EUROPEAN FOOD
SUSTAINABLE CONSUMPTION & PRODUCTION
ROUND TABLE

ENVIFOOD Protocol

Environmental Assessment of Food and Drink Protocol

Version 1.0

[Nov. 20th 2013]

Authorship and acknowledgements

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DISCLAIMER: The views expressed in this document do not necessarily reflect the views of the Food SCP Round Table members or the European Commission and do not prejudge policy positions of the European Commission.

About

Currently, the European Food SCP Round Table is composed of the following members:

Co-Chairing Organisation

European Commission

Supporting Organisations

UNEP - United Nations Environment Programme

EEA - European Environment Agency

Members

ACE - The Alliance for Beverage Cartons and the Environment

APEAL - European Producers of Steel for Packaging

a.v.e.c. - Association of Poultry Processors and Poultry Trade in the EU

CELCAA - European Liaison Committee of Agricultural and Agro-Food Trade

COPA-COGECA - European Farmers and European Agri-cooperatives

EAA - European Aluminium Association

ECPA - The European Crop Protection Association

Empac - European Metal Packaging*

EMRA - European Modern Restaurants Association

EuropaBio - The European Association for Bio-Industries

EUROCOOP - European Community of Consumer Cooperatives*

EUROPEN - The European Organization for Packaging and the Environment

FEFAC - European Feed Manufacturers Federation

FEFANA - European Feed Additives and Premixtures Association

FEVE - The European Glass Container Association

FPE - Flexible Packaging Europe

Fertilizers Europe - European Fertilizer Manufacturers Association

FoodDrinkEurope

FoodServiceEurope

IFAH-Europe - International Federation for Animal Health - Europe

PRO Europe - Packaging Recovery Organisation Europe

PFP – European Primary Food Processors Industry Association

The Sustainability Consortium

WBCSD – World Business Council for Sustainable Development*

WRI - World Resources Institute*

Observer Organisations

* These organisations were no longer members at the time of adoption.

Agriculture and Agri-Food Canada

Dutch Ministry of Agriculture, Nature and Food Quality

ENEA - Italian National Agency for New Technologies, Energy and Sustainable Economic Development

Eurogroup for Animals

Food and Agriculture Organization of the United Nations (FAO)

French Environment & Energy Management Agency (ADEME)

French Ministry of Ecology, Sustainable Development and Energy

Hungarian Ministry of Rural Development

Netherlands Ministry for Environment

Spanish Agriculture Ministry

Spanish Consumers Union (OCU)

Swedish National Food Administration

Swiss Federal Office for the Environment

Technical University of Denmark

UK Department for Environment, Food and Rural Affairs

UK Food Standards Agency

United Nations Development Programme (UNDP)

Foreword

The European Food Sustainable Consumption and Production (SCP) Round Table is an international initiative whose vision is to promote a science-based, coherent approach to sustainable consumption and production in the food sector across Europe, while taking into account environmental interactions at all stages of the food chain. A key principle is that environmental information communicated along the food chain, including to consumers, shall be scientifically reliable and consistent, understandable and not misleading, so as to support informed choice.

The Environmental Assessment of Food and Drink Protocol (ENVIFOOD Protocol) has been developed by the Working Group 1 of the European Food SCP Round Table in accordance with:

- The *Terms of Reference of the European Food SCP Round Table* (2010);
- The *Rules of Procedure for the Working Groups on the Food SCP Round Table* (2010);
- The *Guiding Principles of the Round Table for voluntary environmental assessment and communication of environmental information along the food chain, including to consumers* (2010).

Based on the Guiding Principles of the Round Table (2010), the Protocol was developed through a stepwise procedure which consisted of two scientific workshops (Peacock et al., 2011; De Camillis et al., 2012), a detailed analysis of the relevant methodologies and data for assessing the environmental issues of food and drink products and a series of consultation steps. This consultation process involved all the members of the European Food SCP Round Table, environmental assessment software stakeholders, developers of impact assessment methods, national networks on environmental assessment methodologies, national governments, the United Nations Environment Programme (UNEP), UN Food and Agriculture Organisation (FAO), consumer NGOs, environmental NGOs and the general public.

The Protocol is a live document. As environmental assessment methodologies and guidelines are evolving continuously, any change may be proposed directly to the Secretariat of the European Food SCP Round Table (info@food-scp.eu) during the period of validity.

The Protocol was tested in 2013 through pilot studies.

The coherence between the Protocol rules and the Guiding Principles of the European Food SCP Round Table (2010) should be always ensured. As a general rule, any version of the Protocol is to be proposed by the Round Table Working Group 1, approved by the Steering Committee, and adopted in the annual plenary meeting of Food SCP Round Table. The ENVIFOOD Protocol is intended to be a general methodology that allows the adoption of more detailed sectoral guidance and product category rules (PCRs). Whether this happens within the Round Table or not is subject to future agreements based on the mandate.

The most recent version of the ENVIFOOD Protocol is publicly available on the Food SCP Round Table's website: www.food-scp.eu.

To claim compliance with the ENVIFOOD Protocol, sub-sectoral methodologies or product category rules (PCRs) would need to be checked as follows. In order to be eligible to ask for endorsement, applicant organisations shall:

- Appoint third-party qualified reviewers to critically review the methodologies concerned against the Protocol rules;
- Report on the review process in detail (i.e. date and place of the review, name and qualifications of reviewers, version of the documents and date of revision) and its findings;
- Deviations from the Protocol highlighted by reviewers are to be justified with arguments and reasoning by the applicant organisations. These justifications are to be attached to the

review report when the dossier is submitted to the Food SCP Round Table secretariat for endorsement.

ENVIFOOD Protocol-compliant methodologies shall refer to a specific Protocol version number. The production of new Protocol versions does not affect the validity period of any Protocol-compliant methodology.

Introduction

The Members of the Food SCP Round Table recognise the need to establish a scientifically reliable, practical and harmonised environmental assessment methodology for food and drink products across Europe including, as appropriate, product category specifications to form the basis for voluntary communication of environmental information along the food chain, including to consumers.

An increasing number of operators as well as public authorities have introduced a widening range of different initiatives to inform consumers and other stakeholders about various environmental characteristics of food and drink products and to support continuous improvement in associated environmental performance. These include various labels, statements, product declarations and other means addressing different environmental aspects or impacts of a product.

This on-going proliferation of different initiatives is highly diverse in terms of the chosen scopes, assessment methodologies and means and tools of communication.

As this situation has the potential to confuse or even mislead consumers and other stakeholders and to lead to unnecessary burdens for food chain operators, the Food SCP Round Table has established the ENVIFOOD Protocol to support environmental assessments of food and drink products. The Protocol ensures that environmental information is communicated along the food chain, including to consumers, in a practical and reliable way.

It should be borne in mind, however, that the assessment and communication of the environmental performance of food and drink products must comply with all existing Community rules laid down in the EU Treaty, including those on the free movement of goods[1], and in secondary EU legislation, such as the rules aimed at protecting consumers against misleading and deceiving information[2].

As shown in Figure 1, the Protocol has been developed in accordance with EU legislation and built on the Guiding Principles of the Food SCP Round Table. Other major inputs were:

- Existing and upcoming international standards on life cycle assessment, environmental labels and declarations, and eco-design (e.g. ISO 14040/14044, ISO/TS 14067, ISO1402X, ISO/TR 14062);
- International Reference Life Cycle Data System (ILCD) Handbook: General Guide for Life Cycle Assessment - Detailed Guidance, hereby referred to as ILCD Handbook (EC, 2010);
- The Commission's Product Environmental Footprint (PEF) Guide (EC, 2013);
- Emerging national standards and technical agreements (e.g. PAS 2050, AFNOR BP X 30-323, GHG Protocol);
- Emerging methodologies[3];
- Guidelines[4];
- Critical review of environmental assessment case studies;
- Critical review of data availability and requirements.

[1] Articles 34 and 35 of the Treaty on the Functioning of the European Union.

[2] Including, inter alia, Regulation 1169/2011 on the Provision of food information to consumers, Regulation 767/2009 on the marketing and use of feed, and Directive 2005/29/EC on Unfair Commercial Practices and the recently published European Commission guidance on its implementation (SEC(2009) 1666).

[3] In this context, an "emerging methodology" is a set of rules intended to outline a general/sectoral/sub-sectoral framework for the environmental assessment of food and drink products. A methodology can be contained in: technical standards, legislative acts, and/or sectoral/sub-sectoral guidelines.

[4] In this context, a "guideline" is meant to be a set of rules to outline a product-specific framework for the environmental assessment of food and drink products (e.g. Product Category Rules (PCR) of Type III Environmental Product Declaration schemes).

The Protocol is expected to support a number of environmental instruments for use in communication and to support the identification of environmental improvement options. In particular, as also shown in Figure 1, the Protocol might be the baseline for developing: communication methods, product group/sub-group specific rules (PCRs)[5], criteria[6], tools[7], datasets[8], and assessments.

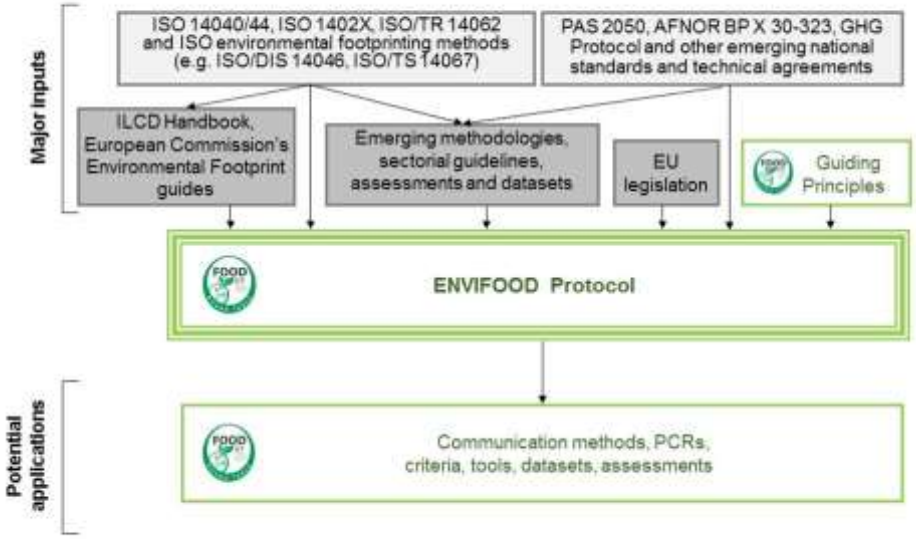

Figure 1. *Inputs to the ENVIFOOD Protocol and its potential applications*

[5] PCRs are, in this context, sets of specific rules to assess the environmental issues of food and drink product groups. According to the ENVIFOOD Protocol, PCRs might also refer to product sub-groups. PCRs are expected to complement the ENVIFOOD Protocol and be either Product Category Rules (PCR) according to ISO 14025 or Product Environmental Footprint Category Rules (PEFCRs) according to Commission's Product Environmental Footprint (PEF). PCRs might be instrumental for Type III Environmental Declarations and environmental footprint programmes. Finally, PCRs might also be the baseline for detailed assessments enabling the definition of environmental performance indicators and criteria.

[6] Criteria are meant to be those qualitative requirements for eco-design, green procurement, Type I eco-label (ISO 14024:1999), and Product Oriented Management Systems (POEMS).

[7] Tools can be defined in this context as those instruments providing science-based quantification of environmental impacts (e.g. sector/product group specific LCA software, environmental performance calculator).

[8] Datasets are defined in the ILCD Handbook (EC, 2010) as Life Cycle Inventory data. The availability of quality-ensured data sets is essential for facilitating robustness, coherence and cost-savings in environmental assessments of food and drink products.

In the context of PCR development, Figure 2 shows how the Food SCP RT sees the relationship between the Protocol and the PEF Guide.

