the reporting elements specified in this OEF Guide (section 8.2).	The OEFSR shall specify and justify any deviations from the default reporting requirements and any additional reporting requirements and/or differentiate reporting requirements that depend on, for example, the type of applications of the OEF study and the type of organisation being assessed. The OEFSRs shall specify whether the OEF results shall be reported separately for each of the selected life cycle stages.
9.1	Review	Any OEF study intended for external communication shall be critically reviewed in order to ensure that: • The methods used to carry out the OEF study are consistent with this OEF Guide; • The methods used to carry out the OEF study are scientifically and technically valid; • The data used are appropriate, reasonable and meet the defined quality requirements; • The interpretation of the results reflects the limitations identified; • The study report is transparent, accurate and consistent.	
9.2	Review Type	Unless otherwise specified in relevant policy instruments, any OEF study intended for external communication shall be critically reviewed by at least one independent and qualified external reviewer (or review team). An OEF study to support a comparative assertion intended to be disclosed to the public shall be based on relevant OEFSRs and critically reviewed by at least three	The OEFSR shall specify the review requirements for OEF studies to be used for comparative assertions intended to be disclosed to the public (e.g. whether a review by at least three independent qualified external reviewers is sufficient).

		independent qualified external reviewers.	
9.3	Reviewer Qualifications	A critical review of the OEF study shall be conducted as per the requirements of the intended application. Unless otherwise specified, the minimum necessary score to qualify as a reviewer or a review team is six points, including at least one point for each of the three mandatory criteria (i.e. verification and audit practice, EF or LCA methodology and practice, and knowledge of technologies or other activities relevant to the OEF study). Score points per criteria shall be achieved by individuals, while score points may be summed across criteria at the team level. Reviewers or reviewer teams 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 part of the mandatory annex of the OEF report.	

(INFORMATIVE)

Annex II. Data Management Plan (Adapted from GHG Protocol Initiative[94])

If a data management plan is developed, the following steps should be undertaken and documented.

1. ***Establish an Organisation accounting quality person/team***. This person/team should be responsible for implementing and maintaining the data management plan, continually improving the quality of organisation inventories, and coordinating internal data exchanges and any external interactions (such as with relevant organisation accounting programs and reviewers).

2. ***Develop Data Management Plan and Checklist***. Development of the data management plan should begin before any data are collected to ensure that all relevant information about the inventory is documented as it proceeds. The plan should evolve over time as data collection and processes are refined. In the plan, the quality criteria and any evaluation/scoring systems are to be defined. The data management plan checklist outlines what components should be included in a data management plan and can be used as a guide for creating a plan or for pulling together existing documents to constitute the plan.

3. ***Perform data quality checks***. Checks should be applied to all aspects of the inventory process, focusing on data quality, data handling, documentation, and calculation procedures. The defined quality criteria and scoring systems form the basis for the data quality checks.

4. ***Review of Organisation inventory and reports***. Selected independent external reviewers should review the study – ideally from the beginning.

5. ***Establish formal feedback loops to improve data collection, handling and documentation processes***. Feedback loops are needed to improve the quality of the organisation inventory over time and to correct any errors or inconsistencies identified in the review process.

6. ***Establish reporting, documentation and archiving procedures***. Establish record-keeping processes for which and how data should be stored; what information should be reported as part of internal and external inventory reports; and what should be documented to support data collection and calculation methodologies. The process may also involve aligning or developing relevant database systems for record keeping.

The data management plan is likely to be an evolving document that is updated as data sources change, data handling procedures are refined, calculation methodologies improve, organisation inventory responsibilities change within an organisation, or the business objectives of the organisation inventory change.

[94] WRI and WBCSB - Annex 3 of the Greenhouse Gas Protocol's Corporate Value Chain (Scope 3) Accounting and Reporting Standard, 2011

(INFORMATIVE)

Annex III. Data Collection Check-list

A data collection check-list is useful for organising data collection activities and results while compiling the Resource Use and Emissions Profile. The following non-exhaustive check-list may be used as a starting point for data collection and organisation of a data collection template:

- Introduction to the OEF study, including an overview of the objectives of data collection and the template/questionnaire employed;
- Information on the entity(ies) or person(s) responsible for measurement and data collection procedures;
- Description of the site where data are to be collected (for example, maximum and normal operation capacity, annual productive output, location, number of employees, etc.);
- Date/year of data collection;
- Description of the Organisation;
- Product Portfolio description;
- Overall flow diagrams[95] for owned/operated facilities within the defined Organisational boundaries;
- Input and outputs per facility;
- Data quality info (technological representativeness, geographical representativeness, time-related representativeness, completeness and parameter uncertainty).

Example: Simplified data collection check-list

Technical overview

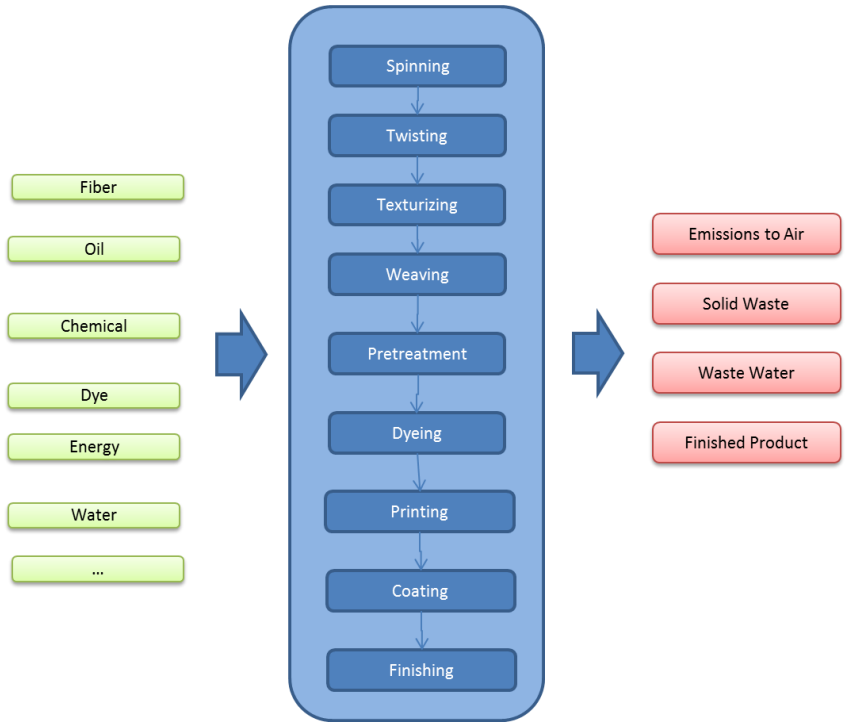


Figure 6 Process overview diagram for the production stage at a T-shirt company

[95] A flow diagram is a schematic representation of the modelled system (foreground systems and links to background system), and all major inputs and outputs.

List of processes within the system boundary: fibre production, spinning, twisting, texturising, weaving, pre-treatment, dyeing, printing, coating and finishing.

Collection of unit process Resource Use and Emissions Profile data

Process name: finishing process

Process diagram: finishing refers to processes performed on yarn or fabric after weaving or knitting to improve the look and, performance, of the finished textile product

In **Figure 7** the flow diagram is presented for a facility within the defined Organisational boundary.

