International Reference Life Cycle Data System (ILCD):

Nomenclature and other conventions for Flows, Flow properties, and Units, as well as for Processes, Contacts, and Sources

Draft

Disclaimer: This is a draft that will undergo further consultation which may result in significant changes of the document. As soon as a next version becomes available it supersedes this version.

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Sources and Acknowledgements

Based on and considering the following documents:

- JRC: Internal draft document on "Nomenclature and structure" for the ELCD core data base, 30th April 2007, further developing the document: "UNEP/SETAC Life Cycle Initiative, Life Cycle Inventory programme, Task Force 2, chapter 4"; Draft version by IVAM, Amsterdam and IKP, Stuttgart. Plus input / comments to authors by Anna Braune, Raul Carlson, Harry van Ewijk, Mark Goedkoop, Rolf Frischknecht, Bart Krutwagen, Greg Norris, Marc-Andree Wolf
- ISO/TS 14048:2002 Environmental management - Life cycle assessment - Data documentation format
- 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.
- Existing documents and elementary flow lists of the following software and database providers that made such available to the JRC or which could be identified and accessed online:
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  - Chalmers: Manual for LCA@CPM, 2005 (http://www.globalspine.com)
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  - Ecobilan: DEAM™ methodical handbook, 2005 (http://www.ecobilan.com/uk_deam.php)
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  - KCL EcoData: KCL, 2005 (www.kcl.fi)
  - PE International: GaBi handbook and GaBi modelling principles, 2006 (www.gabi-software.com)
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  - EDIP97 & EDIP2003 impact methods (www.ipl.dtu.dk),
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- Methodological handbooks and LCI data sets of industry associations:
  - European Database for Corrugated Board Life Cycle Studies, December 2003 (FEFCO, Groupement Ondulé, European Containerboard Organisation - see www.fefco.org)
  - Final Methodology Report of the International Iron and Steel Institute (IISI - www.iisi.org)
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- IUPAC Nomenclature (www.iupac.org; compiled at http://www.chem.qmul.ac.uk/iupac)
- CAS registry (http://www.cas.org)

With contributions from:

- **Participants of the closed Advisory Group and cooperation partner WS on "ELCD reference elementary flows and nomenclature" held on 23 May 2007 in Porto, Portugal**: Clare Broadbent (EUROFER Association), Armando Caldeira-Pires (UnB - University of Brasilia and Brazilian National Life Cycle Database Project), Gil Anderi da Silva (USP - University of Sao Paulo, Brazil), Christian Bauer (Forschungszentrum Karlsruhe and coordinator Network Life Cycle Data Germany), Anna Braune (LBP, Universität Stuttgart, Germany), Carla Castanho (UnB - University of Brasilia and Brazilian National Life Cycle Database Project), Andreas Ciroth (GreenDeltaTC GmbH, Germany), Angeline de Beaufort (FEFCO Association), Cássia Ugaya (UTFPR and Brazilian National Life Cycle Database Project), Jorge Fernandes (UnB - University of Brasilia and Brazilian National Life Cycle Database Project), Michele Galatola (European Commission, DG RTD, Brussels), Olivier Jolliet (University of Michigan, USA), Johannes Kreißig (PE International GmbH, Germany), Celina Lamb (IBICT, Brazilian Ministry for Science and Technology and Brazilian National Life Cycle Database Project), Christian Leroy (EAA - European Aluminium Association), Manuele Margni (Ecointesys GmbH and CIRAIG, Canada), Paolo Masoni (ENEA, Italy), Jan Poulsen (FORCE Technology and Danish LCA Center), Liselotte Schebek (Forschungszentrum Karlsruhe and coordinator Network Life Cycle Data Germany), Alessandra Zamagni (ENEA, Italy).
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- **European Commission, JRC, staff of the European Platform on LCA:** Raffaella Bersani, Kirana Chomkhamsri, Rana Pant, David Pennington, Ugo Pretato, Marc-Andree Wolf.

Contents

1 Summary list of mandatory and recommended nomenclature and conventions

The purpose of this nomenclature and further conventions document is to serve as guidance for Life Cycle Inventory data collection, documentation and use in LCA studies. It is intended to be one component of the International Reference Life Cycle Data System (ILCD) and part of the documentation requirements of the ILCD technical guidance handbook on LCA.

