

Guide to interpret

**the EU PRODUCT ENVIRONMENTAL FOOTPRINT (PEF) GUIDE published
April 9th 2013 as annex II to the Commission Recommendation on the use
of common methods to measure and communicate the life cycle
environmental performance of products and organisations**

15th April 2013

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Introduction

While the PEF Guide intends to provide a “harmonised European methodology” and “to provide detailed and comprehensive technical guidance on how to conduct a PEF study” it contains requirements that may be difficult to interpret for LCA practitioners. This guide is our contribution to clarify the context and meaning of some of the requirements that may otherwise cause problems.

In general, a normal consequential LCA performed according to ISO 14040/44/49 will fulfil the requirements of the PEF guideline. However, some specific points to be aware of are outlined in this guide:

1. Definition of the functional unit
2. Primary data collection requirement for foreground processes
3. The definition and separate reporting of carbon flows according to source
4. Direct and indirect land use change
5. Carbon offset
6. Dataset quality assessment
7. Co-product handling and recycling
8. Impact assessment categories and methods
9. Report structure
10. Reviewer qualifications

1. Definition of the functional unit

The PEF Guide requires the functional unit (called the “unit of analysis”) to be defined according to the following aspects:

- The function(s)/service(s) provided: “what”;
- The extent of the function or service: “how much”;
- The expected level of quality: “how well”;
- The duration/life time of the product: “how long”;
- as well as a NACE Rev. 2 code, minimum 2 digits.

It should be noted that this may not be sufficient for the functional unit to fulfil the requirements of ISO 14044, clause 4.2.3.7 for comparative studies that “the scope of the study shall be defined in such a way that the systems can be compared. Systems shall be compared using the same functional unit”. The comparability requirement implies that the functional unit shall reflect the substitutability of the product on its market, where the product has a functional specification that the customer requires to be fulfilled. A procedure for unambiguous definition of functional units according to the requirement that the functional unit shall express the obligatory product properties on the market segment where the product is sold was arrived at in the Danish methodology consensus-project (Weidema et al. 2004). This procedure has also been adopted by the ecoinvent database (Weidema et al. 2013) and we recommend it for complementing the PEF requirements.

2. Primary data collection requirement for foreground processes

The PEF Guide requires collecting primary data (called “specific data”) from the activities where access to such data is available. These activities are called “foreground processes” as opposed to “background processes”, i.e. activities where no such direct access is possible. This primary data collection requirement is additional to the requirements in the ISO 14040 series. The distinction between foreground and background activities does not appear to have any other practical consequences, although it is required for interpretation of the definition of indirect land use change, see Section 4 below.

3. The definition and separate reporting of carbon flows according to source

The PEF Guide requires inputs and outputs of biogenic carbon sources to be kept separate in the life cycle inventory (“Resource Use and Emissions Profile”). In Annex VI of the PEF Guide, biogenic emissions are described as including “those resulting from the burning (combustion) or degradation of biogenic materials, wastewater treatment and biological sources in soil and water (including CO₂, CH₄ and N₂O), while biogenic removals correspond to the uptake of CO₂ during photosynthesis. Non-biogenic emissions correspond to all emissions resulting from non-biogenic sources, such as fossil-based materials, while non-biogenic removals correspond to the CO₂ that is removed from atmosphere by a non-biogenic source.” From this description it can be deduced that capture of “Carbon dioxide, in air” by carbonation of non-biogenic materials (e.g. in soil or products) is to be calculated as non-biogenic. This is different from the way capture of “Carbon dioxide, in air” is treated in the ecoinvent database (see Weidema et al. 2013), where all such capture is calculated in the same way, i.e. as non-fossil carbon. This implies that when calculating PEFs using the ecoinvent database, and other databases that use the same definitions, such non-biogenic capture of “Carbon dioxide, in air” and its later release shall be re-classified from “non-fossil” to “fossil”.

