LCA-based indicators for recycling: a case study on plastic waste treatment in Flanders

STUDENT

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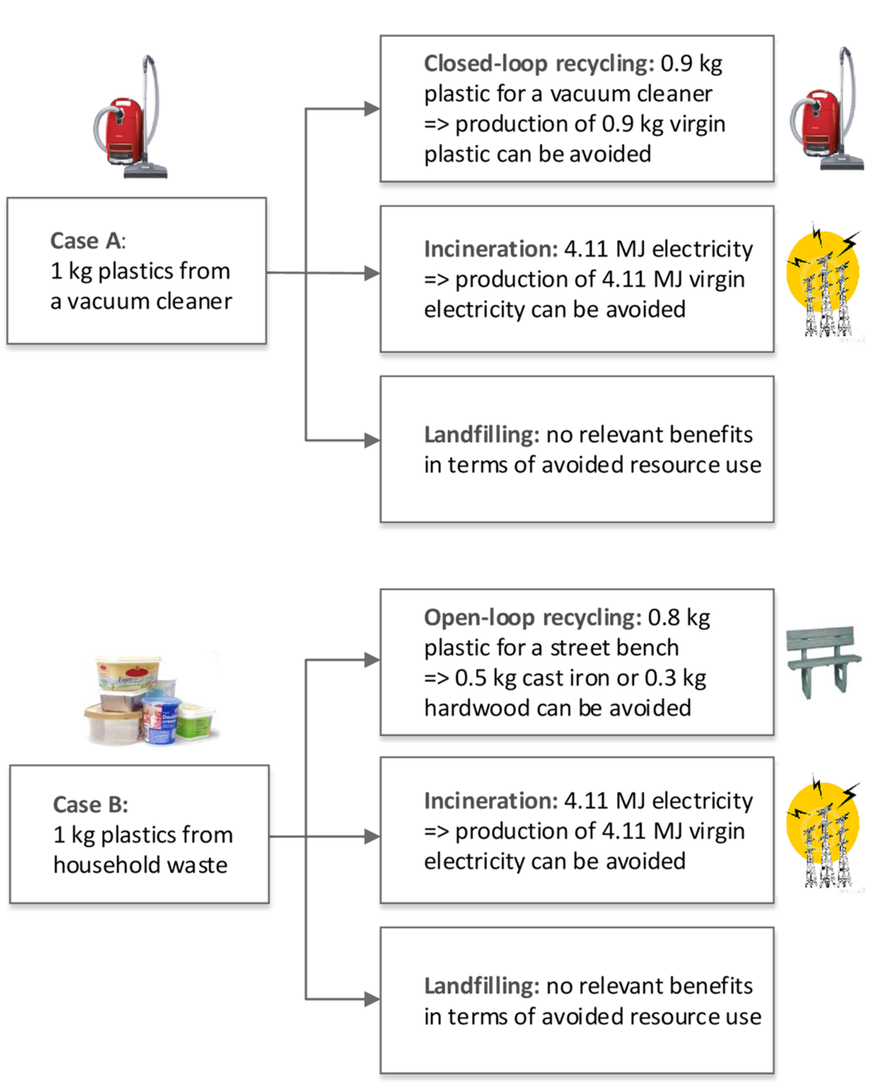
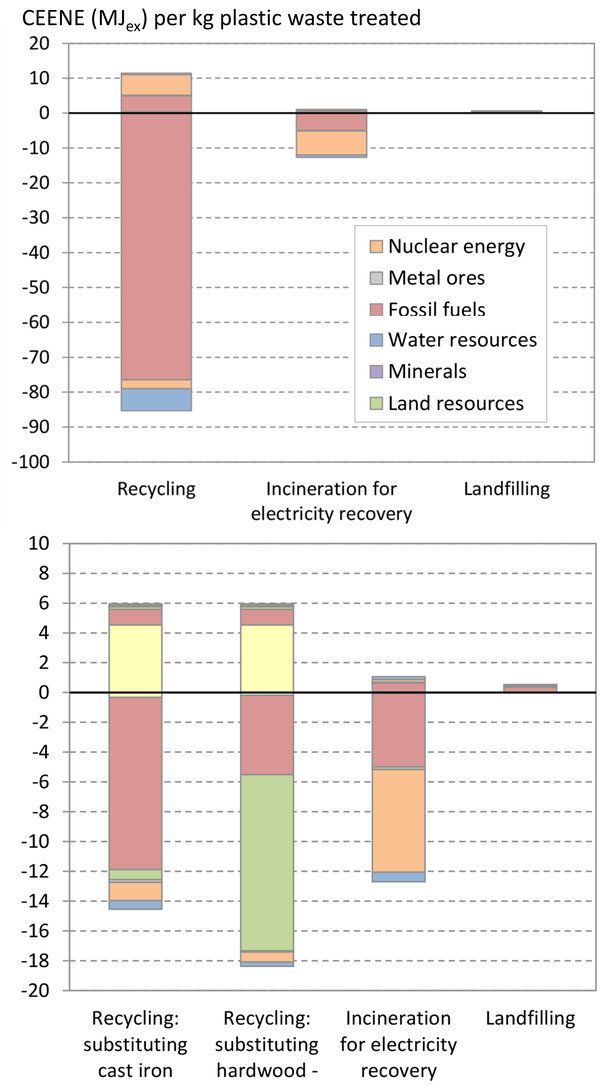
Introduction

- Goal and scope: evaluate the resource efficiency of two cases of plastic waste treatment in Flanders, Belgium: closed-loop recycling of plastics extracted from electronic waste (case A) and open-loop recycling of plastics extracted from household waste (case B)
- Approach: apply the recyclability benefit rate (RBR) indicator of the Joint Research Centre, which expresses the potential environmental benefits related to recycling over the environmental burdens of virgin production and disposal. These benefits and burdens are calculated through LCA.

Life Cycle Assessment (LCA)





Data inventory:
Foreground data of the recycling scenarios were collected on-site. Other data were modelled by the Ecoinvent v2.2 database. The functional unit is the treatment of 1 kg plastic waste.

LCA method:
CEENE-method (Dewulf et al., 2007), determining the resource footprint by quantifying the exergy deprived from the natural environment.

Impact results:
Environmental burdens are on the positive y-axis, environmental benefits are on the negative y-axis.

Recyclability benefit rate:
V is the impact of the avoided virgin production, D is the impact of incineration or landfill, R is the impact of recycling, f is a mass-correction factor for open-loop recycling (e.g. 1 kg recycled plastic replaces 0.66 kg cast iron)

$$RBR_{\substack{closed\\loop}} = \frac{RCR\ (V + D - R)}{V + D}$$

$$RBR_{\substack{open\\loop}} = \frac{RCR\ (f.V' + D - R)}{V + D}$$

Results and conclusions

1) Environmental benefits of recycling are higher than burdens, for both cases
2) Closed-loop recycling has a higher RBR (58%) than open-loop recycling (14%)
3) If the recycled plastics are recycled again, the RBR of case B increases up to 32%.
4) Recycling of these two flows is more resource efficient than incineration or landfill.

The indicator can be used for analysis of the most efficient waste treatment, as well as for ecodesign strategies. Policy makers could use these results in legislation on subsidies and taxes for plastic waste treatment.

Reference: Huysman, S.; Debaveye, S.; Schaubroeck, T.; De Meester, S.; Ardente, F.; Mathieux, F.; Dewulf, J. Application and further development of the recyclability benefit rate indicator for closed-loop and open-loop systems: a case study on plastic recycling in Flanders. Resources, Conservation and Recycling (2015), volume 101, p.53-60

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