Presently, LCA practice in different LCA working groups differ considerably in nomenclature and other conventions. In consequence, LCI data and LCA reports are incompatible on different levels, what strongly limits an efficient, electronic data exchange as well as the clear understanding of reports and data set documentation as well as an efficient review.

The nomenclature and other conventions are subdivided into **"Mandatory"** and **"Recommended"** ones**:**

For ILCD-compliant data sets exclusively the "mandatory" rules are formally required to be thoroughly applied, while the "recommended" rules are made to improve data set documentation and identification and ease data exchange. For in-house use it should be ensured that any deviating nomenclature, classifications etc. can be 1:1 mapped to the ones recommended here in order to be able to create AND import ILCD-compliant data sets without errors or loss of relevant information or the need for manual adjustments.

Please note that methodological issues such as how to inventory renewable resources, sum parameters, etc. are not dealt with in this document, but will be addressed in the main guidance document of the ILCD Handbook. Nomenclature issues on the level of technical LCA terms and in relation to the ILCD reference format are analogously dealt with in the respective documents.

The rules are numbered by chapter number plus additional letters.

3.2.1a: Mandatory (categories and classification by receiving / providing environmental compartment;

- **Resources - Resources from ground**
- **Resources - Resources from water**
- **Resources - Resources from air**
- **Resources – Resources from biosphere**
- **Land use - Land occupation**
- **Land use - Land transformation**
- **Emissions – Emissions to air - Emissions to air, unspecified**
- **Emissions – Emissions to air - Emissions to urban air close to ground**
- **Emissions – Emissions to air - Emissions to air, unspecified (long-term)**
- **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**
- **Other elementary flows**

Note: long-term emissions = occurring over 100 years in future – in practice exclusively from waste deposits.

3.2.1b: Recommended, methodological convention:

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.

3.2.1c: Mandatory, methodological convention:

Emissions to saltwater bodies that are not or only very limitedly connected to the open ocean, such as e.g. the Baltic sea, the Black sea, and the Mediterranean sea etc. should be inventoried as emissions to freshwater, to better reflect the prevalent dilution situation.

3.2.2a: Mandatory on use of inventorying elementary flows in further sub-classes of the providing / receiving environmental compartment:

Further differentiated receiving / providing environmental compartments are presently not supported below the compartments defined more above, as resulting Process data sets would be incompatible with ILCD-compliant data sets and recommended LCIA methods and factors. The use of further sub-compartments is hence discouraged for the time being, unless ILCD-reviewed consistent LCIA factors would be provided in for these elementary flows.

3.2.3.1a: Recommended additional, non-identifying classification of resource elementary flows (for use as sub-classification for the "Resources from ground" top class (example flows in brackets):

- **"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 upper 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. "Geothermal energy", etc.)
- **"Resources from ground, unspecified"** (for resource elementary flows from ground that do not fit into any of the other categories)

3.2.3.1b: Recommended additional, non-identifying classification of resource elementary flows (for use as sub-classification for the "Resources from water" top class (example flows in brackets):

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

3.2.3.1c: Recommended additional, non-identifying classification of resource elementary flows (for use as sub-classification for the "Resources from air" top class (example flows in brackets):

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

Old 3.2.3.4a: content integrated within 3.2.1a

3.2.3.1d: Recommended additional, non-identifying classification of resource elementary flows (for use as sub-classification for the "Resources from biosphere" top class (example flows in brackets):

- **"Renewable genetic resources (species)"** (for extraction/hunting of wild species e.g. "Mahagony wood (Tectona grandis), without bark; standing; primary forest")
- **"Renewable material resources (biomass)"** (e.g. "Round soft wood; 50% H2O")
- **"Renewable energy resources (biomass)"** (e.g. "Wood biomass; 50% H2O, 7.2 MJ/kg")
- **"Resources from biosphere, unspecified"** (for resource elementary flows from biosphere that do not fit into any of the other categories)

3.2.3.2a: Recommended as independent, non-identifying classification of emissions elementary flows (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.)