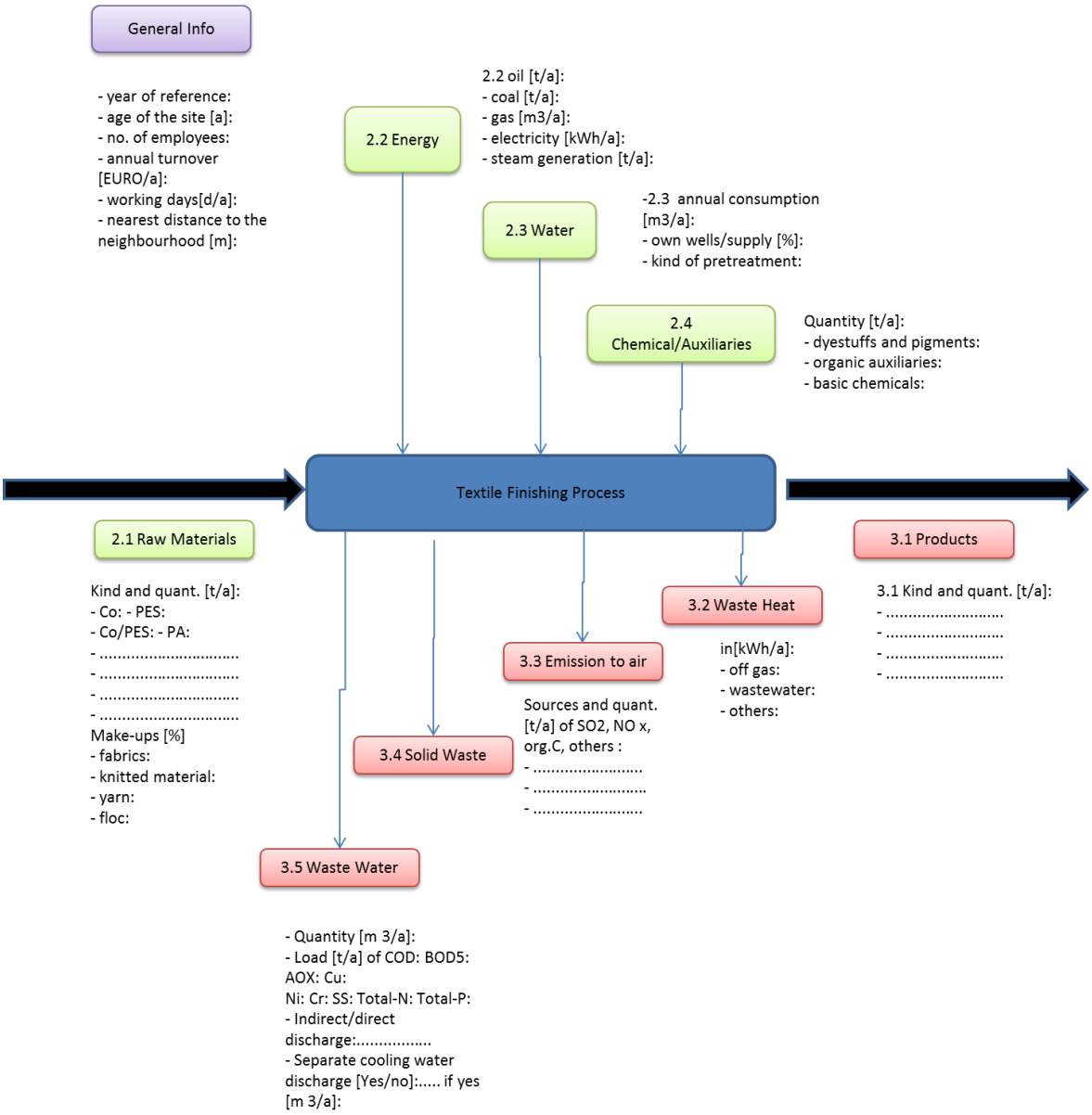


Figure 7: Flow diagram for a facility within the defined Organisational boundary

Total Inputs to Facility

Code	Name	Amount	Unit

Total Outputs from Facility

Code	Name	Amount	Unit

Example of Resource Use and Emissions Profile for a facility (selected substances)[96]

Parameter	Unit	Amount
Energy consumption (non-elementary)	GJ	115.5
Electricity (elementary)	GJ	34.6
Fossil Fuel (elementary)	GJ	76
Natural gas (elementary)	Mg	0.59
Natural gas, feedstock (elementary)	Mg	0.16
Crude oil (elementary)	Mg	0.57
Crude oil, feedstock (elementary)	Mg	0.48
Coal (elementary)	Mg	0.66
Coal, feedstock (elementary)	Mg	0.21
LPG (elementary)	Mg	0.02
Hydro power (elementary)	GJ	5.2
Water (elementary)	Mg	12400
Emissions to air (elementary flows)		
CO2	Mg	5,132
CH4	Mg	8.2

[96] A distinction is made between "**elementary flows**" (i.e. (ISO 14044, 3.12) "*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.*") and "**non-elementary flows**" (i.e. all the remaining 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)

SO2	Mg	3.9
Nox	Mg	26.8
CH	Mg	25.8
CO	Mg	28
Emissions to water (elementary flows)		
COD Mn	Mg	13.3
BOD	Mg	5.7
Tot-P	Mg	0.052
Tot-N	Mg	0.002
Product Outputs (non-elementary flows)		
Pants	#	20,000
T-shirts	#	15,000

Annex IV. Identifying Appropriate Nomenclature and Properties for Specific Flows

The principal target audience for this Annex are experienced Environmental Footprint practitioners and reviewers. This Annex is based on the "International Reference Life Cycle Data System (ILCD) Handbook - Nomenclature and other conventions". (EC – JRC – IES, 2010f). If further information and background is required on nomenclature and naming conventions, please refer to the afore mentioned document, which is available at: http://lct.jrc.ec.europa.eu/ .

Different groups often use considerably different nomenclature and other conventions. As a consequence, Resource Use and Emissions Profiles (for Life Cycle Assessment practitioners: Life Cycle Inventory (LCI) datasets) are incompatible on different levels, thereby strongly limiting the combined use of Resource Use and Emissions Profiles datasets from different sources or an efficient, electronic exchange of data among practitioners. This also hampers a clear unambiguous understanding and review of OEF reports.

The purpose of this Annex is to support data collection, documentation and use for Resource Use and Emissions Profiles in OEF studies by providing a common nomenclature and provisions on related topics. The document also forms the basis for a common reference elementary flow list for use in OEF studies.

This supports efficient OEF work and data exchange among different tools and databases.

The goal is to guide data collection, naming, and documentation in such a way that the data:

- Are meaningful, precise and useful for further EF impact assessments and interpretation and reporting;
- Can be compiled and provided in a cost-efficient way ;
- Are comprehensive and do not overlap;
- Can be efficiently exchanged among practitioners who have different databases and software systems, thereby reducing the likelihood of errors.

This nomenclature and other conventions focus on elementary flows, flow properties and the related units, and give suggestions for the naming of process datasets, product and waste flows, for better compatibility among different database systems. Basic recommendations and requirements are also given on the classification of source and contact datasets.

Table 10 lists the ILCD Handbook rules that are required in OEF studies. Table 11 specifies the rule-category and the relevant chapters of the ILCD Handbook.

Table 10: Required rules for each flow type.

Items	Required Rules from the ILCD- Nomenclature[97]
Raw material, input	2, 4, 5
Emission, output	2,4,9
Product flow	10,11,13,14,15,16,17

[97] ILCD Handbook – Nomenclature and other conventions. http://lct.jrc.ec.europa.eu/assessment/publications

Table 11: ILCD Nomenclature Rules[98].

Rule #	Rule Category	Chapter in ILCD Handbook - Nomenclature and other conventions
2	"elementary flow categories" by receiving / providing environmental compartment	Chapter 2.1.1
4	Further differentiation of providing/receiving environmental compartments	Chapter 2.1.2
5	Additional, non-identifying classification for "Resources from ground" elementary flows	Chapter 2.1.3.1
9	Recommended for both technical and non-technical target audience: additional, non-identifying classification for emissions	Chapter 2.1.3.2
10	Top-level classification for Product flows, Waste flows, and Processes	Chapter 2.2
11	Second level classifications for Product flows, Waste flows, and Processes (for preceding top-level classification)	Chapter 2.2
13	“Base name” field	Chapter 3.2
14	“Treatment, standards, routes” name field	Chapter 3.2
15	“Mix type and location type” name field	Chapter 3.2
16	“Quantitative flow properties” name field	Chapter 3.2
17	Naming pattern of flows and processes	Chapter 3.2

Example of Identifying Appropriate Nomenclature and Properties for Specific Flows

Raw material, Input: Crude oil (Rules 2,4,5)

(1) Specify "elementary flow category" by the issuing / receiving environmental compartment:
Example: Resources - Resources from ground

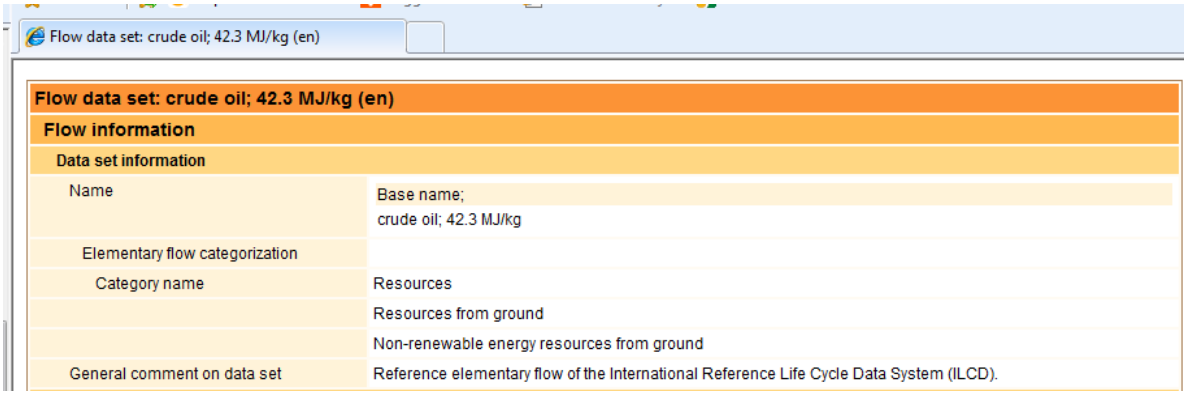
(2) Further differentiation of issuing / receiving environmental compartments
Example: Non-renewable energy resources from ground

(3) additional, non-identifying classification for "Resources from ground" elementary flows

Example: Non-renewable energy resources from ground (e.g. "Crude oil; 42.3 MJ/kg net calorific value")

Flow dataset: Crude oil: 42.3 MJ/kg net calorific value

[98] Same as previous footnote.



Flow data set: crude oil; 42.3 MJ/kg (en)

Flow data set: crude oil; 42.3 MJ/kg (en)	
Flow information	
Data set information	
Name	Base name; crude oil; 42.3 MJ/kg
Elementary flow categorization	
Category name	Resources
	Resources from ground
	Non-renewable energy resources from ground
General comment on data set	Reference elementary flow of the International Reference Life Cycle Data System (ILCD).

