SP Technical Research Institute of Sweden

PART OF RISE

Uncertainty assessment in the Product Environmental Footprint (PEF) guide

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How can we get robust uncertainty estimations?

Agenda

- What contributes to uncertainty in results?
- PEF Pilot Guidance on uncertainty
- DQR
- Discussion

LCA methodologies choices contribute most to uncertainty in result

Baumann and Tillman (2004)

a) the definition of functional unit,

b) system boundaries and allocation procedure,

c) type of data used, and

d) impact assessment.

LCA methodologies choices contribute most to uncertainty in result

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a) the definition of functional unit,

b) system boundaries and allocation procedure,

c) type of data used, and

d) impact assessment.

Reap et al. (2008) expands the list by adding

e) social and economic impact,

f) alternative scenario considerations,

g) negligible contribution (“cutoff”) criteria,

h) technical, spatial and temporal variations,

i) weighting and valuation, and

j) uncertainty in the decision process.

As uncertainty stems from such numerous and various sources, it is important that all are acknowledged for <u>robust uncertainty estimations</u>.

Three types of uncertainty, Huijbregts et al. (2003).

- **Parameter uncertainty**: Uncertainty in data caused by imprecise estimates, assumptions or measurements
- **Scenario uncertainty**: Uncertainty caused by value choices
- **Model uncertainty**: Uncertainty in the models ability to represent the real world

Product Environmental Footprint Pilot Guidance

Guidance for the implementation of the EU Product Environmental Footprint (PEF) during the Environmental Footprint (EF) pilot phase.

Version 5.2 – feb 2016

Environmental Footprint – compliant dataset

List of technical requirements to be fulfilled by datasets to be recognised as EF compliant

- Documentation
- Nomenclature
- Review
- Other methodological requirements
- Data quality criteria and scores

F.1.4 Other methodological requirements

The following methodological requirements shall be fulfilled in order to classify a life cycle inventory dataset as PEF-compliant:

Cut off: a cut-off rule of 95% based on material or energy flow or the level of environmental significance.

Handling multi-functional processes: (1) subdivision or system expansion; (2) allocation based on a relevant underlying physical relationship (substitution may apply here); (3) allocation based on some other relationship.

Direct land use change: GHG emissions from direct LUC allocated to good/service for 20 years after the LUC occurs, with IPCC default values.

Carbon storage and delayed emissions: credits associated with temporary (carbon) storage or delayed emissions shall not be considered in the calculation of the EF for the default impact categories.

Emissions off-setting: not to be included

Capital goods (including infrastructures) and their End of life: they shall be included unless they can be excluded base on the 95% cut-off rule. The eventual exclusion has to be clearly documented.

System boundaries: system boundaries shall include all processes linked to the product supply chain (e.g. maintenance).

Fossil and biogenic carbon emissions and removals:
Time period: emissions and removals shall be calculated as if released or removed at the beginning of the assessment method (no time discount is allowed).

GHG emissions – fossil
These flows account for greenhouse gas emissions to any media originating from the oxidation and/or reduction of fossil fuels by means of their transformation or degradation.
Carbon emissions and uptakes – biogenic
This indicator covers carbon emissions to air from the oxidation and/or reduction of biomass by means of its transformation or degradation and CO_2 uptake from the atmosphere through photosynthesis during biomass growth. The CO_2 uptake by a native forest is excluded and not modelled.
Carbon emissions – land use and transformation
These flows account for the carbon uptakes and emissions originating from carbon stock changes caused by direct land use change and soil carbon uptake (accumulation) and emissions through land management. Carbon exchanges from deforestation, road construction or other soil activities shall be included. The CO_2 uptake by a native forest is excluded and not modelled.