3.3a: Recommended top-level classification of Product flows and for Waste flows:

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

3.3b: Recommended second level classifications of Product flows and Waste flows (grouped along the top-level classification as defined above):

"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 energy 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 recovery"**
- **"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"**
- **"Wholesale and retail"**
- **"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"**

4.2a: Recommended pattern for flow names; examples and details see chapter 4.2:

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

4.3a: Mandatory nomenclature for elementary flows, recommended for product flows (examples in brackets, in some cases compared to the former SETAC WG recommendation) Please note that related LCI methodological issues are not addressed here but will be dealt with in the LCI work chapter of the upcoming LCA handbook:

- **Substances are given a capital first letter (unless preceded by a number as for many organic compounds).** (E.g. "Benzene", but "1,2,3-trichloro-benzene".)
- **Isotopes of elements (e.g. used for radioactive substances) are given in the IUPAC name plus the isotope number added at the end with a hyphen** (e.g. "Radon-220").
- **Particles are 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 should be named according to the commonly used trivial names as also supported by IUPAC** (e.g. “Calcium carbonate” better than the name derived from the SETAC WG rule, which results in “Carbonic acid, calcium salt”).
- **Other simple chemicals should be named according to the commonly used trivial names** (e.g. "Methane", "Sulphuric acid", "Acetone", etc.).
- **Pesticides should be named by their commonly used trivial wherever possible. Brand names should only be used 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 upper calorific value", of course).
- **The attributes of flows "to" for emissions and "in" for resources 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 should not be doubled in the flow name.**
- **The “…, ion” variants of metal emissions should 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 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 “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 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 should always be unambiguous** (e.g. better “Ferrous chloride” or “Iron II chloride” instead of the formerly 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 upcoming "reference elementary flows" of the ILCD system. The use of the corresponding reference elementary flow data sets is mandatory for ILCD-compliant data sets with newly required elementary flows to be named applying the above scheme.**

4.4a: Recommended nomenclature for 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 4.2. Other information such as represented country/region or year is not part of the flow name but 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, at 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".)

4.5a: Recommended nomenclature for processes:

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

5.1a: Recommended classification of 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 2000, private consumer prices", etc.)
“Other flow properties”

5.1b: Recommended 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”

5.2a: Rules for assigning flow properties and units to flows. Mandatory for elementary flows, recommended for product and waste flows, first criterion:

All flows that possess a mass, are measured in the flow property “Mass”, as long as none of the below rules requires to use a different flow property.
The unit group for mass is “Units of mass” with the reference unit “kg”.

5.2b: Rules for assigning flow properties and units to flows. Mandatory for elementary flows, second criterion:

Elementary flows, for which the energy content is the most relevant unit, are measured in the flow property "Upper calorific value".
The unit group for the upper calorific value is "Units of energy" with the reference unit "MJ".
! This does also cover all energy resource elementary flows. Fuel product flows, in contrast, are typically measured in mass (e.g. diesel, hard coal, etc.) or normal volume (e.g. natural gas) or they are measured in "Net calorific value" with the unit "MJ").

5.2c: Rules for assigning flow properties and units to flows. Mandatory for elementary flows, recommended for product and waste flows as referenced in the respective rule below, 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 frequency" with the reference unit "kBq", i.e. Kilo-Bequerel.

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 distance" 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".

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*lenght" 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 secondary 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).

5.3a: Mandatory nomenclature and methodological recommendation for new 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.).

6a Recommended classification for contact data sets

"Group of organisations, project"
"Organisations"

"Private companies"
"Governmental organisations"
"Non-governmental organisations"
"Other organisations"
"Working groups within organisations"
"Persons"
"Other"

7a Recommended classification for source data sets:

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

2 Introduction

2.1 Relationship to other documents and files

This document stands in context of the following documents and files, which will all subsequently be integrated and made accessible via a common web-entry point:

- **ILCD multi-language terminology for LCA, i.e. professional terms in LCA with definitions, synonyms etc. (under development)**
- **ILCD technical guidance handbooks on LCA (under development)**
- **ILCD special guidance handbook for LCIA method and factor development (under development)**
- **ILCD review frame and schemes for LCA work (under development)**
- **ILCD reference format (under development)**
- **Documents and files of the former ELCD 1.0.1 format:**
    - **A developer package of the former ELCD 1.0.1 format is accessible at http://lca.jrc.ec.europa.eu/lcainfohub/developerPage.vm. This package includes further useful documents, sample data sets, and the license conditions.**
    - **ELCD data set types structure: separate MS PowerPoint file illustrating the object-oriented structure of the format; can be accessed at http://lca.jrc.ec.europa.eu/EPLCA/Doc/ELCD-Format_data_set_types_1_0_1.ppt.**
    - **Background document on initial requirements on a common reference format and how this is reflected in existing formats. Extract, see http://lca.jrc.ec.europa.eu/EPLCA/Doc/ELCDformat_TechnicalBackgroundReport2007-03-27_FormatNeeds_ExistingFormats.pdf.**

2.2 Purpose

Different LCA data formats as well as LCA practice in different LCA working groups differ considerably in nomenclature and other conventions. In consequence, LCI data and LCA reports are incompatible on different levels, what strongly limits an

efficient, electronic data exchange as well as the clear understanding of reports, data set documentation and their review.