In Annex VI of the PEF Guide, it is stated that for food and feed, it is allowed to exclude emissions arising from biogenic sources that become part of the product intended for ingestion. Since such exclusions can lead to carbon imbalance in the analysed systems, and thus cannot be scientifically justified, we recommend to refrain from such exclusions, but to be aware that such exclusions can occur in other PEF study results.

4. Direct and indirect land use change

The PEF Guide describes “Indirect Land Use Change” (ILUC) to occur “when a certain change in land use induces changes outside the system boundaries” and that greenhouse gas emissions “that occur as a result of indirect land use change shall not be considered.” It should be obvious that what is outside the system boundaries should never be considered. However, Figure 6 in Annex VI of the PEF Guide shows that what is meant by ILUC is indeed changes *within* the product system, namely those land use changes that are an indirect effect of the land use of (i.e. upstream to) the foreground processes. Thus, the PEF Guide requires the exclusion of all land use change effects, except for activities in the foreground system (i.e. not upstream) where carbon emissions from direct land use changes shall be included, see the following paragraph:

The PEF Guide requires that “temporary (carbon) storage or delayed emissions shall not be considered in the calculation”. This means that all inputs and outputs are to be calculated without concern for their timing, and that future emissions of e.g. CO₂ will be calculated as counterweighing current uptake of CO₂ from the air, and vice versa. This implies that temporary carbon uptake in the soil in relation to direct land use change shall not be included. Thus, for direct land use change, only carbon *emissions* from natural sources shall be accounted for.

The PEF Guide requires that greenhouse gas emissions that occur as a result of direct land use change “shall be allocated to products for 20 years after the land use change occurs”. It is obvious that there will be little incentive to use the PEF Guide for products grown on lands recently converted from other land uses (i.e. converted within the last 20 years), and due to the complications in calculating the correct emissions, we would generally advise against such use of the PEF Guide. It also follows from the above that the prevention of land use change is better pursued with other means than product policies.

5. Carbon offset

The PEF Guide defined offsets as “discrete greenhouse gas (GHG) reductions used to compensate for (i.e., offset) GHG emissions elsewhere, for example to meet a voluntary or mandatory GHG target or cap.” The PEF Guide requires that offsets shall not be included in the PEF study. Compared to an LCA according to ISO 14040, which requires all significant activities to be included, datasets representing such offsets shall therefore be removed before calculating the life cycle inventory (called the “Resource Use and Emissions Profile” in the PEF Guide). However, it is allowed to report this information separately as “Additional Environmental Information.”

6. Dataset quality assessment

The PEF Guide requires the application of a semi-quantitative data quality assessment using a score from 1 to 5 for each of six quality indicators. It is important to understand that this assessment is done at the level of unit process datasets, *not* at the level of individual datapoints (amounts of exchanges etc.), and thereby is completely different from the pedigree matrix approach used by e.g. the ecoinvent database.

The six quality indices can be scored identically for most datasets used in a normal LCA, as demonstrated here for the datasets from the ecoinvent database:

- The completeness indicator can normally be given a score 1 because datasets in the ecoinvent database are required to include all known exchanges. For datasets converted from previous versions of the ecoinvent database there may be explicit exclusions mentioned in the data fields “General information” or “Included processes End” and in such cases a lower score should be applied.
- The 3 indicators for technological representativeness, geographical representativeness, and time-related representativeness describe the correspondence between the dataset and what it is intended to represent. Since datasets in the ecoinvent database are adjusted to be

representative, either by adapting the individual datapoints or their uncertainty to the situation they are intended to represent, all 3 indicators can be given a score 1.

- The indicator for methodological appropriateness and consistency can be given a score 1, since all data in the ecoinvent database are reviewed against the same data quality guideline, which is in accordance with ISO 14044 and the ILCD Handbook.
- The indicator for parameter uncertainty is difficult to interpret, since uncertainty is normally assigned to datapoints and not to abstract entities such as datasets. The only way this indicator can be meaningfully interpreted is by assuming that the uncertainty is to be understood as the uncertainty of the overall environmental impact of the activity represented by the dataset, which requires an aggregation of the different impacts. Anyway, the requirement for a score 4 is a standard deviation of < 50%, which is unlikely to be achievable for most background datasets, so for this indicator a score 5 can be applied as a default.

