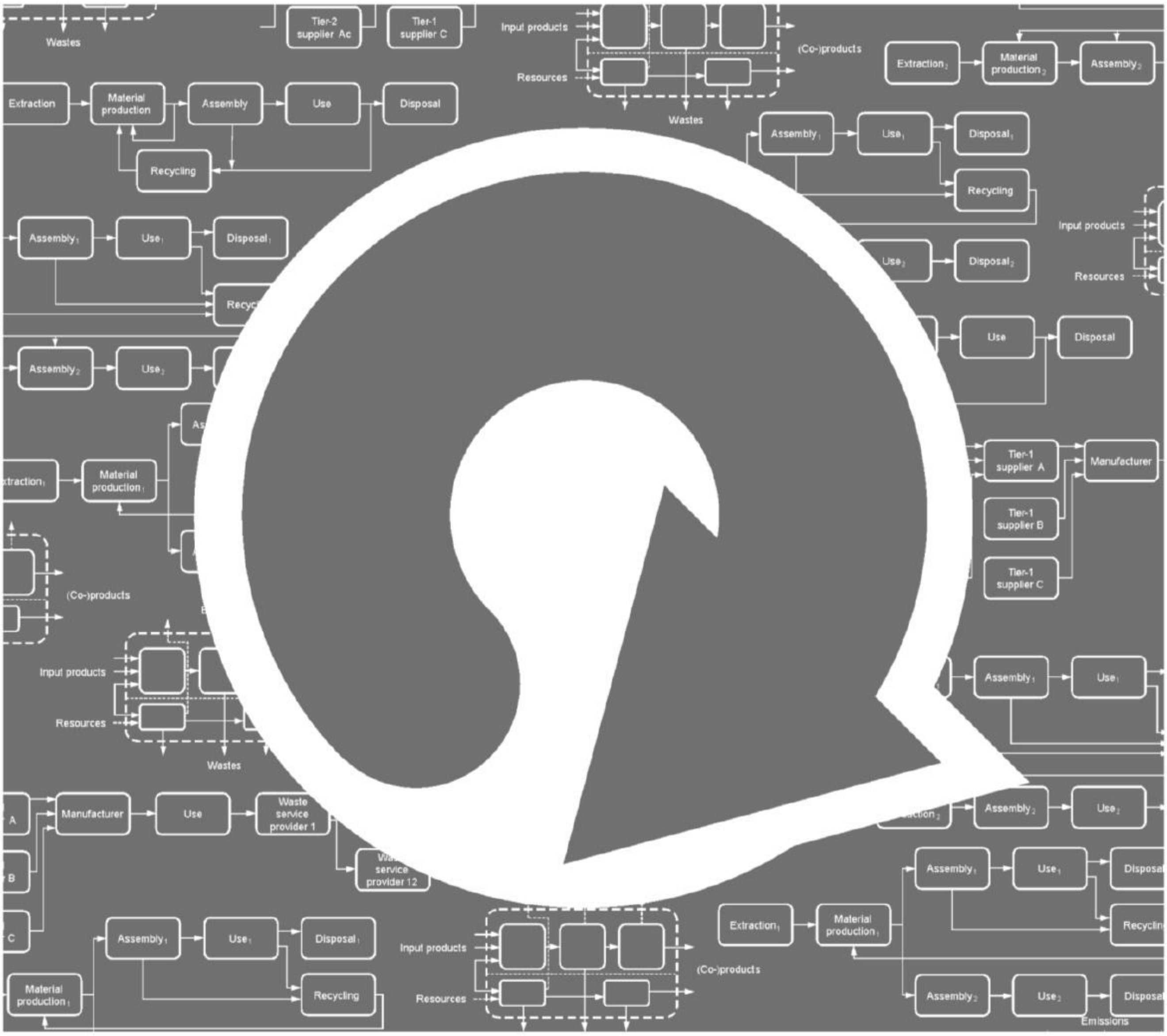
ILCD handbook

International Reference Life Cycle Data System



EUR 24384 EN - 2010

Nomenclature and other conventions

First edition

JRC
EUROPEAN COMMISSION

Institute for Environment and Sustainability

The mission of the JRC-IES is to provide scientific-technical support to the European Union's Policies for the protection and sustainable development of the European and global environment.

Citation: European Commission - Joint Research Centre - Institute for Environment and Sustainability: International Reference Life Cycle Data System (ILCD) Handbook - Nomenclature and other conventions. First edition 2010. EUR 24384 EN. Luxembourg. Publications Office of the European Union; 2010

European Commission

Joint Research Centre

Institute for Environment and Sustainability

Contact information

Address: Via E. Fermi, 2749 – 21027 Ispra (VA) - Italy

E-mail: lca@jrc.ec.europa.eu

Fax: +39-0332-786645

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

http://ies.jrc.ec.europa.eu/

http://www.jrc.europa.eu/

JRC 58197

EUR 24384 EN

ISBN 978-92-79-15861-2

ISSN 1018-5593

doi:10.2788/96557

Luxembourg: Publications Office of the European Union

Printed in Italy

Preface

To achieve more sustainable production and consumption patterns, we must consider the environmental implications of the whole supply-chain of products, both goods and services, their use, and waste management, i.e. their entire life cycle from “cradle to grave”.

In the Communication on Integrated Product Policy (IPP), the European Commission committed to produce a handbook on best practice in Life Cycle Assessment (LCA). The Sustainable Consumption and Production Action Plan (SCP) confirmed that “*(…) consistent and reliable data and methods are required to asses the overall environmental performance of products (…)*”. The International Reference Life Cycle Data System (ILCD) Handbook provides governments and businesses with a basis for assuring quality and consistency of life cycle data, methods and assessments.

This document guides the naming and classification of the various basic elements of Life Cycle Assessment, such as for example flows and units. It supports the development of Life Cycle Inventory data sets and Life Cycle Assessment studies for being ILCD-compliant regarding their nomenclature. The principal target audience for this provisions document is the experienced LCA practitioner and reviewer.

Executive summary

Overview

Life Cycle Thinking (LCT) and Life Cycle Assessment (LCA) are the scientific approaches behind modern environmental policies and business decision support related to Sustainable Consumption and Production (SCP).

The International Reference Life Cycle Data System (ILCD) provides a common basis for consistent, robust and quality-assured life cycle data and studies. Such data and studies support coherent SCP instruments, such as Ecolabelling, Ecodesign, Carbon footprinting, and Green Public Procurement.

This document guides the naming and classification of the various basic elements of Life Cycle Assessment, such as for example flows and units. It supports the development of Life Cycle Inventory data sets and Life Cycle Assessment studies for being ILCD-compliant regarding their nomenclature.

The principal target audience for this provisions document is the experienced LCA practitioner and reviewer.

About Life Cycle Assessment (LCA)

Life Cycle Assessment (LCA) is a structured, comprehensive and internationally standardised method. It quantifies all relevant emissions and resources consumed and the related environmental and health impacts and resource depletion issues that are associated with the entire life cycle of any goods or services ("products").

Life Cycle Assessment is a vital and powerful decision support tool, complementing other methods, which are necessary to help effectively and efficiently make consumption and production more sustainable.

About the International Reference Life Cycle Data System (ILCD)

The ISO 14040 and 14044 standards provide the indispensable framework for Life Cycle Assessment (LCA). This framework, however, makes no specifications on the naming of flows and other kinds of basic elements of an LCA. Presently, LCA practice therefore differs considerably in nomenclature and other conventions. In consequence, LCI data sets from different sources and LCA reports are incompatible on different levels, leading to inefficiencies and leaving room for misinterpretations especially when exchanging data between different organisations.

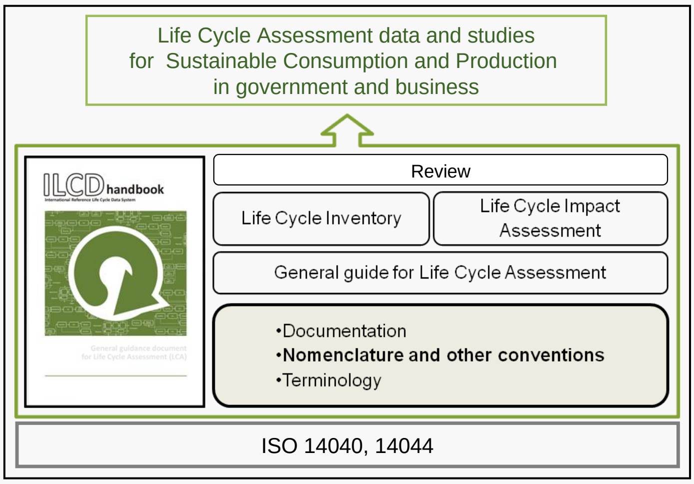
This document you are reading is part of the ILCD Handbook: The ILCD Handbook is a series of technical documents providing guidance for good practice in Life Cycle Assessment in business and government. It is supported by templates, tools, and other components.

Role of this document within the ILCD Handbook

The purpose of this nomenclature and further conventions document is to support a better understanding of LCA study reports and data set documentation, to support an efficient review and to enable an efficient electronic data exchange.

Goal is to guide data collection and documentation in a way that the inventory data

- is meaningful and precise in view of further steps of LCA work and its reporting
- can be compiled and provided in a cost-efficient way
- is comprehensive without overlaps
- supports an efficient data exchange among practitioners also with different database and software systems, thereby reducing errors



The provisions of this document are referenced from other documents of the ILCD Handbook and are equally the basis for providing the ILCD reference elementary flows that are available separately.

Approach taken and key issues addressed in this document

From the above purposes and motivations, the following concrete approach and subsequently the concrete nomenclature and other conventions were derived:

- Start from existing practice
- Comprehensible nomenclature
- Simple rules for naming and classification for elementary flows and other basic elements of an LCA
- Support automatic data set exchange
- Compatibility with different modelling approaches
- Flexible, but guiding recommendations for non-technical target audience (e.g. Executive summary in LCA studies), more strict requirements for communication to technical audience (e.g. with Life Cycle Inventory data sets)
- Default language and multi-language capability

CONTENTS

RULES

1 Introduction

1.1 Relationship to other documents and files

This document stands in context of the following documents and files, which are currently accessible via **http://lct.jrc.ec.europa.eu**:

- **Other technical guidance documents of the ILCD Handbook**
- **ILCD reference elementary flows, i.e. a set of 19000+ elementary flows, as well as flow properties and unit groups.** Implemented based upon this document. Available as both Excel spreadsheet and ILCD formatted data sets as xml files.
- **ILCD reference format, including a developer package of the ILCD format.** This package includes further useful documents and sample data sets. This package also includes two xml files (ILCDClassification.xml and ILCDElementaryFlowCategorization.xml) that implement the whole set of classes and elementaryFlowCategories of this document.

1.2 Purpose of this document

Different LCA working groups use often considerably different nomenclature and other conventions. In consequence, Life Cycle Inventory (LCI) data sets are incompatible on different levels, what strongly limits the combined use of LCI data sets from different sources as well as an efficient, electronic data exchange among practitioners. This situation also hampers a clear and unambiguous understanding of LCA study reports and their efficient review.

The purpose of this document is hence to support Life Cycle Inventory data collection, documentation and use in LCA studies by providing a common nomenclature and provisions on related topics. The document also forms the basis for a common reference elementary flow list for use in both LCI and LCIA work.