Environmental Footprint – compliant dataset

List of technical requirements to be fulfilled by datasets to be recognised as EF compliant

- Documentation
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- Data quality criteria and scores

Dataset Needs Matrix (DNM)

<table>
<tr><th></th><th></th><th>Most relevant process</th><th>Other process</th></tr>
<tr><td rowspan="2">Situation 1: process run by the company applying the PEFCR</td><td>Option 1</td><td>Provide company-specific data (as requested in the PEFCR) and create a company specific dataset partially disaggregated at least at level 1[1] (DQR ≤1.6).</td><td>Provide company-specific data (as requested in the PEFCR) and create a company specific dataset partially disaggregated at least at level 1[54] (DQR ≤1.6).</td></tr>
<tr><td>Option 2</td><td></td><td>Use default secondary dataset, in aggregated form (DQR ≤3.0)</td></tr>
<tr><td rowspan="2">Situation 2: process not run by the company applying the PEFCR but with access to (company-)specific information</td><td>Option 1</td><td>Provide company-specific data (as requested in the PEFCR) and create a company specific dataset partially disaggregated at least at level 1[57] (DQR ≤1.6).</td><td rowspan="3">Use default secondary dataset, in aggregated form (DQR ≤4.0)</td></tr>
<tr><td>Option 2</td><td>Starting from the default secondary dataset provided in the PEFCR, use company-specific activity data for transport (distance), and substitute the sub-processes used for electricity mix and transport with supply-chain specific PEF compliant datasets. The newly created dataset shall have a DQR ≤3.0.</td></tr>
<tr><td>Situation 3: process not run by the company applying the PEFCR and without access to (company)-specific information</td><td>Option 1</td><td>Use default secondary dataset, in aggregated form (DQR ≤3.0)</td></tr>
</table>

Data quality criteria and scores,

- The dataset quality shall be calculated based on the specific quality criteria.
- A semi-quantitative assessment of the overall data quality of the dataset shall be calculated summing up the achieved quality rating for each of the quality criteria, divided by the total number of criteria.
- The Data Quality Rating (DQR) result is used to identify the corresponding quality level.
- The semi-quantitative assessment of the overall data quality of the dataset requires the evaluation (and provision as metadata) of each single quality indicator.

Data Quality Criteria

1. Technological representativeness,
2. Geographical representativeness,
3. Time-related representativeness,
4. Completeness,
5. Parameter uncertainty, and
6. End-of Life Formula (Former Guidance, Methodological appropriateness and consistency)

The formula to re-calculate the Data Quality Rating (DQR) is:

$$\text{DQR} = \frac{TiR + TeR + GR + C + P + EoL}{6}$$

Data quality criteria:

TeR: Technological-Representativeness

TiR: Time-Representativeness

GR: Geographical-Representativeness

C: Completeness

P: Precision/uncertainty

EoL: End-of Life Formula

Quality level	Quality rating	C	TiR	P	TeR	GR	EoL
Very good	1	All 15 PEF Impact Categories	Data are not older than 4 years with respect to the release date or latest review date	≤ 10%	The technologies covered in the dataset are exactly the one(s)modelled	The processes included in the dataset are fully representative for the geography stated in the title and metadata	The EoL formula [2] is implemented in the entire dataset (foreground and all background processes)
Good	2	14 PEF Impact Categories (and all 10 categories classified I or II in ILCD are included)	Data are not older than 6 years with respect to the release date or latest review date	10% to 20%	The technologies modelled are included in the mix of technologies covered by the dataset	The processes included in the dataset are well representative for the geography stated in the title and metadata	The EoL formula [2] is implemented in foreground level-1 + level-2 disaggregated processes (see Figures E.2 and E.3)
Fair	3	12-13 PEF Impact Categories (and all 10 categories classified I or II in ILCD are included)	Data are not older than 8 years with respect to the release date or latest review date	20% to 30%	The technologies modelled are representative of the average technology used for similar processes	The processes included in the dataset are sufficiently representative for the geography stated in the title and metadata	The EoL formula [2] is implemented in foreground at level-1disaggregated processes (see Figure E.2)
Poor	4	10-11 PEF Impact Categories (and all those covered are classified I or II in ILCD)	Data are not older than 10 years with respect to the release date or latest review date	30% to 50%	Technology aspects are different from what described in the title and metadata	The processes included in the dataset are only partly representative for the geography stated in the title and metadata	The EoL formula [2] is not implemented, but all information and data needed to calculate all parameters in the EoL formula are available and transparently documented
Very poor	5	Less than 10 PEF Impact Categories (and all those covered are classified I or II in ILCD)	Data are older than 10 years with respect to the release date or latest review date	> 50%	Technology aspects are completely different from what described in the title and metadata	The processes included in the dataset are not representative for the geography stated in the title and metadata	The EoL formula [2] is not implemented

