

ANALYSIS OF PLASTIC WASTE CIRCULARITY THROUGH LCA

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Upcycling processes are better aligned with the Circular Economy model, which defends that the plastic waste is a valuable resource with the potential to be recirculated in a new material cycle. To ensure the highest number of cycles, products, components and material should be kept at their highest utility and value (Webster, 2017). However, this is not what is happening in the recycling sector because upcycling processes are more complex, and energy and resource-intensive. As a result, the environmental benefits of plastic upcycling are frequently called into question and downcycling methods are implemented owing to their lower complexity and costs, regardless of the irreversible and meaningful loss of quality. In this work, three plastic waste management scenarios have been assessed to determine their potential to contribute to the implementation of the Circular Economy. The chosen waste treatment methods are upcycling of plastic scrap through deinking technology, downcycling by re-extrusion and, finally, incineration. The environmental impacts have been computed through LCA methodology.

The results show that depending on the assumptions made, LCA can lead to conclusions which are opposite to the Circular Economy principles, thus favouring the downcycling and incineration of plastic waste with high potential to be recirculated. Therefore, to make a fairer comparison between upcycling and other waste treatment options, two modifications have been suggested. First, the target market for recycled pellets should be included in the computation since it is reliant on the material's quality. Downcycled dark pellets can be used in applications which cover 24% of the total market. Conversely, upcycled pellets can reach 100% of the market. And second, the energy produced during incineration cannot substitute the energy from fossil fuels. The heating value of plastics is usually higher than the energy consumed during raw pellets production. Therefore, recycling will be always seen as the least favourable option. Nevertheless, according to the Circular Economy principles, the energy has to come from renewable sources. Therefore, if our society is moving forward to this new model, fossil fuels should not be considered. Finally, it has been demonstrated that increasing the quality of recycled plastics through upcycling processes is more beneficial than increasing the recycling rates. This is to say that recycle more is good, but what is needed is to recycle better.

This work is aligned with two of the conference topics:

- LCA of municipal and industrial waste management scenarios.
- LCA of the management of specific waste streams in a circular economy perspective.

Reference:

Webster, K., 2017. The circular economy: A wealth of flows. Ellen MacArthur Foundation Publishing