The purpose of this nomenclature and further conventions is hence to serve as guidance document for Life Cycle Inventory data collection, documentation and use in LCA studies as well as for identifying a reference elementary flow list for use in both LCI and LCIA work.

It is foreseen to be used ILCD-compliant data sets in support of efficient LCA work and for data exchange among different LCA tools and databases.

Goal is to guide data collection 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
- supports an efficient data exchange among practitioners also with different database and software systems, thereby reducing errors

The suggested nomenclature and other conventions will furthermore:

- reflect all relevant needs of LCI practitioners and LCIA method developers as well as reviewers and final users of LCA information
- reflect certain method issues of inventory work, that will be found in the LCI work chapter of the LCA handbook
- be open for relevant new findings and developments in LCI and LCIA

This nomenclature and other conventions focus on flows, flow properties and the related units, but extend to suggestions for the naming of process data sets, for better compatibility among different software systems.

2.3 Approach

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

- **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 "accepted" or at least known and 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-specific names.
- **Simple rules with few exceptions:** A generally applicable naming pattern 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 considered wherever available to prevent mismatching.
  - The nomenclature and other conventions are foreseen for use in ILCD-compliant data sets and will hence also be applied when developing the upcoming reference elementary flow data sets. These data sets will hence strongly ease the use of the nomenclature, by allowing having a complete set of thousands of elementary flows and related flow properties and units ready for use in electronic form for import into LCA software tools. (Recommended LCIA methods and factors will subsequently be provided as ILCD-compliant LCIA method data sets in link to the reference elementary flows.) It is foreseen to maintain and expand this initial list and data sets, which is due by end of 2008, in the coming years as a service to all LCA practitioners.
- **Compatibility with different modelling approaches:** 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.
- **Flexible, but guiding classification according to receiving/providing environmental compartment:** 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. This is implemented here by a classification that should be mandatory on the top category, but can be more flexible on sub-category levels as different approaches are widely in use on those levels. For most proprietary formats, the class (e.g. “Emissions to air”) is part of the flow identifying information, as no UUID-type object identifiers are widely used yet; this has to be considered. Practically, the degree of specification has to reflect both aspects of a technically feasible measurement of the flow values in LCI work and common LCIA practice. Other aspects especially relevant here are the database manageability and error traceability. A further differentiation of receiving or providing environmental media, by geographical area (e.g. country), of flow speciation, environmental conditions etc., is not recommended here for the time being. Such should be revisited again the next years in view of

the development and recommendation of respective further differentiated LCIA methods and factors as well as applicability and acceptance in LCI practice. The ILCD system is intended to further work on these issues.

- **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 top category and user extendable; sub-categories are suggested but equally only as "recommendation", allowing for full flexibility also reflecting the technical limitations of some existing LCA software tools.
  - The names of product and waste flows as well as for unit processes / LCI results should equally have a recommended nomenclature 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."* Implicit the choice for English as a main language for exchange of data is made. At the same time this expresses the need to equally support 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 one 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.

2.4 "Mandatory" and "recommended" rules

The nomenclature and other conventions are subdivided into **"Mandatory"** and **"Recommended"** ones**.** For the former, any deviating use would very likely render data exchange incompatible or laborious and/or result in frequent 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 are guidance only, allowing for more flexibility in individually cases. To consequently apply this guidance nevertheless improves compatibility and work flow in data exchange and reporting and hence saves time and costs.

For ILCD-compliant data sets exclusively the "mandatory" rules are required to be thoroughly applied while the “recommended” ones are recommended.

Please note that the following nomenclature rules partly stand in relationship to methodological recommendations on LCI and LCIA work (e.g. "How to inventory renewable resource flows?"). These method recommendations are developed separately in an on-going effort and will equally be put out for consultation later. Based on the decisions in that work, the nomenclature may need some subsequent modifications.

3 Classification of flows

3.1 Preceding remarks

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 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). Note that for structuring database contents in LCA software applications both can be used, depending on intended users and preference of the software provider.