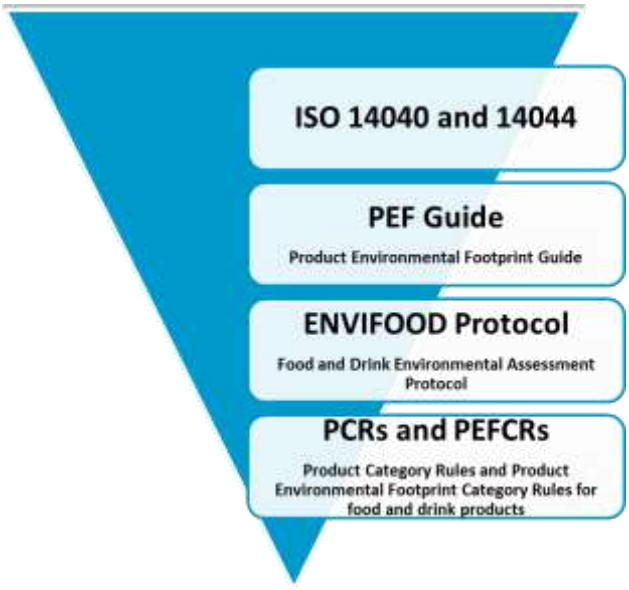

Figure 2. *The ENVIFOOD Protocol in the context of PCR development*

1. Scope

The ENVIFOOD Protocol has been developed in line with the Guiding Principles of the Food SCP Round Table (see Annex A). Among these principles, principle 3 requires to "apply recognised scientific methodologies" and that "use shall be made of international and European standards and guidelines and derived sector-specific documents, as applicable". This Protocol complements such international and European documents, including through alignment. However, in applications in the context of e.g. ISO 14040/44 and the European Commission's Communication Building the Single Market for Green Products including the Recommendations on Product Environmental Footprint, in the case of contradiction, such documents overrule any requirements in this Protocol.

The ENVIFOOD Protocol specifies requirements for assessing the environmental impacts associated with food and drink products along their life cycle (see Figure 3). The Protocol aims at ensuring that assessment results are scientifically reliable and consistent in supporting informed choice. The Protocol also highlights areas in which further guidance is required, e.g. by PCRs (marked in purple text-boxes as described further below).
When accompanied by PCRs, the Protocol provides guidance to support:

- The development of consistent environmental assessments of intermediate products in the context of business-to-business, and of consumer products in the context of business-to-consumer communication (the focus of Working Group 2 of the Food SCP Round Table);
- The identification of environmental improvement options (focus of the Food SCP Round Table Working Group 3).

Although environmental managers and LCA experts are the target audience of this guide, this document represents a stepping stone towards the development of user-friendly and affordable tools for the assessment and communication of environmental impacts. If accompanied with high quality data, those tools are able to drastically alleviate SMEs from the disproportionate burden of such assessments.

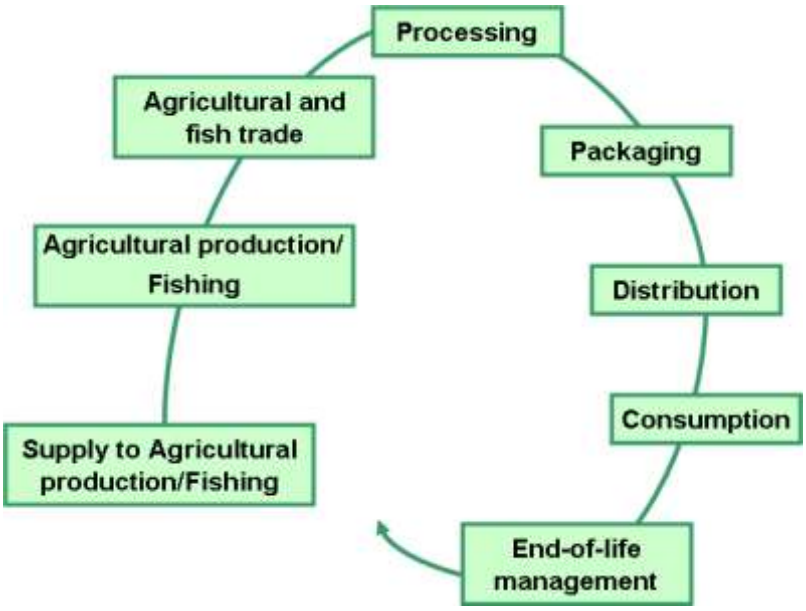

Figure 3. *Generic food and drink life cycle*[9]

[9] The flow diagram is only intended to illustrate the key stages of a generic life cycle for food and drink products. On a case-by-case basis, the generic life cycle in Figure 3 may be fine-tuned in order to include the key operators of the supply chain analysed.

2. Normative reference and relationship with other methodologies

This Protocol follows the methodological framework established for life cycle assessment in ISO 14040:2006 - Environmental management - Life cycle assessment - Principles and framework.

The following documents are indispensable for the application of this methodology. For out-of-date documents, only the edition cited applies.

- The Guiding Principles of the Food SCP Round Table (2010);
- ISO 14040:2006 - Environmental management - Life cycle assessment - Principles and framework.

Beyond its self-standing application to establish product related environmental information following the guiding principles, the Protocol reveals the basis for coherence and quality assurance at the sector level for a number of international and national standards or proprietary guidance documents on life cycle assessment.

Depending on the intended communication, different additional requirements may apply. For these uses, the Protocol serves as guide to set generic requirements in the context of the Food & Drink supply chain and to point to consensus and best practice examples.

For the communication of environmental hotspots or of the environmental performance of a product, several tools and methods exist like ISO 14040. The ILCD Handbook (EC, 2010) or the European Commission's Product Environmental Footprint (PEF) Guide (EC, 2013a) also reveal provisions for this purpose.

The same holds true for dealing with the environmental performance of organisations which is currently deepened within a standardization process in ISO and also supported in the of Organisation Environmental Footprint (OEF) Guide developed by the European Commission (EC, 2013b).

The streamlining of environmental performance communication in form of declarations or indicator profiles requires the establishment of product category rules (PCRs) following ISO 14025 to make use of environmental product declarations (EPD). The European Commission's PEF Guide also refers to PEF Category rules (PEFCR) which can be developed to generate PEF profiles.

As the anticipated communication is directed to consumers to allow informed decisions, not all data modelling approaches detailed in the ILCD Handbook are mirrored in the ENVIFOOD Protocol.

Annex A presents the full version of the Guiding Principles of the Food SCP Round Table.

Annex B presents where the Protocol provides further guidance to ISO 14044:2006 and the PEF Guide.

Annex C highlights where the PEF Guide provides additional guidance to the Protocol.

3. How to read this guide

Each part of this guide dealing with requirements for assessment is divided into the following three sub-sections that are distinguished by their formatting:

Educational explanation (in text box).

The topic concerned is explained briefly to facilitate the reading by a non-expert audience.

Requirements (normal text).

In this part, additional requirements to ISO 14044:2006 are specified.

Areas where more guidance is needed (text box).

Those issues requiring sub-sectoral guidance and/or product specific rules are illustrated in this sub-section. Areas where more research is needed are also highlighted in this sub-section.

The following verbal forms that appear in the ENVIFOOD Protocol are defined in line with CEN (CEN 2010):

- **Shall** is used to express a requirement. If compliance with the Protocol is claimed, compliance with all the expressions with shall is required.
- **Should** is used to express recommendations. A deviation from a “should” requirement is to be justified.
- **May** indicates that the standard is giving permission.
- **Can** describes a possibility.

4. Terms and definitions

Allocation: Partitioning the input or output flows of a process or a product system between the product system under study and one or more other product systems (ISO 14044:2006).

Blue water: Fresh surface and groundwater, in other words, the water in freshwater lakes, rivers and aquifers (Hoekstra et al., 2011).

Background system: The background system consists of processes on which no or, at best, indirect influence may be exercised by the decision-maker for which an LCA is carried out. Such processes are called “background processes” (UNEP/SETAC Life Cycle Initiative, 2011).

Business to business (B2B) communication: The handling of data along the supply chain.

Business to consumer (B2C) communication: The handling of information from the supply chain to the consumer.

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

Comparative assertion: Environmental claim regarding the superiority or equivalence of one product versus a competing product that performs the same function (ISO 14044:2006)

Cradle-to-gate inventory: A partial life cycle of an intermediate product, which includes the consecutive and interlinked stages of a product system from raw material acquisition through to when the product leaves the reporting organisation’s gate (e.g. immediately following the product’s production).

Cradle-to-grave inventory: A complete life cycle of a product which includes all the consecutive and interlinked stages of a product system from material acquisition through to end-of-life

Critical review: Process intended to ensure consistency between a life cycle assessment and the principles and requirements of the International Standards on life cycle assessment (ISO 14044, 2006).

Cut-off: Specification of the amount of material flow, energy flow, or the level of environmental significance associated with unit processes or product systems to be excluded from a study (ISO 14044:2006).

Data quality: Characteristics of data that relate to their ability to satisfy stated requirements (ISO 14044:2006).

Direct land use change: Change in human use or management of land within the product system being assessed (ISO/TS 14067:2013).

Elementary flow: Material or energy entering the system being studied that has been drawn from the environment without previous human transformation, or material or energy leaving the system being studied that is released into the environment without subsequent human transformation (ISO 14044:2006).

Environmental flow requirements: The quantity, quality and timing of water flows required to sustain freshwater and estuarine ecosystems and the human livelihoods and well-being that depend on these ecosystems (Hoekstra et al., 2011).

Foreground system: The foreground system consists of processes which are under the control of the decision-maker for which an LCA is carried out. They are called “foreground processes” (UNEP/SETAC Life Cycle Initiative, 2011).

Green water: The precipitation on land that does not run off or recharge the groundwater but is stored in the soil or temporarily stays on top of the soil or vegetation. Eventually, this part of precipitation evaporates or transpires through plants. Green water can be made productive for crop growth (although not all green water can be taken up by crops, because there will always

be evaporation from the soil and because not all periods of the year or areas are suitable for crop growth) (Hoekstra et al., 2011).

Grey water: The volume of water that is required to assimilate the load of pollutants given natural background concentrations and existing ambient water quality standards (Hoekstra et al., 2011).

Extrapolated data: Data specific to another process or product that has been adapted or customised to resemble more closely the conditions of the process in the assessed product's life cycle (GHG Protocol, 2011).

Evapotranspiration: Evaporation from the soil and soil surface where crops are grown, including the transpiration of water that actually passes through crops (Hoekstra et al. 2011).

Food and drink product: Any substance or product, whether processed, partially processed or unprocessed, intended to be, or reasonably expected to be ingested by humans[10].

Functional unit: The quantified performance of a product system for use as a reference unit (ISO 14044:2006).

Impact: Class representing environmental issues of concern to which life cycle inventory analysis results may be assigned (ISO 14044:2006). An impact represents a specific environmental threat to which life cycle inventory analysis results may be assigned.

Impact indicator: Quantifiable representation of an impact category (ISO 14040:2006). An impact indicator is a quantifiable representation of the contribution of a product unit to the specific impact.

Indirect land use change: Change in the use or management of land which is a consequence of direct land use change, but which occurs outside the product system being assessed (ISO/TS 14067:2013).

Intermediate product: Output from a unit process that is input to other unit processes that require further transformation within the system (ISO 14044, 2006).

Land use change: Change in the purpose for which land is used by humans (e.g. between crop land, grass land, forest land, wetland, industrial land) (PAS 2050, 2011).

Land-use change impacts: Emissions and removals due to land-use change (GHG Protocol, 2011).

Life Cycle: Consecutive and interlinked stages of a product system, from raw material acquisition or generation of natural resources to end of life, inclusive of any recycling or recovery activity (ISO 14044:2006).

Life Cycle Assessment (LCA): Compilation and evaluation of inputs, outputs and potential environmental impacts of a product system throughout its life cycle (ISO 14044:2006).

Life cycle of food and drink products: Consecutive and interlinked stages of the food and drink production and consumption system, ranging from activities related to input supply to agriculture, agricultural production, processing, packaging, transport and logistics, retail, consumption and end-of-life (see Figure 3).

Life-Cycle Interpretation: phase of life cycle assessment in which the findings of either the inventory analysis or the impact assessment, or both, are evaluated in relation to the defined goal and scope in order to reach conclusions and recommendations (ISO 14040:2006).

Life Cycle Inventory Analysis (LCI): Phase of life cycle assessment involving the compilation and quantification of inputs and outputs for a product throughout its life cycle (ISO 14044:2006).

[10] See Regulation (EC) 178/2002 laying down the General Principles and requirements of Food Law.

Offsetting: Mechanism for compensating for all or for a part of the carbon footprint of a product through the prevention of the release of, reduction in, or removal of an amount in a process outside the boundary of the product system (ISO/TS 14067:2013).

Post-consumer material: Material generated by households or by commercial, industrial and institutional facilities in their role as end-users of the product which can no longer be used for its intended purpose. This includes returns of material from the distribution chain (ISO 14021:1999).

Pre-consumer material: Material diverted from the waste stream during a manufacturing process. This excludes reutilisation of materials such as rework, regrind or scrap generated in a process and capable of being reclaimed within the same process that generated it (ISO 14021:1999).

Primary data: quantified value of a unit process or an activity obtained from a direct measurement or a calculation based on direct measurements at its original source (ISO/TS 14067:2013).

Product: Any goods or service (ISO 14040:2006) resulting from a specific unit process (adapted from ISO/IEC 19796-1).

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

Product category rules (PCR): A set of specific rules, requirements and guidelines for environmental declarations for one or more product categories (as adapted by ISO 14025:2006).