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

Goal is to guide data collection, naming, and documentation in a way that the inventory data

- is meaningful and precise in view of further impact assessment and interpretation as well as reporting
- can be compiled and provided in a cost-efficient way
- is comprehensive without overlaps, and

- supports an efficient data exchange among practitioners also with different database and software systems, thereby reducing errors

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

1.3 Approach of this document and nomenclature

From the above purposes and motivations, the following concrete approach and subsequently the concrete nomenclature and other conventions were derived:

- Start from existing practice
- Comprehensible nomenclature
- Simple rules for naming and classification for elementary flows and other basic elements of an LCA
- Support automatic data exchange
- Compatibility with different modelling approaches
- Flexible, but guiding recommendations for use for non-technical target audience, more strict requirements for deliverables for technical audience including Life Cycle Inventory data sets
- Default language and multi-language capability

The following bullets provide some more aspects for each of these issues:

- **Start from existing practice:** The harmonisation process of the nomenclature was started from widely used existing LCA naming schemes. These are implemented in market-relevant LCA databases and software tools and known and/or used by the majority of practitioners.
- **Comprehensible nomenclature:** Lengthy names should be avoided as well as artificial names, rarely used names, ambiguous or otherwise misleading names and – only for elementary flows – industry-sector specific names.
- **Simple rules:** A generally applicable naming pattern and classification / categorisation with few exceptions should be used. This improves the understanding and daily use, makes search functions more efficient and reduces the risk of “twins” in the naming.
- **Support automatic data exchange:**
    - The nomenclature, classification and assignment of flow properties and units to flows should support an automated exchange among the main market relevant LCA data formats, as far as possible. This complements the approach of an object orientated documentation format, i.e. the ILCD reference format that already reflects this need from a format-perspective.

   - Next to flow names, further information items such as CAS Numbers support LCI practice in a structured way in data exchange but also translation to other languages etc. For data exchange (especially for the matching of flow names) the flow name and the CAS No. are both to be considered wherever available to prevent mismatching.
   - The nomenclature and other conventions are foreseen for use in ILCD-compliant data sets and have hence also be applied in developing the ILCD reference elementary flow data sets, flow properties and unit groups. These data sets will hence strongly ease the use of the nomenclature, by allowing having a complete set of elementary flows and related flow properties and units ready for use in electronic form for exchange among LCA software tools.
- **Compatibility with different modelling principles:** As widely done in LCA practice, the names of product flows should be identical as those of the related processes in order to ease searches and to support matrix-type LCI modelling tools. This is not foreseen for multi-functional processes of course, for which a corresponding nomenclature is to be found. The more widely used process chain modelling approaches are equally fully supported.
- **Flexible, but guiding for communication to non-technical audience (e.g. Executive summaries of LCA studies), more strict for technical audience (e.g. LCI data sets, detailed part of LCA studies):** To ease LCA practice and to support a valid LCIA calculation, the elementary flows need to contain the information to the receiving/providing environmental compartment, where required. This is also general practice. The target audience of LCI data sets is always technical while those of LCA studies includes non-technical audience. Hence, a similarly differentiated need for strictness of clear nomenclature for LCI data sets and a more flexible one for communication to non-technical audience is derived. This is implemented here by a classification that is mandatory for LCI data sets while in LCA studies only recommended. For most proprietary formats, the elementaryFlowCategory (e.g. “Emissions to air”) is part of the semantically meaningful flow identifying information, what has to be considered. Practically, the degree of specification has to reflect both aspects of a technically feasible measurement of the flow values in common practice of LCI work and of common LCIA practice. Other aspects especially relevant here are the database manageability and error traceability in inventories. A further differentiation of receiving or providing environmental media, by geographical area (e.g. country), flow speciation, environmental conditions etc., is not recommended here for the time being. The ILCD system is intended to further work on these issues. These should be revisited in the coming years in view of the development of respective further differentiated LCIA methods and factors as well as applicability and data availability in LCI practice.

- **Flexible, but clearly guiding classification and names of product and waste flows:**
    - The classification of product and waste flows as well as for processes should be a "recommendation" only also on the level of the top categories and user extendable; sub-categories are suggested but equally only as "recommendation", allowing for full flexibility also reflecting the technical constraints of some existing LCA software tools.
    - The names of product and waste flows as well as unit processes / LCI results should equally be recommended only, to increase flexibility.
- **Default language and multi-language capability:** According to the report of the SETAC WG on Data Availability and Quality it was found that *"In practical LCI work, the use of deviant nomenclature and local languages other than English cannot be avoided."* Implicitly, the choice for English as a main language for exchange of data is made. At the same time, this expresses the need to support the use of other languages. The naming rules and other conventions made here should be made largely language-independent; i.e. allow that they in principle also work in other languages. This ensures that a translation will be one-to-one in both directions of the translation. In the first place, the English variant of the nomenclature and other conventions is used to develop and apply it. To support a sound management of language-versions of data sets, languages must be dealt with in a clearly structured way, keeping the different translations of a specific data set together (for effective maintenance and extension), i.e. they should be stored in the same file. This is foreseen and technically supported by the ILCD reference format.

The concrete nomenclature and other conventions in the subsequent chapters are derived reflecting the above approaches and considerations and are justified discussing briefly the pros and cons of possible solutions.

1.4 Specific approach for flows

The hierarchical classification of a flow data set is formally equivalent to the assigning of it to a category / sub-category structural level as often done for structuring the user access to the data sets in LCA databases. Two different types of such classifications should be differentiated: those that are mere classes a flow is assigned to (e.g. grouping of substances into "organic" or "inorganic"), and those that actually have a methodological/semantical meaning (e.g. grouping of substances into compartments and sub-compartments of the receiving / providing environment such as "Emissions to air" and "Emissions to water" that result in different LCIA factors for the elementary flows). Focus is here laid on the second type, the semantically meaningful information that is implemented in the ILCD data set format as elementaryFlowCategory. Note that for structuring database contents in LCA software applications both classifications can be used (alternatively or in combination), depending on intended users and preference of the software provider.

Generally, the following problems are identified regarding both the classification of flows and the structure of LCA databases in general:

- No or too little classification/structure (e.g. no structure but hundreds or thousands of objects in database)
- Unbalanced classification/structure (e.g. resulting in hierarchies with 1 to 5 objects in one class but at the same time other classes with over 500 objects)
- Unnecessarily high number of hierarchies used in hierarchical classification/structure (e.g. Elementary flows / Resources / Non-renewable energetic resources / Solid non-renewable energetic resources / Hard coal resources / , where after five mouse-clicks the user can finally see the list of the actual elementary flows of different types of hard coal).
- Classification/structure not oriented to state-of-the-art of LCI practice and/or LCIA methods
- Ambiguous structure (e.g. largely overlapping logic).
- Especially for product and waste flows a "source"-type ("from which industry or process type does the substance come"), a "purpose"-type ("for which purpose is the substance used") and a "substance"-type ("what type of substance is it") classification approach can be found in practice. Of these, the make-type often results in problems, such as e.g. "Sulphur; technical quality" as a product flow is found under "refinery" and "copper industry", but a "Sulphur mix" product flow can not be clearly placed (or found) anywhere. The preferred classification type will depend on the application, i.e. industry-specific eco-design LCI databases would probably be best structured along the use-type, while general back-ground LCI databases would best follow a substance-type classification.

Therefore the recommended hierarchical classifications and recommendation for use in structuring a general database, content should reflect the following considerations:

- Its logic is intuitive and easily comprehensible and independent of the specific e.g. industry context in which the LCA database is used (while in-house a different structure can still be used, data exchange and reporting is based on a common reference structure)
- It has an evenly balanced, and appropriate absolute number of entries in each classification level sub-classifications in each classification, as this allows fast identification of objects. This is typically the case if between 5 to 10 entries exist, both for each classification level and for the data sets in each classification and sub-classification: the human eye and brain can very quickly grasp the content and identify the required next-lower classification.

A smaller number of classes results in too many hierarchies and required "clicks", a much higher number in too long lists to read. For the data sets in the classes, however other aspects are to be considered, such as named in the following bullet-point.

- It puts objects together into one folder that are required in the same context of e.g. LCI work (e.g. when building up an combustion emission inventory, the user will need to compile different organic emissions to air, what is eased if found in the same folder), as far possible
- For elementary flows, its differentiation on top-level is additionally driven from LCIA perspective, i.e. only where LCIA methods require actually a differentiation, a separate classification should be given
- It is not overlapping and leaves no relevant gaps, as far as possible. As this is typically not fully avoidable it offers an “other” option to allow placing objects that can not be (clearly) put elsewhere.
- Finally, as many specific database structures are already employed in widely used LCA tools and databases, the reference structure orients to this existing practice as far as possible as a harmonised suggestion. As some software tools are limited to handle more than two hierarchy levels also for elementary flows, the number of mandatory but also recommended levels should be limited, if acceptable from the other considerations.

The following mandatory and recommended classifications take these considerations into account.

1.5 "Mandatory" and "recommended" items of this document

The nomenclature and other conventions are subdivided into **"Mandatory"** and **"Recommended”** ones. Furthermore, a differentiation is made for deliverables for non-technical target audience, which generally have less strict requirements for exact compatibility and those for technical audience, such as LCI data sets, where different classification systems and the like would render a data exchange among practitioners and their common use more cumbersome.

For "mandatory" items, any deviating use would very likely render data exchange incompatible or LCA study comprehension and review more laborious and/or result in errors that affect the LCI and LCIA results. Other rules are set "recommended" only, as a deviating use would not have the strong negative effects as described just above. They allowing for more flexibility in individually cases. To consequently apply this guidance is intended to nevertheless support better compatibility and a more efficient work flow in data exchange and reporting and hence to save time and cost.

Rule 1: Requirement status of the individual rules:

For ILCD-compliant LCI data sets, LCA studies and other ILCD-compliant deliverables the "mandatory" rules shall always be met, while the “recommended” ones are only recommended.

Many rules are differentiated for technical audience (e.g. applicable to LCI data sets) and non-technical audience (e.g. applicable to Executive summary of LCA studies).

Please note that the following nomenclature rules partly stand in relationship to methodological recommendations and requirements on LCI and LCIA work (e.g. "How to inventory renewable resource flows?"). These method-related provisions are part of the separate ILCD Handbook document "General guide for Life Cycle Assessment".

2 Classification / categorisation of flows

2.1 Classification / categorisation of elementary flows

The main categorisation of elementary flows found in LCA practice is done according to the main receiving / providing environmental compartment, as far as relevant from LCIA perspective. In fact, is this class information part of the flow-identifying information, i.e. it is indispensable.

As an additional, independent and not flow-identifying classification, the classification by substance-type is often used and also suggested here as an additional, independent classification of the flows and in support of an efficient LCI work.

Both can be used in LCA software tools separately or combined to provide their users an efficient, structured access to the data sets.

2.1.1 Classification / categorisation according to (sub)compartment of receiving / providing environment

The smallest denominator for the top-level elementary flow categorisation found in the SETAC Code of Life Cycle Inventory Practice of 2001 refers to the main receiving environmental compartment (for emissions) and providing environmental compartment (for resources). ISO 14044 names "emissions to air, water and soil" as top-level classification, while recommending further differentiation as required for the given goal and scope of the LCA work.

