LIFE CYCLE ASSESSMENT AND CIRCULARITY INDICATORS

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Introduction

KEY ASPECTS OF LCA AND CIRCULAR ECONOMY (CE)

LCA

Standardized methodology

Provide **holistic** perspective

Avoid burden shifting

CE

Relatively **young** approach

Different forms and interpretation

Copious number of **Circularity Indicators** (CIs)

Objective and method

Investigating the relationship between LCA and CIs and their potential role in improving circular decision making through an analysis of recent studies.

Results

SOME RECENT STUDIES THAT INCLUDE BOTH LCA AND CIRCULARITY ASSESSMENT

APPLICATION	METHODOLOGIES	REFERENCE
Washing machines	LCA, Product Circularity Indicator (developed in the study) and Material Circularity Indicator (MCI) of Ellen MacArthur Foundation: applied separately	Bracquené et al., 2020
Alkaline batteries	LCA and MCI: applied separately	Glocic et al., 2020
Tyres	LCA and MCI (adapted): applied separately	Lonca et al., 2018
Asphalt mixtures	A composite indicator of environmental sustainability and circularity assessment where the environmental sustainability is quantified by LCA and circularity by MCI (adapted)	Mantalovas and Di Mino, 2020
Beer packaging	Two sets of indicators are coupled via a Multi Criteria Decision Analysis: i) material circularity based- indicators (Material Reutilization Score) and MCI; ii) a selection of life cycle based-indicators relevant for beer, i.e., climate change, abiotic resource depletion, acidification, particulate matter, water consumption	Niero and Kalbar, 2019
Food packaging	LCA and circularity indicators (input related: recycled content, reuse rate, renewable content; output related: recyclability, recycling rate, recycling output rate, downcycling factor, reuse rate, compostability; energy: share of renewable energy): applied separately	Pauer et al., 2019
PET bottle waste management	LCA and six material efficiency measures including a circularity potential: applied separately	Schmidt et al., 2020
Anaerobic treatment of dairy processing effluents	LCA and two circularity metrics based on Material Flow Analysis and LCA (*material circularity* performance indicator based on the Demand Minimisation Index and *environmental circularity* performance indicator based on the ratio of the total environmental benefits and costs): applied separately	Stanchev et al., 2020

Conclusions

- **CIs are not able**, alone, to assess the **overall** environmental performance of circular strategies. Similarly, **LCA** studies that analyse innovations attributable to circular economy models **should be completed** and enriched by evaluations on the **circularity** of the system.
- **Complete analyses are needed** (combination/integration of LCA with CIs) although they are complex.
- A **shared method** for carrying out and interpreting the results of joined studies of LCA and circularity is desirable.
- We **suggest** to prefer a holistic assessment **starting from an LCA**. Later, after the exclusion of those scenarios resulting with the worst impacts, the **circularity analysis could be performed in support to the decision maker**.

Main References

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Schmidt et al. (2020) Material efficiency to measure the environmental performance of waste management systems: A case study on PET bottle recycling in Austria, Germany and Serbia. Waste Manage 110: 74-86.

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