Ref: http://lct.jrc.ec.europa.eu/

Emission, output: Example: Carbon Dioxide (Rules 2, 4, 9)

(1) Specify "elementary flow categories" by issuing / receiving environmental compartment:

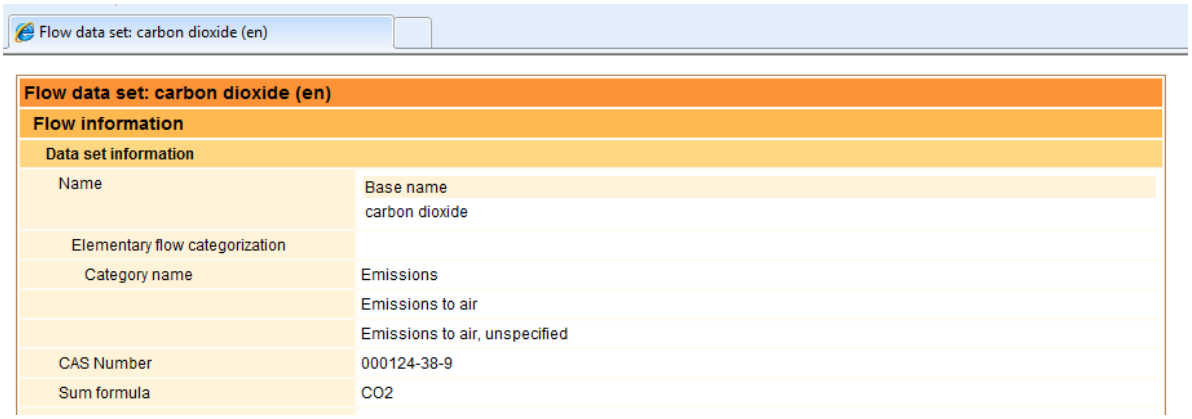
Example: Emissions – Emissions to air - Emissions to air, unspecified

(2) Further differentiation of issuing / receiving environmental compartments

Example: “Emission to air, DE”

(3) Additional, non-identifying classification of emissions

Example: Inorganic covalent compounds” (e.g. "Carbon dioxide, fossil", "Carbon monoxide", "Sulphur dioxide", "Ammonia", etc.)



Flow data set: carbon dioxide (en)

Flow data set: carbon dioxide (en)	
Flow information	
Data set information	
Name	Base name carbon dioxide
Elementary flow categorization	
Category name	Emissions
	Emissions to air
	Emissions to air, unspecified
CAS Number	000124-38-9
Sum formula	CO2

Ref: http://lct.jrc.ec.europa.eu/

Product flow: Example: T-shirt (Rules 10-17)

(1) Top-level classification for Product flows, Waste flows, and Processes:

Example: “System”

(2) second level classifications for Product flows, Waste flows, and Processes (from preceding top-level classification):

Example: “Textiles, furniture and other interiors”

(3) “Base name” field:

Example: “Base Name: White polyester T-shirt”

(4) “Treatment, standards, routes” name field:

Example: “ ”

(5) “Mix type and location type” name field:

“Production mix, at point of sale”

(6) “Quantitative flow properties” name field:

Example: “160 grammes polyester”

(7) Naming convention of flows and processes.

<“Base name”; “Treatment, standards, routes”; “Mix type and location type”; “Quantitative flow properties”>.

Example: “White polyester T-shirt; product mix at point of sale; 160 grammes polyester”

Annex V. Dealing with Multi-functionality in End-of-Life Situations

Dealing with multi-functionality of products is particularly challenging when recycling or energy recovery of one (or more) of these products is involved as the systems tend to get rather complex.

The overall resulting Resource Use and Emissions Profile (RUaEP) per unit of analysis can be estimated using the formula provided below, which:

- Is applicable for both open-loop and closed-loop recycling;
- If relevant/applicable, and can accommodate re-use of the product being assessed. This is modelled in the same manner as recycling;
- If relevant/applicable, can accommodate downcycling, i.e. any differences in quality between the secondary (i.e. recycled or reused) material and the primary (i.e. virgin) material;
- If relevant/applicable, can accommodate energy recovery.

The quantitative figures for the relevant parameters involved need to be gathered in order to use the formula provided below to estimate the overall RUaEP per unit of analysis. Whenever feasible, this should be determined based on data associated with the actual processes involved. However, this may not always be possible / feasible and data may have to be found elsewhere (please note that the explanation provided hereafter for each term of the formula contains a recommendation on how/where to find missing data).

The RUaEP per unit of analysis[99] is calculated with the following formula.

$$(1-R_1)\times E_V + R_1 \times E_{recycled} + R_2 \times \left(E_{recyclingEoL} - E^*_V \times \frac{Q_S}{Q_P} \right) + R_3 \times \left(E_{ER} - LHV \times X_{ER} \times E_{SE} \right) + (1-R_2-R_3)\times E_D$$

The abovementioned formula can be divided into 5 blocks:

$VIRG_{IN} + REC_{IN} + REC_{OUT} + ER_{OUT} + DISP_{OUT}$

These are interpreted as follows (the different parameters are explained in detail hereafter):

- $VIRG_{IN} = (1-R_1)\times E_V$ represents the RUaEP from virgin material acquisition and pre-processing.
- $REC_{IN} = R_1 \times E_{recycled}$ represents the RUaEP associated to the recycled material input and is proportional to the fraction of material input that has been recycled in a previous system.

[99] The unit of analysis can differ depending on the product/material assessed. In many cases this will be 1 kg of material, but may differ if relevant. For wood for example, it is more common to use 1 m^3 as unit of analysis (because the weight differs according to the water content).

- REC_{OUT} = $R_2 \times \left(E_{recyclingEoL} - E^*_V \times \frac{Q_S}{Q_P} \right)$ represents the RUaEP from the recycling (or re-use) process from which the credit from avoided virgin material input (accounting for any eventual downcycling) are subtracted.

- ER_{OUT} = $R_3 \times (E_{ER} - LHV \times X_{ER} \times E_{SE})$ represents the RUaEP arising from the energy recovery process from which the avoided emissions arising from the substituted energy source have been subtracted.

- $DISP_{OUT}$ = $(1 - R_2 - R_3) \times E_D$ represents the net RUaEP from the disposal of the fraction of material that has not been recycled (or re-used) at End-of-Life or handed over to an energy recovery process.

Where:

- E_V = specific emissions and resources consumed (per unit of analysis) arising from virgin material (i.e. virgin material acquisition and pre-processing). If this information is not available, generic data should be used which should be sourced according to the sources of generic data listed in section 5.8.

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

    - If only closed loop recycling takes place: $E^*_V = E_V$;

    - If only open loop recycling takes place: $E^*_V = E'_V$ represents the input of virgin material that refers to the actual virgin material substituted through open loop recycling. If this information is not available, assumptions should be made as to what virgin material is substituted, or average data should be used which should be sourced according to the sources of generic data listed in section 5.8. If no other relevant information is available it could be assumed that $E'_V = E_V$ as if closed loop recycling had taken place.

- $E_{recycled}$ = specific emissions and resources consumed (per unit of analysis) arising from the recycling[100] (or re-use) process of the recycled (or re-used) material, including collection, sorting and transportation processes. If this information is not available, generic data should be used which should be sourced according to the sources of generic data listed in section 5.8.

- $E_{recyclingEoL}$ = specific emissions and resources consumed (per unit of analysis) arising from the recycling process at the End-of-Life stage, including collection, sorting and transportation processes. If this information is not available, generic data should be used which should be sourced according to the sources of generic data listed in section 5.8.

  Note: in closed loop recycling situations $E_{recycled} = E_{recyclingEoL}$ and $E^*_V = E_V$

- E_D = specific emissions and resources consumed (per unit of analysis) arising from disposal of waste material (e.g. landfill, incineration, pyrolysis). If this information is not available, generic data

[100] "Recycled" should be interpreted in a wide context. It includes for example also composting and methanisation.

should be used which should be sourced according to the sources of generic data listed in section 5.8.

- E_{ER} = specific emissions and resources consumed (per unit of analysis) arising from the energy recovery process. If this information is not available, generic data should be used which should be sourced according to the sources of generic data listed in section 5.8.

- E_{SE} = specific emissions and resources consumed (per unit of analysis) that would have arisen from the substituted energy source. If this information is not available, generic data should be used which should be sourced according to the sources of generic data listed in section 5.8.

- R_1 [dimensionless] = "recycled (or re-used) content of material", is the proportion of material in the input to the production that has been recycled in a previous system ($0=<R_1<=1$). If this information is not available, comprehensive and regularly updated statistical information on recycling rates and other relevant parameters can be obtained from suppliers such as Eurostat[101].

- R_2 [dimensionless] = "recycling (or reuse) fraction of material", is the proportion of the material in the product that will be recycled (or re-used) in a subsequent system; i.e. the rate between recycled output and virgin material input. R_2 shall therefore take into account the inefficiencies in the collection and recycling (or re-use) processes ($0=<R_2=<1$). If this information is not available, comprehensive and regularly updated statistical information on recycling rates and other relevant parameters can be obtained from suppliers such as Eurostat[101].

- R_3 [dimensionless] = the proportion of material in the product that is used for energy recovery (e.g. incineration with energy recovery) at EoL ($0=<R_3=<1$). If this information is not available, comprehensive and regularly updated statistical information on recycling rates and other relevant parameters can be obtained from suppliers such as Eurostat[101].

- LHV = Lower Heating Value [e.g. MJ/kg] of the material in the product that is used for energy recovery. This should be determined with an appropriate laboratory method. If this is not possible or feasible, generic data should be used (see, for example, the "ELCD Reference elementary flows"[102], and the ELCD database under EoL treatment / Energy recycling[103]).

- X_{ER} [dimensionless] = the efficiency of the energy recovery process ($0<X_{ER}<1$), i.e. the ratio between the energy content of output (e.g. output of electricity) and the energy content of the material in the product that is used for energy recovery. X_{ER} shall therefore take into account the inefficiencies of the energy recovery process ($0=<X_{ER}<1$). If this information is not available, generic data should be used (see, for example EoL treatment / Energy recycling in the ELCD database).