In between, LCIA methods that differentiate between fresh water and sea water as well as between industrial soil and agricultural soil are well established and reflected in several widely used databases, i.e. the practice has further developed. Nevertheless, the wider default options “Water” and “Soil” should still be provided, given inventory data availability.

While resource-depletion methods do not differentiate the providing environment, a differentiation for practical reasons seems useful. Overall, the structure of the elementary flows was adjusted as shown below.

Regarding the naming rules for the categories and sub-categories it is important to ensure that together with the flow names the identification especially of elementary flows is unique: for these the "category plus sub-category" information is part of the identifying information. For this reason the "resource" and "emission" aspect of at least either the class or the sub-category has always to be part of its name (i.e. "Emissions to water" and not only "Water", as in that case the emission could be misinterpreted as a resource flow). To strengthen this clarity, the category/sub-category information is part of the flow data set attributes in the ILCD reference format and not "only" determined by the folder where the data set is placed. As the category name is clear on each level, it can be implemented also as flat structure, only using the lowest level name, i.e. without the need to create several hierarchy levels. As the number of categories is still quite limited, all can be displayed in one view and without resulting in ambiguities.

This structure is set as mandatory to support easy data exchange among practitioners and to limit errors, since characterisation factors of most existing methods refer to this specification of the environment.

Rule 2: Mandatory for both technical and non-technical target audience: "elementary flow categories" by receiving / providing environmental compartment:

- **Resources - Resources from ground**
- **Resources - Resources from water**
- **Resources - Resources from air**
- **Resources – Resources from biosphere**
- **Land use – Land transformation**
- **Land use – Land occupation**
- **Emissions – Emissions to air - Emissions to air, unspecified**
- **Emissions – Emissions to air - Emissions to air, unspecified (long-term)**
- **Emissions – Emissions to air - Emissions to urban air close to ground**
- **Emissions – Emissions to air - Emissions to non-urban air or from high stacks**
- **Emissions – Emissions to air - Emissions to lower stratosphere and upper troposphere**
- **Emissions – Emissions to water - Emissions to water, unspecified**
- **Emissions – Emissions to water - Emissions to water, unspecified (long-term)**
- **Emissions – Emissions to water - Emissions to fresh water**
- **Emissions – Emissions to water - Emissions to sea water**

- **Emissions – Emissions to soil - Emissions to soil, unspecified**
- **Emissions – Emissions to soil - Emissions to agricultural soil**
- **Emissions – Emissions to soil - Emissions to non-agricultural soil**
- **Emissions – Emissions to soil - Emissions to soil, unspecified (long-term)**
- **Other elementary flows**

Note: long-term = emissions occurring over 100 years in future – in practice exclusively from waste deposits. Emissions within 100 years from the represented year are hence to be inventoried in the other categories without the "... (long-term)" in the name.

To account for the substantial different uncertainty/"unknowability" of how future societies will deal with the waste deposits that we create today, long-term emissions beyond 100 years should be inventories separately. The only two practically relevant cases are emissions to air and to water from waste deposits, why only these two long-term emission compartments are added:

Further discussion/explanations and need for a potential further differentiation: From an LCIA perspective, the above classification – while widely used – has some points to be mentioned and well understood. Some others will need methodological clarification. Also, partly the need may arise to expand the categorisation in future:

Air:

The compartments "Emissions to urban air close to ground" and "Emissions to non-urban air or from high stacks" will need an appropriate and practical definition, as to what is meant by "urban" (practical definition to be derived by approximate population density) and what is meant by "close to ground" / "from high stacks" (e.g. such as all emissions that occur below respectively above the bottom layer of 40 m).

"Emissions to lower stratosphere and upper atmosphere" is of relevance only for a very limited number of certain emissions from air plane combustion engines, such as CO_2. Very few elementary flows will have to be put into that category, avoiding thereby to unnecessarily blowing up the number of flow data sets.

"Emissions to indoor air" may need to be considered separately, when LCIA methods and factors becomes available.

Water:

Fresh water is very diverse and brackish water as well as fresh water close to the sea is not addressed by dedicated LCIA factors, while in such locations many industrial complexes and mayor cities are located, i.e. such emission situations are frequent.

Rule 3: Recommended for both technical and non-technical target audience: Splitting emissions to brackish water:

If an emission into brackish water appears, the amount of emissions should be split into a 50% share of emission to seawater and 50% to freshwater.

Soil:

Direct emissions to non-agricultural soil are rather infrequent and of relevance in LCA mainly for persistent organics and heavy metals that stay and act in the soil for a longer period of time. All field management input into soil (e.g. fertiliser) that leaves it, possibly after conversion to other substances, to groundwater or air is to be modelled as such, while not as emission to soil. See also the related provisions in the "General guidance document on LCA"

Emissions to agricultural soil cover emissions to soil in all sites that are under agriculture for at least some intermitting periods for food or fodder production, i.e. not forestry soils, not industrial sites, but sites for cropping of renewable raw-materials in non-permanent agriculture (as these are typically cropped in alternation with food and fodder) and also gardens (as also here a certain share of food production can be assumed).

2.1.2 Discussion of a possible further differentiation of receiving / providing environment

A further differentiation of the receiving / providing environmental compartments has to be discussed from both LCI and LCIA perspective: From LCIA perspective the clear need for such a differentiation was already identified for some compartments and a number of substances. However, dedicated impact factors derived with comparable approaches for a similar range of substances, and resulting in the required robustness as for the main compartments are not yet available. From LCI side, a further differentiation would result in problems of data availability and of enlarging the elementary flow content of life cycle inventories, increasing the effort for handling and error-checking the data and reporting. At the same time, it would increase the reliability of the results, better reflecting reality.

In conclusion and reflecting on presently available LCIA factors and LCI data, no further sub-compartments are supported for ILCD-compliant LCI data sets for the time being, while in LCA studies reports such can be used, as appropriate (see also related requirements in the "General guide on LCA" document, in the respective scope chapter on preparing the basis for the Life Cycle Impact Assessment). A clear need for research and development is highlighted:

Rule 4: Mandatory for technical target audience, recommended for non-technical target audience: Further differentiation of providing/receiving environmental compartments

Further differentiated receiving / providing environmental compartments below the compartments defined more above shall presently not be used.

Ongoing discussions: For further sub-compartments, three different approaches are in use in mayor LCA databases and tools:

- No further differentiation. This is practice in most cases.
- Further differentiation of the receiving environment into sub-compartments (e.g. "Emissions to groundwater") or the emission-situation / site-type (e.g. "Emission to indoor air"). In use by few database developers.
- Further differentiation of the elementary flows according to the country or region where the emission occurs (e.g. "Emission to air, Spain") or into sub-sub-compartments (e.g. "Emission to deep groundwater"), or the country/region where a resource is entering the technosphere (e.g. "Crude oil from Lybia"). Each of these is in use by few database developers.

The two latter differentiations above are independent from each other. Both have certain advantages and disadvantages: The advantages are that they provide a further detailed inventory that allows in principle for more differentiated analysis including impact assessment. It is argued that the disadvantages outweigh the advantages: the lack or limited availability of related LCIA factors, the lack of accordingly differentiated LCI data, and a correspondingly much larger number of elementary flows (beyond the already defined 19000+) to handle and quality control are to be named. For these reasons, no further differentiation of the receiving / providing environmental compartments is foreseen so far.

The ILCD reference format nevertheless allows working with any of the above differentiations: The country/region information of elementary flows can be stored in the individual Input and Output flows in the Process or LCI result data set, and can also be entered directly in the flow data set, resulting in a different data set object, while such flow data sets are not permissible for ILCD-compliant LCI data sets and other deliverables for technical target audience. Also a differentiation into further environmental sub-compartments can be done be defining own hierarchical elementary flow categories; this is technically supported. Please note, that the resulting elementary flow data sets would not be ILCD-compliant.

Further joint LCI and LCIA expertise is required to develop an appropriate and practical solution for this issue, which would be developed subsequently and reflected in a future revision of this document.

2.1.3 Classification according to substance-type of elementary flow

Building on the recommended classification and structure of the former SETAC WG on Data Availability and Quality of 2001, also here a substance-type-based classification is suggested as additional, independent and NON-identifying classification. In the ILCD reference format and for Emissions it is implemented as "Classification", for Resources it is part of the "elementaryFlowCategory"

As resources and emissions require in practice a different substance-type based classification, these are addressed separately. The one for resources is hence foreseen for use as sub-classification under the "Resources" elementaryFlowCategory, the one for emissions as independent "Classes" for each of the "Emissions to ..." "elementaryFlowCategory".

2.1.3.1 Substance-type based classification for resources

The following classification is suggested for resource flows.

Rule 5: Mandatory for technical target audience, recommended for non-technical target audience: additional, non-identifying classification for "Resources from ground" elementary flows (example flows in brackets; if no example is given this means that this class will probably not be used actively):

- **"Non-renewable material resources from ground"** (e.g. "Sand", "Anhydrite; 100%", etc.)
- **"Non-renewable element resources from ground "** (e.g. "Gold", "Copper", etc.)
- **"Non-renewable energy resources from ground "** (e.g. "Hard coal; 32.7 MJ/kg net calorific value", "Uranium; natural isotope mix; 451000 MJ/kg", etc.)
- **"Renewable element resources from ground " (**e.g. "Radon", etc.)
- **"Renewable energy resources from ground"** (e.g. "Wind energy", "Water energy; running", etc.)
- **"Renewable material resources from ground"**
- **"Renewable resources from ground, unspecified"** (for renewable resource elementary flows from ground that do not fit into any of the other categories)
- **"Non-renewable resources from ground, unspecified"** (for non-renewable resource elementary flows from ground that do not fit into any of the other categories)

Please note, that for several resources the "function" of the resource (e.g. the above listed example of uranium ore as energy carrier) is dominating the chemical "element" character of the uranium. Or, in other words: the classification is to a small but certain degree ambiguous. The few cases however, in which the possibility for different classification exist, are justified by the large majority of cases, where the user much easier finds the required flow compared to other classification schemes.

