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## A comparative cradle-to-grave life cycle assessment of single-use plastic shopping bags and various alternatives available in South Africa

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### Abstract

The pervasive use of plastics, coupled with inadequate waste management systems in many countries, has led to widespread leakage of plastics into the environment. In South Africa, the predominant type of shopping bags are single-use plastic bags; but paper, biodegradable plastic and re-usable bags have emerged as alternatives. To compare these alternatives in terms of environmental impacts across the whole product life cycle, we carried out a cradle-to-grave life cycle assessment (LCA) of 16 shopping bag types available in South Africa. The comparison includes single-use plastic, bioplastic and paper bags, as well as re-usable bags (typically made from plastic in South Africa). The functional unit was based on the estimated annual volume of groceries purchased per capita. An attributional LCA was carried out using the ReCiPe 2016 Midpoint(H) method, with 18 mid-point impact categories. In addition, given the lack of an impact category for plastic pollution in existing methods, we developed a mid-point indicator based on the persistence of plastics (and other materials) leaked to the environment (Persistence of leaked material, PersistenceLM). Specific attention was placed on modelling end-of-life and waste management in the South African context. Economic-based allocation at the point of substitution was used to apportion environmental impacts to virgin and recycle material, and the production of recycle was modelled using system expansion.