Linking Data Choices and Context Specificity in Life Cycle Assessment of Waste Treatment Technologies: A Landfill Case Study

To generate meaningful results, life cycle assessments (LCAs) require accurate technology data that are consistent with the goal and scope of the analysis. While literature data are available for many products and processes, finding representative data for highly site-specific technologies, such as waste treatment processes, remains a challenge. This study investigated representative life cycle inventory (LCI) modeling of waste treatment technologies in consideration of variations in technological level and climate. The objectives were to demonstrate the importance of representative LCI modeling as a function of the specificity of the study, and to illustrate the necessity of iteratively refining the goal and scope of the study as data are developed. A landfill case study was performed where 52 discrete landfill data sets were built and grouped to represent different technology options and geographical sites, potential impacts were calculated, and minimum/maximum (min-max) intervals were generated for each group. The results showed decreasing min-max intervals with increasing specificity of the scope of study, which indicates that compatibility between the scope of study and LCI model is critical. Hereby, this study quantitatively demonstrates the influence of representative modeling on LCA results. The results indicate that technology variations and site-specific conditions (e.g., the influence of precipitation and cover permeability on landfill gas generation and collection) should be carefully addressed by a systematic analysis of the key process parameters. Therefore, a thorough understanding of the targeted waste treatment technologies is necessary to ensure that appropriate data choices are made within the boundaries of the defined scope of the study.

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