Product system: Collection of unit processes with elementary and product flows, performing one or more defined functions that models the life cycle of a product (ISO 14044:2006).

Proxy data: Data from a similar activity that is used as a stand-in for the given activity. Proxy data can be extrapolated, scaled up, or customised to represent the given activity (GHG Protocol, 2011).

Reference flow: Measure of the outputs from processes in a given product system required to fulfil the function expressed by the functional unit (ISO 14044:2006).

Reporting: Presenting data to internal management and external users such as regulators, shareholders, the general public or specific stakeholder groups (GHG Protocol, 2011).

Secondary data: Data obtained from sources other than a direct measurement or a calculation based on direct measurements at the original source (ISO/TS 14067:2013).

System Boundary: Set of criteria specifying which unit processes are part of a product system (ISO 14044:2006). The system boundary determines which unit processes shall be included or excluded from the study. The system boundary of an LCA normally includes all activities from extraction of raw materials through processing, manufacturing, use, repair and maintenance processes as well as transport, waste treatment and might concern other purchased services.

Unit process: Smallest portion of a life cycle for which data are analysed when performing a life cycle assessment (ISO 14044:2006).

Waste: Any substance or object which the holder discards or intends or is required to discard (Directive 2008/98/EC). Substances or objects which the holder intends or is required to dispose of (ISO 14044:2006, 3.35).

Water consumption: Water removed but not returned to the same basin (ISO/DIS 14046:2013).

Water stress index: The ratio of total annual freshwater withdrawals to water availability (Pfister et al., 2009).

Water withdrawal: The volume of freshwater abstraction from surface or groundwater. Part of the freshwater withdrawal will evaporate, another part will return to the catchment where it was

withdrawn and yet another part may return to another catchment or the sea (Hoekstra et al., 2011).

5. Principles

The ENVIFOOD Protocol has been developed in full consideration of the Guiding Principles of the Food SCP Round Table (2010) that are relevant for assessment. ENVIFOOD Protocol-compliant PCRs and sub-sectoral guides are also to be in line with these principles.

The lead principle:

Environmental information communicated along the food chain, including to consumers, shall be scientifically reliable and consistent, understandable and not misleading, so as to support informed choice.

I. Principles for the voluntary environmental assessment of food and drink products

Principle 1: Identify and analyse the environmental aspects at all life-cycle stages;

Principle 2: Assess the significant potential environmental impacts along the life-cycle;

Principle 3: Apply recognised scientific methodologies;

Principle 4: Periodically review and update the environmental assessment;

II. Principles for the voluntary communication of environmental information

Principle 5: Provide information in an easily understandable and comparable way so as to support informed choice

Principle 6: Ensure clarity regarding the scope and meaning of environmental information

III. Principles for both voluntary environmental assessment and communication

Principle 7: Ensure transparency of information and underlying methodologies and assumptions;

Principle 8: Ensure that all food chain actors can apply the assessment methodology and communication tools without disproportionate burden;

Principle 9: Support innovation;

Principle 10: Safeguard the Single Market and international trade.

Annex A presents the extended version of the Guiding Principles of Food Sustainable Consumption & Production Round Table (2010).

6. Methodological framework

The rules of the ENVIFOOD Protocol in conjunction with other international and European standards and recommendations such as ISO 14044:2006 contributes towards greater coherency and quality assurance for assessing the environmental performance of food and drink products according to an attributional modelling approach. Depending on the communication type concerned (i.e. business to business or business to consumer) some rules for assessment have been differentiated in the Protocol. Business to business (B2B) communication-related applications of this Protocol only refer to data sharing among supply chain partners and not data disclosed to the public.

6.1 Functional unit

What is a functional unit?

The functional unit is the quantified performance of a product system for use as a reference unit. It describes the function of the product and it is the basis for the calculations in LCA assessments. Reference flows are the amount of products needed to fulfill the function. Using the same functions based on the same functional units in the form of their reference flows is required to compare LCA results (ISO 14044:2006).

Although general LCA methodologies leave a lot of flexibility, food and drink products are often measured in weight, volume or serving.

Note: The specification of functional units covers the situation in which the function is provided as accurately as possible (e.g. packed, unpacked, on shelve, on plate, at farm gate).

6.1.1 Unit of analysis for Business to Business (B2B) communication-related applications

Many materials and intermediate products are used in the supply chain of consumer goods. The final use and function of these are not always known at the point of sale for the operator selling its product. If a functional unit is common in B2B relationships (e.g. for the payment of intermediate products, fat content of milk may be used), this functional unit may also be used for the calculation of life cycle impacts. Otherwise the unit of analysis corresponds to the reference flow.

6.1.2 Unit of analysis for B2C communication-related applications

For B2C communication-related applications, the unit of analysis is the functional unit that should be in line with the requirements of the EU Regulation 1169/2011 on the provision of food information to consumers for nutrition declarations, as relevant. Hence, the functional unit should be expressed per weight or volume (i.e. 100 g or ml). In addition, it may be expressed otherwise (i.e. per portion, per consumption unit or per unit sold) as stated by the relevant PCRs.

6.2 System boundaries

What are system boundaries?

System boundaries are a set of criteria specifying which unit processes are part of a product system (ISO 14040:2006). The system boundary should as far as possible include all relevant life cycle stages and processes (EC, 2010). Cut-off criteria will determine how completely a system is assessed (i.e. which inputs will be taken into consideration in the assessment). According to ISO, using initial identification of inputs based on mass alone may lead to significant omissions, hence energy and environmental significance should also be used as cut-off criteria. See Figure 4 below for an example of a system boundary.

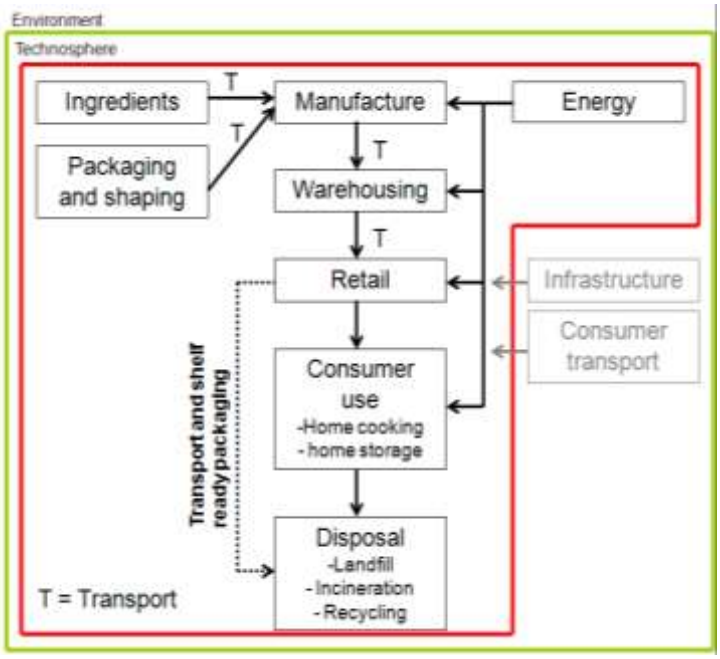

Figure 4: Example of a system boundary

Note: The primary production of ingredients and packaging is implicitly included in the system

6.2.1 System Boundary for B2B communication-related applications

B2B is defined as the handling of data along the food chain. All relevant life cycle stages should be included from a cradle-to-gate approach.

6.2.2 System Boundary for B2C communication-related applications

All relevant life cycle stages should be considered in the system boundary (i.e. from-cradle-to-grave approach). However, different system boundaries can be set up, depending on the use phase of the product group concerned. All assumptions shall be clearly reported.

6.2.2.1 System boundary for product group 1

Those products characterised by a large variety of uses.

No specific instructions on amounts and how to use in final dish on pack.

Examples: salt, flour, cocoa powder, fresh fruits and vegetable, fresh meat.

- Full life cycle shall be considered, if relevant PCR defines a use phase. Use phase should be excluded if there is no such guidance.

6.2.2.2 System boundary for product group 2

Those products characterised by a typical/dominant use. Some variable components are possible (e.g. how coffee is consumed, with milk and sugar, black etc.).

In this case either no instruction on use but a common habit can be expected or an instruction on dominant use (e.g. 1 stock cube per 0.5 l of water but not no direction if stock is used for risotto etc.).

Examples: Coffee beans, tea, ice cream in a tub, stock cubes, pasta sauce, ready to drink beverages, cereals, cordial, sausages.

- Full life cycle shall be considered;
- Use phase to be described by typical/dominant use e.g. drink is drank cold;
- Variable components should be excluded (e.g. adding of ice or lemon to a drink);
- Need to consider regional/country variations in use/habit;
- If typical/dominant use requires additional ingredients; representative data for these ingredients should be used.

6.2.2.3 System boundary for product group 3

Those products with clear, unambiguous instructions on use. It is expected that most consumers follow these instructions before consuming the intended final product. Additional components are possible. Usually clear serving sizes are given.

Examples: Ready meal, sachet for instant cappuccino, ice cream on a stick, instant soup.

- Full life cycle shall be considered;
- Assume that consumers follow recommended instructions on pack;
- If instructions require the use/inclusion of additional ingredients (e.g. water, cream, meat), then representative values for these ingredients should be used.

* The lists of examples is not comprehensive and are included for illustrative purposes.

6.2.3 Life cycle phases that need special consideration

Some life cycle phases of food and drink products are particularly complicated and require an in-depth analysis before a modelling exercise is conducted. This section lists some key elements to be taken into account in any assessment per life cycle phase concerned.

6.2.3.1 Use phase

Issues requiring sub-sectoral guidance and/or product specific rules

These recommendations refer only to system boundary definition for B2C-related applications.

Product Group 1: PCRs shall decide whether or not to define a use phase. Use phase should be ideally described on a specific example or, alternatively, be based on an average of different typical use patterns. The following unit processes should be considered part of the use phase (note that modelling implies taking into account all relevant inputs and outputs, including quantities and fate of any form of waste occurring during the operation, e.g. the quantity and fate of food waste during the steps mentioned below):

- Storage
- Washing (e.g. vegetables)
- Preparation (e.g. peeling)
- Cooking
- Use of other appliances for consumption (e.g. electric grater, blender)
- Chilling/freezing
- Cleaning (e.g. pans, dishes, utensils, surfaces)

Product Group 2: Typical/dominant use of a product shall be defined (e.g. whether soft drinks are drank cold; coffee is consumed with other ingredients such as milk and sugar, etc.). PCRs should consider regional variations in habits where appropriate.

6.2.3.2 Waste management and end of life treatment

While there is a broad consensus on how to identify and quantify “waste flows” within the production steps of food and drink products, it is more difficult to measure waste in the consumer use phase. Given the important contribution of food waste to the environmental impacts of food and drink products, it is crucial for industry sectors to reach agreement on default values to be used as well as on procedures for the generation of reliable primary data in the consumption stage.

Waste streams to be modelled – system boundaries

Waste which ceases to be waste should be treated according to section 6.4.

Pre-consumer: Pre-consumer waste occurs up to and including the point of sale. All waste occurring during the production of a food and drink product up to the point of sale are part of the industrial inventory.

Post-consumer: As the use phase can be a significant contributor to overall environmental impacts in terms of resource consumption and waste generation, primary input data should be preferred for waste generated in the use phase. Such data can be obtained through consumer studies. The methodology for such studies, as well as default data to be used in the absence of primary data, should be subject to more specific product guidance such as PCRs or sector guidance.

Examples of waste streams

Some potential food and drink waste is diverted from the waste disposal stream by the consumer. Waste treatment may also occur at the household level, for example in the case of home composting.

If collected, waste may become part of the municipal solid waste system and may undergo further treatment. If collected for recovery, food and drink waste will enter the waste stream for compostable materials. Used packaging also enters installed collection systems, which may be accessible within each household, at public places and/or at central collection points.

Annex D provides a check-list to make sure that all options are recognised for each waste quantity leaving the system.

Modelling

Modelling waste streams is a complex task as each treatment step is associated with the occurrence of new, but different waste streams until final disposal. A waste stream's characteristics depend on the installed technologies and capacities and will differ from region to region. Official statistics may help to understand given waste streams.

For existing products, waste treatment statistics and recycling statistics may be used if it can be justified through third party verified information. For packaging, for example, compliance with CEN Packaging Standards can be assessed. In all other cases conservative estimates should be used. For existing products, specific end-of-life data at the given geography shall be used. Waste treatment statistics and recycling statistics may be used as proxy if such specific data are not available. The decision shall be documented and justified. For broader analyses it may be advisable also to consider technological changes and developments in waste treatment.

Issues requiring sub-sectoral guidance and/or product specific rules

Sub-sectoral guidance and/or product specific rules are required for assessing if (and how) benefits and loads of a waste treatment process are allocated to the product/functional unit, which recognise specific boundary conditions in geographical and temporal terms.

