INTEGRATING THE RECYCLING POTENTIAL INTO THE ENVIRONMENTAL ASSESSMENT OF BUILDING MATERIALS

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Abstract

Building components are often assessed based on system boundaries from "cradle-to-gate". In this setting material recycling is commonly reflected by a supply mix blended with primary and secondary material. Being constant, this supply mix makes no difference between differing recycling potentials of individual construction parts. In a study, a Swiss eco-label was analysed and extended by a value corrected substitution, including recycling in the valuations scope. Only parts from aluminium were considered. The recycling potential of each individual aluminium part was determined and the system boundaries were expanded for value corrected substitution of primary materials. The resul ts indicate an improved rating for components with a high recycling potential. The method proved to be able to include recycling options into the focus of the assessment, giving an incentive for closing material cycles in the building industry.

Introduction

Often the inventories of building components use system boundaries from "cradle-to-gate", excluding the use and end-of-life phase (recycling). The recycling issue usually is covered with a generic share of secondary material in the supply mix. However, this approach does not discriminate against different recycling potentials of individual construction parts, discouraging material recycling in a comparative setting. The study Classen (2004) integrates the recycling potential of aluminium into a Swiss labelling system.

eco-devis

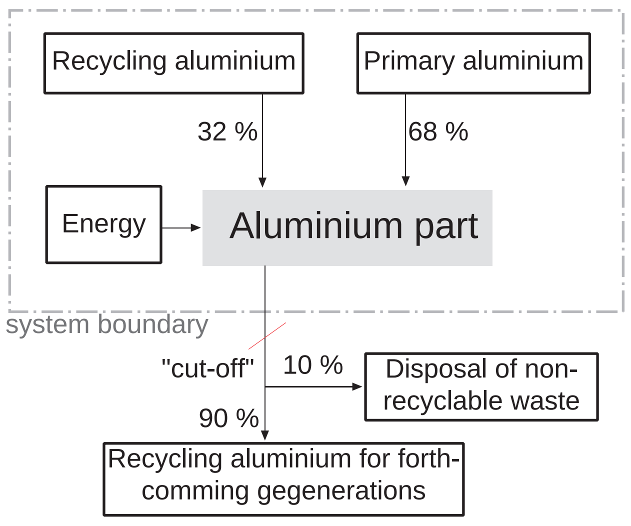
The Swiss labelling system eco-devis (Vogel et al. (2003)) rates construction materials based on different criteria, the most important being "Graue Energie", i.e. the sum of the Cumulative Energy Demand (CED) of non-renewable primary energy and hydropower. Within the construction parts covered in eco-devis, 68 are made from aluminium. The parts range from façade tiles to beads, some of them - like windows or doors - are made from multiple aluminium elements.

Recycling as Special Case of Allocation: "Cut-off" and "Value Corrected Substitution"

Aluminium production usually is modelled with generic supply mix and "cut-off"-approach. Individual recycling lies outside system boundary.

The material is regarded as a blend consisting of primary (virgin) and secondary (recycling) aluminium with a fixed ratio reflecting the average global or regional production. At the end of the life time the metal leaves the system without environmental burdens ("cut-off") as secondary material source for forthcoming generations (fig. 1). With this mental model, no difference is made between a part with eg. 90% recycling potential and a compound with no recycling potential at all.

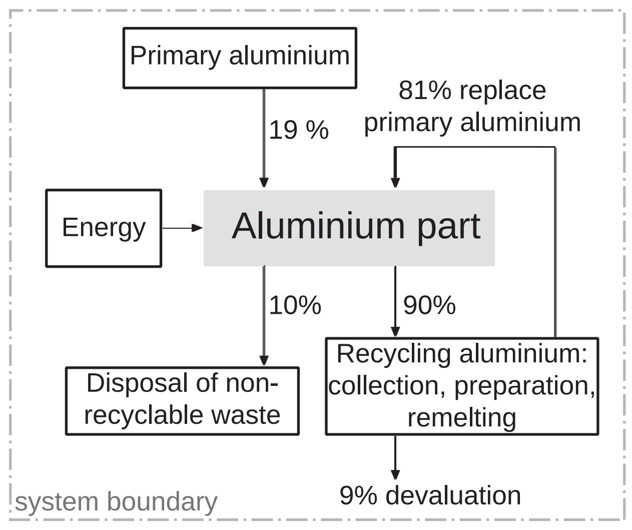
fig. 1. "Cut-off"-approach



Value corrected substitution models the end-of-life options explicitly, thus including individual recycling into focus of valuation.