Rule 6: Mandatory for technical target audience, recommended for non-technical target audience: additional, non-identifying classification of "Resources from water" elementary flows (example flows in brackets; if no example is given this means that this class will probably not be used actively):

- **"Non-renewable element resources from water"** (e.g. Magnesium, Bromium, Hydrogen etc.)
- **"Non-renewable material resources from water"**
- **"Non-renewable energy resources from water"**
- **"Renewable element resources from water"**

- **“Renewable material resources from water ”** (e.g. "Groundwater, etc)
- **“Renewable energy resources from water”** (e.g. "Hydro energy; running", “Tidal energy”, etc.)
- **“Renewable resources from water, unspecified”** (for renewable resource elementary flows from water that do not fit into any of the other categories)
- **“Non-renewable resources from water, unspecified”** (for non-renewable resource elementary flows from water that do not fit into any of the other categories)

Rule 7: Mandatory for technical target audience, recommended for non-technical target audience: additional, non-identifying classification of "Resources from air" elementary flows (example flows in brackets; if no example is given this means that this class will probably not be used actively):

- **“Non-renewable material resources from air”**
- **“Non-renewable element resources from air”**
- **“Non-renewable energy resources from air”**
- **“Renewable element resources from air” (**e.g. "Oxygen", "Argon", etc.)
- **“Renewable energy resources from air”** (e.g. Wind energy, solar energy, etc.)
- **"Renewable material resources from air"**
- **“Renewable resources from air, unspecified”** (for renewable resource elementary flows from air that do not fit into any of the other categories)
- **“Non-renewable resources from air, unspecified”** (for non-renewable resource elementary flows from air that do not fit into any of the other categories)

Rule 8: Mandatory for technical target audience, recommended for non-technical target audience: additional, non-identifying classification of resource elementary flows (for use as sub-classification for the "Resources from biosphere" top class (example flows in brackets; if no example is given this means that this class will probably not be used actively):

- **"Renewable genetic resources from biosphere"** (for extraction/hunting of wild species e.g. “Mahagony wood (Tectona grandis), without bark; standing; primary forest”)
- **"Renewable material resources from biosphere"** (e.g. “Round soft wood; 50% H2O”)
- **“Renewable energy resources from biosphere"** (e.g. "Wood biomass; 50% H2O, 7.2 MJ/kg”)
- **“Renewable element resources from biosphere”**

- **“Renewable resources from biosphere, unspecified”** (for renewable resource elementary flows from biosphere that do not fit into any of the other categories)

2.1.3.2 Substance-type based classification for emissions

The following classification is suggested for emissions:

Rule 9: Recommended for both technical and non-technical target audience: additional, non-identifying classification for emissions (examples in brackets; applying the nomenclature as defined in this document):

- **“Metal and semimetal elements and ions”** (e.g., "Arsenic", "Cadmium", "Chromium, III", etc.)
- **“Non-metallic or -semimetallic ions”** (e.g. "Ammonium", "Phosphate", etc.)
- **“Inorganic covalent compounds”** (e.g. "Carbon dioxide, fossil", "Carbon monoxide", "Sulphur dioxide", "Ammonia", etc.)
- **“Cyclic organics”** (e.g. "Hexachloro-benzene", "Cyclopentane", "Naphthalene", etc.)
- **“Acyclic organics”** (e.g. "Ethene", "3-methyl-1-butene", "1,2-chloro-pentane" etc.)
- **“Pesticides”** (e.g. "Chlorfenvinphos", "Tributyl-tin" etc.)
- **“Radioactives”** (e.g. "Cesium-137", "Radon-220", etc.)
- **“Particles”** (e.g. "PM <2.5µm", "PM 2.5-10µm", etc.)
- **"Other substance type"**

While the structure keeps to a certain degree the SETAC WG suggestion, it comes to a more balanced structure with a clearer separation of the organic and inorganic emissions, and keeps the large number of highly specific pesticides separate, i.e. "out of the way" of daily work of most practitioners and also avoiding the use of a third or fourth hierarchy level. At the same time it is to be acknowledged that this classification is not 100% overlap-free, what however appears justified from a general practicality perspective.

2.2 Hierarchical classification of Product flows, Waste flows and Processes

In order to support an effective and efficient data exchange, some basic guidelines on the classification of Product and Waste flows as well as Processes are helpful, while flexibility should remain especially for deliverables to be communicated to non-technical target audience to use an own structure for suitable communication to the target audience. The same classification is used for product/waste flows and the corresponding processes For ILCD-compliant LCI data sets and to ease electronic data exchange, sorting into the same categories implies a mandatory use of these classes. For any deviating LCA software-internal use, a simple mapping can be used.

The flexibility in the classification is important to be able to customize industry specific flows on product level, which helps use in-house the different industrial sectors and to ease communication / data collection with non-LCA experts.

Rule 10: Mandatory for technical target audience, recommended for non-technical target audience: top-level classification for Product flows, Waste flows, and Processes:

- **"Energy carriers and technologies"**
- **"Materials production"**
- **"Systems"**
- **"End-of-life treatment"**
- **"Transport services"**
- **"Use and consumption"**
- **"Other services"**

A deeper differentiation by further sub-classifications, such as some databases make use of, is not regarded as crucial information for documentation. Nevertheless, further specifications and a second level classification has been defined for ILCD documentation-compliant deliverables including LCI data sets, as it eases daily LCA work:

As additional information for the following sub-classifications, it should be noted that product flows can both represent goods and services, but also other activities such as consumption, storage etc., which are more of a process nature, while formally services. Equally it covers waste flows which would be found jointly with the respective waste-treatment services below the class "End-of-life treatment". This applies analogously for the corresponding processes.

Rule 11: Mandatory for technical target audience, recommended for non-technical target audience: second level classifications for Product flows, Waste flows, and Processes (for preceding top-level classification):

"Energy carriers and technologies"

- **"Energetic raw materials" (Note: this refers to the extracted products and related technologies, not the resources e.g. in the ground)**
- **"Electricity"**
- **"Heat and steam"**
- **"Mechanical energy"**
- **"Hard coal based fuels"**
- **"Lignite based fuels"**

- **"Crude oil based fuels"**
- **“Natural gas based fuels”**
- **"Nuclear fuels"**
- **"Other non-renewable fuels"**
- **"Renewable fuels"**

“Materials production”

- **“Non-energetic raw materials” (Note: this refers to the extracted products and related technologies, not the resources e.g. in the ground)**
- **"Metals and semimetals"**
- **"Organic chemicals"**
- **"Inorganic chemicals"**
- **"Glass and ceramics"**
- **"Other mineral materials"**
- **"Plastics"**
- **"Paper and cardboards"**
- **"Water"**
- **"Agricultural production means"**
- **“Food and renewable raw materials"**
- **"Wood"**
- **"Other materials"**

“Systems"

- **"Packaging"**
- **"Electrics and electronics"**
- **"Vehicles"**
- **"Other machines"**
- **"Construction"**
- **"White goods"**
- **"Textiles, furniture and other interiors"**
- **"Unspecific parts"**
- **"Paints and chemical preparations"**

- **"Other systems"**

"End-of-life treatment"

- **"Reuse or further use"**
- **"Material recycling"**
- **"Raw material recycling"**
- **“Energy recycling"**
- **"Landfilling"**
- **"Waste collection"**
- **"Waste water treatment"**
- **"Raw gas treatment"**
- **"Other end-of-life services"**

"Transport services"

- **"Road"**
- **"Rail"**
- **"Water"**
- **"Air"**
- **"Other transport"**

“Use and consumption"

- **"Consumption of products"**
- **"Use of energy-using products"**
- **"Other use and consumption"**

"Other Services"

- **"Cleaning"**
- **"Storage"**
- **"Health, social services, beauty and wellness"**
- **"Repair and maintenance"**
- **"Sale and wholesale"**
- **"Communication and information services"**

- **“Financial, legal, and insurance”**
- **“Administration and government”**
- **“Defence”**
- **“Lodging and gastronomy”**
- **“Education”**
- **“Research and development”**
- **“Entertainment”**
- **“Renting”**
- **“Engineering and consulting”**
- **"Other services"**

3 Nomenclature for Flows and Processes

3.1 Nomenclature - existing shortcomings

Considering the requirements on nomenclature and structure, the following shortcomings can be observed in the existing naming schemes of flows and processes:

- Too general names (e.g. "Steel") or the lack of appropriate naming rules for general flows. If a specific steel flow needs to be defined it should be better specified e.g. "Steel sheet; C35; 2mm thickness", or if a general steel flow is needed it should be named e.g. “Steel, unspecific” (while the usefulness of such unspecific inventories has to be questioned, of course).
- Too lengthy and unstructured names, rendering their display in lists and graphical user interfaces of LCA software tools difficult
- Rarely used naming patterns, that are not generally understood / accepted or do not support effective database searches (e.g. splitting up of names with changes of order of name fragments; abbreviated names; codes instead if names; formal chemical names instead of the commonly used trivial names for common chemicals (e.g. "Hydrogennitride" instead of "Ammonia") and for complex pesticides (e.g. "2-chloro-n-(2,6-diethylphenyl)-n-(methoxymethyl)-acetamide" instead of "Alachlor")).
- Industry-specific naming for generally used elementary flows (e.g. "Anhydrous Ammonia" instead of "Ammonia"; for a product(!) flow the name "Anhydrous Ammonia", with further flow specifying information might be appropriate, of course.)
- Outdated naming (e.g. "Niob" instead of "Niobium")

The ILCD reference format tries to address and overcome the above shortcomings. Before coming to the naming recommendations, the structuring of the name information in the ILCD reference format and the recommendations into four name components will be explained and motivated in the following sub-chapter:

3.2 Structuring flow names

In the ILCD reference format, the following structure for flow names is implemented. It is composed of one basic name and three additional fields for further flow specifying information, which is of use mainly for product flows and waste flows, while for only few elementary flows (such as for certain renewable material and energy resources). The splitting up into individual documentation fields is done to help display of information in graphical user interfaces and to support a comprehensive, structured identification of product and waste flows.

Part of the identifying information of elementary flows is the class it is put into, e.g. "Emissions to air". This information is hence not again entered as part of the flow name, to avoid redundancy. While this is not fully symmetrically to product and waste flows where the class is not part of the identifying information, this reflects general practice in LCA software tools and databases.

Please note that further information related to product and waste flows such as on geographical area or producing company, age of the data, etc., are documented separately. In the ILCD reference format this is done in dedicated format fields.

Next to the further details given below, the following general rules apply:

Rule 12: Recommended for both technical and non-technical target audience: General flow and process naming rules:

- the entries within the same name component field should be listed separated by the character ",". Within the entries of the various name component fields the character ";" should be avoided
- abbreviations should be avoided in the base name field, unless these are very widely in use and complement the long name in the name field (e.g. do not use "PP" for "Polypropylene", but it can be added as "Polypropylene, PP") or chemical element symbols (e.g. do not use "Fe" for "Iron"). Chemical symbols can be used in the "Quantitative flow properties" field to indicate concentrations (e.g. "45% Fe" for an iron ore can be used).
- brackets within the field entries should be avoided

Note: the entries among the four separate name component fields are separated by the character ";". (This is done automatically by the co-called stylesheets that transform the xml files of the ILCD formatted data sets to e.g. html or Excel format.)

Rule 13: Mandatory for technical target audience, recommended for non-technical target audience: "Base name" field:

Definition: "General descriptive name of the flow. Technical language should be used."

Additional recommendations: The technical name should be given as it is used in the respective industry or towards their customers. For emissions the "base name" is the only one to be used; for certain resource flows also the last name component "quantitative flow properties" (see more below) is required, e.g. for energetic raw materials such as "Hard coal; 32.7 MJ/kg net calorific value". Recommendations for land use flows will depend on further developments in the LCIA area.

Rule 14: Mandatory for technical target audience, recommended for non-technical target audience: "Treatment, standards, routes" name field:

Definition: "Qualitative information on the (product or waste) flow in technical term(s): treatment received, standard fulfilled, product quality, use information, production route name, educt name, primary / secondary etc. separated by commata."

