

DATA QUALITY ASSESSMENT OF LCI DATASETS – A SYSTEMATIC APPROACH TO INTEGRATE DIFFERENT USER REQUIREMENTS

Kirsten Biemann (KIT), Marco Recchioni** (JRC), Fabrice Mathieux** (JRC).*

** Karlsruhe Institute of Technology, Institute for Technology Assessment and Systems Analysis; E-mail contact: Kirsten.Biemann@kit.edu*

*** Joint Research Centre, European Commission, Ispra (Italy)*

Keywords: data quality assessment, LCI, user requirements, systematic approach

ABSTRACT

The data quality of an LCI assesses whether different requirements are met taking into account the goal and scope. A systematic approach was developed that checks the data quality of a dataset against different user requirements. As an example this was applied to a data set from the European Reference Life Cycle Database [ELCD 3.0]. Here general requirements from the International Life Cycle Data System (ILCD) handbook and the Product Environmental Footprint (PEF) Guide were complemented by specific user needs. User requirements, data quality criteria and target states were defined. The actual state of the data was compared to the target and possible shortcomings were identified. From this a recommendation how to use or improve the dataset was deducted.

INTRODUCTION

Data quality is defined as “characteristics of data that relate to their ability to satisfy stated requirements” [ISO 14044]. Data quality assesses whether the following aspects are in line with the goal and scope: time-related, geographical and technology coverage, precision, completeness, consistency, reproducibility, sources of data and uncertainty. [ISO14044] Some data quality requirements (e.g. ILCD entry-level compliance, PEF guide quality criteria) have been developed recently in order to facilitate a coherent use of datasets and to ease quality improvements.

To be ILCD entry-level compliant, a dataset needs to follow ISO 14040/44 and to state data quality accordingly. Furthermore the nomenclature and documentation need to be in accordance to the ILCD format and a review must be done by a qualified reviewer for PEF and ILCD entry-level compliance. [ILCD] [PEF]

The PEF guide defines 6 data quality criteria to be rated from 1 (best) to 5: technological representativeness (TeR), geographical representativeness (GeR), time-related representativeness (TiR), completeness (C), precision/uncertainty (P) and methodological appropriateness and consistency (M).

The context-specific TeR, GR and TiR may be further defined in Product Environmental Footprint Category Rules (PFCR). C specifies the share of (elementary) flows that are included in the inventory. P measures the variability of the data values. M checks whether the modeling is PEF compliant. So far the only PCR in existence is for Intermediate Paper Products [PFCR] which was considered for this illustrative analysis.

Score	TeR	GR	TiR	C	P	M
1	Same process/ technology	Country specific	<3 years	>90%	≤ 10%	Fully compliant
2	Technology mix	EU 27 mix	3-5 years	80-90%	10-20%	Cradle to grave Multifunctionality according to ISO 14040/44 End of life modeling included
3		EU countries	5-10 years	70-80%	20-30%	2 out of 3
4	Similar products	Other countries	10-15 years	50-70%	30-50%	1 out of 3
5	Unknown	Global/ unknown	>15 years unknown	<50% unknown	> 50% unknown	none

Table 1: Illustrative example of PFCR quality requirements [PFCR]

In the PEF guide, the data quality rating (DQR) is calculated as follows [PEF]:

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

For PEF compliance a “good” DQR (≤ 3.0) covering at least 70% of the contributions to each environmental footprint impact category is needed. [PEF]

METHOD

Using qualitative criteria from different data quality assessment methods a systematic approach was developed that enables users to rate data quality according to their needs.

Definition of general requirements

First the envisaged application of the data set is defined. Compliance with ILCD entry-level or PEF requirements may be complemented by user specific quality requirements. By increasing the knowledge about the product or technology, critical aspects that are relevant for the environmental assessment are identified.

Data quality criteria and assessment

A set of indicators and their reference states is defined and the data set is analyzed. The actual states of the data quality are compared to the reference and shortcomings are reported.