Next to the complementary classifications suggested below, also a specific recommendation is given for their combined use for structuring the elementary flow data sets in the database. It could be argued, that there is no need to select certain classifications and define their foreseen use for the database structure. In practice this is however seen beneficial for various reasons: Tables and graphics as well as appendices in LCA reports - that typically use the database hierarchies for structuring - will be easier readable and comparable both for final users but also for reviewers although being developed in different tools/databases. Also to learning use a different LCA software, e.g. when changing job, will be easier if a common structure is used for the database content.

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 (while hundreds or thousands of objects in database)
- Unbalanced classification/structure (e.g. resulting in hierarchies with 1 to 5 objects but at the same time others 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).
- Classification/structure not oriented to state-of-the-art of LCI practice and/or LCIA methods (either outdated or referring to research-level methods without proven robustness and applicability in LCI practice in industry)
- Inappropriate or ambiguous structure (e.g. largely overlapping or flows).
- Especially for product and waste flows a make-type ("from which industry or process type does the substance come"), a use-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 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 background LCI databases would best follow a substance-type classification.

Therefore the recommended hierarchical classifications and recommendation for use in structuring a general database, as here, 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, while exchanging data and reporting in 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 scan. 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 closely orient to these considerations:

3.2 Classification of elementary flows

The main classification 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. indispensable.

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

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

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

The smallest denominator for the top-level elementary flow classification 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 default option “Water” and “Soil” should still be provided, given inventory data availability.

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

Regarding the naming rules for the classes and sub-classes it is important to make sure that together with the flow names the identification especially of elementary flows is unique: for these the class+sub-class(es) is part of the identifying information. For this reason the "resource" and "emission" aspect of at least either the class or the sub-class 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 class/sub-class(es) 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 class 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 classes 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 limiting errors, since characterisation factors of most existing methods refer to this specification of the environment.

3.2.1a: Mandatory (categories and classification 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**
- **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 freshwater (groundwater and surface 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 classification 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. i.e. very few elementary flows will have to be put into that class, avoiding thereby to unnecessarily blowing up the number of flow data sets.

"Emissions to indoor air" may need to be considered separately

The outcome of the ongoing work on recommended LCIA methods and factors will consider the above towards the required definitions and when and how to expand the classification.

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.

3.2.1b: Recommended:

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.

Also, some seas such as the Baltic sea and the Black sea face other impact situations than the open ocean due to a much more limited dilution and hence accumulation of immissions in these water bodies:

3.2.1c: Mandatory:

Emissions to saltwater bodies that are not or only very limitedly connected to the open ocean, such as e.g. the Baltic sea, the Black sea, and the Mediterranean sea etc. should be inventoried as emissions to freshwater, to better reflect the prevalent dilution situation.

Soil:

Direct emissions to 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 input into soil that leaves it to groundwater or air should be modelled as such, while not as emission to soil.

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).

3.2.2 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 would it 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 recommended for the time being, but a clear need for research and development is highlighted:

3.2.2a: Mandatory:

Further differentiated receiving / providing environmental compartments are presently not supported below the compartments defined more above, as resulting Process data sets would be incompatible with ILCD-compliant data sets and recommended LCIA methods and factors. The

use of further sub-compartments is hence discouraged for the time being, unless ILCD- reviewed consistent LCIA factors would be provided for to these elementary flows.

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 some 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 where a resource is entering the technosphere (e.g. "Crude oil from Lybia"). In use by some database developers.

The two further differentiations as named above are independent from each other. Both have certain advantages and disadvantages. Among the here dominating disadvantages the lacking or limited availability of related LCIA factors, the lack of accordingly differentiated LCI data, and the strongly growing lists of elementary flows 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 in the ILCD system. Also a differentiation into further environmental sub-compartments can be done be defining own hierarchical classifications; this is technically supported. Please note, that the resulting elementary flow data sets would not be compatible with the ones of the ILCD system.

Further joint LCI and LCIA expertise is required to develop an appropriate and practical solution for this issue. The ongoing work on recommended LCIA methods and factors of the ILCD system will contribute to this but substantial further research needs to be started soon.

3.2.3 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. This is here introduced as separate classification, as it has no relevance for the impact assessment and as it is of completely different nature than is

the classification by receiving / providing environmental compartment. This substance-type classification is suggested to be used as sub-classifications for the before listed first level classification according to receiving / providing environmental compartments.