		Most relevant process	Other process
Situation 1: process run by the company applying the PEFCR	Option 1	Provide company-specific data (as requested in the PEFCR) and create a company specific dataset partially disaggregated at least at level 1[1] (DQR ≤1.6).	Provide company-specific data (as requested in the PEFCR) and create a company specific dataset partially disaggregated at least at level 1[54] (DQR ≤1.6).
	Option 2		Use default secondary dataset, in aggregated form (DQR ≤3.0)
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Three types of uncertainty, Huijbregts et al. (2003).

- **Parameter uncertainty**: Uncertainty in data caused by imprecise estimates, assumptions or measurements
- **Scenario uncertainty**: Uncertainty caused by value choices
- **Model uncertainty**: Uncertainty in the models ability to represent the real world

Parameter uncertainty: Uncertainty in data caused by imprecise estimates, assumptions or measurements

Data quality criteria DQR:

Technological representativeness,

Geographical representativeness,

Time-related representativeness,

Precision/uncertainty

Scenario uncertainty: Uncertainty caused by value choices

Uncertainty due to value choices (scenario uncertainty) has recently started to receive more attention (Hellweg & Milà I Canals 2014, Gregory et al. 2013, De Schryver et al. 2013, Lloyd &Ries 2007)

PEF Guidance

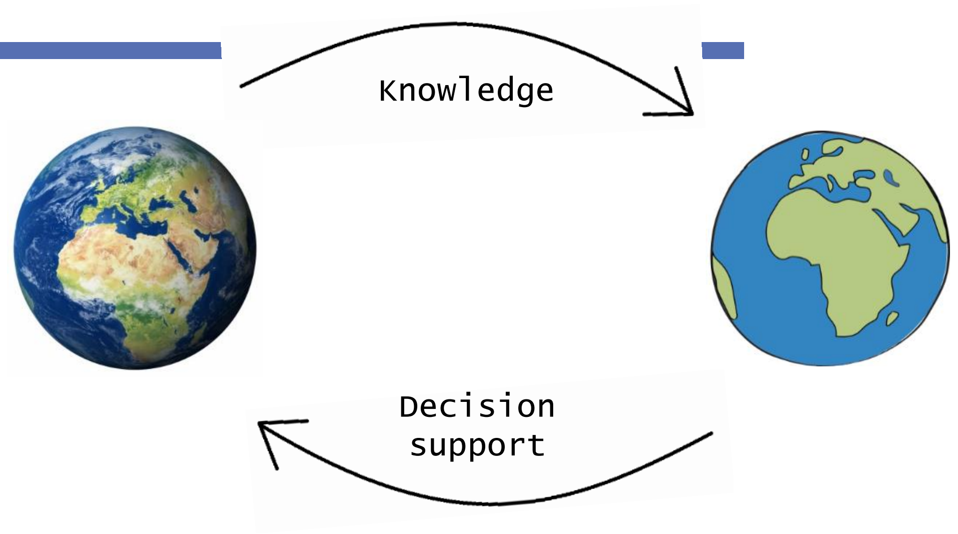
Other methodological requirements

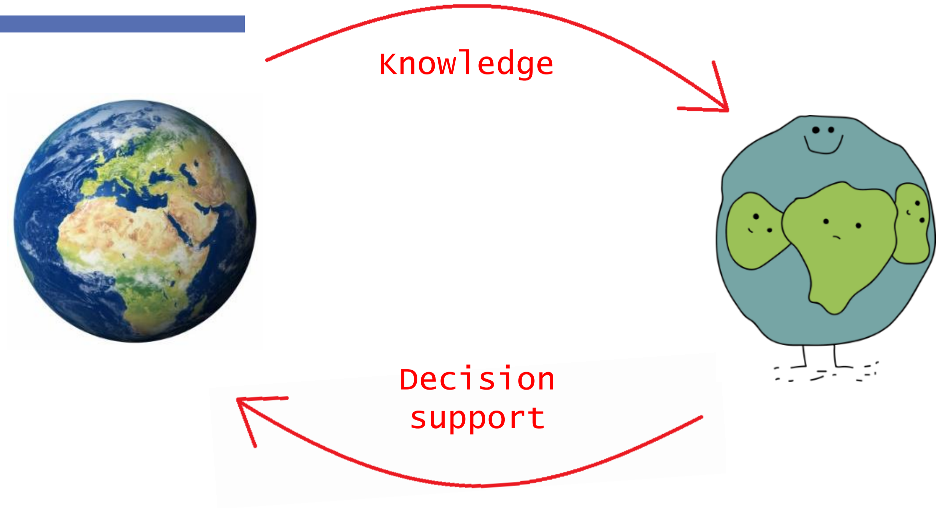
- Cut off
- Handling multi-functional processes
- Direct land use change
- Carbon storage and delayed emissions
- Emissions off-setting
- Capital goods (including infrastructures) and their End of life
- System boundaries
- Fossil and biogenic carbon emissions and removals

Model uncertainty: the models ability to represent the real world.

Data quality criteria DQR:

- Completeness (environmental impact categories)
- End-of Life Formula


Knowledge
Decision
support


Knowledge
Decision support

Discussion: Data Quality Criteria
1. Is any criteria missing?
2. Are each critera as important as the other one?

1. Technological representativeness,
2. Geographical representativeness,
3. Time-related representativeness,
4. Completeness,
5. Parameter uncertainty, and
6. End-of Life Formula (Former Guidance, Methodological appropriateness and consistency)

$$\text{DQR} = \frac{TiR + TeR + GR + C + P + EoL}{6}$$

Discussion: Other methodological requirements”?
1. Is something missing?
2. Can/should something from “Other methodological requirements” be included in DQR?

- Cut off
