Relevance of a French simplified LCI database using building products industry data

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Session: LCI data, validation, aggregation, uncertainties
In some Product Category Rules (PCR) defined to produce EPD according to ISO 14025, templates for reporting a reduced list of LCI flows can be provided e.g. RT Env. Declaration (Finland), INIES (France) etc.

In the French EPD (called FDES), this template, not compulsory but highly followed by the building industry, is included in the publicly EPD report available online.

### Objective of this study

Assess the relevance of such reduced list of LCI flows in a French LCI database using industry data

<table>
<thead>
<tr>
<th>Emissions to air</th>
<th>g/kg</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO₂</td>
<td>265</td>
</tr>
<tr>
<td>CO</td>
<td>0.233</td>
</tr>
<tr>
<td></td>
<td>0.195</td>
</tr>
<tr>
<td></td>
<td>0.975</td>
</tr>
<tr>
<td></td>
<td>0.753</td>
</tr>
<tr>
<td></td>
<td>4×10⁻³</td>
</tr>
<tr>
<td></td>
<td>52.5×10⁻³</td>
</tr>
<tr>
<td></td>
<td>0.55</td>
</tr>
<tr>
<td>Ti</td>
<td>19.3×10⁻³</td>
</tr>
<tr>
<td></td>
<td>62.5×10⁻³</td>
</tr>
</tbody>
</table>

Exemple of reporting on LCI flows in the RT Finnish EPD program
- Ecoinvent database (version 2.0)
- 113 LCA data on building materials and products collected as « complete cumulative LCI »
  - Bitumen, brick, cement, concrete, glass, gypsum plaster board, insulation products (e.g. wood, glass and rock wools)
  - Wooden products (e.g. glued laminated timber, particle board, sawn timber)
  - Paint, polycarbonate, polyurethane, polystyrene, PVC
  - Metals (e.g. aluminium, copper, steel, zinc) etc.
Classification rules based on a document (in addition to the PCR) provided by the French trade union of construction materials*

\[ I_{m,p} = \sum_{x=1}^{n} F_{x,p} \times C_{x,m} \]

**OPTIONS**

1. Removal of some elementary flows

2. Aggregation of some elementary flows

\[ \tilde{I}_{m,p} = \sum_{x=1}^{n-k} F_{x,p} \times C_{x,m} \]

\[ \tilde{I}_{m,p} = \sum_{x=1}^{n} F_{x,p} \times \bar{C}_{x,m} \]

\[ \varepsilon_{m,p} = \left| \frac{(\tilde{I}_{m,p} - I_{m,p})}{I_{m,p}} \right| < 5\% \]

Complete and simplified LCIA indicators

- Global Warming Potential (GWP)
  - Complete LCIA following [IPCC, 2007]
  - Simplified LCIA using
    - 3 elementary flows only, no aggregated flows

\[
\tilde{I}_{GWP,p} = F_{CO2,p} \times C_{CO2} + F_{CH4,p} \times C_{CH4} + F_{N2O,p} \times C_{N2O}
\]

- Photochemical Ozone Creation Potential (POCP)
  - Complete LCIA following [Derwendt et al, 1998] used in [CML, 2001]
  - Simplified LCIA using
    - 1 aggregated flow (hydrocarbons) and 4 other flows

\[
\tilde{I}_{POCP,p} = F_{Hydrocarb,p} \times \bar{C}_{Hydrocarb} + F_{CH4,p} \times C_{CH4} + F_{CO,p} \times C_{CO} + F_{SO2,p} \times C_{SO2}
\]


Complete and simplified LCIA indicators

- Photochemical Ozone Creation Potential (POCP)
  - Simplified LCIA
    - Statistical distribution of POCP factors for hydrocarbons

<table>
<thead>
<tr>
<th>POCP factors</th>
<th>Min</th>
<th>1st quartile</th>
<th>Median</th>
<th>Mean</th>
<th>3rd quartile</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>-0.09</td>
<td>0.24</td>
<td>0.41</td>
<td>0.49</td>
<td>0.66</td>
<td>1.38</td>
</tr>
</tbody>
</table>

- Disability Adjusted Life Loss Years (DALY)
  - Complete LCA according to [Goedkoop and Spriesma, 2000]
  - Simplified LCIA using
    - Aggregated flows: particles (PM2.5, PM10), PAH, chromium etc.
    - Non aggregated flows for the rest of the elementary flows

NB: All the assumptions for the elementary flows and characterization factors are available in the appendix of the article available on the website of the symposium

Global results (113 building materials)

Number of building materials’ simplified LCI data complying with the 5% cut-off of LCIA:
- GWP >95%
- POCP ~10%
- DALY ~25%
Detailed results (GWP), complete LCI/LCIA
Sample of 15 building materials

- CFC-14 / HFC-116
- HFC-134a / HFC-152a

Results from SimaPro version 7.2
Detailed results (POCP), complete LCI/LCIA
Sample of 15 building materials

The hydrocarbons as well as VOC are mainly responsible for the differences between complete and simplified LCIA

Results from SimaPro version 7.2
The particles ($<2.5\mu m$, $>2.5\mu m$ and $<10\mu m$) are mainly responsible for the differences between complete and simplified LCIA.

Results from SimaPro version 7.2
For 113 cradle-to-gate data of building materials (ecoinvent 2.0)

<table>
<thead>
<tr>
<th>Added elementary flow to the list</th>
<th>Accuracy of results compared to complete LCIA method *</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>GWP</strong></td>
</tr>
<tr>
<td>0</td>
<td>95%</td>
</tr>
<tr>
<td>2-4</td>
<td>100%</td>
</tr>
<tr>
<td>(CFC, HCFC)</td>
<td></td>
</tr>
<tr>
<td>50</td>
<td>100%</td>
</tr>
<tr>
<td>(Hydrocarbon)</td>
<td></td>
</tr>
</tbody>
</table>

*in terms of percentage of building materials’ LCI data complying with the 5% threshold for LCIA calculations
Conclusions and perspectives

- This study enabled to identify improvement potentials for reduced LCI data
- GWP, POCP and DALY were studied for cradle-to-gate LCI data of building materials integrated in a LCI database developed at CSTB
- Specific actions need to be taken into account to improve the accuracy of some selected LCI flows (e.g. VOC, hydrocarbons, particles) in the French LCI database using industry data
- New European standard for EPD (EN 15804) coming up…
  - French EPDs will be updated and the level of details of LCI will be improved (compliance with e.g. ILCD Handbook nomenclature of elementary flows)
  - Specific actions (e.g. differentiation of size of particles) may not be taken into account by the building industry as the EN 15804 standard does not require toxicity indicators
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THANK YOU VERY MUCH FOR YOUR ATTENTION

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