Sub-sectoral guidance and/or product specific rules are also required for assessing default data for waste generation in the use phase as well as the methodology for generating primary data for waste generation in the use phase.

What time-dimension factors need to be considered?

Elementary flows to the environment may occur in very long terms, in particular for landfilling. Guidance exists in the ILCD framework to differentiate the inventory of flows within the first 100 years from now/time of study and those beyond (“long-term”). It is then suggested to keep both in the inventory, calculate Life Cycle Impact Assessment (LCIA) results separately, use the first 100 years and discuss results including the long-term emissions. In line with the Food SCP Round Table’s principles 1, 2 and 3, differentiation of the ILCD inventory needs justification.

6.3. Data quality requirements and dealing with data gaps

What are data quality requirements?

High quality data are the basis of any high quality product environmental assessments. According to ISO 14044:2006, the dimensions of data quality are: time-related coverage, geographical coverage, technology coverage, precision, completeness, consistency, reproducibility, source of data and uncertainty of the information. On the basis of these dimensions and in relation to the purpose of the assessment, requirements based on data quality levels are defined.

Verifiable and product specific primary data are preferred to secondary data. Quality should be assessed against the following dimensions: technological, temporal and geographical representativeness, completeness, and precision.

Primary data are required for processes operated or managed by (i.e. under managerial or financial control of) the reporting organisation. Exceptions are possible whenever high quality secondary data are available and may best represent reality (e.g. emissions from livestock, their manure and soil). A product that may derive from different production plants shall be represented by weighted averages. Whenever primary data are not available, then secondary data of the highest practical quality should be used.

Whenever there is a lack of datasets, their significance should be evaluated first, before pursuing the use of extrapolated data. In this context, a dataset is significant if it is above the cut-off threshold. If the estimated data have the potential to change the conclusion of the study (see the section on system boundaries), then they should be included. Data extrapolations may be used for this purpose.

Preference shall be given to primary and secondary data which are compliant with the ILCD Data Network entry level requirements (EC, 2012). Secondary data should be country-specific. To assess data quality, the PEF data quality indicator (EC, 2013a) should be used. Data and calculations need to be transparent, enabling external peer reviews.

6.4. Handling multi-functional processes (allocation)

What is a multi-functional process?

The sum of the allocated inputs and outputs of a unit process shall be equal to the unallocated inputs and outputs of the unit process (ISO 14044:2006). Depending on the context, different solutions to solve multi-functionality are appropriate. The following hierarchy provided in ISO 14044:2006 shall apply:

Step 1: Wherever possible, allocation needs be avoided by:

a. Dividing the unit process to be allocated into two or more sub-processes and collecting the input and output data related to these sub-processes;

b. Expanding the product system to include the additional functions related to the co-products, taking into account the requirements of section 4.2.3.3 in ISO 14044:2006.

Step 2: Where allocation cannot be avoided, the inputs and outputs of the system should be partitioned between its different products or functions in a way that reflects the underlying physical relationships between them; i.e. they should reflect the way in which the inputs and outputs are changed by quantitative changes in the products or functions delivered by the system.

Step 3: Where physical relationship alone cannot be established or used as the basis for allocation, the inputs should be allocated between the products and functions in a way that reflects other relationships between them. For example, input and output data might be allocated between co-products in proportion to the economic value of the products.

Beyond guidance on allocation procedure for co-products from ISO 14044:2006, the following shall apply for the food and drink sector: economic allocation shall be used by default in Step 3, using a price average over a three year period.

6.4.1 Multi-functional processes in end of life modelling

When it comes to product end-of-life modelling, applicable ISO requirements shall be followed. Substitution techniques where the substituted product is known shall be considered as a Step 2 approach for dealing with multi-functionality. Where used, it is crucial to identify the substituted product (the material, function or energy carrier and conversion which is replaced). In general recycling/energy recovery, for example, is to be modelled towards the first marketable product/material/energy and substitute.

Three types of substitution are distinguished:

1. The specific substitution, if it is internal recycling or if there is a specific local use (e.g. the use of methane (CH_4) from a landfill that produces electricity in generator that otherwise would be driven by diesel, for example);
2. The substitution of the country-mix of the specific superseded product, if there is a market step in between and a direct equivalent product exists (e.g. electricity from a waste incinerator that is fed into the national grid);
3. The substitution of a wider function or the market that is superseded.

In any case, substitution introduces value choices and uncertainty. In line with the Food SCP Round Table's Guiding Principles, the actual substitution is to be modelled as accurately as possible.

Issues requiring sub-sectoral guidance and/or product specific rules

For specific allocation problems, relevant stakeholders (constituencies from the Food SCP Round Table) shall develop solutions to the allocation problem that will be applied by all stakeholders. To that extent, the form in Annex E shall be used. Whenever a specific allocation problem has been agreed upon by the stakeholders, it shall be approved by the Working Group 1 of the Food SCP Round Table.

If allocation cannot be avoided and Annex E results in recommending the economic allocation technique, then PCRs shall provide more detail on what market prices are to be taken as reference.

Recycling and related allocation procedures

Examples of modelling approaches given in ISO 14044:2006 include:

a) A closed-loop allocation procedure applies to closed-loop product systems. It also applies to open-loop product systems where no changes occur in the inherent properties of the recycled material. In such cases, the need for allocation is avoided since the use of secondary material displaces the use of virgin (primary) materials. However, the first use of virgin materials in applicable open-loop product systems may follow an open-loop allocation procedure outlined in point b.

b) An open-loop allocation procedure applies to open-loop product systems where the material is recycled into other product systems and the material undergoes a change to its inherent properties.

6.4.2 Sensitivity analysis

Whenever unit processes cannot be subdivided with certainty, system expansion (substitution) shall be performed as a sensitivity analysis. Whenever an additional function (system expansion) cannot be identified with certainty, allocation based on underlying physical relationships shall be performed as a sensitivity analysis.

Whenever it is unclear if allocation based on underlying physical relationships is appropriate, economic allocation shall be performed as a sensitivity analysis. Whenever economic allocation is performed, sensitivity analyses on the assumed market price shall be performed.

6.5. Environmental and other impacts

What is an environmental impact?

Life Cycle Impact Assessment (LCIA) aims at understanding and evaluating the magnitude and significance of potential environmental impacts for a product system throughout the life cycle of the product (ISO 14044:2006).

An impact represents a specific environmental threat to which life cycle inventory analysis results may be assigned. An impact indicator is a quantifiable representation of the contribution of a product unit to the specific impact. The selection of environmental impacts is a mandatory step of LCIA and this selection should be justified and consistent with the goal and scope of the study (ISO 14040:2006).

Environmental impacts can be modelled at different levels in the chain of cause (emissions, resource consumptions) to effects (impacts on e.g. climate, species, or human health). A distinction is to be made between midpoint impacts (which characterise impacts somewhere in the middle of the chain of cause to effect), and endpoint impacts (which characterize impacts at the effect). Endpoint methods provide indicators at or close to an area of protection. Usually three areas of protection are recognised: human health, natural environment, and natural resources (see below). The aggregation at endpoint level and at the areas of protection level is an optional phase of the assessment according to ISO 14044:2006. This is described in the Figure 5 below.

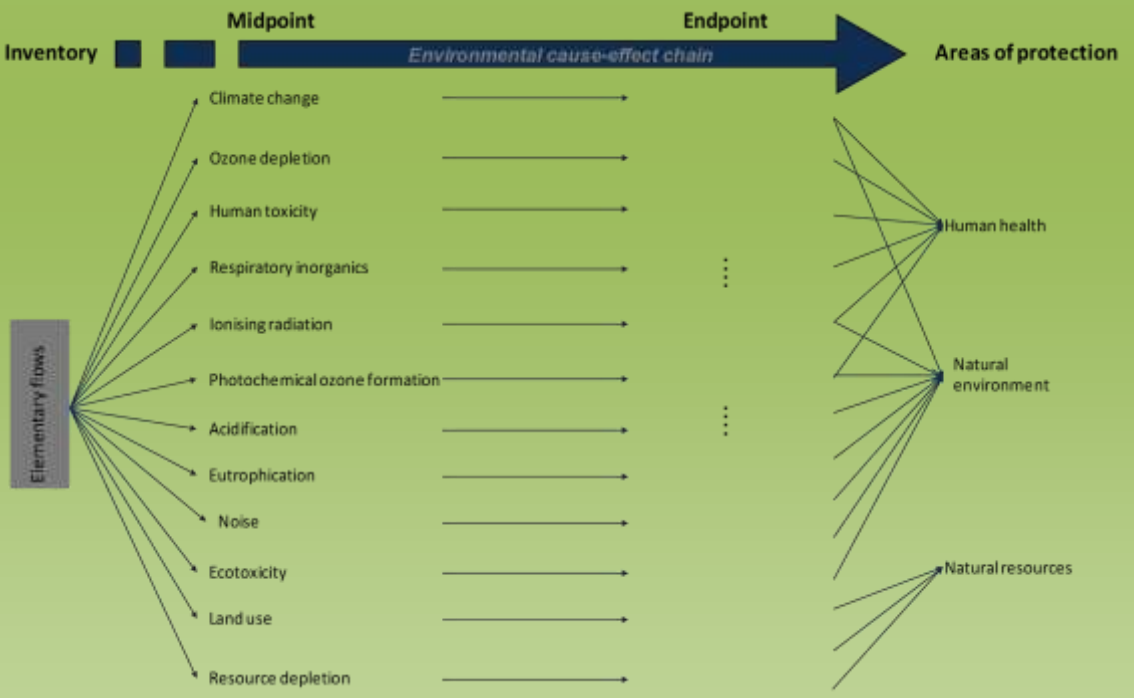

Figure 5: Framework for environmental impact assessment (EC, 2011)

What is an environmental impact? (Continued)

Climate change is a midpoint impact, for example. The results of the Life Cycle Inventory are the amount of greenhouse gas emissions per functional unit. Using a characterisation model and a characterisation factor, such as the Global Warming Potential for each gas, these results can be expressed under the same midpoint impact indicator which is kilograms of CO_2 equivalents per functional unit. Climate change can also be characterised at end point levels such as impact on crops or on forest and can have consequences at the Areas of Protection level on human health and natural environment.

This chapter provides a default list of impacts whose significance shall be assessed against the criteria suggested in section 6.5.1. Environmental impacts identified as significant should be assessed using the assessment models recommended in Table 1 on page 29. They represent the scientific consensus regarding assessment models.

The following section of the chapter consists of a more in-depth description of water stress and water scarcity, which are midpoint impact categories falling into the resource depletion category. Finally, the chapter refers to Land Use Change. Guidance is provided on how to proceed with the LCI phase regarding Land Use Change and with the LCIA regarding climate change and Land Use Change. Information is also provided in Annex F on capturing impacts on biodiversity.

6.5.1 Identification of significant potential impacts

ISO 14044:2006 states that issues such as choice, modelling and evaluation of impacts can introduce subjectivity into the LCIA phase. Therefore, there is a need for guidance on this issue. The list of impacts above represents a starting point for the assessment. Exclusion of impacts is allowed only when robust, substantiated and transparent argumentation is provided. A stepwise approach (screening phase and detailed analysis in order to check accuracy and improve precision) is recommended in that regard. The criteria suggested by the Food SCP Round Table to identify relevant impact categories are the following:

a) Relevance of the impact for food and beverages. A set of relevant source types and some bibliographic references (e.g. LCA studies, results of the Life Cycle indicators project, EIPRO (Tukker et al., 2006), sector-specific reports by governmental environmental agencies) should be provided as basis to justify any exclusion based on this criterion.

b) Scientific robustness and applicability of methods and models

c) Correlation between impact categories (win/win situations)

The specific methods, listed in Table 1, represent the latest scientific consensus and are currently recommended for use. More information on these methods is available in the "Recommendations for Life Cycle Impact Assessment in the European context (EC, 2011)" from the ILCD Handbook (2010).

