Modelling requirements on LCI models under the Environmental footprint for interoperable data exchange via the eILCD format

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1. Introduction

The goal of this document is to outline the modelling requirements in the eILCD format in the Environmental Footprint (EF) context, to enable fully interoperable exchange of LCI/EF models (with priority for partially aggregated datasets) across widely used LCA software. Compliance to ILCD-EL or EF compliance requirements[1] is a pre-requisite, therefore it will not be further addressed in this document.

This paper builds on an analysis of the different requirements[2], together with common and unique features, of some of the most widely used LCA software systems and databases that have joined the open Data Working Group on a voluntary basis:

- GaBi
- openLCA
- RangeLCA
- SimaPro
- Umberto
- Yukan platform
- ecoinvent database[3].

More specifically, this document built on the identification of common features, which can be supported by the majority of the software systems mentioned above. Understanding common and individual unique features in the different software tools helped to derive a modelling guideline which aims to ease the exchange of models[4] from one LCA software tool to another and to identify the modelling aspects that are allowed/not allowed in the eILCD format.

In chapter 2 guidelines are defined and they shall be followed to deliver EF-compliant datasets and models in eILCD format. In this chapter, modelling approaches that cannot be represented in the eILCD format are also listed and described.

2. Conventions and modelling specifications

In this section, conventions and modelling specifications are defined and they shall be followed to

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[1] https://eplca.jrc.ec.europa.eu/LCDN/developerEF.xhtml

[2] The Interface Paper was prepared by Andreas Ciroth (GreenDelta) and Sebastian Schulz (Thinkstep/Sphera) in the context of the remodeling project of the EF pilot phase.

[3] the ecoinvent Association contributed with feedback to both the software and the data provider side based on their experience in data management, database interaction and integration into software tools, and based on the experience in the use of internal software tools

[4] With the word "models" it is also meant simplified models, such as EF-compliant datasets disaggregated at level-1.

deliver EF-compliant datasets and models in eILCD format.

2.1. Parameters:

This aspect is cross-cutting with ILCD specifications: parameters are used within a process, but specific settings can be specified in the *lifecyclemodel* dataset (a.k.a. eILCD dataset).

If parameters are used in the model:

- Parameters which refer to other parameters outside of a process dataset[5] (e.g. global parameters, project parameters, parameters in other software or external databases etc.) are not allowed.

- The following syntax of equations in the parameter section is permissible[6]:

    o Parameter names may be up to 15 characters long.

    o Parameter names shall only contain alphabetic characters, digits, underscores and dashes (no spaces or other special characters are allowed).

    o Parameter names shall begin with an alphabetic character, not a digit or special character (e.g. names like "2parameters" are not allowed).

    o Formulas with standard mathematical operations like addition, subtraction, multiplication, division. Allowed operators are:
        - +
        - -
        - *
        - /
        - ^
        - >
        - <
        - =
        - >=
        - <=
        - IF(boolean expr)
        - OR(boolean expr)
        - AND(boolean expr)
        - NOT(boolean expr)
        - POW(base, exponent)

    o Parentheses ( ) are allowed

    o A formula must not be longer than 255 characters.

    o In formulas, references to other parameters or variables are allowed, unless they result in circular references or a division by zero

2.2. Naming convention for processes and life cycle stages

Life Cycle Stages (LCS) are specified in the field *<groupDeclarations>* in the *lifecyclemodel* dataset. LCS declaration is an optional element.

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[5] i.e. parameters which are using other parameters not belonging to the same process dataset.

[6] This aspect should be defined at ILCD format level (parameters are defined at process level (in ILCD format), while the *lifecyclemodel* of the eILCD format only provides values for those parameters)

If they are declared, the life cycle stages shall follow the naming conventions specified in the JRC technical report (Zampori, Pant, 2019), unless they are specified in a different way in a PEFCR/OEFSR. The list of default life cycle stages is:

- Raw material acquisition and pre-processing;

- Manufacturing (production of the main product);

- Distribution (product distribution and storage);

- Use stage;

- End of life (including product recovery or recycling).

If justified, life cycle stages may be split or added. The justification shall be included in the documentation.

2.3. Modelling processes and linking

When defining processes, the below points shall be followed:

- Processes shall contain a defined amount for each flow independent of accumulation/storage/time.