Additional recommendations and examples: Examples for types of terms that should be used preferably are:

- For "treatment received": e.g. "polished", "cleaned", "chromium plated", "sterilised", etc.
- For "standard fulfilled": technical standards such as for material grades/purity, fulfilled emission limits, etc.
- For "product quality": other qualitative information such as e.g. "glossy", "UV-resistant", "flame-retardant", "antibacterial finishing", etc.
- For "use information": e.g. "indoor use", "bottle grade", "for wafer production", etc.
- For "production route name": process or production route used for producing this product, such as "suspension polymerisation", "spray dried", "Fischer-Tropsch", etc.
- For "educt name": main in-going products ("educts") in case different routes exist may be needed, such as "from ore roasting" for sulphuric acid, "pine wood" for timber, etc. (note that in practice often the educt is part of the commonly used base name, e.g. "Pine wood table").
- For "primary / secondary": "primary", "secondary"; for mixes with a fixed share of primary/secondary it should be enough to quantify the shares in the next name field on "Quantitative flow properties".

Rule 15: Mandatory for technical target audience, recommended for non-technical target audience: “Mix type and location type” name field:

Definition: "Specifying information on the (product or waste) flow whether being a production mixture or consumption mix, location type of availability (such as e.g. "to consumer" or "at plant"), separated by commata."

Additional recommendations and examples:

- "Production mix" refers to the weighted average mix of production-routes of the represented product in the given geographical area and for the named technology (if any; otherwise overall average for all technologies).
- "Consumption mix" is analogous i.e. including the weighted contribution of imported and exported products from/to outside the given geographical area, with the trade partners (e.g. countries) explicitly considered. Both apply both to goods and services. Entry is not required for technology-specific product flows or waste flows that do not depend on the geographical region.

- For "location type of availability", the mainly required entries are: "at plant" (i.e. as/when leaving the production site), "at wholesale" (i.e. as/when leaving the wholesale storage), "at point-of-sale" (i.e. as/when leaving the point of sale to user), "to consumer" (i.e. including all transport, storage, wholesale and sale efforts and losses; consumer can be both private and business consumer). Further location types are possible and are to be named analogously. In case the point of entry to the wholesale / sale is to be named, the attribute "to" should be used, instead of the term "at" (e.g. "to wholesale" would include the transport efforts and losses until the good reaches the wholesale). Confusion with the intended use of a product/waste should be avoided, i.e. "at waste incineration plant", not "for waste incineration"; the latter would be a qualitative specifying property (as the waste may have received a dedicated pre-treatment etc.) and be put into the respective name field “Treatment, standards, routes”.

Rule 16: Mandatory for technical target audience, recommended for non-technical target audience: “Quantitative flow properties” name field:

Definition: "Further, quantitative specifying information on the (product or waste) flow, in technical term(s): qualifying constituent(s)-content and / or energy-content per unit, as appropriate. Separated by commata. (Note: non-qualifying flow properties, CAS No, Synonyms, Chemical formulas etc. are documented exclusively in the respective fields.)"

Additional recommendations and examples: Examples for which kind of terms should be used preferably are:

- For "qualifying constituent(s)-content and / or energy-content per unit": quantitative element-, substance-, or energy-content, expressed in units per unit of a relevant other flow property. Examples: "24% Fe", "9.6 MJ/kg net calorific value", "90.5% methane by volume". Note that often the units are not required explicitly; e.g. "24% Fe" refers per default to "mass/mass". If another relation is meant, this one has to be given explicitly, of course, e.g. "24% Fe molar" for chemical interim products or e.g. "13.5% ethanol by volume" for wine. Any ambiguity should be avoided, of course.

Rule 17: Mandatory for technical target audience, recommended for non-technical target audience: naming pattern of flows and processes.

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

3.3 Naming of Elementary flows

As a valuable starting point towards an accepted naming scheme for elementary flows the nomenclature rules as described in the SETAC WG on Data Availability and Quality (Beaufort-Langeveld et al. 2001), chapter 2, section "Nomenclature rules: Avoidance of synonyms" has been used: several database providers and hence many practitioners work – however only partly - with this naming scheme. In the SETAC document some principles and some simple rules are described that support a clear naming and identification of substances.

The underlying principle is that that name should be chosen, which gives rise to the least misunderstanding and that it must indicate what is actually measured. The names are to be sought first in the CAS registry system and if ever possible, one of the registered index names should be used. (For CFC/HCFC/Halon nomenclature see Chapter 2, Appendix 6 in (Beaufort-Langeveld et al. 2001).)

Based on experience gained with this nomenclature rules and the flow lists in use within the past 9 years, some shortcomings were however identified. These need correction as they give either rise to misunderstandings or proved not sufficiently practice-oriented in daily LCI work, i.e. have not been widely adopted since then. Before coming to the mandatory rules, two of these will be discussed in further detail:

The meaning of a few elementary flows of metals remains unclear in (Beaufort-Langeveld et al. 2001), as the element's name is used as flow name while for some flows a variant "…, ion" exists. Accordingly, as long as no practice tested LCIA methods for substance speciation exist, the "…, ion" variants of metal emissions should be joined with the element into one elementary flow. There is however an ongoing discussion and work for development of LCIA methods and factors that differentiate speciation while meeting available inventory data. A future solution should hence involve discussion with LCIA experts and industry LCI practitioners.

Substituted organics are in present LCA practice named in various ways - partly based on the new IUPAC recommendation, i.e. main carbon-body first, plus the substituent (e.g. "benzene, 1,2,3-trichloro-"), or in the formerly recommended IUPAC-nomenclature (e.g. "1,2,3-trichloro-benzene"). It is suggested here to use this former recommendation for all flows, as this is from LCA practice perspective seen more appropriate, since in industry LCA practice and in most LCA groups the "old" IUPAC recommendations still prevail. Also, for many substances several carbon-bodies are equivalent and hence different names are possible, i.e. new IUPAC-naming is not clear in all cases, or the name determination is very complex. Also, IUPAC rules are changing any several years, step-wise for sub-groups of chemicals (e.g. a new nomenclature for inorganic chemicals came out in 2005, specific organic chemicals groups have frequent nomenclature updates). In daily work the uninterrupted naming is hence seen as more helpful. (In future revisions the existence and practice-acceptance of IUPAC names and IUPAC-maintained available web-based ontologies should be checked).

A number of other issues that were addressed in (Beaufort-Langeveld et al. 2001) document are not included here as they are of a methodological and not mainly nomenclature nature, e.g. inventorying of sum parameters such as VOC, COD etc. and flow groups etc. All these issues are dealt with in the LCI chapter of the "ILCD Handbook - General guide for LCA".

Rule 18: Mandatory for technical target audience, recommended for non-technical target audience: naming of elementary flows (examples in brackets, in some cases compared to the former SETAC recommendation):

- **Substances and materials should be given a lower case first letter. Brand names should be given a upper case first letter** (E.g. "benzene", "1,2,3-trichloro-benzene", "Alachlor").
- **Isotopes of elements (e.g. used for radioactive substances) are given the IUPAC name plus the isotope number added at the end with a hyphen** (e.g. "radon-220").
- **Particles are to be inventoried via the widely used and understood abbreviation "PM", with further specification of the particle size class** (e.g. "PM <2.5µm" or "PM unspecified".)
- **Salts of O-containing acids are to be named according to the commonly used trivial names as also supported by IUPAC** (e.g. “calcium carbonate” better than the name derived from applying the SETAC WG rule, which results in “carbonic acid, calcium salt”).
- **Other simple chemicals are to be named according to the commonly used trivial names, if widely used** (e.g. "methane", "sulphuric acid", "acetone", etc.).
- **Pesticides should be named by their commonly used trivial or even brand names when commonly used as trivial names across industry** (e.g. "Alachlor" better than "2-chloro-n-(2,6-diethylphenyl)-n-(methoxymethyl)-acetamide").
- **Artificial splitting of fixed technical terms with change of order of the name fragments is to be avoided** (e.g. "hard coal" better than “coal, hard”; the complete flow name should comprise quantitative flow properties information, e.g. "hard coal; 32.7 MJ/kg net calorific value", of course).
- **The attributes of flows "to" for emissions and "in" for resources as foreseen in the SETAC WG document are redundant, as this information is already given by the class the flow belongs to (e.g. "Emissions to air"), as this is part of the elementary flow identifying information. For the sake of shortening the flow names this info is not be doubled in the flow name.**
- **The “…, ion” variants of metal emissions are to be joined with the elemental flow, with the exception of chromium** (e.g. the flow “iron” to water should represent all variants, i.e. Fe III, Fe II, organically bound or ionic or complexed iron and metallic Fe to water; note that NO "ion" information is

inn the name.). The only exception are the commonly used flows “chromium III” and “chromium VI” ions, while a joint flow “chromium, unspecified” is required, too, that one joining also metallic chromium. (To be revised in view of further developed LCIA methods.)

- **Substituted organics are to be named applying the former IUPAC recommendation, that was in place until the late 1990ies and is still widely preferred in industry practice** (e.g. “1,2,3-trichloro-benzene“ better than the new IUPAC pattern that was recommended by the SETAC WG “benzene, 1,2,3-trichloro-“).
- **CFCs and HCFCs are to be named using their trivial name. The full chemical name is to be given in the “Synonyms” field only** (e.g. “HFC-227” as flow name with the chemical name "1,1,1,2,3,3,3-heptafluoro-propane" only in the "Synonyms" field)**.**
- **Carbon dioxide and methane are to be separately inventoried whether from biogenic or fossil sources, both as emission and resource (the latter e.g. from uptake into biomass); the source is added at the end of the base name separated by a comma.** (E.g. "carbon dioxide, fossil", "methane, biogenic").
- **A clearer specification is required for certain flows, e.g. “Wood” from primary forests, as it is unclear whether it refers to the wood only or the whole tree; extracted is however often the tree as a whole** (e.g. better “Mahagony wood (Tectona grandis), without bark; standing; primary forest” instead of “wood, Mahagony, standing”. In case the bark would be extracted as well as often done in primary forests, an additional flow of “other wood biomass” would be inventoried).
- **Last but not least: Naming is always to be unambiguous** (e.g. better “ferrous chloride” or “iron II chloride” instead of the formerly SETAC recommended “iron chloride”, while in this case it is recommended to inventory this emission as the two elementary flows “iron” and “chloride” anyway; this will be addressed in the LCI method chapter of the LCA handbook.)

- Taking this baseline the above recommendation for nomenclature is applied to derive the names for the "ILCD reference elementary flows”.

Based on the outcome of the discussions with experts and key industry stakeholders the final reference elementary flow list for LCI and LCIA work will be developed / identified on basis of these nomenclature and conventions rules.

3.4 Naming of Product flows and Waste flows

In LCA practice it is most important to agree on a nomenclature pattern for elementary flows, as these are the commonly used ones across all LCI data sets, while product flows (and often also waste flows) will be defined individually anyway. Nevertheless, to ease LCA work and communication as well as efficient data set identification and exchange, recommendations for naming product flows are given here. These recommendations are however only intended to give guidance. In LCI modelling in industry practice it is common to use industry specific or even company specific names to ease the link to other internal data systems and for communication either e.g. with plant operators and along the supply chain. The given structure of flow names (see chapter 3.2) with one basic name and three additional fields gives sufficient flexibility to name any product unambiguous.

Hence, a general guidance on the naming of product and waste flows is given by the definitions of the four flow name fields, with recommendation of which information to document and to put where. This is seen necessary, to easy the use of LCI results across industries and to make sure, that e.g. products, that are clearly identified within the context of the producing industry receive a clear name that is also understood outside of that industry. This reflects the reality that LCA practitioners that do not work directly in a specific industry have to be supported in their daily work to minimise errors. The use of the defined guidelines for the naming of processes and product flows will of course be not mandatory for the functionality or an exchange of data sets.