Primary material is substituted by the anticipated recycling of the part (fig. 2). Since the application range of recycling aluminium is limited respective to the range of primary aluminium, a value correction is applied as proposed in Werner (2005). In this way the degree and quality of recycling is included within the scope of the valuation. High recycling potential is regarded as saving primary resources.

fig. 2. Value corrected substitution

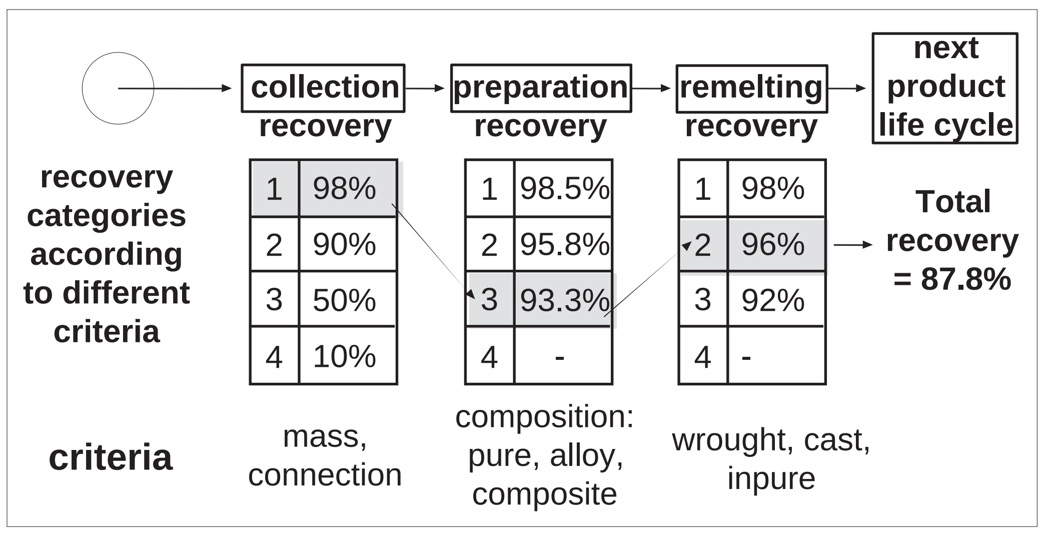


Integrating the Recycling Potential of Aluminium into a Swiss Ecoloabel

Total Aluminium Recovery

For each individual aluminium element the potential total recovery was calculated based on its properties (fig. 3). Recovery degrees were classified into categories with an estimated recovery rate. These estimates were taken from surveys with experts and literature (e.g. Boin & Houwelingen (2004); Rombach (2002); Werner (1999); Wolf (2000)). The total recovery indicates the amount of the material reused in a next product life cycle.

fig. 3. Recycling potential derived from composite recovery rates



Value Correction

Reflects the possibly limited application range of a secondary material. A correction of 90% has been done, according to the ratio of the long-term averages in the quotation of virgin and recycling aluminium at the London Metal Exchange (Werner (2005)). No correction has been applied for elements like façade tiles which occur in big amounts and a high quality.

Recycling Potential

The recycling potential - as defined in this study - equals "total recovery rate" x "value correction". It indicates the amount of substituted virgin material.