The PEF Guide requires the six data quality indicator scores to be aggregated 1:1, i.e. by adding the six scores and divide by 6. Using the above default values this would result in an overall Data Quality Rating of $(1+1+1+1+1+5)/6 = 1.7$, which is called "Very good quality" and is well above the minimum requirements of the PEF Guide.

It should be clear from the above description that the PEF data quality rating at the dataset level should be seen as an additional requirement and not a replacement of the sensitivity analysis required by ISO 14044 to ensure that no significant data are excluded. We therefore recommend practitioners to continue their practice of calculating the overall uncertainty of the results by e.g. Monte Carlo simulation, applying uncertainty and data quality assessment at the level of individual datapoints, using both basic uncertainty and additional uncertainty via the pedigree matrix applied by the ecoinvent database, which also includes an indicator for reliability, both of which are very important for the overall uncertainty.

7. Co-product handling, recycling and linking of datasets

The PEF Guide requires that “wherever possible, subdivision or system expansion should be used to avoid allocation. Subdivision refers to disaggregating multifunctional processes or facilities to isolate the input flows directly associated with each process or facility output. System expansion refers to expanding the system by including additional functions related to the co-products.” System expansion is the ISO 14044/49 term for substitution. The description here thus corresponds to the normal consequential modelling, as described in ISO 14044/49 and the ILCD Handbook (EC 2010) as applicable for “goal situation B for meso/macro-level decision support” and recommended by the ecoinvent Centre for consequential LCA modelling.

Since allocation can always be avoided by subdivision or system expansion, as in the ecoinvent system model ‘Substitution, consequential, long-term’, the above requirement actually makes superfluous the more complicated options for

allocation described in the rest of the decision hierarchy of clause 5.10 of the PEF Guide, and especially the elaborate formula for recycling allocation provided in Annex V of the PEF Guide. That these options are at all described in the PEF Guide must stem from an uncertainty around whether allocation can indeed always be avoided by subdivision or system expansion, which was also the original background for adding the last option in the hierarchy of ISO 14044. However, that allocation can always be avoided was proven theoretically in Weidema (2001) and has now been practically implemented with the system model 'Substitution, consequential, long-term' of theecoinvent database.

System expansion is equally applicable to and possible for all cases of recycling, i.e. where the by-product needs to pass through a treatment (recycling) activity before being able to substitute a reference product of another activity. The preference of the PEF decision hierarchy for system expansion therefore means that also recycling situations shall always be treated by system expansion. Using system expansion only for some by-products and the procedure described in Annex V of the PEF Guide for situations of recycling would violate mass balances and create an inconsistency in the system models, and can therefore not be intended.

Although the PEF Guide does not prescribe any specific algorithm for linking datasets into product systems, i.e. how to determine the inputs to product markets, it is noteworthy that the references that were present in the drafts of the PEF Guide to the model for "goal situation A" of the ILCD Handbook (a system model mixing elements from attributional and consequential modelling, applying average inputs rather than marginal inputs to the markets) are no longer contained in the final PEF Guide. This supports our interpretation that the normal consequential model for linking datasets can be applied.

8. Impact assessment categories and methods

The PEF Guide requires the use of 14 specified impact categories and models. The PEF Guide describes normalisation as a recommended step and weighting as an optional step. We would advise against the use of normalisation, since it is difficult to present dimensionless normalised results in such a way that they are not misleading, implicitly leading to a 1:1 weighting of the normalised impact category results.

9. Report structure

The required elements of a PEF Report are the same as required by ISO 14044, but additionally these elements shall be structured in three parts: a Summary, the Main Report, and an Annex.

10. Reviewer qualifications

The scheme for self-declaration of the qualifications of the reviewers is an additional requirement compared to ISO 14040/44.

References

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