Rule 19: Recommended for both technical and non-technical target audience: naming of product and waste flows:

Product and waste flows are to be named using technical names, being as precise as possible, with the different types of information being documented into the four names fields as defined and illustrated for the ILCD reference format. See chapter 3.2. Other information such as represented country/region or year should not be part of the flow name but be documented in separate documentation fields.

(Examples:

Product flows "Aluminium extrusion profile; primary production; Production mix, at plant", "Stainless steel hot rolled coil; annealed and pickled, grade 304, austenitic, electric arc furnace route; production mix, at plant; 18% chromium, 10% nickel", "Diesel; consumption mix, at refinery; 200 ppm sulphur", "Electricity AC; consumption mix, to consumer; 220V", "Corrugated board boxes; consumption mix; 16.6% primary fibre, 83.4% recycled fibre", "Polyethylene terephthalate (PET) granulate; bottle grade; production mix, at plant", "Lorry, 22t; interurban, one-way; load factor 80%, EURO 3", "Lorry, unspecified", "Incineration of polyethylene (PE); waste incinerator with dry flue gas cleaning technology; production mix", "Loaded cargo" and "Cargo at destination".

Waste flows "Household waste; production mix; 9.5 MJ/kg net calorific value", "Overburden; 0.20% lead, 0.13% zinc, 0.5% sulphur", "Waste tyres, unspecified"

Note: even if country/region and year are not part of the product flow name but documented in separate fields, they can be used jointly in LCA software tools with a matrix modelling approach to create unique links between all processes of the product system.

3.5 Naming of processes

While this document focuses on flows, flow properties and units, for practicality reasons the related nomenclature covers the names for processes as well, as these are in LCA practice oriented to or (for matrix-type LCA software) are named identical to the process' reference flow (if there is only one). To also meet the interests of flexible modelling and naming of not-matrix-type LCA software that allows to have different names for product flows than those of the process, the geographical reference of the flows is documented not as part of the flow name, but in a separate documentation field. This also meets the needs of matrix-type LCA software, as the name and geography information items can be easily joined inside the matrix-type tools and also uniquely be split up again in export.

However, as stated before, this document is to provide only a general guidance nomenclature for processes to ease comprehensibility and compatibility when exchanging data sets. The following guidelines are recommendations for process naming in order to avoid deviations that would render difficult the understanding of reports and identification of process data sets.

The below rules apply to all types of process data sets uniformly, whether they are Unit processes, LCI results or Partly terminated systems.

Rule 20: Recommended for both technical and non-technical target audience: naming of processes:

The name of process data sets with exactly one "reference flow" should be identical to the name of that reference flow.

Geographical and data set age information is documented not as part of the flow or process name, but in a separate documentation field.

The name of multi-functional process data sets with more than one "reference flow" should combine the name of the technology / plant represented and include information on all reference flows.

The name of process data sets with quantitative references other than "reference flow" (e.g. “functional unit”, “production period”, "other flow", etc.) should be named according to their quantitative reference. If required for clarity, this name should be combined with the technology or plant name.

To support this, in the ILCD reference format the name of “Process" data sets is structured identically to the name of product flows, with four identically defined name fields (see more above).

4 Classification, nomenclature and assignment of Flow properties, Unit groups, and Units

Flow properties and units are on one side indispensable to correctly specify flows and on the other side one of the most prominent error sources in LCA. Therefore a clear structure and clear rules are important for error-free LCI work and data exchange.

Flow properties that are used for flows can be "extensive" (e.g. energy content, element content, volume, etc.) or "intensive" (e.g. temperature, pressure, etc.). For calculating and analysing LCI results only extensive properties are of interest (e.g. the net calorific energy content of all energy resources are linearly summed up per reference flow of the modelled product system to yield the primary energy consumption figure), while intensive properties are often used to specify flows without using them in subsequent calculations (e.g. temperature and pressure of different steams as co-products of a process).

Providing all the relevant extensive flow properties with flow data sets eases data exchange and conversion between different properties and also different unit systems.

4.1 Classification of Flow properties and Unit groups

There are basically three kinds of flow properties of interest in state-of-the-art LCA:

- Technical flow properties that describe the main physical and technical properties such as e.g. calorific content,
- chemical composition of flows that describe e.g. the elemental composition of the flow (and not chemical properties why the class name is a bit different than the other two for better clarity), and
- economic flow properties that describe the economic value of the flow.

For flow properties and unit groups the number of data sets to be expected is too small to justify a second-level hierarchy, while it should be avoided to have one long list only. Hence only the three main flow property groups are differentiated as classes. Even if software tools can internally not store objects in classes, by exporting them to reports or the ILCD reference format, the assignment to the three suggested classes is straightforward:

Rule 21: Mandatory for technical target audience, recommended for non-technical target audience: classification for flow properties:

“Technical flow properties" (e.g. "Net calorific value", "Mass" etc.)

"Chemical composition of flows" (e.g. "Iron content", "Methane content" etc.)

"Economic flow properties” (e.g. "Market value US 1997, bulk prices", "Market value EU-27 2008, private consumer prices", etc.)

“Other flow properties”

Chemical composition of flows are kept separately from technical flow properties as the number of data sets in these classes is rather high.

Note: Please note that there are no "environmental flow properties" or "environmental unit groups" as for LCIA factors the data set type "LCIA method" was introduced in the ILCD format. These LCIA method data set type is of a different quality and needs a quite different and more comprehensive documentation than e.g. technical flow properties.

Rule 22: Mandatory for technical target audience, recommended for non-technical target audience: classification of unit groups:

“Technical unit groups" (e.g. "Units of energy", "Units of mass", etc.)

"Economic unit groups" (e.g. "Units of currency 1997", "Units of currency 1998", etc.)

“Other unit groups”

Note that no "Chemical composition unit groups" class is required, as the related flow properties / LCIA factors will always use technical Unit groups and units (e.g. mass, volume, etc.). E.g. it will be "kg" Iron content (per given reference unit of an enriched ore flow, i.e. kg Fe per kg iron ore).

The assignment of year-dependent currency units is required to be able to convert both among different units within one currency (e.g. "Euro" and "Euro-cents") and among currencies while the exchange rates change with time. Together with year-specific economic flow properties (and the option to further differentiate different price-levels in different regions and additionally between e.g. bulk trade prices and consumer prices) a complete automatic conversion is enabled.

A "LCIA method unit group class" (for LCIA method data sets) is not required, as this will be equally expressed e.g. in kg (i.e. "kg" "CO2-equivalents" for the LCIA method "Climate Change Potential").

4.2 Names of Flow properties, Unit groups and Units; their assignment to Flows

Errors in LCI work and in data exchange occur regularly when differing flow properties are used, i.e. when gases are measured in mass by the data provider, but in volume in the receiving database or in net calorific value by one and in upper calorific value by another. The same type of errors occurs when differing unit systems or units are used for the same flow such as mg, g, kg, ounces, pounds, short tons, bushels etc. for the flow property "mass".

To minimise such errors and to ease an automatic conversion in daily data import and export, as well as to support readability and acceptance of LCA reports, a harmonisation is required here as well and rules are to be defined to derive the underlying properties and units for the reference elementary flow list and data sets.

(See also next chapter for naming of new flow properties, Unit groups and Units): The naming of flow properties and units should apply commonly understood names, often derived from physics. For chemical composition of flows, the chemical names as used for flow names are to be used; see respective chapter.

For the units themselves common terms, often abbreviations, are to be used, such as kg, US$, l etc.

Considering the existing realities in LCI and LCIA practice, the following hierarchy of rules are set for flow properties and units of flows:

Rule 23: Mandatory for technical target audience, recommended for non-technical target audience: Reference flow properties and reference units for types of flows, first criterion:

All flows that possess a mass, are measured in the flow property "Mass", as long as none of the below rules would require to use a different flow property.

The unit group for mass is "Units of mass" with the reference unit "kg".

Rule 24: Mandatory for technical target audience, recommended for non-technical target audience: Reference flow properties and reference units for types of flows, second criterion:

Elementary flows, for which the energy content is the most relevant unit, are measured in the flow property "Net calorific value".

The unit group for the net calorific value is "Units of energy" with the reference unit "MJ".

Product and waste flows such as fuels, in contrast, can be measured as is general usage, e.g. in mass (e.g. diesel, hard coal, etc.), normal volume (e.g. natural gas), "Net calorific value" with the unit "MJ", or other. Note that for Uranium ore, for which a net calorific value *per se* can not be given, the usable fission energy content is expressed nevertheless as "Net calorific value" to ease aggregation with other fossil energy resources to primary energy consumption figures.

Further explanations and discussion:

The reasoning for measuring energy resource elementary flows such as crude oil in their net calorific value property, is that this allows to use a limited number of crude oil elementary flows, while fully supporting the energy-related impact assessment of "Resource depletion". Some existing databases measure crude oil in mass, with the effect, that each crude oil resource with differing energy content requires an own elementary flow to properly inventory the non-renewable primary energy consumption. This so far lead to extremely many elementary flows in the LCI result inventories, identically for hard coal and lignite as well as for natural gas resources.

Exergy would be - from a scientific point of view - a more appropriate flow property for elemental flows of energy resources, but reality in LCI practice presently speaks rather against it. Using exergy would however allow to better address energy resource use as very wet energy carriers such as biomass including e.g. manure have very low or even negative net (and also upper) calorific content values but can be converted to biogas with a seemingly positive energy balance, "creating" energy (or more exactly: net calorific value). At the same time, the property exergy also works well for all other energy carriers. Difficulties would arise (to some degree) when collecting inventory numbers, as very often only the net calorific values are measured and the exergy value would have to be calculated considering further information such as especially the water content. This issue is to be further discussed with industry practitioners and other LCA experts in context of future revisions of the ILCD methodology.

Rule 25: Mandatory for technical target audience, recommended for non-technical target audience: Reference flow properties and reference units for types of flows, further criteria:

Product and waste flows that are typically dealt with in standard volume and for which none of the other units named in this chapter is in use in practice, are measured in the flow property “Standard volume” (e.g. for the product flows “Compressed air; 10 bar”, "Oxygen; from refill gas cylinder of 40 l; 150 bar", etc.). Not applicable to elementary flows.

The unit group is “Units of volume” with the reference unit “m3”.

Elementary flows for which the substance’s radioactivity is in focus, are measured in the flow property “Radioactivity” (e.g. elementary flow "thallium-201")**.**

The unit group is “Units of radioactivity” with the reference unit “kBq”, i.e. Kilo-Becquerel.

Flows that are typically dealt with in number of items are measured in the flow property “Number” (e.g. product flows "Spare tyre passenger car; generic average", "Milk cow; Holstein, alive, start of lactation" etc.).

The unit group is “Units of items” with the reference unit “Item(s)".

Product and waste flows that are typically dealt with in length or distance are measured in the flow property “Length” (e.g. product flows "Welding seam; MIG/MAG, steel on steel" and "Water pipe; copper; max 5 bar, 15mm diameter", etc.). Not applicable to elementary flows.

The unit group is “Units of length” with the reference unit “m”.

Product and waste flows that are typically dealt with in duration are measured in the flow property "Time" (e.g. product flow / functional unit "Storage in warehouse; unheated"). Not applicable to elementary flows.