Data quality discussion and recommendation

Data quality is discussed and a recommendation on whether to use or how to improve the dataset is given.

RESULTS

For illustration of the approach, the data quality of the ELCD 3.0 dataset “Steel hot dip galvanized (ILCD), production mix, at plant, blast furnace route, 1kg, typical thickness between 0.3 - 3 mm. typical width between 600 - 2100 mm” is rated against different user requirements. Quality requirements from PEF are assessed using the PFCR for intermediate paper products. Then two fictive applications are added: User 1 is an Italian company searching for a full ILCD entry-level compliant LCI on steel coils bought from different suppliers worldwide; User 2 is a German company doing a greenhouse gas footprint on steel coils. For the latter, PEF compliant data for German conditions (or gate to gate data from a similar area) is needed.

User	Criteria	Reference	Actual State	Room for improvement
PFCR	Time-related representativeness	< 3 years	2008	5 years (<i>TiR of 2</i>)
User 1 and 2		2013		5 years
PFCR	Geographical representativeness	Country specific	global	global (<i>GR of 5</i>)
User 1		global		-
User 2		Germany		Similar conditions
User 1	Technological representativeness	Clearly stated	Technology mix	-
PFCR and User 2		Same process/ technology		<i>Technology mix (TeR of 2)</i>

Table 2: Technological, geographical and time-related representativeness

User	Criteria	Reference (R)	Actual State	Room for improvement
PEF	System boundary	Cradle to grave (no cut-off) (incl. end of life modeling)	Cradle to gate	<i>Product flows as in- and outputs</i> <i>cut-off criteria used</i>
User 1		Cradle to gate (incl. end of life modeling)		<i>No end of life</i> <i>Product inflows</i>
User 2		Gate to gate		<i>Not gate to gate</i>
PEF	Multifunctionality	Dealing with multifunctionality according to ISO 14040/44	System expansion	-
User 2		Multioutput process		<i>No multioutput</i>

User	Criteria	Reference (R)	Actual State	Room for improvement
PEF User 1	Elementary flows	Emissions to water, air, ground Resources (material/energy)	Emissions to water, air and ground Resources (material/energy)	<i>Resources from ground are listed as output</i>
User 2		Greenhouse gases		-

Table 3: Methodological appropriateness and emission coverage

DISCUSSION

The example above shows that the data quality of an ILCD entry-level compliant dataset varies greatly depending on different user needs.

The dataset is well suited for user 1 except that the remaining product flows need to be accounted for. However the requirements from user 2 are not met. For the PEF DQR methodological appropriateness (M) is rated 3 since the dataset is cradle to gate and no end of life modeling is included. No data on precision (P) and completeness (C) is found resulting in a score of 5. With a DQR of 3.7 (taking into account the considered PFCR) the dataset seems to require a quality improvement. The development of more specific PFCR or the adoption of qualitative criteria for assessing P and C may however lead to a different result.

CONCLUSIONS

Since the data quality changes significantly for different uses in life cycle based assessments it can only be partly defined by the data providers. While uncertainty and completeness (P and C) can be rated at the dataset level, data on time, geography and technology as well as modeling approaches can be left to the user for rating. A good documentation is essential to enable a data quality assessment by the user. By applying product category rules default requirements for generic contexts can be provided but they cannot replace the need for each user to check whether the data is suitable for a specific context or not.

REFERENCES

- ILCD International Reference Life Cycle Data System (ILCD) Data Network: Compliance rules and entry-level requirements. European Union 2012
- ISO 14040/44 Environmental management- Life Cycle Assessment- Principles, frameworks and guidelines, 2006
- PEF Product Environmental Footprint Guide. European Commission 2013
- ELCD database European Life Cycle Database version 3.0 <http://elcd.jrc.ec.europa.eu/ELCD3/>
- PFCR Product Footprint Category Rules (PFCR) for Intermediate Paper Products. Final document of the paper PFCR pilot project 2011

Note: The views expressed in the article are personal and do not necessarily reflect an official position of the European Commission.