Characterization factors for all impact assessment models, other than the one on water use, are the same as per the PEF Guide. They can be downloaded from the European Reference Life Cycle Database (ELCD): http://elcd.jrc.ec.europa.eu/ELCD3/LCIAMethodList.xhtml

Characterization factors for the assessment model here recommended for water use can be found in: http://www.ifu.ethz.ch/ESD/downloads/EI99plus

Table 1: Environmental and other impacts, assessment models and indicators[11]

Impact Category	Impact Assessment Model	Indicators	Source
Climate Change	Bern model - Global Warming Potentials (GWP) over a 100 year time horizon.	kg CO_2 equivalent	Intergovernmental Panel on Climate Change, 2007
Ozone Depletion	EDIP model based on the ODPs of the World Meteorological Organization (WMO) over an infinite time horizon.	kg CFC-11 equivalent	WMO, 1999
Ecotoxicity for aquatic fresh water	USEtox model	CTUe (Comparative Toxic Unit for ecosystems)	Rosenbaum et al., 2008
Human Toxicity - cancer effects**	USEtox model	CTUh (Comparative Toxic Unit for humans)	Rosenbaum et al., 2008
Human Toxicity – non-cancer effects**	USEtox model	CTUh (Comparative Toxic Unit for humans)	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+ eq	Seppälä et al.,2006; Posch et al., 2008
Eutrophication – terrestrial	Accumulated Exceedance model	mol N eq	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 use	Water stress index model	m^3 water use related to local scarcity of water	Ridoutt, B.G. and Pfister, S., 2010***
Resource Depletion – mineral, fossil	CML2002 model	kg antimony (Sb) equivalent	van Oers et al., 2002
Land use[12]	Soil Organic Matter (SOM) model	Kg C (deficit)	Milà i Canals et al., 2007

* Mainly based on Rabl and Spataro (2004) and Greco et al. (2007).

****** Human toxicity assessment models in LCA do not capture food safety issues, which are addressed by Regulation (EC) No 178/2002.

*** In this context, the scope of this method is limited to blue water only. More detail in section 6.5.2.

[11] Based on the PEF Guide (EC, 2013a), other than the model recommended for water use.

[12] Land Use reflects the damage to ecosystems due to the effects of occupation and transformation of land according to the ILCD definition. See section 6.5.3 for more detail.

Beyond the impact indicators inventory data can provide relevant information about a product's environmental performance. The use of energy, divided by the energy source, can be established as an inventory indicator if considered relevant.

Water use is part of the resource depletion category and should be assessed. Given its importance for the food and drink sector (and in particular the agricultural supply chain), the water use indicator shall be reported separately from other resource use indicators.

Grouping, weighting and normalisation of impact indicators to end-point scores is optional according to ISO 14044:2006. Because there is a risk of subjectivity (value-choices) and uncertainties are generally higher with end-point scores than with impact indicators (mid-point scores), the ENVIFOOD Protocol does not give any guidance and recommendations on grouping, weighting and normalisation.

Issues requiring sub-sectoral guidance and/or product specific rules

Other environmental impact indicators shall be included if the environmental impact is found significant for a given assessment.

6.5.2 Water scarcity and water use assessment

Background

Water is a valuable natural resource because it both allows life to be sustained and it cannot be replaced by any other substance. Freshwater is scarce in some regions, countries, or even continents, thus leading to notable resource supply problems. In addition, a substantial amount of water can be used for producing foods, biofuels, or renewable raw materials (Dominguez-Faus et al. 2009).

Water-use has major implications on the following areas of protection: human health, ecosystem quality and resource availability (in terms of availability of freshwater for future generations).

With regards to human health, water scarcity in terms of, for example, lack of surface water and groundwater for agricultural irrigation may have major implications on malnutrition. Approximately one third of the world‘s population is threatened by a lack of water to meet daily needs (International Water Management Institute 2007).

Regarding ecosystem quality, water scarcity may affect biodiversity, as sensitive species may not be able to cope with reduced “environmental flow requirements”. Water for irrigation and for industry competes with water for the environment. This situation has the potential to negatively impact aquatic biodiversity and the health of riparian, floodplain and estuarine ecosystems (Ridoutt and Pfister 2010).

Where surface water and groundwater resources are consumed at a rate that exceeds the short-term replacement (and where non-renewable blue water resources are consumed, like fossil groundwater resources), this is a form of resource depletion that limits the availability of blue water for multiple priority purposes over the time.

Unlike “water resource management”, on which the scientific community has begun to map and analyse water availability, water use and water pollution, the LCA community has been dealing with water use assessment only recently. Although a wide range of impact assessment methods for LCA have been developed (Bayart et al. 2010; Berger and Finkbeiner 2010), how to properly account for and assess water use is still a challenge in the LCA community (Berger and Finkbeiner 2010). To address water use in LCA, the UNEP SETAC Life Cycle Initiative has an on-going project and results are coming underway (Bayart et al. 2010). In parallel, the International Organization for Standardization (ISO) is currently developing an international standard on water footprint.

Nevertheless, even if carbon footprinting and water footprinting evoke the same principle of measurement referring to a distinct impact, the water footprint approach is currently more challenging and needs further development within the LCA community. Unlike carbon emissions, which affect the entire planet wherever the emission occurs, the water impact is linked to the location (watershed, river, lake, etc.) where the water is sourced. In this case the local availability of water reflected across the water stress factor is key and must be taken into account in the definition of water-related impact assessments. Furthermore, the impact of polluted water released in the environment is linked to complex mechanisms related to the amount of pollutants, molecule type and receptor. Thus, the impact of releasing polluted water must be evaluated by taking into consideration the complexity of those phenomena and not exclusively through an angle of pollutants concentration.

Although the terms used in this section are mostly those of the Water Footprint Network methodology developed by experts in the “water resource management” field (Hoekstra et al. 2011), the concepts of blue, green, and grey water have been revisited in order to best position them in the LCA framework and provide recommendation accordingly.

Inventory

Quality and quantity over space and time are crucial aspects to be considered when accounting for blue, green and grey water use.

- Blue water withdrawal is a possible freshwater input flow of unit processes. It can be differentiated between irrigation water for farming, and process water for factories including conversion to potable water for human use. Blue water flows should be included in life cycle inventories.
- Green water is a controversial aspect in water accounting. Until it becomes blue water, green water neither contributes to environmental flows, which are needed for the health of freshwater ecosystems, nor is it accessible for other human uses. Indeed, green water is only one of the many resources acquired through land occupation: access to solar radiation, wind and soil are others (Ridoutt and Pfister 2010). As green water dominates in current global food production and will become more important if food security for a growing world population is to be met (Rockström et al. 2009), it should be considered in the context of the land use impact elementary flows. However, green water flows should not be included in life cycle inventories because of the lack of scientific consensus on specific land use assessment models.
- Grey water is the possible freshwater input flow to dilute a certain volume of polluted water e.g. in a waste water treatment plant. As the formula to calculate grey water is not scientifically-sound enough for product environmental assessments because of double counting to some respect with blue and green water, grey water shall not to be included as such in life cycle inventories. Yet, whereas diluting waste water is allowed, the actual freshwater input flow to waste water treatment unit processes is to be accounted in life cycle inventories according to its own nature (i.e. grey water will result in either blue water or green water).

Note: At present, emission flows to freshwater are generally well-incorporated in those impact assessment methods used in LCA. In particular, those emission flows to freshwater are generally captured by impact categories such as eutrophication and freshwater eco-toxicity, applying complex fate and effect models.

Impact assessment

While the ISO standardisation process for water footprint is on-going, impacts related to water use shall be assessed according to the method by Ridoutt and Pfister (2010). According to that method, water use (in terms of blue water only) is to be assessed using the regionalised water stress indexes developed by Pfister et al. (Pfister et al. 2009) as characterisation factors.

Note: The method by Pfister et al. (2009) is preferred to the Swiss Ecological Scarcity Method by Frischknecht et al. (2008), which was recommended by the ILCD Handbook (European Commission's Joint Research Centre 2011), because the first method produces more geographically-representative and accurate results than the latter.

Green water is recommended by Ridoutt and Pfister (2010) to be considered in the context of the land use impact. Yet, scientific consensus on how to account for the land use impact due to green water use is still missing. For this reason, green water shall not be accounted for in this context.

6.5.3 Land use change

What is land use change?

Land use change (sometimes referred to land transformation or land conversion) should be understood as referring to a change in the use or management of land by humans, which may lead to a change in land cover. Six categories are used by IPCC to describe land cover (forest land, grassland, cropland, wetlands, settlements and other land) plus a seventh category of perennial crops, i.e. multi-annual crops whose stem is usually not annually harvested such as short rotation coppice and oil palm. This means, that, for example, a change from grassland to cropland is a land-use change, while a change from one crop (such as maize) to another (such as rapeseed) is not. Cropland includes fallow land (i.e. land set at rest for one or several years before being cultivated again). A change of management activities, tillage practice or manure input practice is not considered land-use change.

Cropland occupies around 1500 Mha (million hectares) of around 13200 Mha of total global land (excluding the Arctic). Almost 4000 Mha is used to supply livestock, either through pasture, grassland or fodder produced on cropland. The total of land used for food and drinks is therefore considerable. Normally land would be cleared in order to be suitable as pasture or cropland, and that land use change (LUC) can have impacts across several impact categories, and therefore need to be addressed.

There are however several different ways of accounting for LUC, which, if not harmonised, will give considerable variations. LUC takes place as a result of several drivers, which are not trivial to identify. The rules set out here are therefore based on a 2-step approach.

The impacts of land use change may be considered in several environmental impact categories. This chapter is therefore divided into a section on establishing the *inventory*, i.e. how much land use change (LUC) is assumed to take place, and a second section that discusses the *impact*. The only LUC impact included at this stage is specific to GHG emissions, as this is the only impact that can be appropriately assessed for food and drinks products at this point in time (LUC impacts on e.g. water scarcity or biodiversity is too complex and is dependent on the specific location of LUC). In LCI datasets, the inventory data regarding LUC shall be reported separately from other GHG emissions. Equally, when it comes to the LCIA, the specific impact on climate change due to LUC shall be reported separately from the non-LUC related impact on climate change.

6.5.3.1 Guidance - Methodologies for calculation of land use change

LUC can be calculated in two ways, depending on the data availability for the organisation undertaking the assessment:

1. Macro-level approach: When micro-level data is not available, the LUC is calculated based on annual LUC statistics with the help of data on the specific crop and the country of origin.
2. Micro-level approach: When the origin of the functional unit (the food and/or drink product) is known.

Inventory for macro-level approach

The approach described in the PAS 2050-1:2012 for horticulture shall be adopted. It encompasses all LUC taking place in the country of origin (if information is available – see below if not), but allocates the LUC among the crops that are seen to be the drivers of LUC over the last 20 years. The method thereby avoids the discussion of indirect land-use change emissions, since all LUC within the country is included in the approach. The needed data are

publicly available from IPCC and FAO statistics. Moreover, an Excel spread sheet is made available to make the calculations for all relevant crops and pasture. Note that currently no allocation is made between LUC for drivers other than cropland and pasture. In addition to the PAS 2050-1:2012, the Food SCP Round Table recommends to use only the weighted country average approach to calculate land use change. This approached is described below.

When the country of origin is known

When the country of production is known, but the former land use is not known (i.e. micro level approach is not possible), the following iteration should be applied to determine whether land use change should be taken into account:

Has the crop area harvested for the assessed crop in the country increased in the last 20 years?

- If NO, no LUC associated with this crop needs to be considered
- If YES, has the total cropland (annual or perennial according to the assessed crop) increased in the country in the last 20 years?
  - If NO, no LUC associated with this crop needs to be considered
  - If YES, it is necessary to consider LUC associated with this crop

The LUC inventory hectare is then determined by:

- The area expansion of cropland/pasture at the expense of forest
- The area expansion of cropland/pasture at the expense of grassland
- The area expansion of cropland/pasture at the expense of perennial tree cropland
- The area expansion of cropland/pasture at the expense of other annual cropland

For the evaluation of these trends in land use change of the assessed crop, the average crop area in the most recent three years shall be compared with the three-year average of the prior 20 years, as found in the FAO statistics.

When country of origin is not known

When neither the country of production nor the former land use is known, the same reasoning should be applied, using a weighted average between the countries in which the crop is grown.

Inventory for micro-level approach

Several methodologies and certification schemes exist for calculating land use change GHG emissions. To ensure comparability across products it is important that identical rules apply while administrative burden must be minimized by building on existing methodologies. Analysing across methodologies, it appears that the sustainability criteria that apply to biofuels used in the EU since 2009 is the most widely used methodology. Building on this set of rules offers some advantages:

- The methodology has already been tested and approved
- Several producers of biofuels are also producers of food and drink products and would not know whether their product would end up as food, fuel or feed. It therefore simplifies if the same set of rules applies.
- In case a producer wants to certify its products, the necessary schemes are already in place[13].

[13] Voluntary schemes already adopted by the Commission are available here:

The cut-off date for the micro-level approach is January 2008, meaning that only cropland that was also cropland in January 2008 can be assigned a LUC of zero. If the land has changed status between January 2008 and today, the land necessary to produce the functional unit constitutes the land use change (Directive 2009/28/EC, 2009).

6.5.3.2 Guidance on Impact – greenhouse gas emissions from land use change

Impact – Greenhouse gas emissions from land use change macro level

Emissions from carbon stock changes caused by land use change shall be calculated using the rules set out in the PAS 2050-1. The variation of carbon stock in soil shall be calculated according to IPCC Guidelines (2006). This is done in the excel tool available with PAS 2050-1 which provides ready to use values at country level.