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" class, the one for emissions for each of the "Emissions to ..." classes.

3.2.3.1 Substance-type based classification for resources

The following classification is suggested for resource flows.

3.2.3.1a: Recommended additional, non-identifying classification for "Resources from ground" elementary flows (example flows in brackets):

- **"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 upper 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.)
- • **"Resources from ground, unspecified"** (for 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 "elementary" 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 than by other classification schemes.

3.2.3.1b: Recommended additional, non-identifying classification of resource elementary flows (for use as sub-classification for the "Resources from water" top class (example flows in brackets)**:**

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

3.2.3.1c: Recommended additional, non-identifying classification of resource elementary flows (for use as sub-classification for the "Resources from air" top class (example flows in brackets)**:**

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

Old 3.2.3.4a: content integrated within 3.2.1a

3.2.3.1d: Recommended additional, non-identifying classification of resource elementary flows (for use as sub-classification for the "Resources from biosphere" top class (example flows in brackets):

- **"Renewable genetic resources (species)"** (for extraction/hunting of wild species e.g. "Mahagony wood (Tectona grandis), without bark; standing; primary forest")
- **"Renewable material resources (biomass)"** (e.g. "Round soft wood; 50% H2O")
- **"Renewable energy resources (biomass)"** (e.g. "Wood biomass; 50% H2O, 7.2 MJ/kg")
- **"Resources from biosphere, unspecified"** (for other resource elementary flows from biosphere that do not fit into any of the other categories)

3.2.3.2 Substance-type based classification for emissions

The following classification is suggested for emissions:

3.2.3.2a: Recommended as independent, 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.)

While the structure keeps to a certain degree the SETAC 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 not 100% overlap-free, what however appears justified from a general practicality perspective.

3.3 Hierarchical classification of product flows and waste flows

In order to support an effective and efficient data exchange, some basic guidelines on the classification of product flows are helpful, while flexibility should be given to users and database developers to use an own structure.

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

The smallest denominator on the first level classification are the following groups, which are to be used by "recommendation" in the ILCD reference format, but are not mandatory. In consequence, the list of entries for this "Top-category of flow" for product flows is user-extendable and can also be replaced by the user with a newly defined list, still providing ILCD-compliant data sets:

3.3a: Recommended top-level classification for Product flows and for Waste flows:

- **"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 list for a proposal for a second level classification of product flows has been defined and is suggested to be used for general data exchange in the ILCD Data Network, 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".

3.3b: Recommended second level classifications for Product flows and Waste flows (grouped along the top-level classification as defined above):

“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 energy 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 recovery"**
- **"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"**
- **"Wholesale and retail"**
- **"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" "**

4 Nomenclature for Flows and for Processes

4.1 Nomenclature - existing shortcomings

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

- 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, should be appropriate, of course.)
- Outdated naming (e.g. "Niob" instead of "Niobium")

On basis of the knowledge of the above shortcomings, the following considerations were made. 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:

4.2 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 ECD reference format this is done in dedicated format fields.

General rules:

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

- the entries among the four separate name component fields are separated by ";"
- the entries within the same name component field are listed separated by ","; within the entries of the various name component fields the ";" should be avoided
- abbreviations should be avoided, unless these are very widely in use and complement the long name (e.g. PP for Polypropylene --> "Polypropylene, PP") or element signs (e.g. Fe for Iron) while these only for use in the "Quantitative flow properties" field to indicate concentrations
- brackets are to be avoided

“Base name”:

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" is required, e.g. for energetic raw materials such as "Hard coal; 32.7 MJ/kg upper calorific value". Recommendations for land use flows will depend on related upcoming LCIA recommendations.

“Treatment, standards, routes”:

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 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".

“Mix type and location type”:

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. "at 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”.

“Quantitative flow properties”:

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 a 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 upper 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.

4.2a: Recommended naming pattern; examples and details see chapter 4.2:

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

4.3 Naming of Elementary flows

As a starting point towards an accepted naming scheme for elementary flows it is proposed to use the nomenclature rules as described in the SETAC WG on Data Availability and Quality, chapter 2, section “Nomenclature rules: Avoidance of synonyms”: 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 of the Code of Life-Cycle Inventory Practice 2003)

Based on experience gained with this nomenclature rules and the flow lists in use within the past 6 years, some shortcomings were 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 several elementary flows of metals is unclear in the SETAC WG document, 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-way (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, for the following reasons: In industry LCA practice and in most LCA groups the "old" IUPAC recommendations prevail. Also, for many substances several wordings are possible, i.e. 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.

