Tackling Recycling Aspects in EN15804: the Metal Case

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Should we allocate environmental value to secondary/recycled materials?
The 2 usual LCA methods for recycling

<table>
<thead>
<tr>
<th>« Recycled Content »</th>
<th>« End of Life recycling »</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cut-off rule applied on recycled materials exiting the system, i.e. no allocation rule</td>
<td>Allocation rule applied, i.e. as recommended by ISO and ILCD</td>
</tr>
<tr>
<td>Recycled materials are « free of environmental burdens/values »</td>
<td>Environmental benefits calculated on basis of the primary material savings resulting from the end of life recycling</td>
</tr>
<tr>
<td>Recycled content is the key indicator</td>
<td>EoL recycling rate is the key indicator</td>
</tr>
<tr>
<td>Recycling benefits given to the product using recycled materials</td>
<td>Recycling benefits given to the product providing recycled materials</td>
</tr>
<tr>
<td>Promote the consumption/use of recycled materials</td>
<td>Promote the production/preservation of recycled materials</td>
</tr>
<tr>
<td>Method 100:0</td>
<td>Method 0:100</td>
</tr>
</tbody>
</table>
Metal building products: the « Cradle to Cradle » life cycle

The high economic value of metal scrap is the main driver
Recycling of end-of life metal building products: an efficient business

- Aluminium
  - **Collection rates > 95% showed** by a TUDelft study
  - 9 demolition sites analysed in 6 EU countries
  - Large parts, such as windows, corrugated roof plates, curtain walls and exterior cladding plates collected and dismantled separately for direct remelting

- Steel
  - UK survey showed that 99% of steel section are collected as well as 92% of rebars

- High value of metal scrap is a key incentive and major economic impetus for recycling
- **A recycling rate of 90-95% is typically reached** for metal products used in buildings, e.g. aluminium window frame or steel section
Due to market growth, “scrap” is missing in spite of a high EoL recycling rate.
Example: Aluminium supply of the EU market


- Primary production
- Total recycling
- Net-imports
EN 15804: Modularity principle and recycling benefits

**MODULES A TO C**
(i.e. no allocation rule for recycling)

\[ \text{Module D} = \text{EoL} - \text{RC} \]
Module D principle: considering recycled materials on life cycle basis in accordance with ISO rules

Input flows from reuse/recycling or energy recovery (non-elementary flows)

Output flows for reuse/recycling or energy recovery (non-elementary flows)

Input of secondary products, material and fuels

Environmental aspects

Module D: Net environmental aspects from reuse/recycling and energy recovery (output minus input)

Building system boundary

- Product stage (Modules A1 to A3)
- Construction stage (Modules A4 to A5)
- Use stage (Modules B1 to B7)
- End of life stage (Modules C1 to C4)

Environmental aspects

Output of secondary products, material and fuels
Module D calculation for a metal product – Flows & system boundary

- System boundary (section 6.3.4.5 of EN15804)
  - After physical preparation (e.g. shredding and sorting), metal scrap usually satisfy the « end of waste » criteria
  - Scrap enter and exit the system boundary
  - Secondary material = sorted metal scrap

- Input and output flows
  - Metal scrap are used in the metal supply chain and are generated at the end of life
  - Calculation needs to address the net environmental aspects of scrap flow, i.e. outputs minus inputs
  - Provided the scrap at the input and output of product system have the same properties, the methodology can be applied to the net flow of scrap
Module D principle – simplification

Building system

Module D
Module D calculation for a metal product – substitution principle (section 6.4.3.3)

- **Point of functional equivalence**
  - For metal products, the point of functional equivalence is the ingot, i.e. where recycled metal substitutes primary metal

- **Net impacts calculation: « avoided impact » principle**
  - **Loads**: Recycling loads from « scrap up to ingot » including metal losses
  - **Benefits**: Primary metal substituted/saved by the recycled metal scrap enter and exit the system boundary
  - A correction factor should be applied if full substitution cannot take place
  - Results/indicators = Loads – Benefits

\[
\text{Loads} \quad \text{minus} \quad \text{Benefits} = \text{Module D}
\]
Case 1:
1 kg of Al product
Production (RC):
0.4 kg of recycled aluminium
EoL:
0.9 kg of recycled aluminium
Case 1: GHG calculation principle – Aluminium ingot production

<table>
<thead>
<tr>
<th>Type of production</th>
<th>GHG*</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Primary metal production up to ingot</td>
<td>9,7</td>
<td>kg CO2 equiv/kg metal ingot</td>
</tr>
<tr>
<td>Recycling (from end of life product up to ingot)</td>
<td>0,5</td>
<td>kg CO2 equiv/kg metal ingot</td>
</tr>
</tbody>
</table>

*Source: Environmental Profile Report for the European Aluminium Industry, EAA, April 2008

<table>
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<tr>
<th>Data related to the studied product</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ingot production</td>
</tr>
<tr>
<td>Metal supply from primary</td>
</tr>
<tr>
<td>Metal supply from recycling</td>
</tr>
<tr>
<td><strong>Total</strong></td>
</tr>
</tbody>
</table>
Extrusion
Ingot
Casting
Crushing / shredding
Sorting
Dismantling and collection
Use
Integration in building
System boundary
Exit the product system

GHG = 0.5
40%
GHG = 9.7
60%

GHG of the ingot production (module A1) = 6
# Case 1: Example of GHG calculation – Module D

## Data for the calculation

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<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>EoL recycling rate (considering all losses)</td>
<td>90%</td>
</tr>
<tr>
<td>Factor reflecting the ability of substitution</td>
<td>100%</td>
</tr>
<tr>
<td>% of recycled metal to be considered in module D</td>
<td>50%</td>
</tr>
</tbody>
</table>

\[ = 90\% \text{ (output) } - 40\% \text{ (input)} \]

Assuming the same properties for the scrap used at the input and output sides.

## Module D Calculation

<table>
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<th>GHG emissions</th>
<th>Comments</th>
</tr>
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<tbody>
<tr>
<td>Recycling burdens kg CO2-eq/kg ingot</td>
<td>0.25</td>
</tr>
<tr>
<td>Benefits from substitution kg CO2-eq/kg ingot</td>
<td>-4.85</td>
</tr>
<tr>
<td><strong>Total module D</strong> kg CO2-eq/kg ingot</td>
<td>-4.6</td>
</tr>
</tbody>
</table>

These additional benefits are calculated from the primary metal which is saved by 50% of additional recycling at EoL.
Module D = EoL - RC

GHG = -4.6

Environmental value of net flow of secondary material leaving the system

GHG for ingot production = 6
Case 1: Aluminium frame

Module A1

Module D

Not according to EN15804
Case 2: steel sections

Module A = mix production = 1,15 tCO2eq

Module D = (RR-RC) * Y * (Ev-Er) = (0,95-0,85) * 1,6 = 0,15 tCO2eq

GWP section = 1,15 - 0,15 = 1,00 tCO2eq

Source: worldsteel, European data, 2010

Ref: worldsteel data 2010
Conclusions

- Properly considering recycling aspects into LCA/EPD is crucial.
- Recycled content approach is surely not enough, especially for metal products.
- Hence, complementing the information through the Module D concept as used in EN15804 is essential for transparently reporting the full benefits of recycling, in a “cradle to grave” or “cradle to cradle” LCA as recommended by ISO or ILCD while avoiding any double crediting or counting issue.
- Ultimately, module D is intended to be used to promote:
  - design for reuse, recycling and recovery of all building materials, including metals.
  - sound end of life treatment strategies for all types of building products.
Thank you for your attention