

## Resource use assessment of a portable battery recycling system

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Waste portable batteries have been recognized as an important waste stream, of which a proper and sustainable management strategy might help not only to prevent the risks of toxics leaching but also in function of raw materials conservation. Unlike existing studies on waste portable battery management with a main focus on emissions, this case study uses a resource-oriented approach to thoroughly analyze the performance of waste portable batteries collection and recycling.

The portable batteries take-back and recycling system in Belgium, organized by Bebat, was selected as the case. The study was conducted at two levels. At the cradle to gate level, the performance of the Bebat collection and sorting system for the mixed waste portable battery in three successive years 2011, 2012 and 2013 was assessed. At the cradle to grave level, the performance of the whole collection and recycling chain of Alkaline and ZnC batteries, the two biggest fractions, was analyzed and then benchmarked with an incineration scenario. To gain a comprehensive analysis and in order to cover different environmental aspects of natural resource consumption, three existing life cycle impact assessment (LCIA) methods (i.e., CEENE, CML and ReCiPe) representing three different LCIA method groups were used. Additionally, a new LCIA method, the criticality-based impact assessment method (CIAM) has been proposed to cover the socio-economic aspects of natural resource consumption. Overall, the results show that in all assessment perspectives, both the Bebat collection and sorting system and the whole take-back and recycling chain of the Alkaline and ZnC battery performed best in 2012. Moreover, the collection step mainly accounts for the total burden of the whole battery collection and recycling chain. In the comparison of the two management scenarios, the ReCiPe result does not show significant differences. However, the abiotic resource depletion potential score given by the CML method in the recycling scenario is eight times lower than in the incineration scenario. In accounting for the total resource consumption in the whole life cycle, the recycling system requires only half of the material criticality, but it consumed 12% more exergy than the incineration system. These comparisons indicate that the waste portable batteries management system organized by Bebat is less exergy efficient but has higher benefits in term of abiotic resource savings.