- Qs = quality of the secondary material, i.e. the quality of the recycled (or re-used) material (see note below).

[101] Data on hazardous / non-hazardous waste generation and treatment per each Member State can be found at: http://epp.eurostat.ec.europa.eu/portal/page/portal/environment/data/main_tables;
Data on municipal solid waste generation and treatment per each Member Sate can be found at: http://europa.eu/rapid/pressReleasesAction.do?reference=STAT/12/48&format=HTML&aged=0&language=EN&guiLanguage=en; and at: http://epp.eurostat.ec.europa.eu/tgm/refreshTableAction.do?tab=table&plugin=1&pcode=tsdpc240&language=en;

[102] http://lct.jrc.ec.europa.eu/assessment/publications

[103] http://lca.jrc.ec.europa.eu/lcainfohub/datasetList.vm?topCategory=End-of-life+treatment&subCategory=Energy+recycling

- Qp = quality of the primary material, i.e. the quality of the virgin material (see note below).

Note: Q_s/Q_p is a dimensionless ratio taken as an approximation for any differences in quality between the secondary material and the primary material ("downcycling"). Following the EF multi-functionality hierarchy (see section 5.11), the possibility of identifying a relevant, underlying physical relationship as a basis for the quality correction ratio will be assessed (the limiting factor shall be determining). If this is not possible, some other relationship shall be used, for example, economic value. In this case, the prices of primary versus secondary materials are assumed to serve as a proxy for quality. In such a situation, Qs/Qp would correspond to the ratio between the market price of the secondary material (Qs) and the market price of the primary material (Qp). Market prices of primary and secondary materials can be found in online sources[104]. The quality aspects to be considered for the primary and secondary material shall be specified in the OEFSR.

[104] For instance: http://data.worldbank.org/data-catalog/commodity-price-data; http://www.metalprices.com/; http://www.globalwood.org/market/market.htm; http://www.steelonthenet.com/price_info.html; http://www.scrapindex.com/index.html.

Annex VI: Guidance on the Calculation of (Direct) Land Use Change Emissions Relevant for Climate Change

Credits associated with temporary (carbon) storage or delayed emissions shall not be considered in the calculation of the OEF for the default impact categories, unless otherwise specified in a supporting OEFSR. However, credits associated with temporary (carbon) storage or delayed emissions may be reported under "Additional Environmental Information" if foreseen and justified in the goal/scope of the OEF study.

INTRODUCTION

This Annex gives guidance on the calculation of carbon stock emissions related to land use change contributing to climate change. This annex is divided into two sections. The first section presents guidance on the inclusion of land use change emissions in the calculation of climate change. The second section provides a summary of the equations used in the 2006 IPCC Guidelines for National Greenhouse Gas Inventories (IPCC 2006) for the calculation of greenhouse gas emissions from agriculture, forestry and other land use.

For the cases in which the life cycle of the Organisation includes products consisting of biogenic materials, the impact of land use change on climate change must be accounted for.

The impact of land use change on climate change results basically from a change in carbon stocks in a land. The carbon stock changes in ecosystems can be divided into three main carbon storage/sink pools, some including sub-pools: (i) biomass (above- and below ground); (ii) dead organic matter (dead wood and litter) and (iii) soil organic carbon (IPCC 2006).

The impact on climate is a result of biogenic CO_2 emissions and removals, caused by carbon stock change, and biogenic and non-biogenic CO_2, N_2O and CH_4 emissions (e.g. biomass burning). Biogenic emissions include those resulting from the burning (combustion) or degradation of biogenic materials, wastewater treatment and biological sources in soil and water (including CO_2, CH_4 and N_2O), while biogenic removals correspond to the uptake of CO_2 during photosynthesis. Non-biogenic emissions correspond to all emissions resulting from non-biogenic sources, such as fossil-based materials, while non-biogenic removals correspond to the CO_2 that is removed from atmosphere by a non-biogenic source (WRI and WBCSD 2011b).

Changes in land use might be classified as being direct or indirect:

Direct Land Use Changes (dLUC) occur as the results of a transformation from one land use type into another, which takes place in a unique land cover, possibly incurring changes in the carbon stock of that specific land, but not leading to a change in another system.

Indirect Land Use Changes (iLUC) occur when a certain change in land use induced changes outside the system boundaries, i.e. in other land use types. These indirect effects can be assessed by economic modelling of the demand for land or by modelling the relocation of activities on a global scale. The main drawbacks of such models are their reliance on trends, which might not reflect future developments, and their commonly basis on political decisions.

Figure 8 shows the schematic representation of both direct and indirect land use changes, for which biofuel production is taken as the introduced land use change.

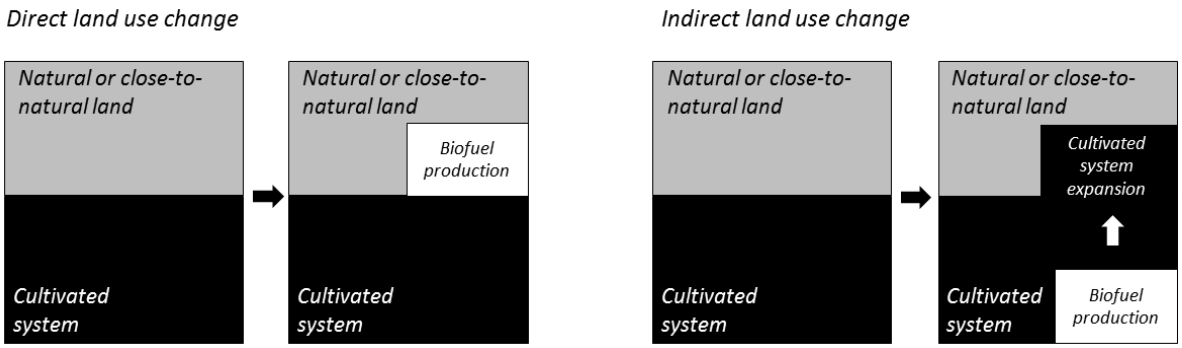


Figure 8 Schematic representation of direct and indirect land use changes. (CE Delft 2010)

No widely accepted provisions exist for the calculation of emissions resulting from indirect land use change, so no specific recommendations or guidance are supplied here. These shall not be assessed in the OEF study.

For the release and uptake of CO_2 caused by direct land use change, the use of the most recent IPCC CO_2 emission factors shall be used, unless more accurate, specific data are available. Detailed provisions are given in this document, based on the main IPCC equations (IPCC 2006) to calculate emissions resulting from land use change. Other emissions as a result of land use change (e.g. NO_3^- losses to water, emissions from biomass burning, soil erosion, etc.) should be measured or modelled for the particular case or using authoritative sources.

Some of the current mostly applied methodologies for accounting for GHG emissions and removals from land use changes have been analysed, including (i) AFNOR BP X 30-323; (ii) ISO 14067; (iii) BSI PAS 2050:2011 and PAS 2050-1:2012 (iv) WRI/WBCSD GHG Protocol Product Standard; and the (v) EC ILCD Handbook.

In coherence with the European Food Sustainable Consumption and Production Roundtable (Food SCP) and the published ENVIFOOD Protocol, the application of PAS 2050:2011 (BSI 2011) is recommended, supplemented by the PAS2050-1 (BSI 2012), for the assessment of GHG emissions from the cradle-to-gate (from raw material extraction to manufacturing) stages of the life cycle of horticultural products. The PAS 2050-1:2012 takes into account the emissions and removals involved in the cultivation of a horticultural crop product and should supplement rather than substitute PAS 2050:2011. A supplementary excel file is also provided by the British Standard Institution (BSI) for the PAS 2050-1:2012 calculations. It is important to emphasise that both standards address only the impacts contributing to global warming potential. Complementary information is supplied by the GHG Protocol (WRI and WBCSD 2011b).

In this Guide, the general provisions of the recommended PAS 2050:2011 are highlighted, together with the equations used in the 2006 IPCC GHG emissions and removals calculations.

SECTION 1: GUIDANCE ON THE INCLUSION OF LAND USE CHANGE EMISSIONS AND REMOVALS ON THE CALCULATION OF IMPACT ON CLIMATE CHANGE

According to the GHG Protocol (WRI and WBCSD 2011b), land use change impacts on climate change result from:

- "**Biogenic CO_2 emissions and removals due to carbon stock change** occurring as a result of land conversion within or between LU (Land Use) categories" (WRI and WBCSD 2011b).
- "**Biogenic and non-biogenic CO_2, N_2O and CH_4 emissions** resulting from the preparation of converted land, such as biomass burning or liming (only biomass burning, liming and other practices *used to prepare converted land*. Biomass burning and fertilizer application due to agricultural and forestry practices are also included in the inventory as attributable processes, separate from LUC impacts)" (WRI and WBCSD 2011b).
- "*If companies are not sure whether emissions are from a biogenic or non-biogenic source, they should include those emissions as non-biogenic*" (WRI and WBCSD 2011b).

This Annex provides guidance for specific situations, following the recommendations of PAS 2050:2011 (BSI 2011), PAS 2050-1;2012 (BSI 2012) and the GHG Protocol (WRI and WBCSD 2011b).