The unit group is "Units of time" with the reference unit "d", i.e. days.

Product and waste flows that are typically dealt with in weight multiplied with distance are measured in the flow property "Mass*length" (e.g. product flow / functional unit "Road transport; bulk goods, generic mix; long distance"). Not applicable to elementary flows.

The unit group is "Units of mass*length" with the reference unit "t*km".

Product and waste flows that are typically dealt with in volume multiplied with distance are measured in the flow property "Volume*length" (e.g. product flow / functional unit "Road transport; voluminous goods, generic mix; long distance"). Not applicable to elementary flows.

The unit group is "Units of volume*length" with the reference unit "m3*km".

Person transport product flows / functional units are given in the flow property "Person*distance". Not applicable to elementary flows.

The unit group is "Units of items*length" with the reference unit "Items*km".

Flows that are typically dealt with in surface area are measured in the flow property "Area" (e.g. elementary flow "Land conversion; XY specification", product flow / functional unit "Surface cleaning; heavily soiled, plastic; 1 m2").

The unit group is "Units of area" with the reference unit "m2".

Flows that are typically dealt with in surface area multiplied with time are measured in the flow property "Area*time" (e.g. elementary flow "Land occupation; XY specification", product flow / functional unit "Façade weather protection; exposed, white; 70% reflection").

The unit group is "Units of area*time" with the reference unit "m2*a". (1 year approximated as 365 days)

Product and waste flows that are typically dealt with in volume multiplied with time are measured in the flow property "Volume*time" (e.g. product flow / functional unit "Landfill occupation"). Not applicable to elementary flows.

The unit group is "Units of volume*time" with the reference unit "m3*a". (1 year approximated as 365 days)

For products where the content of specific elements or of well defined chemical compounds is of interest, the respective information should be given as secondary flow property for conversion, display or modelling purposes. This is done using flow properties of the type "Substance/element X content", e.g. "Cadmium content", "Ammonia content", "Water content", "Methane content" etc. (Nomenclature for the element or substance name should be identical to the one for these elements or substances as given elsewhere in this document).

Depending on the specific interest, the information can be given in mass or volume units: E.g. "Iron content" in the product flow "Iron ore, enriched; floating …" as mass information or "Methane content" in the product flow "Natural gas; …" volumetric. The required "Unit group data set" is then the same as already defined "Units of mass" and "Units of volume", i.e. there is no necessity to define new Unit group data sets.

For product and waste flows where the economic value should be given (typically as <u>secondary</u> flow property for allocation purposes or cost calculation in Life Cycle Costing) this is done using the flow property "Market value", which is further specified as required, typically referring to the country or region, time period, and wholesale/retail etc. situation, by adding the respective information: E.g. "Market value US 1997, bulk prices", "Market value EU 2000, private consumer prices". (Can be used for e.g. product / waste / elementary flows "Gold", "Waste tyres", "Carbon dioxide", etc.).

The unit group name is formed by the combination of the string "Units of currency" and an addition that characterises the time period to which it refers, e.g. "1997", "1990-1999", "May 1995" etc., e.g. "Units of currency 1997" with the reference unit "EUR", i.e. Euro. (Note: The reference to a time period is required to allow giving correct average conversion numbers for other currencies for that time period).

Remarks:

Factors for conversion among different flow properties and unit systems, e.g. between Nm^3 and kg for natural gas, or ounces to kg for gold etc. are to be dealt with within the databases. To enable that data imported or exported in these reference flow properties and units can be appropriately converted all relevant flow properties should be given. This topic is hence no issue of this nomenclature, but the inter-convertible units for the predefined unit groups of mass, volume etc. are to be provided within the flow data sets. In case of the reference flow data sets of the ILCD system, this is an item of high priority for future work.

4.3 Nomenclature for new Flow properties, Unit groups and Units

Rule 26: Mandatory for technical target audience, recommended for non-technical target audience: Creation and naming of flow properties, unit groups and units:

The creation/use of new flow properties, unit groups and units should be avoided, if possible, and any of the existing ones as provided in the upcoming more complete list of the ILCD system should be used.

If the creation of new flow properties and unit groups is unavoidable (as to be expected e.g. for economic flow properties), they should be named following the same pattern as the ones above, i.e. flow properties carry the name of the physical or other property, units carry the unit short as name (with the option to provide a long name and further info in the comment field foreseen in the data format). Unit groups are named by a combination of the string "Units of" and the name of the flow property they refer to. Please note, that in some cases it is useful to have common unit groups for more than one flow property were all are measured in the same units. In such cases the naming can be referred to a more general flow property (e.g. "Energy" → "Units of energy") and not only to one specific one (e.g. NOT "Units of net calorific value" or "Units of exergy" etc.).

5 Classification of Contacts

For easing a structured management of Contact data sets, the following hierarchical classification is recommended.

Rule 27: Recommended for technical and non-technical target audience: classification of contact data sets:

"Group of organisations, project"

"Organisations"

- **"Private companies"**
- **"Governmental organisations"**
- **"Non-governmental organisations"**
- **"Other organisations"**

"Working groups within organisations"
"Persons"
"Other"

6 Classification of Sources

For easing a structured management of Source data sets, the following hierarchical classification is recommended. The logic behind this classification is to ease fast identification for the differentiated source classes that have a special function in the ILCD format and are often referenced from within process data sets (e.g. reference to embedded image-flow chart or to applied compliance system). [Note: The bibliographic type of sources (e.g. paper, oral communication, chapter in anthology etc. is documented in the source data set's field "Publication type".]

Rule 28: Recommended for technical and non-technical target audience: classification of source data sets:

"Images"
"Data set formats"
"Databases"
"Compliance systems"
"Statistical classifications"
"Publications and communications"
"Other source types"

Note that the category "Images" has to be assigned in order a graphical file (e.g. a .jpg or .gif file) is actually displayed embedded into the html files for web-browser, via the ILCD web display stylesheet that converts the ILCD-formatted xml data set files to html.

7 Annex: Development of this document

Based on and considering the following documents

The background document has been drafted taking into account amongst others the following existing sources:

Harmonised ISO standards

- ISO 14040: 2006 Environmental management - Life cycle assessment – Principles and framework
- ISO 14044: 2006 Environmental management - Life cycle assessment - Requirements and guidelines

A large number of LCA manuals of business associations, national LCA projects, consultants and research groups as well as scientific LCA publications have been analysed and taken into account. The detailed list is provided more below.

Two major starting points - next to established but widely deviating practice in industry, National LCA projects, research and consultancy databases - have been the SETAC Life Cycle Inventory Code of Practice (reference see more below at "Beaufort-Langeveld, A. et al." of 2001) and the unpublished last draft document of the UNEP/SETAC Life Cycle Initiative's Task Force 2, chapter 4 of May 2005.

Drafting

This document was initially drafted in early 2007 by contractors (see list more below) with support under the European Commission Joint Research Centre (JRC) contract no. contract no. 383136 F1SC concerning “Enhancement of the ELCD core database”.

This work has been funded by the European Commission, partially supported through Commission-internal Administrative Arrangements (Nos 070402/2005/414023/G4, 070402/2006/443456/G4, 070307/2007/474521/G4, and 070307/2008/513489/G4) between DG Environment and the Joint Research Centre.

Invited stakeholder consultations

An earlier draft version of this document has been discussed in a closed advisory groups workshop in May 23, 2007, inviting National Life Cycle Database Initiatives outside the European Union, business associations as members of the Business Advisory Group, Life Cycle Assessment software and database developers and Life Cycle Impact Assessment method developers as members of the respective Advisory Groups at that time.

Public consultation

A public consultation was carried out on the advanced draft guidance document from November 16, 2007 to December 4, 2007.

Dedicated invitation emails have in addition been sent to more than 60 organisations and groups from government, industry, research and consulting from within the EU and globally.

Overview of involved or consulted organisations and individuals

The following organisations and individuals have been consulted or provided comments, inputs and feedback during the invited or public consultations in the development of this document:

Internal EU steering committee:

- European Commission services (EC),
- European Environment Agency (EEA),
- European Committee for Standardization (CEN),
- IPP Regular Meeting Representatives of the 27 EU Member States

National database projects and international organisations:[1]

- United Nations Environment Programme, DTIE Department (UNEP-DTIE)
- Brazilian Institute for Informatics in Science and Technology (IBICT)
- University of Brasilia (UnB)
- Japan Environmental Management Association for Industry (JEMAI)
- Research Center for Life Cycle Assessment (AIST), Japan
- SIRIM-Berhad, Malaysia
- National Metal and Material Technology Center (MTEC), Focus Center on Life Cycle Assessment and EcoProduct Development, Thailand

Advisory group members

Business advisory group members:

- Alliance for Beverage Cartons and the Environment (ACE)
- Association of Plastics Manufacturers (PlasticsEurope)
- Confederation of European Waste-to-Energy plants (CEWEP)
- European Aluminium Association (EAA)
- European Automobile Manufacturers' Association (ACEA)

Disclaimer: Involvement in the development or consultation process does not imply an agreement with or endorsement of this document.

[1] Note that this and the following lists necessarily reflect the status when the invited workshop of May 2007 had been held.

- European Cement Association (CEMBUREAU)
- European Confederation of Iron and Steel Industries (EUROFER)
- European Copper Institute (ECI)
- European Confederation of woodworking industries (CEI-Bois)
- European Federation of Corrugated Board Manufacturers (FEFCO)
- Industrial Minerals Association Europe (IMA Europe)
- Technical Association of the European Natural Gas Industry (Marcogaz)

LCA database and tool advisory group members:

- BRE Building Research Establishment Ltd - Watford (United Kingdom)
- CML Institute of Environmental Science, University of Leiden (The Netherlands)
- CODDE Conception, Developement Durable, Environnement (now: Bureau Veritas) - Paris (France)
- ENEA – Bologna (Italy)
- Forschungszentrum Karlsruhe GmbH - Eggenstein-Leopoldshafen (Germany)
- Green Delta TC GmbH – Berlin (Germany)
- Ifu Institut für Umweltinformatik GmbH – Hamburg (Germany)
- IVL Swedish Environmental Research Institute – Stockholm (Sweden)
- KCL Oy Keskuslaboratorio-Centrallaboratorium Ab – Espoo (Finland)
- LBP, University Stuttgart (Germany)
- LCA Center Denmark c/o FORCE Technology – Lyngby (Denmark)
- LEGEP Software GmbH - Dachau (Germany)
- PE International GmbH – Leinfelden-Echterdingen (Germany)
- PRé Consultants – Amersfoort (The Netherlands)
- Wuppertal Institut für Klima, Umwelt, Energie GmbH – Wuppertal (Germany)

Life Cycle Impact Assessment advisory group members:

- CML Institute of Environmental Science, University of Leiden (The Netherlands)
- Ecointesys Life Cycle Systems - Lausanne (Switzerland)
- IVL Swedish Environmental Research Institute – Stockholm (Sweden)
- PRé Consultants – Amersfoort (The Netherlands)
- LCA Center Denmark – Lyngby (Denmark)
- Musashi Institute of Technology (Japan)
- Research Center for Life Cycle Assessment (AIST) (Japan)

Disclaimer: Involvement in the development or consultation process does not imply an agreement with or endorsement of this document.