- Handling multi-functional processes
- Direct land use change
- Carbon storage and delayed emissions
- Emissions off-setting
- Capital goods (including infrastructures) and their End of life
- System boundaries
- Fossil and biogenic carbon emissions and removals

Discussion: Data gaps
1. Can data gaps be included in DQR?
2. How can data gaps be handled if not in DQR?

Data gap: absolute gap eg dataset or a relevant flow is missing

Data gap: qualitativ data gap eg dataset is available but its DQR is higher than the minimum requested.

Conclusions from discussion of Completeness

Can the metric Completeness be adressed in another way in the DQR template?

Suggestion: Step 1. Massbalance, Step 2. Substance check

Work procedure: The datagaps will be identified in the mass balance and substance check and be listed/notified in report.

Validation of the result of the DQR method. (The same data will be sent to 10 experts who will make the DQR for the data. This will be used for an iterative procedure/better version of the DQR).

Conclusions from discussion of SME´s usage of DQR

How can SME apply the DQR template? (A tool for SMEs is under development, helping SMEs to perform a PEF.)

Suggestion:

1. Develop a database with as good secondary data as possible.
2. Link the SME tool to a qulity check of the primary data.
3. Validation/External check of quality of the data.

Conclusions from discussion of accepted tolerance in uncertainty

What is the difference/tolerance in the uncertainty we can accept?

Suggestion: Parameter uncertainty: part of the solution is to work with the data quality.

Scenario uncertainty is not included today in the question above.

Model uncertainty is not included today in the question above.

What about the global uncertainty in case of aggregated score communication.
This is model uncertainty which is not included in PEF today.

Conclusions from the discussion of the DQR matrix (figure 17)

- To fill in the matrix is valuable
- The quality rating can give the impression that it is more scientific than it is.
- Each critera are not as important as the other one in the formula?

Conclusions from discussion of Primary data – Secondary data

- Primary data is inventored by the PEF practitioner together with the company.
- Secondary data is inventored by database suppliers. The data in the databases is used by many practitioners and is therefore spread widely. Therefore, it is very important that the databases consist of data with a low uncertainty.

Our recommendation to improve data is to put much effort in the database work.

Thank you for your attention!