Knowledge on previous LU category and production location

Following PAS 2050:2011 (BSI 2011), three distinct situations (and respective guidelines) can be identified, depending on the availability of information about the location of production and the previous land use category:

- "**Country of production and previous LU are known**: GHG emissions from LUC from a previous land use into the current one might be found in Annex C, from the PAS 2050:2011 (BSI 2011). For the emissions not listed in Annex C, the 2006 IPCC Guidelines for National Greenhouse Gas Inventories should be used" (BSI 2011).
- "**Country of production is known and previous LU is unknown**: GHG emissions shall be the estimate of LUC average emissions for that crop in that country" (BSI 2011).
- "**Country of production and previous LU are unknown**: GHG emissions shall be the weighted average LUC emissions of that specific commodity in the countries in which it is grown" (BSI 2011).

- **Data on a specific land area is available**: data should be applied (WRI and WBCSD 2011b).

- **Data on a specific land use cannot be gathered**: the recommendation is to "first check for most probable locations by means of:
  - choice of the largest producing location or the most likely;
  - scenario analysis;
  - average data on locations" (WRI and WBCSD 2011b).

"Otherwise, historical data can be collected, by means of land use imaging or average data, for the estimation of impacts over the past years" (WRI and WBCSD 2011b).

- "**Product is harvested** and **land is converted into another managed land use type/category:** stock changes are distributed among all products resulting from that land. GHGs emissions and removals impacts are distributed over the amortization period" (WRI and WBCSD 2011b).

- "**Product is harvested**, but **no land use change** occurs: any stock change is attributable to the products resulting from the harvested land" (WRI and WBCSD 2011b).

- "**Product is not harvested**, but **land use change occurs**: LU impacts must be distributed to the product produced on the converted land" (WRI and WBCSD 2011b).

I. EMISSIONS AND REMOVALS FROM LAND USE CHANGE (LUC)

General emissions and removals to be included in the assessment

Following PAS 2050:2011 (BSI 2011) the emissions and removals to be included in the assessment are:

- **Gases included** in **Annex A of the PAS 2050:2011** (BSI 2011);

  OBS: Some exceptions may apply for biogenic carbon emissions and removals related to food and animal feed products (see 5.11, page 9, PAS 2050:2011)

- For methane (CH_4) emissions resulting from waste combustion with energy recovery, refer to 8.2.2, page 22, PAS 2050:2011.

CO_2 removals by carbon storage in products

Following PAS 2050:2011 (BSI 2011) CO2 removals by carbon storage in products:

"shall be included whenever a part or all removed carbon is not emitted to the atmosphere, with the **100-year assessment period**. OBS: where a product is recycled, the carbon storage benefit ends for that product, but the product using recycled material receives a C storage benefit (as long as one can demonstrate that the recycled material was created for the purpose of being used in the product)" (BSI 2011).

Soil carbon change (more than that included in the IPCC factors)

Following PAS 2050:2011 (BSI 2011) CO2 removals by carbon storage in products:

Shall be excluded, unless calculated as part of LUC or unless provided for in a supplementary requirement of PAS (see 4.3, p7, PAS 2050:2011) (BSI 2011).

"**Carbon incorporated in plants and trees with a life of 20 years or more that are not products themselves** but are part of a product system **should be treated in the same way as soil carbon**, unless the plants and trees are resulting from a direct land use change occurring within the previous 20 years" (BSI 2011).

Aircraft emissions and removals

Following PAS 2050:2011 (BSI 2011):

"**No multiplier or other correction shall be applied** to the GWP of emissions and removals arising from aircraft transport" (BSI 2011).

Treatment of land use change

Following PAS 2050:2011 (BSI 2011):

"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**" (BSI 2011).

"Emissions arising from **indirect land use change** is **not included**" (BSI 2011) in the PAS 2050.

Offsetting

Following PAS 2050:2011 (BSI 2011):

"GHG emissions offset mechanisms, including but not limited to voluntary offset schemes or nationally or internationally recognized offset mechanisms, shall not be used at any point in the assessment of the GHG emissions of the product" (BSI 2011).

II. ASSESSMENT PERIOD FOR THE INCLUSION OF GHG EMISSIONS AND REMOVALS: TIME PERIOD OF THE INVENTORY

This guidance follows the specification of the **100-year period for the assessment period following the formation of the product** (IPCC 2006). As specified in the GHG Protocol (WRI and WBCSD 2011b), the end-of-life stage should be included, even if the use stage is longer than the 100 years.

III. ASSESSMENT PERIOD FOR LAND USE CHANGE IMPACTS

Following the recommendations from both the GHG Protocol (WRI and WBCSD 2011b) and PAS 2050:2011 (BSI 2011), carbon stock change occurring (i) within a **20-years** period (default period according to IPCC (IPCC 2006), or (ii) a **single harvest period from the extraction of the evaluated product** (even if longer than 20 years) should be included in the calculation. These changes must be a result of human interventions and the longest period should be chosen.

Following PAS 2050:2011 (BSI 2011), if the information on the period cannot be demonstrated, one of the two following options shall be chosen regarding the data on which the land use change occurred:

- "January 1st of the earliest year in which it can be demonstrated that the land use change had occurred", or (BSI 2011);
- "January 1st of the year in which the assessment of GHG emissions and removals is being carried out" (BSI 2011).

IV. LIMITED DATE FOR VALIDITY OF ANALYSIS

According to the PAS 2050:2011 (BSI 2011), the validity of the analysis is limited to a "maximum period of two years, unless there is a change in the LC of the product whose GHG emissions are being assessed, in which situation the validity ceases".

V. UNCERTAINTY

In accordance with PAS 2050:2011 (BSI 2011), uncertainties can be reduced in the following ways:

- Replacing secondary data for primary data;
- Improving the quality of data;
- Improving model calculations;
- Carrying out additional peer review processes.

SECTION 2: GUIDANCE ON THE CALCULATIONS ACCORDING TO IPCC 2006 GUIDELINES FOR NATIONAL GREENHOUSE GAS INVENTORIES

According to the IPCC (2003), three distinct tiers are defined for estimating GHG emissions and removals:

- **Tier 1** - "methodologies based on activity data that are spatially coarse, such as nationally or globally available estimates of deforestation rates, agricultural production statistics, and global land cover maps" (IPCC 2003).
- **Tier 2 -** "methodologies applying emission factors and activity data which are defined by the country for the most important land uses/activities" (IPCC 2003).
- **Tier 3 -** "methodologies using models and inventory measurement systems tailored to address national circumstances, repeated over time, and driven by high-resolution activity data and disaggregated at sub-national to fine grid scales" (IPCC 2003). The methods applied in Tier 3 provide a higher certainty of results.

The calculations are mainly carried according to six land use categories IPCC (2006):

- Forest land;
- Cropland;
- Grassland;
- Wetlands;
- Settlements;
- Other land.

Further, according to the IPCC (2006), three main carbon pools are used in the calculation of carbon stock changes for each land-use category:

- Biomass (above and below ground);
- Dead Organic Matter (dead wood and litter);
- Soils (soil organic matter).

Summary of equations for the calculation of greenhouse gas emissions and removals resulting from carbon stock changes in biomass (above- and belowground), dead organic matter and soils (IPCC 2006)

The equations refer to the methods of Tiers 1, 2 and 3 and to land remaining in the same land use category and/or land converted into another land use category for three carbon pools: biomass (**Error! Reference source not found.**), dead organic matter (Table 12) and soils (Table 13).

BIOMASS CHANGE (GAIN or LOSS)

Table 1 2006 IPCC Guideline Methods for estimating change in carbon stocks in biomass (IPCC 2006)

	LAND REMAINING IN THE SAME LAND USE CATEGORY	**LAND CONVERTED TO ANOTHER LAND USE CATEGORY**
Methods for estimating total change in C stocks in biomass (ΔC_B)	**Tier 1** **Eq. 2.7** (p.2.12): Annual change in C stocks in biomass in land remaining in a particular land-use category (**Gain-Loss Method**) **Tiers 2 & 3** **Eq. 2.8** (p.2.12): Annual change in C stocks in biomass in land remaining in the same land-use category (**Stock-Difference Method**) **OBS**: *Default CF value of aboveground forest biomass: 0.47 (see Table 4.3, p. 4.48). Other values are given in Tables 4.7 (p. 4.53, forests) and 4.8 (p. 4.54, forest plantations)*	**Tier 1** **Eq. 2.7** (p.2.12): Annual change in C stocks in biomass in land remaining in a particular land-use category (**Gain-Loss Method**) **Tiers 2 & 3** **Eq. 2.15** (p.2.20): Annual change in biomass C stocks on land converted to another land-use category **Eq. 2.16** (p.2.20): Initial change in biomass carbon stocks on land converted to another land category
Methods for estimating increase in C stocks in biomass (ΔC_G) **-** **Biomass (Gain):**	**Tiers 1, 2 & 3** **Eq. 2.9** (p.2.15): Annual increase in biomass C stocks due to biomass increment in land remaining in the same land-use category In which $G_{TOTAL\ i,j}$ is calculated using **Eq. 2.10**:	**Tiers 1, 2 & 3** **Eq. 2.9** (p.2.15): Annual increase in biomass C stocks due to biomass increment in land remaining in the same land-use category In which $G_{TOTAL\ i,j}$ is calculated using **Eq. 2.10**:

Total aboveground and belowground biomass growth	**Eq. 2.10** (p.2.15) Average annual increment in biomass: **a) Tier 1:** biomass increment data (dry matter) are used directly; **b) Tiers 2 & 3:** net annual increment data are used to estimate G_W by applying a biomass conversion and expansion factor.	**Eq. 2.10** (p.2.15) Average annual increment in biomass: **a) Tier 1:** biomass increment data (dry matter) are used directly; **b) Tiers 2 & 3:** net annual increment data are used to estimate G_W by applying a biomass conversion and expansion factor.
Methods for estimating decrease in C stocks in biomass (ΔC_L) **-** **Biomass (Loss)** *Roundwood removal/harvest, Fuelwood removal/ harvest/ Gains & losses from disturbances (e.g. fire, insects, diseases)*	**Tier 1 (Gain-Loss Method)** **Eq. 2.11** (p.2.16) Annual decrease in C-stocks due to biomass losses in land remaining in the same land-use category **Eq. 2.12** (p.2.17) Annual C loss in biomass due to wood removals **Eq. 2.13** (p.2.17) Annual C loss in biomass due to fuelwood removal For **Tier 1**, "R must be set to zero if no changes of below-ground biomass are assumed". **Eq. 2.14** (p.2.18) Annual C loss in biomass due to disturbances **OBS:** "*The **Tier 1** assumption is that all of $L_{disturbances}$ is emitted in the year of disturbance. **Tier 2 and 3** methods assume that some of this carbon is emitted immediately and some is added to the dead organic matter pools (dead wood,*	**Tier 1 (Gain-Loss Method)** **Eq. 2.11** (p.2.16) Annual decrease in C-stocks due to biomass losses in land remaining in the same land-use category **Eq. 2.12** (p.2.17) Annual C loss in biomass due to wood removals **Eq. 2.13** (p.2.17) Annual C loss in biomass due to fuelwood removal For **Tier 1**, "R must be set to zero if no changes of below-ground biomass are assumed". **Eq. 2.14** (p.2.18) Annual C loss in biomass due to disturbances **OBS:** "*The **Tier 1** assumption is that all of $L_{disturbances}$ is emitted in the year of disturbance. **Tier 2 and 3** methods assume that some of this carbon is emitted immediately and some is added to the dead organic matter pools (dead wood,*

	litter) or HWP".	*litter) or HWP*". **OBS:** "*Tier 1 employs a default assumption that there is no change in initial biomass carbon stocks due to conversion", so the same calculation used for "land remaining in the same land use category can be applied*". **Tiers 2 & 3** **Eq. 2.15** (p.2.20) Annual change in biomass C-stocks on land converted to another land-use category **Eq. 2.16** (p.2.20) Initial change in biomass C-stocks on land converted to another land use category

CHANGE IN CARBON STOCKS IN DEAD ORGANIC MATTER (DOM)

Table 12 2006 IPCC Guideline Methods for estimating change in carbon stocks in dead organic matter (IPCC 2006)

	LAND REMAINING IN THE SAME LAND USE CATEGORY	LAND CONVERTED TO ANOTHER LAND USE CATEGORY
Methods for estimating annual changes in carbon stock in Dead Organic Matter (DOM) pools	**Tier 1** *"The **Tier 1** assumption for both dead wood and litter pools for all land-use categories is that their **stocks are not changing over time** if the land remains within the same land use category. Thus the carbon in biomass killed during a disturbance or management event (less removal of harvested wood products) is assumed to be released entirely to the atmosphere in the year of the event"*. **For Tiers 2 & 3** **Eq. 2.17** (p.2.21) Annual change in C-stocks in dead organic matter **Eq. 2.18** (p.2.23) Annual change in C-stocks in Dead Wood (DW) or litter (LT) (**Gain-Loss Method**) **Eq. 2.19** (p.2.23) Annual change in C-stocks in DW or LT (**Stock-Difference Method**) **OBS**: "*whenever the stock change method is used, the area used in the carbon stock calculations at times t_1 and t_2 must be identical". (…) "It's good practice to use the area at the end of the inventory period (t_2) to define the area of land remaining in the land-use category*."	**Tier 1** "***Tier 1** method assume that all carbon contained in biomass killed during a land-use conversion event (less harvested products that are removed) is **emitted directly to the atmosphere and none is added to dead wood and litter pools***". **For Tiers 2 & 3** **Eq. 2.23** Annual change in C stocks in DW and LT due to land conversion *"The Tier 1 assumption is that DOM pools is non-forest land categories after the conversion are zero, i.e. they contain no carbon. The Tier 1 assumption for land converted from forest to another land-use category is that all DOM carbon losses occur in the year of land-use conversion. Conversely, conversion to Forest Land results in buildup of litter and dead wood carbon pools starting from zero carbon in those pools. DOM carbon gains on land converted to forest occur linearly, starting from zero, over a transition period (default assumption is 0 years). This default period may be appropriate for litter carbon stocks, but in temperate and boreal regions it is probably too short for dead wood carbon stocks"*.

	Input of biomass to dead organic matter **Eq. 2.20** (p.2.24) Annual carbon in biomass transferred to dead organic matter **Eq. 2.21** (p.2.24) Annual biomass carbon loss due to mortality **Eq. 2.22** (p.2.25) Annual carbon transfer due to slash and burn	

CHANGE IN CARBON STOCKS IN SOILS

Table 13 2006 IPCC Guideline Methods for estimating change in carbon stocks in soils (IPCC 2006)

	LAND REMAINING IN THE SAME LAND USE CATEGORY	LAND CONVERTED TO ANOTHER LAND USE CATEGORY
Methods for estimating soil carbon change	**Soil C estimation methods** **Eq. 2.24** (p.2.29) Annual change in carbon stocks in soils **OBS**: "*No Tier 1 or 2 methods are provided for estimating the change in soil inorganic C stocks due to limited scientific data for derivation of stock change factors; thus the net flux for inorganic C stocks is assumed to be zero".* **Tiers 1 & 2** **Mineral soils** **Eq. 2.25** Annual change in organic carbon stocks in mineral soils Use of **Table 2.3** (p.2.31) Default reference (under native vegetation) soil organic C stocks (SOC_{REF}) for mineral soils Use of **Table 5.5** (p.5.17 and 5.18) Relative stock change factors for different management activities on **cropland** (over 20 years) Use of **Table 6.2** (p.6.16) Relative stock change factors for **grassland** management (time dependence, D, 20 years)	**Soil C estimation methods** **Eq. 2.24** (p.2.29) Annual change in carbon stocks in soils **OBS**: "*No Tier 1 or 2 methods are provided for estimating the change in soil inorganic C stocks due to limited scientific data for derivation of stock change factors; thus the net flux for inorganic C stocks is assumed to be zero".* **Tiers 1 & 2** **Mineral soils** **Eq. 2.25** Annual change in organic carbon stocks in mineral soils Use of **Table 2.3** (p.2.31) Default reference (under native vegetation) soil organic C stocks (SOC_{REF}) for mineral soils Use of **Table 5.5** (p.5.17 and 5.18) Relative stock change factors for different management activities on **cropland** (over 20 years) Use of **Table 6.2** (p.6.16) Relative stock change factors for **grassland** management (time dependence, D, 20 years)

	Organic soils **Eq. 2.26** (p.) Annual carbon loss from drained organic soils (CO_2) **OBS**: "*Essentially, Tiers 1 and 2 represent land-use and management impacts on soil C stocks as a linear shift from one equilibrium state to another*".	**Organic soils** **Eq. 2.26** Annual carbon loss from drained organic soils (CO_2) **OBS:** "*Essentially, Tiers 1 and 2 represent land-use and management impacts on soil C stocks as a linear shift from one equilibrium state to another*".

Annex VII: Mapping of Terminology Used in this OEF Guide with ISO Terminology

This Annex provides a mapping of the key terms used in this OEF Guide with the corresponding terms used under ISO 14044:2006. The reason for diverging from the ISO terminology is to make the OEF Guide more accessible to its target audience, which also includes groups that do not necessarily have strong background knowledge of environmental assessment. The tables below provide such a mapping of diverging terms.

Table 14: Mapping of key terms

Terms used in ISO 14044:2006	Correspondent terms used in this OEF Guide
Functional unit	Unit of analysis
Life cycle inventory analysis	Resource Use and Emissions Profile
Life cycle impact assessment	Environmental footprint impact assessment
Life cycle interpretation	Environmental footprint interpretation
Impact category	Environmental footprint impact category
Impact category indicator	Environmental footprint impact category indicator

Table 15: Mapping of data quality criteria

Terms used in ISO 14044:2006	Correspondent terms used in this OEF Guide
Time-related coverage	Time-related representativeness
Geographical coverage	Geographical representativeness
Technology coverage	Technological representativeness
Precision	Parameter uncertainty
Completeness	Completeness
Consistency	Methodological Appropriateness and Consistency
Sources of the data	Covered under “Resource Use and Emissions Profile”
Uncertainty of the information	Covered under “Parameter uncertainty”

ANNEX VIII. OEF Guide and ILCD handbook: Major Deviations

This annex points out the most important aspects of how this OEF Guide deviates from the ILCD Handbook, and provides a concise justification for these deviations.