- Processes shall contain the same flow only once per input or output side (e.g. NOT having the same electricity flow or resource flow multiple times on the input side). One exchange for multiple connections shall not be used[7]. Option C in Figure 1 is the only one allowed in eILCD.
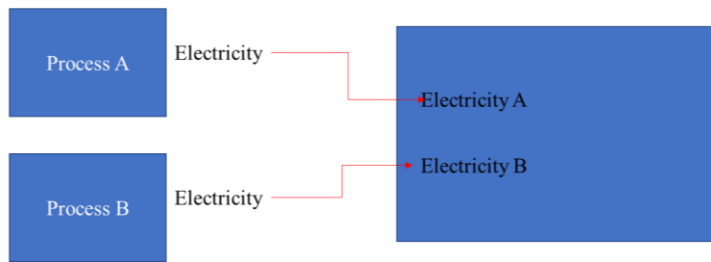
Figure 1

Option A) – Not Allowed
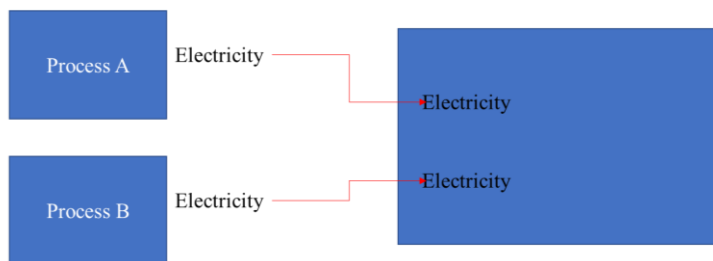
Option B) – Not allowed
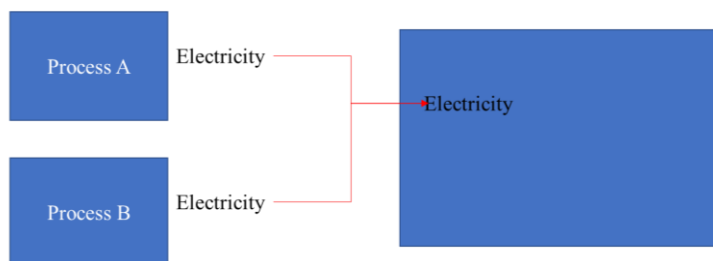
Option C) – Allowed

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[7] The reference flow of the *ReferenceToReferenceProcess* shall remain unlinked, to avoid that the flow is linked twice, in the situation that the dataset is used for further linking in an EF model. This provision may be revised after the EF transition phase.

- Linking processes through product flows with different UUIDs shall be limited to unavoidable situations, for example where both product flows (of the connection) have been already defined in existing EF-compliant datasets.

  Non-exhaustive list of situations:

    o linking existing EF-compliant dataset to another existing EF-compliant dataset: existing product flows shall be used, even if they are different,

    o linking existing EF-compliant dataset to newly created EF-compliant dataset: use the product flows of the existing EF-compliant dataset also in the newly created one,

    o linking two newly created EF-compliant datasets: the same product flow in both 'ends' of the connection shall be used.

  Intermediate/Conversion processes may be used to avoid linking of product flows with different UUID.

- When creating an eILCD model of a PEF study, the use of a newly created dataset multiple times in the model with different parameter values is not allowed. When the default parameter value of the newly created dataset cannot be used, a new EF-compliant dataset shall be generated. This provision does not apply to level-1 disaggregated datasets.

2.4. Model

Transferring very complex LCI models from one LCA software tool to another might be challenging. Because of this it might make sense to consider modelling only as complex as necessary:

- Scenario modelling (i.e. having one LCI model with several different scenario parameter constellations) shall be avoided.

- In every system it shall be clear which process delivers the quantitative reference (typically the reference flow, sometimes also used as functional unit). This process is the one specified in the field *ReferenceToReferenceProcess*.

- The system shall be scaled to the amount and unit of the reference flow.

2.5. Documentation

The whole system needs to be documented. Requirements:

- The metadata information shall be stored in the process identified as the one delivering the quantitative reference (*ReferenceToReferenceProcess*)

- Reference shall be made to the aggregated version of the dataset, using the field *referenceToResultingProcess*.The aggregated version of the dataset shall be stored in the "processes" folder.

- The metadata of the corresponding aggregated version of the dataset shall be copied to the

corresponding fields in the process identified as *ReferenceToReferenceProcess*.

In the case of more complex EF models, such as the Representative Products (RP) and Representative Organisations (RO), as a minimum, the documentation of the reference product/organisation under assessment shall be provided. Additional information would be an additional value but not mandatory. The more elaborate explanation (modelling choices, assumptions, etc.) of how the model is built should be part of the report that accompanies the model.

- The LCIA results shall be reported in the LCIA results section of the process identified in the field *ReferenceToReferenceProcess*, for all the EF impact categories at the end of the XML structure. The LCIA results shall match the ones of the corresponding aggregated version.