Decision making within waste management: combined uncertainty and scenario analysis for the life cycle assessment of a danish case study

Bisinella, Valentina; Conradsen, K.; Christensen, Thomas Højlund; Astrup, Thomas Fruergaard

Publication date:
2017

Document Version
Version created as part of publication process; publisher's layout; not normally made publicly available

Citation (APA):
Bisinella, V., Conradsen, K., Christensen, T. H., & Astrup, T. F. (2017). *Decision making within waste management: combined uncertainty and scenario analysis for the life cycle assessment of a danish case study*. Abstract from Sardinia 2017, 16th International Waste Management and Landfill Symposium , S. Margherita di Pula, Italy.

DECISION MAKING WITHIN WASTE MANAGEMENT: COMBINED UNCERTAINTY AND SCENARIO ANALYSIS FOR THE LIFE CYCLE ASSESSMENT OF A DANISH CASE STUDY

V. BISINELLA, K. CONRADSEN, T.H. CHRISTENSEN, T.F. ASTRUP

Technical University of Denmark, Department of Environmental Engineering, Miljøvej, Building 113, 2800 Kongens Lyngby, Denmark

Life Cycle Assessment (LCA) is often employed in decision-support contexts for identifying optimal waste management solutions. However, very often LCA is asked to quantify the environmental performance of new technologies that will operate within potentially different and uncertain background conditions. So far, the potential evolution of these background conditions has been often critical for the identification of the most favourable waste management solution (*e.g*., Fruergaard and Astrup, 2011).

The present study provides the environmental assessment of three future waste management options for residual municipal solid waste for the case study of the city of Copenhagen in 2025. The assessed waste management options are: (S1) incineration in a future facility, or incineration in a future facility with prior (S2) treatment in a future waste refinery (Tonini et al., 2013), or (S3) source segregation of organic waste for anaerobic digestion. The technological scope of the LCA was highly uncertain due to the design stage of the considered options and the hypothetical future source segregation scheme. Moreover, the choice of the background energy framework contributed with further epistemological uncertainty, since the municipality aims at being carbon neutral by 2025. So far, uncertainty in waste LCA models has been systematically assessed on a parameter level by Bisinella et al., (2016), which provided a systematic a Global Sensitivity Analysis (GSA) approach. Epistemological uncertainty in LCA has been investigated by many authors as scenario analysis (*e.g.* Spielmann et al., 2005), but so far never combined with existing uncertainty assessment methods.

The present study combined parameter uncertainty and scenario analysis across future waste management solutions and energy frameworks with the aim to provide a reliable and transparent methodology for decision making within LCA. The study was carried out with the waste-LCA model EASETECH (Clavreul et al., 2014). The GSA approach was applied to the three waste management scenarios within four consistent energy framework contexts for Copenhagen in 2025. For each context, the GSA approach provided the features of each design-stage technology contributing the most to the uncertainty in the results. In combination with the scenario analysis, the study obtained a final hierarchy of the waste management solutions with the highest probability of representing the most sustainable solution across future background energy contexts.

References

Bisinella, V., Conradsen, K., Christensen, T.H., Astrup, T.F., 2016. A global approach for sparse representation of uncertainty in Life Cycle Assessments of waste management systems. Int. J. Life Cycle Assess. 21.

Clavreul, J., Baumeister, H., Christensen, T.H., Damgaard, A., 2014. An environmental assessment system for environmental technologies. Environ. Model. Softw. 60, 18–30.

Fruergaard, T., Astrup, T., 2011. Optimal utilization of waste-to-energy in an LCA perspective. Waste Manag. 31, 572–82.

Spielmann, M., Scholz, R., Tietje, O., Haan, P. De, 2005. Scenario Modelling in Prospective LCA of Transport Systems. Application of Formative Scenario Analysis (11 pp). Int. J. Life Cycle Assess. 10, 325–335.

Tonini, D., Martinez-Sanchez, V., Astrup, T.F., 2013. Material resources, energy, and nutrient recovery from waste: Are waste refineries the solution for the future? Environ. Sci. Technol. 47, 8962–8969.