1. Target audience(s):
   As opposed to the ILCD Handbook, the OEF Guide is aimed at people who have limited knowledge of life cycle assessment. It is therefore written in a more accessible manner.
2. Completeness check:
   The ILCD Handbook gives two options for checking completeness: (1) completeness check at the level of each environmental impact and (2) completeness check at the level of the overall (i.e. aggregated) environmental impact. The OEF Guide considers completeness only at the level of each environmental impact. In fact, as the OEF Guide does not recommend any specific set of weighting factors, the overall (i.e. aggregated) environmental impact cannot be estimated.
3. Extension of the goal definition
   The OEF Guide is meant for use in specific applications, therefore extensions of the goal definition are not foreseen.
4. Scope definition includes “limitations”
   The scope definition of the OEF Guide shall also include specifications of the limitations of the study. In fact, based on experience gained with the ILCD Handbook, the limitation can be properly defined only when practitioners have information regarding all aspects related to the goal definition and the function of analysis.
5. Review procedure is defined in the goal definition:
   The review procedure is essential to improve the quality of an OEF study, therefore it needs to be defined in the first step of the process, i.e. the goal definition.
6. Screening step instead of iterative approach
   The OEF Guide recommends that a screening step be conducted to obtain an approximate estimation of each environmental impact for the default EF impact categories. This step is similar to the iterative approach in the ILCD Handbook.
7. Data quality rating
   The OEF Guide makes use of five rating-levels for evaluating the data quality (excellent, very good, good, fair, poor), compared to the three levels used in the ILCD Handbook. This will allow for the use of data with lower data quality levels in the OEF study compare with those required by the ILCD Handbook. Also, the OEF Guide uses a semi-quantitative formula for assessing data quality, making it easier to achieve e.g. “good” data quality.
8. Multi functionality decision hierarchy
   The OEF Guide provides a decision hierarchy for solving multi-functionality of products/organisations which deviates from the approach endorsed by the ILCD Handbook. The OEF Guide also provides an equation for solving multi-functionality in recycling and energy recovery situations at the end-of-life stage.
9. Sensitivity analysis
   Carrying out sensitivity analysis of the results is an optional step in the OEF Guide. This is expected to reduce the workload for users of the OEF Guide.

ANNEX IX. Comparison of Organisation Environmental Footprint Key Requirements with Other Methods

Although similar widely accepted corporate environmental accounting methods and guidance documents align closely on much of the methodological guidance they provide, it is noteworthy that discrepancies and/or lack of clarity remains on a number of important decision points, which reduces the consistency and comparability of analytical outcomes. This annex provides a summary of selected key requirements of this OEF Guide and compares these with a number of existing methods. It is based on the document "Analysis of Existing Environmental Footprint Methodologies for Products and Organizations: Recommendations, Rationale, and Alignment", that can be accessed via http://ec.europa.eu/environment/eussd/corporate_footprint.htm. (EC-IES-JRC, 2011b)

Comparison of key requirements: OEF Guide vs. other methods

	OEF Guide	**ISO 14064 (2006)**	**ISO WD/TR 14069 (working draft 2, 2010)**	**ILCD (2011)**	**GHG protocol (2011)**	**Bilan Carbone (version 5.0)**	**DEFRA CDP (2009)**	**CDP – water (2010)**	**GRI (version 3.0)**
Life Cycle Thinking (LCT)-based	Yes	Scope 1, 2 (not LCT) and optional for scope 3[105] (LCT).	Scope 1, 2 (not LTC) and optional for scope 3 (LCT).	Yes.	Scope 1, 2 (not LCT) and 3 (LCT).	Scope 1, 2 (not LCT) and 3 (LCT).	Scope 1 and 2 (not LCT) recommended as minimum and discretionary for significant scope 3 (LCT) emissions.	No.	Not explicit. For some indicators, direct + indirect impacts must be accounted for.
Applications and exclusions	**In-house applications** may include support to environmental management, identification of	Organisational design, development, management and reporting of GHG emissions for	See ISO 14064.	Organisation-level analyses (organisational design, development, management and reporting,	Intended to support accountancy and disclosure for internal use and external	May be applied to GHG accountancy and disclosure for industrial organisations, legal entities,	Intended to support GHG disclosure for businesses and other private or public sector organisations,	Intended to inform corporate disclosure to investors.	Intended to inform sustainability accountancy for corporate disclosure to all relevant

[105] Emissions are classified into three "scopes". Scope 1 relates to the direct emissions (i.e., emissions from sources that are owned or controlled by the reporting Organisation). Scope 2 emissions are indirect emissions (i.e., emissions that are a consequence of the activities of the reporting Organisation, but occur at sources owned or controlled by another organisation) from the generation of purchased energy consumed by the Organisation and scope 3 emissions are all other indirect emissions that occur in the Organisation's value chain. (WRI and WBCSD 2011a)

Comparison of key requirements: OEF Guide vs. other methods									
	OEF Guide	**ISO 14064 (2006)**	**ISO WD/TR 14069 (working draft 2, 2010)**	**ILCD (2011)**	**GHG protocol (2011)**	**Bilan Carbone (version 5.0)**	**DEFRA CDP (2009)**	**CDP – water (2010)**	**GRI (version 3.0)**
	environmental hot-spots, environmental improvement and performance tracking; **External applications** (e.g. B2B, B2C) cover a wide range of possibilities, from responding to costumer and consumer demands, to marketing, benchmarking, environmental labelling, etc.	the purpose of corporate risk management, voluntary initiatives, GHG markets, or regulatory reporting.		monitoring).	applications.	territories, or territorial structures, specific projects or activities. It is also intended to be applicable for use within the frameworks for reporting provided by ISO 14064, the GHG Protocol, and the Carbon Disclosure Project.	including SMEs, voluntary sector organisations and local authorities.		stakeholders.
Target audiences	B2B and B2C.	B2B and B2C.	B2B and B2C.	B2B and B2C.	B2B, B2CB2B, Business to interested stakeholder	internal	B2B, B2C, Internal, public, voluntary and	institutional investors	B2B and B2C.

Comparison of key requirements: OEF Guide vs. other methods									
	OEF Guide	**ISO 14064 (2006)**	**ISO WD/TR 14069 (working draft 2, 2010)**	**ILCD (2011)**	**GHG protocol (2011)**	**Bilan Carbone (version 5.0)**	**DEFRA CDP (2009)**	**CDP – water (2010)**	**GRI (version 3.0)**
					through public reporting.		private sector.		
Scope	Default cradle-to-grave.	Scope 1, 2 and optional for Scope 3	Scope 1, 2 and optional for Scope 3	Full cradle-to-grave life cycle accountancy	Scope 1, 2 (Corporate standard) and Scope 3 (Value Chain Standard)	Scope 1, 2 and 3.	Scope 1, 2 recommended as a minimum and discretionary for significant scope 3 emissions.	Does not refer to Scopes (nor life cycle based).	Scope concept is not referred to (rather, users are instructed to account for impacts of activities over which the company has control or significant influence).
System boundaries	Control approach (financial and/or operational).	Choice of equity share, financial control, or operational control approach	Choice of equity share, financial control, or operational control approach	Not specified.	Boundaries defined based on equity share or control criteria.	Choice of equity share, financial control, or operational control approach	Choice of equity share, financial control, or operational control approach	Choice of equity share, financial control, or operational control approach	Financial/operational control AND ability to exert significant influence
Functional unit (FU)	Concept of functional unit (organisation as goods/service provider) and reference flow (Product Portfolio = the	Does not use FU and reference flow concept		Applies functional unit concept for organisation analyses (what, how much, for how long).	Does not use FU and reference flow concept				

Comparison of key requirements: OEF Guide vs. other methods									
	OEF Guide	**ISO 14064 (2006)**	**ISO WD/TR 14069 (working draft 2, 2010)**	**ILCD (2011)**	**GHG protocol (2011)**	**Bilan Carbone (version 5.0)**	**DEFRA CDP (2009)**	**CDP – water (2010)**	**GRI (version 3.0)**
	sum of goods/services provided by the organisation over the reporting interval)								
Cut-off criteria	Not allowed.	Based on considerations of materiality, feasibility and cost effectiveness.	To be determined relative to study goals.	To be determined relative to study requirements.	Discouraged.	Discouraged.	Discouraged.	Permissible where data is lacking.	Based on control/influence/significance.
Impact categories and enviromental impact assessment methods	A default set of 14 mid-point impact categories and specified impact assessment models with according impact indicator. Any exclusion	GHG emissions	GHG emissions	15 impact categories (12 midpoint and 3 end point) with recommended impact assessment models and according impact indicators.	GHG emissions	GHG emissions	GHG emissions	Water use.	All relevant social, economic and environmental impacts.

Comparison of key requirements: OEF Guide vs. other methods

	OEF Guide	ISO 14064 (2006)	ISO WD/TR 14069 (working draft 2, 2010)	ILCD (2011)	GHG protocol (2011)	Bilan Carbone (version 5.0)	DEFRA CDP (2009)	CDP – water (2010)	GRI (version 3.0)
	shall be explicitly justified and their influence on the final results discussed. Such exclusions are subject to review.								
Modelling approach (attributional vs. consequential)	Takes elements from both attributional and consequential modeling approaches.	No guidance.	Provides 23 categories for scope 3.	Attributional modelling and industry-average substitution for EOL processes.	• Provides modelling spreadsheets with embedded (but customisable) default emission factors that are applied to activity data. • Provides 15 categories e.g. business travel, investment for modeling Scope 3 emissions, with recommended inclusions for	• Provides modelling spreadsheets with embedded (but customisable) default emission factors that are applied to activity data. • Bilan Carbone method aims to provide average emissions factors which are accurate within one order of magnitude	• Provides modelling spreadsheets with embedded default emission factors that are applied to activity data. Also provides a high level diagnostic tool for indirect emissions from the supply chain. • These emission factors are updated annually.	No guidance.	No guidance.