Results, Conclusions and used Sources

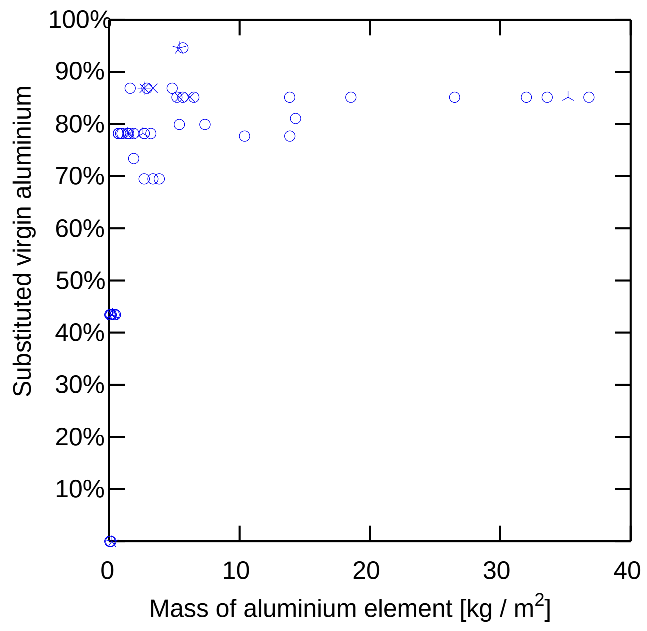
RESULT 1: The mass of aluminium element determines the degree of recovery.

The results show the dominant role of the mass of an individual element.

The bigger the element, the better the collection recovery and the recycling potential (fig. 4).

Smaller elements are more easily lost during the recycling process and occur often in a mixed fraction with an additionally smaller total recovery.

fig. 4. Recycling potential of aluminium elements (= degree of substituted virgin aluminium)

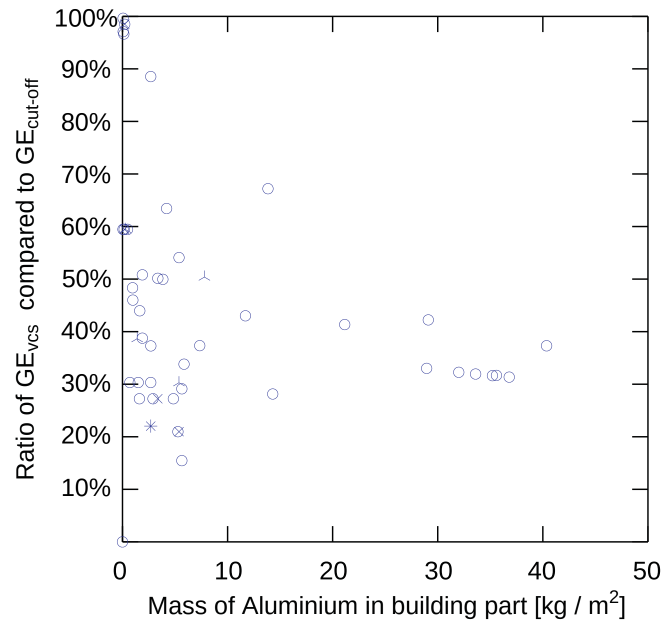


RESULT 2: High recycling potential leads to substantial reduction of accounted "Graue Energie" (GE).

The substitution of virgin aluminium by aluminium from recycling leads to a substantial reduction of "Graue Energie" (GE) for those parts with a high recycling potential (fig. 5).

For other parts with low or no recycling potential the result is not significantly altered compared to the original assessment in eco-devis.

fig. 5. Reduction of GE with VCS-approach compared to the approach used in eco-devis.



Conclusions

- The work shows that the method is suitable to include the recycling potential of construction parts from Aluminium into the scope of the valuation.
- Big construction parts which occur in large quantities and that are of high quality alloy have a high recycling potential.
- The value corrected substitution of virgin aluminium with the recycled metal leads to a reduction of the impacts assessed by the valuation by GE.
- The results indicate a markedly improved assessment for components with a high recycling potential. This gives an incentive for the design and use of components with good recycling abilities.

Sources

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