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# Assessment of New Trends in Product Packaging Using the LCA Method: A Case Study of a Conventional Plastic Bottle Versus an Eco-Innovative Paper Bottle*

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## Abstract

The article presents new trends in product packaging using the case study of a conventional plastic bottle made of fossil-based plastics (PET, PVC and HDPE) and an eco-innovative paper bottle made of paper and recycled/ conventional plastics (rPET and HDPE). The life cycle assessment (LCA) – the ReCiPe Midpoint (H) method – has been selected for the comparative analysis of the environmental impacts of both beverage bottles. The scope was defined from the extraction of raw materials, through the manufacture of individual materials used in the bottles, up to the manufacturing process of bottles themselves (cradle-to-gate analysis), and thus the stage of waste management was excluded from the analysis. The characterisation results proved that the plastic bottle has a more detrimental impact on the environment than the paper bottle in 12 out of 14 impact categories, i.e. climate change, ozone depletion, terrestrial acidification, marine eutrophication, human toxicity, photochemical oxidant formation, particulate matter formation, freshwater ecotoxicity, marine ecotoxicity, changes in agricultural, urban and natural lands, metal depletion and fossil depletion, on average by 25.46%. Only in the categories of freshwater eutrophication and ionising radiation, the plastic bottle has a more positive impact on the environment than the paper bottle, by 8.75% and 7.89% respectively. Although the obtained results are dependent on the local circumstances (ex. the available sources of energy) and the applied characterisation models, they set the directions for further development of eco-innovation in packaging. The replacement of conventional fossil-based plastics by new composite materials, including recycled plastics, together with new construction and design concepts of packaging, brings measurable environmental benefits and thus proves a high eco-innovation potential.

**Keywords:** Eco-innovation, packaging, life cycle assessment (LCA), plastic bottle, paper bottle, circular economy, ReCiPe method

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