

Life Cycle Assessments of Environmental and Climate Impacts of Chemical Recycling Technologies – Towards a Systemic Approach for Transparency and Comparability

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Abstract

Life cycle assessment (LCA) – as a methodology for the structured evaluation of direct and indirect environmental impacts of products, processes or services throughout its life cycle – is increasingly utilized to support evaluation and decision processes regarding the opportunities and risks of products/technologies/services for decarbonization, including the defossilization of the chemical sector. However, while there are applicable methodological guidelines – including ISO standards as well as general and application specific reference documents – for the application of LCA to chemical processes, its utilization for assessing the environmental and climate impacts that will be associated with chemical recycling (CR) technologies has resulted in specific questions that are not clearly addressed in existing guidelines. These relate especially to the balancing of chemical conversion processes, the definition of assessment scope and interfaces, the consideration of the dynamic development of CR processes as well as the issue of confidential process data.

Increasingly, researchers and practitioners are drawing attention to the observation that reported LCA studies in the CR context are often intransparent as to assumptions and boundary conditions they have utilized (i.e. "black box") which limited their comparability. To address the challenge of transparency and comparability in LCA of CR technologies, this presentation will introduce a systemic and transparent approach for evaluating CR technologies.

Specific focus points include: (1) a classification of CR process pathways and the selection of the respective conventional reference technology, (2) the definition of the assessment scope and functional unit determined by the multifunctionality of CR pathways, (3) consistency issues during inventory modelling of CR processes, (4) the integration of technology-related uncertainty due to the ongoing technology development (prospective LCA), and (5) requirements on reporting of confidential process data. The presentation aims to summarize the most critical points on CR as a developing subject within the fields of waste-to-products and defossilization of the chemical industry for the participants.