Carbon Footprint Guidance Document

Position Paper

International Aluminium Institute

General

Increasingly suppliers of aluminium semis and finished products are faced with customer requests asking for the "Carbon Footprint" of the offered products in order to determine how far they contribute to climate change. In such a case, the sales of products showing a significantly higher Carbon Footprint than products from competing materials might be affected.

The Carbon Footprint of all products under consideration needs to be properly and consistently calculated, based on the rules of life cycle assessment (ISO 14044), as explained in the European Commission document "CARBON FOOTPRINT - what it is and how to measure it" (see http://lca.jrc.ec.europa.eu/Carbon_footprint.pdf).

For LCA practitioners please refer to the IAI Carbon Footprint Guidance Document: Position Paper – Technical Information" using the following link: www.world-aluminium.org/cache/fl0000165.pdf

The main pitfalls

Typically aluminium products compare favourably with products made from competing materials, but if basic rules of life cycle assessment are not respected, then they can be in a disadvantageous position. The following examples show the most common pitfalls:

Disregarding different mass

Products produced from different materials are often compared on the basis of the material mass. However, because of its high strength and low density, aluminium products are often significantly lighter than competing products. If the mass difference is not taken into account, then the aluminium products can be at a disadvantage.

EXAMPLE 1: Comparison on mass basis, disregarding the functional unit:

For a one-way glass bottle, the Carbon Footprint has been calculated as 0,94 kg CO_2e per kg. For the aluminium can, considering 50 % recycling rate, the Carbon Footprint has been calculated as 8,96 kg CO_2e per kg. It seems that the Carbon Footprint of the glass bottle is lower than the Carbon Footprint of the aluminium can.

But the glass bottle is 25 times heavier than the aluminium can of the same volume. Consideration of the functional unit, as required by ISO 14044 standard, means that the Carbon Footprint of 1 kg aluminium cans has to be compared with the Carbon Footprint of 25 kg of glass bottles. Then the 8,96 kg CO_2e for the aluminium cans must be compared with 23,5 kg CO_2e for the glass bottle.

Disregarding end-of-life recycling

All end-of-life operations, from the product after use to the recycled ingot, have to be considered, based on expected recycling rates. For recyclable products such as metals it is appropriate to apply the "cradle-to-cradle" approach. In this approach the starting point is the raw material in form of granules, powders or ingots, which is fabricated and manufactured into final products and then used and recycled back into the raw material. Typically, aluminium products are characterised by high end-of-life recycling rates which often makes a significant difference, especially when aluminium is compared with plastics or refractory materials.

The Carbon Footprint value calculated on a "cradle-to-gate" basis starts with the raw material in the form of bauxite and aluminium in discarded products, which are fabricated and manufactured into final products and then used. Then a product with a high recycled content gets the recycling credits and not the product with the high end-of-life recycling rate, which is not merited. For example buying an aluminium can with a high recycled content will not reduce the carbon footprint globally, since the scrap will only be taken away from another product, but recycling it after use will.

NOTE: The term "supply chain" which is often used in the literature instead of "life cycle" is misleading, as it invites to disregard recycling.

EXAMPLE 2: Comparison on a cradle-to-gate basis, disregarding recycling

The Carbon Footprint of an aluminium window frame with a mass of 20 kg has been calculated cradle-to-gate, with no recycled content assumed, as 20*(1,6+10,4) kg CO2e = 240 kgCO2e, from which 20*10,4 kg CO2e = 208 kgCO2e is related to the production of primary aluminium from bauxite and 20*1,6 kgCO2e = 32 kg CO2e is related to the production or the window frame from the ingot. This value is significantly higher than the Carbon Footprint values of window frames made of alternative materials.

However, when the typical recycling rate of a window frame of 94% is considered, then 94% of the 208 kg CO2e for the production of primary aluminium, i.e. 196 kgCO2e, are substituted, but 11 kg CO2e have to be added for the end-of-life operations. Taking all this into account, the real Carbon Footprint value of the aluminium window frame is 55 kg CO2e, i.e. 32 kg CO2e related to the production of the window frame from the ingot, 11 kg related to the recycling operations and 12 kg CO2e related to the substitution of the 6 % recycling loss. This value compares positively with the Carbon Footprint values of window frames made of alternative materials.

Disregarding the use stage

It is often difficult to determine the Carbon Footprint of the use stage, as it depends on a number of parameters. However, the inclusion of the use stage in the Carbon Footprint is crucial in order to allow fair comparison between different products. This is especially important for vehicles where the use stage represents more than 80% of total energy consumption.

Aluminium in vehicles is often compared with heavier materials. Disregarding the use stage means disregarding the greenhouse gas savings through light-weighting.

EXAMPLE 3: Comparison of bumper beams - aluminium and steel
(www.world-aluminium.org/cache/fl0000124.pdf)

An aluminium bumper beam with a mass of 3,9 kg is compared with a steel bumper beam of 7,0 kg. If only production and recycling - including substitution of primary material by recycled material - then the Carbon Footprint value of both alternatives are not significantly different (aluminium: 10,1 kg CO2e; steel 10,9 kg CO2e).

Including the Carbon Footprint of the use stage increases the Carbon Footprint values significantly: Now the Carbon Footprint of the aluminium bumper beam is 89 kg CO2e, compared with 167 kg CO2e for the steel alternative. The reason of this difference is the fuel savings by the lower mass of the aluminium bumper beam.

Special considerations for different market sectors

Automotive and mass transport sector

In comparative studies, the savings of energy through reduction in the weight of a vehicle have to be included, see IAI transport study and automotive model: www.world-aluminium.org/cache/fl0000124.pdf.

Building sector
The high durability and the end-of-life recycling rate of aluminium products in the building sector have to be included in the study. The advantages of aluminium products for specific building applications (e.g. electrical conductivity of cables, reflectivity for solar applications) have to be taken into account.

Packaging sector
In a comparative study, the functional unit (e.g. a can with a can of the same volume and not 1kg of cans with 1kg of cans) must be identical, especially the quantity of the product in the package, the expected life-time, the aroma conservation and the spoilage rate of the product in the package.
In the incineration process of packaging waste, energy is generated by the combustion of the aluminium foil, but, contrary to paper and plastics, no CO_2 is produced.
The positive impacts resulting from the transportation of the packaging material including the distribution of the packaged good and, the sealing properties (for conservation of product, avoidance of spoilage and tampering), have to be taken into account. Usually aluminium packaging systems have a lower mass than those from competing materials and provide a better protection for the packaged goods.