Public consultation

Contributors providing written feedback in the public consultation:

Organisations

- The Italian National Energy on New Technology, Energy and the Environment (ENEA)
- European Federation of Corrugated Board Manufacturers (FEFCO)
- E2 Management Consulting AG, Switzerland
- CML, Leiden University, The Netherlands
- Verband der Wellpappen-Industrie (German Corrugated Board Association) VDW

Participants in the consultation workshop of May 23, 2007 (written registration)

SURNAME	*Name*	*Organisation*
Anderis	Gil	USP - University of San Paolo
Bauer	Christian	Forschungszentrum Karlsruhe
Braune	Anna	Universität Stuttgart
Broadbent	Clare	EUROFER
Carldeira-Pires	Armando	UnB - University of Brasilia
Castanho	Carla	UnB - University of Brasilia
Ciroth	Andreas	GreenDeltaTC GmbH
de Beaufort	Angeline	FEFCO
Fernandes	Jorge	UnB - University of Brasilia
Galatola	Michele	European Commission DG RTD
Jolliet	Olivier	University of Michigan
Kreißig	Johannes	PE International GmbH
Lamb	Celina	IBICT
Leroy	Christian	EAA _ European Alluminium Association
Margni	Manuele	Ecointesys
Masoni	Paolo	ENEA
Poulsen	Jan	FORCE Technology
Schebek	Liselotte	Forschungszentrum Karlsruhe
Ugaya	Cássia	UTFPR
Zamagni	Alessandra	ENEA

Disclaimer: Involvement in the development or consultation process does not imply an agreement with or endorsement of this document.

Contractors as members of the initial drafting team

- Harald Florin (PE International, Germany)
- Phillippe Osset (Ecobilan - Price-Waterhouse, France)
- Oliver Schuller (LBP, University of Stuttgart, Germany)

Coordinators and contributors from the Joint Research Centre (JRC, IES)

- Marc-Andree Wolf (project coordinator)
- Raffaella Bersani
- Kirana Chomkhamsri
- Rana Pant
- David W. Pennington

Disclaimer: Involvement in the development or consultation process does not imply an agreement with or endorsement of this document.

Existing provisions

The guidance document has been drafted starting from the following existing sources:

Harmonised standards

- ISO 14040:2006 Environmental management - Life cycle assessment – Principles and framework
- ISO 14044:2006 Environmental management - Life cycle assessment - Requirements and guidelines

Governmental guidance documents

- BSI British Standards Institute (2008): PAS 2050 ”Specification for the measurement of the embodied greenhouse gas emissions of products and services” on Carbon footprinting. And: BSI British Standards (with DEFRA and Carbon Trust) (2008). Guide to PAS 2050 - How to assess the carbon footprint of goods and services. ISBN 978-0-580-64636-2.

National LCA database manuals

- AusLCI and ALCAS: Guidelines for Data Development for an Australian Life Cycle Inventory Database. Committee Draft of 8th July 2008. (http://alcas.asn.au/auslci/pmwiki/uploads/AusLCI/AUSLCI_Data_Guidelines_CD_July08.doc).
- Danish EPA (editor): Reports of the EDIP guidelines 2003. Environmental Project No. 216.6, 862 2003, 863 2003, 70 2004.
- JEMAI (2002): Japan Environmental Management Association for Industry (JEMAI) data collection manual. 2002.
- Korea: Asia Pacific Economic Cooperation - APEC & Ministry of Commerce, Industry and Energy Republic of Korea (editors): Lee, Kun-Mo & Inaba, Atsushi: Life Cycle Assessment - Best Practices of ISO 14040 Series. February 2004.
- Swiss ecoinvent Centre (2007) - Frischknecht, R., Jungbluth, N. (editors), Althaus, H.-J.; Doka, G.; Dones, R.; Heck, T.; Hellweg, S.; Hischier, R.; Nemecek, T.; Rebitzer, G.; Spielmann, M.; Wernet, G. (authors): Ecoinvent report No. 1: Overview and Methodology for the ecoinvent database v. 2.0. Dübendorf, 2007. (www.ecoinvent.org).
- NREL: U.S. LCI Database Project Development Guidelines (Final draft). Feb. 2004. NREL/SR-33806. (http://www.nrel.gov/lci/docs/dataguidelinesfinalrpt1-13-04.doc).

Methodological handbooks of industry associations

- ACE (no year): Guideline on Liquid Packaging Board (LPB) LCI data compilation, version 1.0. Unpublished
- EUROFER (2000): European LCI Database for Coiled Flat Stainless Steel Products. Methodology Report. European Confederation of Iron and Steel Industries, Stainless Producers Group. April 2000. Unpublished.
- worldsteel/IISI (2002, 2005, 2007): Worldwide LCI Database for Industry Steel Products. Final Methodology Report of the International Iron and Steel Institute. 2002. Updated annex "IISI Recycling methodology", 2005. Plus separate methodology report "Geyer, R. & Bren, D.: Life Cycle Greenhouse Gas Emission Assessments of Automotive Materials -The Example of Mild Steel, Advanced High Strength Steel and Aluminium in Body in White Applications" on recycling modelling methods, 2007. (www.worldsteel.org).
- FEFCO, GEO, ECO (2006): European Database for Corrugated Board Life Cycle Studies, November 2006. (European Federation of Corrugated Board Manufacturers - FEFCO, European Association of makers of Corrugated Base Papers - GEO, European Containerboard Organisation - ECO). (www.fefco.org).
- IAI (2003): Life Cycle Assessment of Aluminium: Inventory Data for the Worldwide Primary Aluminium Industry, March 2003. (www.world-aluminium.org).
- Boustead I (2005). Eco-Profiles of the European Plastics Industry. Methodology. Report for PlasticsEurope, Last revision March 2005. (www.plasticseurope.org).
- DEKRA Umwelt GmbH (2008). Final draft: PlasticsEurope Eco-profiles and Environmental Declarations - Life Cycle Inventory Methodology and Product Category Rules (PCR) for Uncompounded Polymer Resins and Reactive Polymer Precursors. December 2008. Unpublished.
- Tikana L, Sievers H, Klassert A (2005). Life Cycle Assessment of Copper Products. Deutsches Kupferinstitut (DKI) and European Copper Institute (ECI). Unpublished.

Documents related to nomenclature and related conventions in the field of Life Cycle Assessment and other scientific literature

- Beaufort-Langeveld, A. et al. (Eds.): SETAC Code of Life-Cycle Inventory Practice, 2001. Developed by the former SETAC WG on Data Availability and Quality 1998-2001.
- Chalmers: Manual for LCA@CPM, 2005 (http://www.globalspine.com)
- CML University Leiden: CMLCA format documents and database, 2005
- CML: Handbook on Life Cycle Assessment, Operational Guide to the ISO Standards. CML 2002 (www.leidenuniv.nl/cml/ssp/projects/lca)
- Ecobilan: DEAMTM methodical handbook and database, 2005 (http://www.ecobilan.com/uk_deam.php)
- Frank C. et al.: SETAC Guidelines for Life Cycle Assessment: A “Code of Practice”, 1993.

- Hauschild, M.Z. & Wenzel, H. (1998). Environmental assessment of products. Vol. 2 - Scientific background, 565 pp. Chapman & Hall, United Kingdom, Kluwer Academic Publishers, Hingham, MA. USA. ISBN 0412 80810 2.
- IPCC (2006): 2006 IPCC Guidelines for National Greenhouse Gas Inventories.
- KCL EcoData: KCL, 2005
- Kemna, K.; van Elburg, M.; Li, W.; van Holstein, R. (2005). MEEUP Methodology Report. Final report to the European Commission, dated 28.11.2005.
- LBP University of Stuttgart / PE International: GaBi handbook and GaBi modelling principles, 2006 (www.gabi-software.com)
- Lindfors, L.-G.; Christiansen, K.; Hoffman, L.; Virtanen, Y.; Juntilla, V.; Hanssen, O.-J.; Rönning, A.; Ekvall, T.; and Finnveden, G. (1995). Nordic Guidelines on Life-Cycle Assessment. (Copenhagen: Nordic Council of Ministers).
- NN (2003): Meeting report of the “International Workshop on Quality of LCI Data”; FZK; Karlsruhe, Germany, 2003
- NN (2007): General programme instructions for an International EPD®system for environmental product declarations, Draft Version 0.3 - dated 2007-11-09.
- UNEP/SETAC Life Cycle Initiative, Life Cycle Inventory programme, First phase 2001-2005: Task Force 2, chapter 4: IVAM, Amsterdam and IKP, Stuttgart: "Nomenclature and structure"; (latest) draft of 17 May 2005, unpublished
- Weidema, B.; Cappellaro, F.; Carlson, R.; Notten, P. Pålsson, A.-C.; Patyk, A.; Regalini, E.; Sacchetto, F.; Scalbi, S. (2004): Procedural guideline for the collection, treatment, and quality documentation of LCA data. Printed by ENEA. ISBN 88-8286-110-4
- Wenzel, H.; Hauschild M.Z.; and Alting, L. (1997). Environmental assessment of products. Vol. 1 - Methodology, tools and case studies in product development, 544 pp. Chapman & Hall, United Kingdom, Kluwer Academic Publishers, Hingham, MA. USA. ISBN 0 412 80800 5.

European Commission

EUR 24384 EN – Joint Research Centre – Institute for Environment and Sustainability

Title: International Reference Life Cycle Data System (ILCD) Handbook - Nomenclature and other conventions.

Author(s): -

Luxembourg: Publications Office of the European Union

2010 – 48 pp. –21.0 x 29.7 cm

EUR – Scientific and Technical Research series – ISSN 1018-5593

ISBN 978-92-79-15861-2

doi:10.2788/96557

Cite as: European Commission - Joint Research Centre - Institute for Environment and Sustainability: International Reference Life Cycle Data System (ILCD) Handbook - Nomenclature and other conventions. First edition 2010. EUR 24384 EN. Luxembourg. Publications Office of the European Union; 2010.

Abstract

Life Cycle Thinking (LCT) and Life Cycle Assessment (LCA) are the scientific approaches behind modern environmental policies and business decision support related to Sustainable Consumption and Production (SCP). The International Reference Life Cycle Data System (ILCD) provides a common basis for consistent, robust and quality-assured life cycle data and studies. Such data and studies support coherent SCP instruments, such as Ecolabelling, Ecodesign, Carbon footprinting, and Green Public Procurement. This document guides the naming and classification of the various basic elements of Life Cycle Assessment, such as for example flows and units. It supports the development of Life Cycle Inventory data sets and Life Cycle Assessment studies for being ILCD-compliant regarding their nomenclature. The principal target audience for this provisions document is the experienced LCA practitioner and reviewer.

How to obtain EU publications

Our priced publications are available from EU Bookshop (http://bookshop.europa.eu), where you can place an order with the sales agent of your choice.

The Publications Office has a worldwide network of sales agents. You can obtain their contact details by sending a fax to (352) 29 29-42758.

The mission of the JRC is to provide customer-driven scientific and technical support for the conception, development, implementation and monitoring of EU policies. As a service of the European Commission, the JRC functions as a reference centre of science and technology for the Union. Close to the policy-making process, it serves the common interest of the Member States, while being independent of special interests, whether private or national.

LB-NA-24384-EN-C

EUROPEAN COMMISSION

Publications Office

ISBN 978-92-79-15861-2