Impact – Greenhouse gas emissions from land use change micro-level

Annualised emissions from carbon stock changes caused by land-use change shall be calculated.

The method by which a connection is made between information or claims concerning LUC of final products and raw material or intermediate products is known as the chain of custody. For the purpose of food and drinks used in Europe it is appropriate to at least ensure that the origin and relevant LUC is physically related to the production of food and drinks consumed in the EU.

http://ec.europa.eu/energy/renewables/biofuels/sustainability_schemes_en.htm

Annex A: Guiding Principles of Food Sustainable Consumption & Production Round Table

Objectives of the Guiding Principles:

The below Guiding Principles are the starting point of the work of the European Food Sustainable Consumption and Production (SCP) Round Table on the voluntary environmental assessment of food and drink products and the voluntary communication of environmental information along the food chain. [14] **The assessment and communication of the environmental performance of food and drink supply chains can make an important contribution to the EU's environmental protection and SCP objectives.**

To this end, this document lays down a number of Guiding Principles that shall be respected in the development of a harmonised framework methodology for the environmental assessment specifically of food and drink products and which shall form the basis of voluntary communication of environmental information along the food chain, including both business-to-business (B2B) and business-to-consumers (B2C). The Guiding Principles aim to promote consistency among approaches applied across Europe and to facilitate the provision of environmental information that is scientifically reliable, consistent, understandable and not misleading, while being practical to use and focussed, so as to enable informed choice.

Background:

The partners of the food and drink chain gathered in the European Food SCP Round Table are committed to helping consumers and other partners along the food chain to make informed choices by providing them with accurate and understandable information on relevant product characteristics, including environmental performance. Effective environmental information requires scientifically reliable and consistent environmental assessment methodologies to be applied along the food chain and the ability to effectively and efficiently communicate this information from one stage in the food chain to the next until it reaches the consumer.

More recently, an increasing number of food chain partners as well as public authorities have introduced a widening range of different initiatives to inform consumers and other stakeholders more broadly about various environmental characteristics of food and drink products and to support continuous improvement in associated environmental performance. These include various labels, statements, product declarations and other means addressing different environmental aspects or impacts[15] of a product[16].

This ongoing proliferation of different initiatives shows a high degree of diversity in terms of their chosen scope, assessment methodologies and means and tools of communication. This reflects the vast variety of food and drink products and the complexity of their environmental aspects along the life-cycle, which is, inter alia, strongly influenced by natural processes at farm level. There is at present no commonly applied methodology to assess and communicate

[14] For readability reasons, the term "food chain" is used in the remainder of this document as a synonym for "food and drink chain". It includes suppliers to the agricultural sector, agriculture, agro-food trade, food and drink processors, the packaging supply chain, transport & logistic operators, retailers and restaurants, consumers, including public procurers, and end-of-life operators.

[15] For definitions see page 4.

[16] Examples: a product's carbon footprint, agricultural and fishing practices, transport mode or distance, packaging weight, recyclability, bio-degradability, renewability or impacts on biodiversity.

environmental information along the food chain, including to consumers, in a practical and reliable way[17].

This situation has the potential to confuse or even mislead consumers and other stakeholders and to lead to unnecessary burdens for food chain operators. It should be borne in mind, however, that the assessment and communication of the environmental performance of food and drink products must comply with all existing Community rules laid down in the EU Treaty, including those on the free movement of goods[18], and in secondary EU legislation, such as the rules aimed at protecting consumers against misleading and deceiving information[19].

The Members of the Round Table support the voluntary provision of relevant product-related information along the food chain including to consumers and aim at identifying opportunities for continuous self-improvement. Therefore they consider it vital that the information provided is scientifically reliable, consistent, understandable and not misleading. Not only will the contrary undermine consumer trust in any type of information provided by the food chain and lead to accusations of "greenwashing", it will also run counter to the objective of contributing effectively to environmental improvement. Similarly, the growing number of different schemes and requirements will become untenable.

The Members of the Round Table recognise the need to establish a scientifically reliable, practical and harmonised environmental assessment methodology for food and drink products across Europe – including, as appropriate, product category specifications – to form the basis for voluntary communication of environmental information along the food chain, including consumers.

Questions to be considered in the process:

The first step in this process is for all involved food chain partners to learn more about the practical implications of the various environmental assessment and information systems, their scientific reliability, effectiveness, practicability, relevance for food chain partners and consumers, costs and benefits at the different food chain stages, possible shortcomings and barriers. Various essential questions need to be considered in this respect, including inter alia:

- How to measure, verify, collect and consolidate environmental information along the entire food chain in an efficient way?
- How to consider the various environmental aspects and/or impacts of the production and consumption of different categories of food and drink products in a consistent framework methodology?
- How to consider specificities of highly diverse food and drink products with different beneficial and adverse environmental impacts at different stages of their life-cycle?

[17] Life-cycle Assessments (LCAs) based on ISO 14040 and ISO 14044 are conducted by different food chain partners for various purposes and are an important source of robust environmental information. LCAs in compliance with existing standards and recommendations involve costs, which make their systematic use across entire product portfolios unrealistic and virtually prohibitive for use by SMEs. LCA standards also leave a certain degree of flexibility in making methodological choices and results are not universally comparable. With a view to supporting life-cycle thinking/assessment while reducing complexity and costs, it is desirable to agree first on a harmonised methodology for the environmental assessment of food and drink products. Based on this harmonised approach, consistent LCAs and environmental criteria, e.g. in the form of key performance indicators for different product categories, can be developed, which will also help focus and simplify the collection of pertinent high-quality data in a systematic manner.

[18] Articles 34 and 35 of the Treaty on the Functioning of the European Union

[19] Including, *inter alia,* Directive 2000/13/EC on food labelling, Regulation 767/2009 on the marketing and use of feed, and Directive 2005/29/EC on Unfair Commercial Practices and the recently published European Commission guidance on its implementation (SEC(2009) 1666).

- What costs and benefits are involved as well as what challenges are the various food chain operators, including SMEs, facing or going to face in this respect?
- How should a uniform environmental assessment methodology be designed in order to support the identification of continuous environmental improvement potentials at all stages of the food chain?
- How effective are existing and emerging environmental information tools along the food chain and vis-à-vis the consumer? What kind of information is relevant for consumers? What type of questions could we and should we expect consumers and food chain partners to have now and in the near future? How can consumer confusion be avoided?
- What is already available at the European and international level to help assess and communicate the potential environmental impacts associated with the production and consumption of food and drink products?

Guiding Principles for further work on voluntary assessment and communication:

In order to address these questions systematically, the members of the Round Table agreed to define first a set of common guiding principles on voluntary environmental assessment and communication, before establishing concrete assessment methodologies. This will allow stakeholders to evaluate the results of ongoing and future work against the objective of providing environmental information which is scientifically reliable, consistent, understandable and not misleading.

The Guiding Principles do not lay down any specific methodology, instrument or tool to assess and communicate environmental information to consumers, nor are they intended to prejudge the outcome of ongoing work in this field. Existing and emerging methodologies and tools will be assessed during the second stage of the work of the Round Table in order to evaluate whether and how the Guiding Principles can be put into practice.

In developing these principles, use has been made of existing international, European and national standards and guidelines[20] in the particular context of the food chain.

A voluntary and harmonised approach:

In order to support food chain partners of different sizes, structures and resources in their efforts to provide reliable environmental information in line with their corporate, sector and national conditions, the Guiding Principles promote the establishment of a voluntary framework methodology for the environmental assessment of food and drink products. The framework methodology shall be practical to use and shall avoid disproportionate burden or costs on the various food chain operators, while being scientifically robust. In order to ensure consistency and comparability of results, operators applying the assessment framework are required to apply life-cycle thinking[21], where appropriate, supported by environmental assessment tools, with a view to identifying the significant environmental impacts along all food chain stages. All voluntary communication of environmental information shall comply with the Guiding Principles outlined in this document.

[20] For example the ISO 14020 and 14040 series, EU Guidelines on Making and Assessing Environmental Claims, ICC International Code of Environmental Advertising, General programme instructions for Environmental Product Declarations (EPD).

[21] Life-cycle thinking aims at supporting decisions in public policy and in the private sectors by considering effects along the supply chain, during the use and end-of-life management of products with the aim of ensuring overall improvement and avoiding shifting impact from one stage of the life-cycle to another (Joint Research Centre).

Environment in the sustainability context:

While the Guiding Principles focus, for topical reasons, on the environmental aspects of sustainability, it is vital to bear in mind that the concept of sustainable development is complex and includes important social and economic dimensions, which are not covered by the scope of this document. However, when designing sustainability strategies for the food chain, environmental considerations must be taken forward in a holistic, parallel consideration of ongoing work in the economic and social spheres of sustainability.

The Guiding Principles

Definitions:

Building on international standards under ISO.[22] Unchanged ISO definitions are produced below in *italic style.* Food chain specific additions / refinements are produced in roman style.

Food and drink product:
Any substance or product, whether processed, partially processed or unprocessed, intended to be, or reasonably expected to be ingested by humans.[23]

Life-cycle *of food and drink products:*
Consecutive and interlinked stages of the food and drink production and consumption system, ranging from activities related to input supply to agriculture, agricultural production, processing, packaging, transport and logistics, retail, consumption and end-of-life.

Environmental aspect:
An environmental aspect is an element of an organisation's activities, products or services which can interact with the environment. This may include outputs (e.g. emissions to air, releases to water and to soil) as well as inputs (e.g. the use of resources).

Environmental impact:[24]
Changes to the environment, adverse or beneficial, that result from environmental aspects are called environmental impacts. The relationship between environmental aspects and impacts is one of cause and effect. [25]

For example, the aspect "release of greenhouse gas emissions" contributes to the environmental impact "climate change". Other environmental impacts include, for example, the acidification of soils and surface water, eutrophication of water bodies, eco-toxicity, resource depletion or changes in biodiversity. Environmental issues of concern to which environmental aspects may be assigned are called impact categories.[26]

Significant environmental impact:
The significance of an impact is determined considering its contribution to the change to the environment, *legal issues and the concerns of internal and external interested parties.*

[22] Including: ISO 14044:2006: Environmental management – Life-cycle assessment – requirements and guidelines; ISO 14021:2001: Environmental labels and declarations -- Self-declared environmental claims (Type II environmental labelling); ISO 14025:2006: Environmental labels and declarations -- Type III environmental declarations -- Principles and procedures;
[23] See Regulation (EC) 178/2002 laying down the General Principles and requirements of Food Law.
[24] It should be noted that 'environmental impact" is used synonymously in the context of this document for contributions to impacts or risks or pressures on the environment.
[25] To improve clarity, we may consider adding an example for activity, aspect and impact (e.g. activity: road transport; aspect: CO2 emissions; impact: climate change).
[26] See ISO 14044:2006: Environmental management – Life-cycle assessment – requirements and guidelines

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

Product category:
A group of food and/or drink products subject to a common specification of the environmental assessment framework methodology.

Misleading actions:[27]
In the context of this document, *a* commercial practice shall be regarded as misleading if it contains false *environmental* information and is therefore untruthful or in any way, including overall presentation, deceives or is likely to deceive the average *food chain partner or* consumer, even if the information is factually correct, in relation to one or more *environmental aspects or impacts of a product,* and in either case causes or is likely to cause them to take a transactional decision that they would not have taken otherwise.

Misleading omissions:[28]
In the context of this document, a commercial practice shall be regarded as misleading if, in its factual context, taking account of all its features and circumstances and the limitations of the communication medium, it omits material *environmenta*l information that the average *food chain partners or* consumer needs, according to the context, to take an informed transactional decision and thereby causes or is likely to cause the average *food chain partner or* consumer to take a transactional decision that they would not have taken otherwise.

Environmental information:
In the context of this document, environmental information covers environmental product performance information as well as use-related environmental advice.

Environmental product performance information can be qualitative or quantitative. It can either indicate the overall environmental performance of a product, i.e. it covers all significant impacts over the full life-cycle, or it indicates specific/individual environmental aspects or impacts of a product along its life-cycle or at certain stages thereof. Environmental product information aims to support informed choice. Use-related environmental advice is information passed on to downstream partners in the food chain, including to consumers, with the aim to enable them to minimise environmental impacts during use, handling and disposal of the product.

[27] See Article 6 of the UCP Directive
[28] See Article 7 of the UCP Directive

The principles

The lead principle:

Environmental information communicated along the food chain, including to consumers, shall be scientifically reliable and consistent, understandable and not misleading, so as to support informed choice.