Comparison of key requirements: OEF Guide vs. other methods									
	OEF Guide	**ISO 14064 (2006)**	**ISO WD/TR 14069 (working draft 2, 2010)**	**ILCD (2011)**	**GHG protocol (2011)**	**Bilan Carbone (version 5.0)**	**DEFRA CDP (2009)**	**CDP – water (2010)**	**GRI (version 3.0)**
					each.				
Data quality requirements (DQRs)	Data quality is assessed against 6 criteria (technological, geographical and time-related representativeness, completeness, parameter uncertainty and methodological appropriateness and consistency). DQRs are mandatory for OEF studies intended for external communication, recommended for studies	Requires data management plan + uncertainty assessment. Refers to ISO 14064-3 for validation / verification requirements.	See ISO 14064-1.	Adopts ISO 14044.	Recommends qualitative data quality scoring for scope 3 calculations. Specifies criteria for a data management plan. Guidelines on the GHG website for uncertainty assessments.	Recommends the calculation of 95% confidence intervals. Spreadsheet calculators provided for uncertainty estimates.	No requirements. Refers to GHG protocol for uncertainty estimates	No guidance. Requests percentage of water withdrawals and discharges that have been verified or assured.	No guidance. Recommends uncertainty assessment.

Comparison of key requirements: OEF Guide vs. other methods

	OEF Guide	ISO 14064 (2006)	ISO WD/TR 14069 (working draft 2, 2010)	ILCD (2011)	GHG protocol (2011)	Bilan Carbone (version 5.0)	DEFRA CDP (2009)	CDP – water (2010)	GRI (version 3.0)
	intended for in-house applications. For the processes accounting for at least 70% to each impact category, "good quality" required for both specific and generic data based on a semi-quantitative assessment. […]								
Specific data	Required for all foreground processes and for background processes, where appropriate. However, in	Required for corporate activities within the system boundary.	Provides list of 23 categories for which primary "activity" data should be collected for Scope 3 modelling.	Preferred for foreground system and main background processes.	Provides guidance on collection of specific data for corporate scope 3 activities.	Required for corporate activities within the system boundary.	Required for corporate activities within the system boundary.	No guidance	No guidance

Comparison of key requirements: OEF Guide vs. other methods									
	OEF Guide	**ISO 14064 (2006)**	**ISO WD/TR 14069 (working draft 2, 2010)**	**ILCD (2011)**	**GHG protocol (2011)**	**Bilan Carbone (version 5.0)**	**DEFRA CDP (2009)**	**CDP – water (2010)**	**GRI (version 3.0)**
	case generic data is more representative or appropriate than specific data (to be justified and reported) for foreground processes, generic data shall be used for the foreground processes too.		Provides guidance for different approaches to data collection.						
Generic data	Should be used only for background processes. Generic data shall, where available, be sourced from: • Data developed in line with the	Should be derived from a recognised source and be current and appropriate.	Describes range of situations where secondary data may be sourced.	For all other data needs.	Provides description of generic data for each category in scope 3. Preferred sources: internationally recognised government or peer-reviewed sources.	Provides emission factors and average activity data. Other generic data should be sourced from ELCD and peer-reviewed data.	Provides emission factors (more site specific data should be used if available). May use EUTS, CCA and CRC data.	No provisions provided.	No provisions provided.

Comparison of key requirements: OEF Guide vs. other methods

	OEF Guide	ISO 14064 (2006)	ISO WD/TR 14069 (working draft 2, 2010)	ILCD (2011)	GHG protocol (2011)	Bilan Carbone (version 5.0)	DEFRA CDP (2009)	CDP – water (2010)	GRI (version 3.0)
	requirements for the relevant OEFSRs • Data developed in line with the requirements for OEF studies; • ILCD Data Network • ELCD **Data collection template:** the template provided is informative								
Allocation / multi-functional hierarchy	OEF multi-functionality hierarchy: (1) subdivision or system expansion; (2) allocation based on a relevant underlying	No guidance	No guidance. For transport allocation must be based on mass, volume or economic value.	Adopts ISO 14044.	Adopts ISO 14044. Calculation tool for stationary combustion provides 2 allocation options.	Adopts ISO 14044, except for using economic allocation.	No guidance. Supplementary transport and logistics guidance provides details on allocation.	No guidance	No guidance

Comparison of key requirements: OEF Guide vs. other methods

	OEF Guide	ISO 14064 (2006)	ISO WD/TR 14069 (working draft 2, 2010)	ILCD (2011)	GHG protocol (2011)	Bilan Carbone (version 5.0)	DEFRA CDP (2009)	CDP – water (2010)	GRI (version 3.0)
	physical relationship (here *substitution* may apply); (3) allocation based on some other relationship								
Allocation for recycling	Specific guidance (including formula!) provided, also accounting for energy recovery.	No guidance	No guidance.	Adopt ISO 14044.	Adopt ISO 14044. Calculation tool for stationary combustion provides 2 allocation options.	Avoided impacts method for open-loop recycling, Stock method for closed-loop recycling.	No guidance	No guidance	No guidance
Emissions off-setting	Shall not be included in the assessment.	Reductions from purchased credit or other external projects must be documented and reported separately.	Refers to ISO 14064-1.	Shall not be included in the assessment.	Inventory method.	Excludes emission reductions from purchased offsets and similar mitigation projects.	Gross emissions (prior to reductions), net emissions to be reported separately. Refers to "good quality" criteria for offsets and green tariffs. Guidance on	No guidance.	No guidance.

Comparison of key requirements: OEF Guide vs. other methods

	OEF Guide	ISO 14064 (2006)	ISO WD/TR 14069 (working draft 2, 2010)	ILCD (2011)	GHG protocol (2011)	Bilan Carbone (version 5.0)	DEFRA CDP (2009)	CDP – water (2010)	GRI (version 3.0)
							reductions from investment in domestic woodland creation.		
Setting targets and tracking progress	No requirements.	Requires justification of base year choice and development of a base year recalculation policy.	No further guidance beyond ISO 14064-1.	No requirements.	Requires justification of base year choice. Recommends setting scope-specific targets.	Spreadsheet to manage reduction targets. Encourages use of absolute instead of intensity-based targets.	Suggests specific steps for setting GHG reduction targets. Guidance on recalculating base years.	No guidance. Option of reporting on an economic or physical basis.	No guidance provided concerning base year + recommends 2 previous reporting years.
Reporting	The study report shall include a Summary, a Main Report, and an Annex. Any additional supporting information can be included, e.g. a Confidential report. The contents	Detailed list of recommend report contents. For public disclosure in compliance with ISO 14064-1, a publically available report must be provided (conform to the standard).	Will further specify reporting guidance.	3 levels of reporting requirements depending on the application (i.e. internal use, 3rd party, comparative assertion)	Report template provided.	No guidance, but recommended report contents.	Report template provided.	Document itself is a reporting guide.	Stipulates base content for report. 3 types of disclosures. Report template provided.

Comparison of key requirements: OEF Guide vs. other methods

	OEF Guide	ISO 14064 (2006)	ISO WD/TR 14069 (working draft 2, 2010)	ILCD (2011)	GHG protocol (2011)	Bilan Carbone (version 5.0)	DEFRA CDP (2009)	CDP – water (2010)	GRI (version 3.0)
	closely follows ISO 14044 requirements on reporting. For comparative assertions (intended to be disclosed to the public), ISO reporting requirements go beyond OEF reporting requirements. Informative reporting template provided.	Refers to ISO 14064-3							
Sectorial specificity	Provides guidance for the development of Organisation Environmental	No.	No, except for local authorities.	Encourages sectorial guidelines.	Provides sector-specific calculation tools.	Provide guidance for several sectors.	Sector specific guidance for freight transport provided.	No.	Range of sector specific supplements to general guidance.

Comparison of key requirements: OEF Guide vs. other methods									
	OEF Guide	**ISO 14064 (2006)**	**ISO WD/TR 14069 (working draft 2, 2010)**	**ILCD (2011)**	**GHG protocol (2011)**	**Bilan Carbone (version 5.0)**	**DEFRA CDP (2009)**	**CDP – water (2010)**	**GRI (version 3.0)**
	Footprint Sector Rules.								
Relationship with product footprint guidance	The OEF is in line with the PEF as it encompasses also the Product Portfolio of the Organisation.	ISO 14067 refers to ISO 14064-3.	Refers to ISO 14067.	Provides coherent methodological reference point for both product and corporate environmental footprint methods.	No. Can serve as tool for identifying product hot-spots.	No direct relationship with BP X30-323, but similarities. Common methodological rules for carbon biogenic and allocation for recycling are under construction.	No.	No.	No.
Review, validation/verification	OEF studies intended for external communication require review by an independent and qualified external reviewer (or review team.) OEF studies intended to	Review report or 3rd party verification statement should be available for public assertions. Required level of validation and verification depends on	Will provide verification guidance.	Requirements based on intended application.	Provides detailed guidance, but not a requirement.	Encourage 3rd party critical reviews for comparative assertions and other external applications.	Requires 3rd party verification for external reduction projects to ensure good quality. Refers to ISO 14064.	Requests information for % of withdrawals that are 3rd party verified.	No requirements.

Comparison of key requirements: OEF Guide vs. other methods									
	OEF Guide	**ISO 14064 (2006)**	**ISO WD/TR 14069 (working draft 2, 2010)**	**ILCD (2011)**	**GHG protocol (2011)**	**Bilan Carbone (version 5.0)**	**DEFRA CDP (2009)**	**CDP – water (2010)**	**GRI (version 3.0)**
	support a comparative assertion require review by 3 independent external reviewers. Minimum requirements on reviewer qualifications apply.	several criteria.							
Guide for SMEs	No.	No.	No.	No.	No.	Mainly used by SMEs.	Yes.	Limited guidance.	No.