

## **The recyclability benefit rate of closed-loop and open-loop systems: A case study on plastic recycling in Flanders**

Sofie Huysman, Sam Debaveye, Thomas Schaubroeck, Steven De Meester, Fulvio Ardenete, Fabrice Mathieux, Jo Dewulf

### **Abstract**

Over the last few years, waste management strategies are shifting from waste disposal to recycling and recovery and are considering waste as a potential new resource. To monitor the progress in these waste management strategies, governmental policies have developed a wide range of indicators. In this study, we analyzed the concept of the recyclability benefit rate indicator, which expresses the potential environmental savings that can be achieved from recycling the product over the environmental burdens of virgin production followed by disposal. This indicator is therefore based on estimated environmental impact values obtained through Life Cycle Assessment (LCA) practices. We quantify the environmental impact in terms of resource consumption using the Cumulative Exergy Extraction from the Natural Environment method. This research applied this indicator to two cases of plastic waste recycling in Flanders: closed-loop recycling (case A) and open-loop recycling (case B). Each case is compared to an incineration scenario and a landfilling scenario. The considered plastic waste originates from small domestic appliances and household waste other than plastic bottles. However, the existing recyclability benefit rate indicator does not consider the potential substitution of different materials occurring in open-loop recycling. To address this issue, we further developed the indicator for open-loop recycling and cascaded use. Overall, the results show that both closed-loop and open-loop recycling are more resource efficient than landfilling and incineration with energy recovery.