I. Principles for the voluntary environmental assessment of food and drink products

Principle 1: Identify and analyse the environmental aspects at all life-cycle stages

Principle 2: Assess the significant potential environmental impacts along the life-cycle

Principle 3: Apply recognised scientific methodologies

Principle 4: Periodically review and update the environmental assessment

II. Principles for the voluntary communication of environmental information

Principle 5: Provide information in an easily understandable and comparable way so as to support informed choice

Principle 6: Ensure clarity regarding the scope and meaning of environmental information

III. Principles for both voluntary environmental assessment and communication

Principle 7: Ensure transparency of information and underlying methodologies and assumptions

Principle 8: Ensure that all food chain actors can apply the assessment methodology and communication tools without disproportionate burden

Principle 9: Support innovation

Principle 10: Safeguard the Single Market and international trade

The lead principle:

Environmental information communicated along the food chain, including to consumers, shall be scientifically reliable and consistent, understandable and not misleading, so as to support informed choice.

Scientifically reliable and consistent:

In order to be scientifically reliable, the environmental assessment shall be based on methodologies and scientific data that are recognised and widely accepted in scientific or professional disciplines and that are sufficiently thorough and comprehensive to produce results that are accurate and reproducible. To the extent possible, data should be coherent with the assessment methodology. Use shall be made of international and European

standards and recommendations and of derived sector-specific guidance documents, as applicable.

In order to ensure consistency in assessing the significant environmental impacts of food and drink products, a common framework assessment methodology shall be applied to all food and drink products. Where necessary, methodological specifications should be applied at the level of product categories, but they shall be in line with the common framework methodology.

Easy to understand and not misleading:

Environmental information shall be communicated to food chain partners and consumers in an easily understandable, factual and unambiguous way, so as to support informed choice.

Operators shall use the means and format of communication that is the most suitable and effective to support informed choice by the recipient of the information.

Assessment methodology and communication shall ensure, to the extent possible, comparability of presented environmental product performance information.

Information shall be relevant, addressing the significant environmental impacts related to the product life-cycle. Where communication of environmental information is limited to individual environmental aspects or impacts along the life cycle, or to specific life-cycle stages, the scope and meaning of the provided information must be specified in a clear, accurate and unambiguous manner. In particular, such information shall not be presented as reflecting the overall environmental performance of the product. If in such cases quantitative environmental information is presented, it shall be based on the corresponding section of the framework assessment methodology with a view to ensure consistency and comparability.

In addition, and in accordance with the requirements of Directive 2005/29/EC on unfair commercial practices, environmental information must not be misleading in any way.

I. Principles for the voluntary environmental assessment of food and drinks products

Principle 1:

Identify and analyse the environmental aspects at all life-cycle stages
In order to enable an accurate assessment of the overall environmental performance of different food and drink products, their respective environmental aspects at all life-cycle stages shall first be identified, inventoried and analysed. Such life-cycle data must be well-documented in an appropriate format.

Principle 2:

Assess the significant potential environmental impacts along the life-cycle
Environmental aspects along the life-cycle of different food and drink products contribute to different associated environmental impacts. In order to provide an accurate picture of the product's overall environmental performance, the significant environmental impacts along the life-cycle shall be assessed. Depending on the type of product, they may fall into different environmental impact categories.

In order to improve consistency in conducting the above analysis and assessment, methodological specifications of the framework assessment methodology shall be applied at the level of product categories where necessary but they must be in line with the common framework methodology.

Principle 3:

Apply recognised scientific methodologies
The environmental assessment shall be based on scientific data and methodologies that are sufficiently thorough and comprehensive to produce results that are accurate and reproducible. The applied assessment methods shall be recognised and widely accepted in scientific or professional disciplines or be otherwise scientifically defensible. To the extent possible, data should be coherent with the assessment methodology and the development and use of standardised data sets should be facilitated whenever possible. Use shall be made of international and European standards and guidelines and derived sector-specific guidance documents, as applicable.
The process of developing assessment methodologies shall include an open, participatory consultation with all interested parties. Reasonable efforts shall be made to achieve a consensus throughout the process.

Principle 4:

Periodically review and update the environmental assessment A periodic review of the basis for the assessment should occur to account for innovation and other significant changes along the supply chain, updates in data and improvement in assessment methodologies. This review should be conducted at a frequency consistent with the pace of innovation.

II. Principles for voluntary environmental communication along the food chain including to consumers

Principle 5:

Provide information in an easily understandable and comparable way so as to support informed choice
For environmental information to be effective, i.e. to enable partners along the food chain including consumers to make informed choices, it has to be presented in an easily understandable, factual and clear way.
Assessment methodology and communication shall ensure, to the extent possible, comparability of presented environmental product performance information.
There is a multitude of means (i.e. channels) through which environmental information can be communicated (i.e. conveyed) along the food chain and to consumers, including through websites, reports, leaflets, on-shelf, on a product or packaging, through media, advertising, technical bulletins, product literature, declarations, or any emerging new communication technologies.
Equally, there is a multitude of different formats to present (i.e. to display) environmental information, including qualitative and quantitative statements, symbols, tables or graphics.
Given the high diversity of food and drink products and actors along the food chain, operators shall use the means and format of communication that is the most suitable and effective to support informed choice by the recipient of the information.

Different means and formats of communication can be used for different products and for different recipients at different stages of the food chain (e.g. formats to communicate with consumers (B2C) may differ from those aimed at customers along the food chain (B2B) or at public authorities). Efforts shall be made to work towards harmonisation within individual formats (e.g. to avoid a proliferation of different graphics or symbols).

Principle 6:
Ensure clarity regarding the scope and meaning of environmental information

The communication of environmental information to food chain partners and to consumers shall reflect the scope of the underlying assessment of significant environmental impacts along the life-cycle.
Where the environmental information is limited to individual environmental aspects or impacts along the life-cycle, or to specific life-cycle stages, the scope and meaning of the provided information must be specified in a clear, accurate and unambiguous manner. In particular, such information shall not be presented as reflecting the overall environmental performance of the product. This clarification could, for instance, take the form of a clarifying statement and/or an unambiguous design of graphics and labels or via other means and channels of communication. It shall be easily accessible and understandable for the food chain operators or the consumer. If in such cases quantitative environmental information is presented, it shall be based on the corresponding section of the framework assessment methodology with a view to ensure consistency and comparability so as to support informed choice.
In addition, and in accordance with the requirements of Directive 2005/29/EC on unfair commercial practices, environmental information must not be misleading in any way.
The communication of environmental information must not create the impression that the product has a positive environmental impact or lower adverse environmental impacts than a comparable product where this claim is not true or cannot be verified. The communication must not emphasise one single environmental aspect or impact if this creates the wrong impression of reflecting the product's overall environmental performance along its life-cycle. In addition, it must not hide negative environmental trade-offs along the product life-cycle.[29] Misleading practices in communicating environmental information include both misleading actions and misleading omissions.[30]

III. Principles for both voluntary environmental assessment and communication

Principle 7:
Ensure transparency of information and underlying methodologies and assumptions

Environmental information shall be transparent. i.e. Information concerning the assessment procedure, methodology, data source, criteria, underlying principles, assumptions and boundary conditions shall be available to all interested parties on request and clearly referenced in line with international standards and recommendations. There may be limits to the availability of specific information due to confidential business information, intellectual property rights or other legal restrictions. In the latter case, independent peer review and/or accreditation shall provide a basis to retain confidentiality whilst securing consumer confidence.

[29] This paragraph is based on the new EC guidance on the UCP Directive
[30] See Articles 6 and 7 of UPC Directive.

Environmental information shall be accurate. Limitations to the validity of the information (including uncertainty, e.g. due to quality of data and applied methodology) should be made available. All data-sources shall be documented, clearly identified and credible.

Principle 8:
Ensure that all food chain actors can apply the assessment methodology and communication tools without disproportionate burden

Procedures and requirements for the voluntary assessment of food and drink products and for voluntary communication of environmental information shall be limited to those necessary to ensure that the provided information is scientifically reliable, consistent, understandable and not misleading, so as to enable informed choice.
All actors along the food chain, regardless of size (including SMEs), shall have equal opportunity to voluntarily assess their products and to communicate environmental information. Involvement shall not be hindered by extraneous factors or requirements such as procedural complexity, disproportionate costs, or unreasonable information or bureaucratic demands.

Principle 9:
Support innovation

Procedures and requirements for the voluntary assessment of food and drink products and for voluntary communication of environmental information shall always take into account and promote innovation to improve the performance of the product, including its environmental performance along the life-cycle.
Environmental information shall be expressed in terms of performance and continuous improvement rather than product design or descriptive characteristics. This approach leaves maximum flexibility for technical or any other type of innovation. Prescriptive design criteria or implicit preference for a technology shall be avoided.

Principle 10:
Protect the environment and increase consumer awareness whilst safeguarding the Internal Market and international trade agreements

Procedures and requirements for the voluntary environmental assessment of products and voluntary communication of environmental information, including to consumers, have as main objectives environmental protection, improving consumer awareness, a shift towards more sustainable consumption and production patterns and the promotion of green growth. They shall not be prepared, adopted, or applied in a manner which would constitute a distortion of competition or an unjustifiable obstacle and to the proper functioning of the Internal Market of the European Union and to the international trade agreements. The current development of international and EU standards on the environmental assessment and communication of products, both in the EU and in Third Countries, will help promote a smoother articulation between the two legitimate objectives of free trade and environmental protection.

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Annex B: Illustration of where the ENVIFOOD Protocol provides further guidance to ISO 14044:2006 and the PEF Guide

As outlined in section *2. Normative reference and relationship with other methodologies*, the ENVIFOOD Protocol is built on ISO 14044:2006.

ENVIFOOD Protocol	*ISO 14044:2006*	*PEF Guide*
6.1. Functional unit	4.2.3.2. Function and functional unit	4.2. Unit of analysis and reference flow
6.2. System boundaries	4.2.3.3. System boundary	4.3. System boundaries for Product Environmental Footprint Studies
6.3. Data quality requirements and dealing with data gaps	4.2.3.6. Data quality requirements	
6.4. Handling multi-functional processes (allocation)	4.3.4. Allocation	5.10. Handling multi-functional processes
6.5. Environmental and other impacts	4.2.3.4. LCIA methodology and types of impacts	4.4. Selecting Environmental Footprint Impact Categories and Assessment Methods
6.5.1. Identification of significant potential impacts	4.2.3. Scope of the study 4.2.3.4 LCIA methodology and types of impacts 4.4.2.2. Selection of impact categories, category indicators and characterization models	4.4. Selecting Environmental Footprint Impact Categories and Assessment Methods 4.5. Selecting additional environmental information to be included in the PEF
6.5.2. Water scarcity and water use assessment	4.2.3.5. Types and sources of data	5.4 Resource Use and Emissions Profile Data
6.5.3. Land use change	4.2.3.5. Types and sources of data	5.4 Resource Use and Emissions Profile Data

Annex C: Further specification in the PEF Guide

This annex provides an overview of key additional specifications in the PEF Guide. Running an assessment following this annex is not sufficient to claim compliance with the PEF Guide (2013).