A number of other issues that were addressed in the SETAC WG 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 will be dealt with in the LCI chapter of the upcoming LCA handbook that will also undergo a stakeholder consultation.

4.3a: Mandatory nomenclature, and resulting reference elementary flows (examples in brackets, in some cases compared to the former SETAC recommendation)**:**

- **Substances are given a capital first letter (unless preceded by a number as for many organic compounds).** (E.g. "Benzene", but "1,2,3-trichloro-benzene".)

- **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 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 should be named according to the commonly used trivial names as also supported by IUPAC** (e.g. “Calcium carbonate” better than the name derived from the SETAC WG rule, which results in “Carbonic acid, calcium salt”).
- **Other simple chemicals should be named according to the commonly used trivial names** (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 upper 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 should not be doubled in the flow name.**
- **The “…, ion” variants of metal emissions should 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 should 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 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 should always 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 upcoming "reference elementary flow data sets" that are mandatorily to be used for ILCD-compliant data sets, with any newly required elementary flows to be named applying the above scheme.**

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.

4.4 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 Process or LCI result data sets, while product flows (and often also waste flows) will be defined individually anyway. Nevertheless, to ease LCA work and communication and compatibility of data sets, recommendations for naming product flows are given here; they are also required very practically to name the product flows in the ILCD Data Network to ease identification of data sets. 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 4.2) with one basic name and three additional fields gives sufficient room 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 unnecessary 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.

4.4a: Recommended:

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 4.2. Other information such as represented country/region or year is not part of the flow name but 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, at 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.

4.5 Naming of processes

While this document addresses by its title "exclusively" flows, flow properties and units, for practicality reasons the related nomenclature will automatically cover 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.

4.5a: Recommended:

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

Geographical and 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 the 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).

5 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" ones (e.g. temperature, pressure, etc.). For calculating and analysing LCI results only extensive properties are of interest (e.g. the upper 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.

5.1 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:

5.1a: Recommended 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 2000, 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 as these are of a different quality and need a quite different and more comprehensive documentation than e.g. technical flow properties.

5.1b: Recommended classification for 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”

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.

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).

For the same reason no "LCIA method unit group class" (for LCIA method data sets) is required, as this will be equally expressed e.g. in kg (i.e. "kg" "CO2-equivalents" for the LCIA method "Climate Change Potential"). Please note that "Impact unit groups" are exclusively required for "LCIA method data sets", i.e. have no connection with "Flow properties".)

5.2 Names for Flow properties, Unit groups and Units and 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 for the ILCD Data Network.

(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:

5.2a: Mandatory for elementary flows, recommended for product and waste flows, first criterion:

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

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

5.2b: Mandatory for elementary flows, second criteria:

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

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

! This does also cover all energy resource elementary flows. Fuel product flows, in contrast, are typically measured in mass (e.g. diesel, hard coal, etc.) or normal volume (e.g. natural gas) or they are measured in "Net calorific value" with the unit "MJ").

Further explanations and discussion:

The reasoning for measuring energy resource elementary flows such as crude oil in upper calorific value, 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; this will also be addressed in more detail in the method chapter on LCI work of the upcoming LCA handbook.

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 upper calorific content values but can be converted to biogas with a seemingly positive energy balance, "creating" energy (or more exactly: upper calorific value). At the same time does the property exergy also work well for all other energy carriers. Difficulties would arise (to some degree) when collecting inventory numbers, as very often only the net or the upper 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 during the development of the methodology recommendations at the JRC.

5.2c: Mandatory for elementary flows, recommended for product and waste flows as referenced in the respective rule below, 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 frequency" with the reference unit "kBq", i.e. Kilo-Bequerel.

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 distance" 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*lenght" 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 secondary 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. among 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 will be made available by the European Platform on LCA.

5.3 Nomenclature for new Flow properties, Unit groups and Units

5.3a: Mandatory:

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.).

6 Classification of Contacts

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

6a Recommended classification for contact data sets:

"Group of organisations, project"

"Organisations"

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

"Working groups within organisations"

"Persons"

"Other"

7 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".]

7a Recommended classification for 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 webbrowser, via the ILCD webdisplay-stylesheet that converts the xml files to html.