Spatial differentiation of LCI datasets: implication of new characterisation methods and necessity of a finer data collection to reduce LCIA results uncertainties

The example of EEE products

Etienne LEES-PERASSO[1], Julie ORGELET[1]

[1] Bureau Veritas CODDE, 170 rue de Chatagnon - ZI Centr'alp, 38430 Moirans, France

E-mail contact: etienne.lees-perasso@fr.bureauveritas.com

1. Introduction

The electric and electronic equipement (EEE) sector is a globalized market. Industries are spread worldwide, same products can be manufactured in various countries leading to different environmental impacts. Moreover, some newly developed characterisation methods, as mentionned in ILCD handbook [1] and used in the PEF initiative [2], include a spatial differentiation. Therefore, it is important to keep environmental data concerning EEE products up to date in order to reduce the LCIA results uncertainties.

Besides, that strong need of updating LCI datasets is facing the difficulty to access to data on new technologies. Indeed, the manufacturing processes are often trade secrets. The EEE sector also has a very complex supply chain, involving many factories from various countries making an overall vision difficult.

This presentation aims at qualifying and quantifying the uncertainties on LCIA results led by both the spatial differentiation of LCI datasets and of the characterisation methods, then determining what the improvement of LCI dataset and LCA data collection must be to achieve coherent LCA results and interpretations.

2. Identification of country-dependent variables

The LCA practitioners use LCI datasets to represent EEE manufacturing systems. They are usually developed from data collected in Europe where good quality data are available along the manufacturing process (growing of silicon columns, epitaxy, front-end, back-end, encapsulation). As the silicon component market is innovation-driven, the technologies used in all European countries are equivalent. Therefore, the country-dependent environmental aspects are limited. The main ones are listed in the table 1 below.

Country-dependent aspects	Modeling rules
Water source	Repartition surface water/groundwater source [4]
Energy mix	ELCD electricity LCI datasets [3]

Table 1: Country-dependent environmental aspects

3. Influence of spatial differentiation of characterisation methods

The introduction of two spatialy differentiated characterisation methods in the ILCD recommendations (namely acidification (A) and terrestrial eutrophication (TE)) leads to the display of more variation between countries: The figure 1 below shows how this differentiation modifies the LCIA results on a generic silicon semiconductor component for those two characterisation methods, based on the four main European producting countries: Germany, United Kingdom, France and Italy.

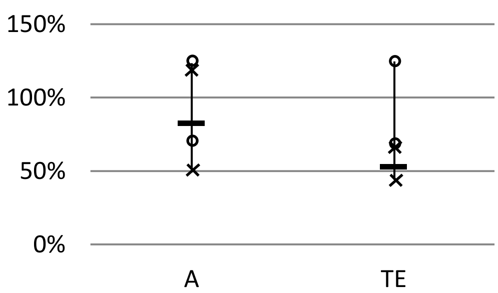

Figure 1: LCIA results variability, with and without characterisation method spatial differentiation

— : average of the 4 countries (100% is the average value of the 4 countries without spatial differentiation)

× : min and max, with spatial differentiation of the characterisation methods

○ : min and max, without spatial differentiation of the characterisation methods

4. Data collection limitations

The producers rarely know the localisation of the manufacturing sites along the production line of the product they use, except for their supplying site (i.e. the encapsulation manufacturing site country). As the encapsulation phase generates less impact than front-end or back-end phases, this limited vision leads to a low LCIA result uncertainty reduction, as shown in the figure 2 below. For this example, the encapsulation country is considered as being France.

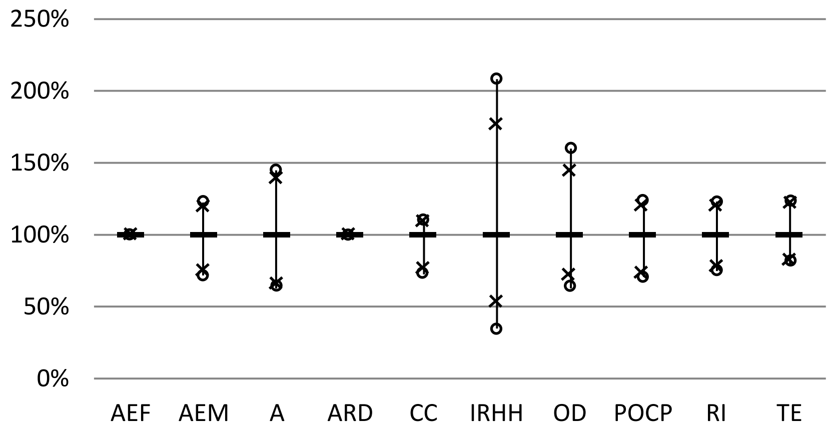

Figure 2: Reduction of LCIA results variability led by determining the encapsulation phase country

Legend: level I and II ILCD-recommended characterisation methods (AEF: aquatic eutrophication freshwater; AEM: aquatic eutrophication marine; A: acidification; ARD: abiotic resource depletion; CC: climate change; IRHH: ionizing radiation human health; OD: ozone depletion; POCP: photochemical ozone creation potential; RI: respiratory inorganics; TE: terrestrial eutrophication)

— : average of the 4 countries

× : min and max, encapsulation country defined

○ : min and max, encapsulation country not defined

5. Conclusions

Achieving a better geographical representativeness of EEE related LCI and LCA data collection is important to provide more reliable LCI datasets and LCA. The existing databases can provide spatialy differentiated LCI datasets, but this aspect is facing a lack of information from the manufacturers concerning the different places of production through the whole production chain, leading to high uncertainties in LCA results and hindering their interpretation.

A first step in improving the LCA results would be to define the most common country of each production step of a component. A market share study could lead to this information. The LCI dataset improvement would then be performed in order to evaluate the uncertainties reduction.

Finally, this article shows that the EEE sector has yet to be mature on the spatial differentiation problematics and improve his knowledge on the whole production chain of their products. Though the number of required data may be too high, therefore finding innovative solutions will be necessary to solve this aspect.

6. References

[1] European Commission and Joint Research Center, ILCD handbook - General guide for life cycle assessment - Detailed guidance. 2010
[2] European Commission, “European Product Environmental Footprint (PEF) program” 2013
[3] Directorate General Joint Research Centre JRC and European Commission, “European Reference Life Cycle Database (ELCD)” 2007
[4] FAO, “AQUASTAT database” Food and Agriculture Organization, Rome, Italy, 2009