PEF Guide	*ENVIFOOD Protocol*
3. Defining the goal(s) of the PEF study *1.1.General* Goal definition for a PEF study shall include: intended application(s); reasons for carrying out the study and decision context; target audience; weather comparisons and/or comparative assertions are to be disclosed to the public; commissioner of the study; review procedure (if applicable). The PEFCR shall specify the review requirements for a PEF study.	1. Scope
4. Defining the scope of the PEF study *4.1. General* The scope definition for a PEF study shall be in line with the defined goals of the study and shall include: unit of analysis and reference flow; system boundaries; environmental footprint (EF) impact categories; assumptions/limitations. *4.2. Unit of analysis and reference flow* Slightly additional guidance to define functional unit at PEFCR level is provided (e.g. reference to NACE code(s)). An appropriate reference flow shall be determined in relation to the unit of analysis.	6.1. Functional unit
4.3. System boundaries for PEF Studies A diagram representing system boundaries should be included in the scope definition. The system boundary shall be defined following general supply-chain logic, including all stages from raw material extraction through processing, production, distribution, storage, use stage and end-of-life treatment of a product, as appropriate to the intended application of the study. The system boundaries shall include all processes linked to the product supply chain relative to the unit of analysis. The processes included in the system boundaries shall be divided relative to the foreground and background system they refer to.	6.2. System boundaries

The PEFCR shall specify the system boundaries for product category PEF studies, including specification of relevant life cycle stages and processes that should be generally assigned to each stage. Any deviation from the default cradle-to-grave approach shall be explicitly specified and justified. The PEFCR shall specify downstream scenarios. Offsets shall not be included in the PEF study, but may be reported separately as “Additional Environmental Information”.	
4.4. Selecting EF Impact Categories and assessment methods For a PEF study, all of the default impact categories and associated specified EF impact assessment models specified in Table 2 shall be applied. Any exclusion shall be explicitly documented, justified, reported in the PEF report and supported by appropriate documents. The influence of any exclusion on the final results, especially related to the limitations in terms of comparability with other PEF studies shall be discussed in the interpretation phase and reported. Such exclusions are subject to review. PEFCRs shall specify and justify any exclusion of the default EF impact categories, especially those related to aspects of comparability.	6.5. Environmental and other impacts
4.5. Selecting additional environmental footprint information to be included in the PEF If the default EF impact categories or the default impact assessment models do not properly cover the potential environmental impacts of the product being evaluated, all related relevant environmental aspects shall be additionally included under “additional environmental information”. These shall, however, not substitute the mandatory assessment models of the default EF impact categories. The supporting models of these additional categories shall be clearly referenced and documented with the corresponding indicators. On the top of that, further requirements and guidance for development of PEFCRs are provided in the PEF Guide.	6.5. Environmental and other impacts
4.6. Assumptions/limitations All limitations and assumptions shall be transparently reported. The PEFCR shall report product-category-specific limitations and define the assumptions necessary to overcome the limitations.	No specification
5. Compiling and recording the resource use and emission profile Procedures, guidance and requirements to compile inventories (i.e. Resource use and Emission Profile) in support of PEF	6.3. Data quality requirements and dealing with data gaps

studies are specified. Requirements for PEFCR development are also provided (e.g. The PEFCRs shall specify: the use stage scenarios to be included in the study, if any; the timespan to be considered for the use stage).	
5.4.9. Additional considerations for compiling the resource and emission profiles Further specification is provided on how to account for and report: removals and emissions of biogenic carbon sources; renewable energy generation; and temporary carbon storage and delayed emissions.	6.5.3 Land use change 6.2.3.2 Waste management and end of life treatment
5.6. Data quality requirements - Data quality criteria are described in Table 3. On top of these criteria, additional aspects on documentation (i.e. compliance with ILCD Format), nomenclature (i.e. compliance with ILCD nomenclature and review shall be fulfilled). - Data quality requirements are described in Table 4. - Criteria in support of data quality assessments are provided in Table 5. - A formula to measure Data Quality Rating against data quality requirements is specified and shall be used. Overall data quality levels according to the achieved data quality ratings are outlined in Table 6. How PECRs will be used in support of data quality scoring is also specified via additional requirements and an example.	6.3. Data quality requirements and dealing with data gaps
5.7. Specific data collection The PEF Guide refers to specific and generic data in lieu of primary and secondary data, respectively. There is no conceptual difference between these terms. Additional requirements for development of PEFCRs are also specified. *5.8. Generic data collection* More detail on how to source secondary data is provided in the PEF Guide. A hierarchy of different sources of secondary datasets is provided to prioritise certain sources of secondary data over others. The PEFCR shall specify: where the use of secondary data is permitted as an approximation for a substance for which specific data is 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.	6.3. Data quality requirements and dealing with data gaps

5.9. Dealing with remaining unit process data gaps/missing data Currently, cut-off is not foreseen in the PEF Guide. So, when the Protocol is used in conjunction with the PEF Guide, no cut-off is seemingly allowed. According to the PEF Guide, any data gaps shall be, in fact, filled using the best available secondary or extrapolated data. 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. The PEFCR shall specify potential data gaps and provide detailed guidance for filling these gaps.	
5.10. Handling multi-functional processes Additional information describing the hierarchy for resolving multi-functionality issues in ISO 14044 is provided in the PEF Guide. Concepts like direct and indirect substitution are introduced and examples are provided. A formula is provided to model and resolving multi-functionality issues in product end-of-life. Additional specification is also provided in support of PEFCR development.	6.4. Handling multi-functional processes (allocation) 6.4.1. Multi-functional processes in end of life modelling 6.2.3.2 Waste management and end of life treatment
6. Environmental footprint impact assessment Guidance and requirements to the life cycle impact assessment phase (classification and characterization; normalization and weighting) are detailed in the PEF Guide.	6.5. Environmental and other impacts
7. Interpretation of product environmental footprint results Guidance on how to interpret PEF study results and requirements are detailed in the PEF Guide. In particular, guidance and requirements are provided to: assess the robustness of the PEF model; identify hotspots; estimate uncertainty; to draw conclusions and to advance recommendations while highlighting any limitation of the study. Additional requirements for PEFCR development are also provided.	6.4.2. Sensitivity analysis
8. PEF reports Guidance on how to report PEF study results and requirements are detailed in the PEF Guide. Additional requirements for PEFCR development are also provided.	6.5. Environmental impacts

9. EF critical review Specification on review type and reviewer qualification is provided along with in the PEF Guide. Additional requirements for PEFCR development are also provided.	6.3. Data quality requirements and dealing with data gaps

Annex D: Check list of options for waste

The following list can best used as a check-list to make sure that all options are recognized for each waste quantity leaving the system.

Re-use

Re-use occurs for packaging only. It covers re-fill, transport packaging, as well as baskets and bags for loose food-items.

Material recycling

Material recycling is used for packaging only. It includes reprocessing, by means of a manufacturing process, of a used packaging material into a product, a component incorporated into a product, or a secondary (recycled) raw material; excluding energy recovery and the use of the product as a fuel.

Chemical recovery

Chemical recovery is a process to recover valuable chemical substances by chemical treatment of end-of-use packaging for a variety of uses displacing other natural resources in production processes. It includes solvolysis (hydrolysis, glycolysis, methanolysis) and pyrolysis (microwave, catalytic reactions, thermal reactions).

Organic recovery

Organic recovery is used for food wastes and may in certain regions accept compostable non-food materials such as packaging.

Anaerobic digestion

Anaerobic digestion delivers chemicals including methane, heat energy and digestate out of biomass. It can be:

- Dry / wet
- Mesophilic/thermophilic
- Single step / multi step – two or multiple phase digestion with and without separation of dry matter after the first phase
- Codigestion / single feedstock digestion
- Batch / semi-continuous
- Mixing methods: stirring, turning, percolating (dry)

Aerobic composting

Aerobic composting delivers compost out of biomass, which can be used as fertilizer, as it contains organic material and nutrients. It can be done by:

- Composting in piles
- Tunnel composting

- Drum reactors

Mechanical-Biological Treatment

Mechanical Biological Treatment (MBT) is an integrated mixed waste management system combining both mechanical treatment processes, such as sorting and material recovery, and biological treatment processes, such as composting and anaerobic digestion. MBT plants can incorporate a number of different processes in a variety of combination, depending on the purpose of the operation, which makes them suitable to process mixed household waste as well as commercial and industrial waste. Typical aims of MBT can be:

- Reduction of the organic matter content of wastes prior to landfilling
- Recovery if valuable recyclable materials
- Possibility of baling of waste and the operation of a “dry landfill”
- Conversion of the organic fraction into a compost-like output for use on land,
- Anaerobic digestion of the organic fraction and generation of methane for fuel or heating purposes
- Generation of refuse derived fuel (RDF)

Energy recovery

- Delivers energy out of wastes (food, packaging) or by-products/wastes out of preceding waste treatments
- Municipal solid waste incineration with energy recovery
- Anaerobic digestion

Sewage sludge treatment

Sewage sludge treatment delivers compost and methane out of liquid (bio-) wastes.

Final disposal

This comprises landfill and incineration without heat recovery delivering ashes destined for landfill. Landfill models may be categorised into the following:

- Unmonitored dump sites
- Monitored – high-tech leachate control & gas management, gas capturing
- Hazardous waste landfills
- Inert landfills
- Low –organic waste landfills

Annex E: Template for handling multi-functional processes

Multi-functionality in _____ production: Allocation to _____ and _____

Proposed by _____	Date:
Approved by the Roundtable WG1	Date:

Description

Brief description of the multi-functional issue, including references to scientific documentation on the issue, and possible existing PCR or sub-sectoral guidance.

Retained solution

A description of the solution that is retained for the multi-functionality issue.

Justification

Justification should be based on the ISO hierarchy and the section in the ENVIFOOD Protocol. If applicable, it should be clearly described why alternative solutions to multi-functionality that are prioritised in the ISO hierarchy have not been retained.

Limitations of the recommended solution

If applicable, a description of situations in which the recommended solution would not provide reliable results, e.g. unusual use of co-products.

Allocation ratios recommended for background systems

Allocation to Co-Product 1 and Co-Product 2 is recommended in a ratio of X to Y for background systems. This calculation is based on the method provided above, taking data from sources A and B.

References

Full references to literature used for the above shall be provided.

Annex F: Biodiversity

The impact assessment procedure in LCA starts with modelling impacts along mostly linear, deterministic, cause-effect chains by linking the inventory elementary flows to the so-called midpoint impact categories (Curran et al. 2011). Midpoint impact categories are, for example, climate change, ecotoxicity, and those other impacts listed in the grid above. In an optional step of the LCA impact assessment procedure, midpoint impacts are aggregated in endpoints before being grouped into three areas of protection: human health, natural environment, and natural resources.

The United Nations Convention on Biological Diversity defined biodiversity as “the variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems” (CBD 2005). The impacts on biodiversity are taken into account in LCA in different steps (i.e. both at midpoint and endpoint). However, although the development and inclusion of potential endpoint indicators for biodiversity in LCA has been ongoing for several years, the underpinning methods for assessing some of the midpoint impacts are still under development. Therefore, an all-embracing endpoint indicator for biodiversity cannot be recommended at this stage.

Unlike some methodological gaps, impacts on biodiversity can still be captured in LCA, but at the midpoint level. Capturing midpoint impacts affecting biodiversity can e.g. also provide meaningful indications to address the magnitude of potential biodiversity loss. Mainly on the basis of the analysis conducted by Curran et al. (2011), we provide below some examples on how some midpoint impact categories relate to biodiversity loss:

- *Land use:* According to Moore (2002), around 50% of the whole land surface globally has suffered anthropogenic transformation, among which 20% has been transformed into permanent crops and 25% into other uses, mainly pastures. According to the latest EU Natura 2000 Barometer, 17.5% of national areas in EU are covered under Natura 2000. In the past years, although the increase in food demand has driven an intensification of cultivated systems, rather than the expansion of the production areas (Millennium Ecosystem Assessment 2005), the use of feedstock for the production of biofuels has led to the conversion of natural or close-to-natural land use types into managed ones. This conversion of natural habitat to human use has been the main driver of biodiversity loss over the past century.
- Among the areas of protection in the impact assessment procedure, the natural environment is the one related to life support functions and biodiversity. Land use impact assessment is mainly approached by three main attributes; biodiversity, soil ecosystem quality and biotic production potential (Milà i Canals et al., 2007). Among those attributes, biodiversity is an intrinsic ecosystem value and it can be defined in three levels: genetic diversity, species diversity and ecosystem diversity (ibid.). For now, indicators for use in LCA have mainly been proposed on the level of species and ecosystem diversity. The UNEP SETAC Life Cycle Initiative has a dedicated think tank on this topic and is due to come up with methods in the coming years.
- *Blue water footprint – Resource depletion:* Blue water use driven by anthropogenic activities does not only reduce regional resource availability, but also affects the functioning and diversity of water-dependent terrestrial and freshwater ecosystems.

- *Climate change:* Emission of greenhouse gases is expected to cause large number of terrestrial extinction over the next century due to changing temperature, precipitation, and seasonality. Invasive alien species are also expected to have overall impacts in Europe due to climate change and on their own.
- *Acidification and eutrophication:* These issues lead to a disruption of the natural nutrient balance, altering the habitat condition and the species composition in ecosystems, and leading to a loss of biodiversity.
- *Ecotoxicity:* This refers to the potential for biological, chemical or physical stressors to affect ecosystems. Stressors can occur in the natural environment or can be introduced to ecosystems through human activity, potentially at levels high enough to alter the natural biochemistry, physiology, behavior and interactions of the living organisms that comprise an ecosystem. The use of chemicals in farming practices has the potential to cause ecotoxicological effects by reaching organisms through the pathways of air, water and soil.

To capture the impacts on biodiversity in the assessment and to evaluate the magnitude of drivers leading to biodiversity loss, impacts should be assessed at mid-point level.

As there is no scientific consensus yet on the suitable methods to address land use and land use change with regard to biodiversity loss, that piece of information shall be reported separately in terms of the following indicators: m^2 occupied per year and m^2 changed per year. In this context, these indicators are indicators are considered to be a rough proxy of the natural habitat loss by both flora and fauna.

Inventories shall include that piece of information only when land use change from natural habitat, as defined under Natura 2000, to any other use has occurred, and only when that change has taken place over the last 20 years. In cases where it is unknown what the previous land use was, that additional information on land occupation shall be included in the inventory.

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