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Life cycle assessment of multi-product dairy processing using Irish butter and milk powders as an example

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Abstract

The Irish dairy industry faces a challenging market and a focus on the environmental impacts of products, both of which affect sustainable growth. The objectives of the study were to use life cycle assessment to analyse three products from four companies, to find the major contributors to energy use and greenhouse gas emissions, to understand the variation of environmental impacts and to identify the scope for improvement. Cumulative energy demand (CED) and carbon footprint (CF) of butter, skimmed milk powder (SMP), and fat filled powder (FFP) were calculated. The system boundary was from farm gate to processor gate to facilitate benchmarking.

Data quality was generally sufficient, but data gaps were identified for steam sub-metering. Butter CED varied from 6.93 to 9.73 MJ/kg solids, butter CF from 0.41 to 0.62 kg CO₂ eq/kg solids, SMP CED from 24.57 to 27.53 MJ/kg, SMP CF from 1.40 to 1.70 kg CO₂ eq/kg solids, FFP CED was 26.14 MJ/kg solids and FFP CF was 1.65 CO₂ eq /kg solids. Site specific data allowed explanation of variations by differentiating between practices and operational efficiency. Trade-off between renewable energy and ingredients revealed insights to the CF. Reactive power and wastewater treatment capacity demand further research. Valuable recommendations on how to better conduct LCA with industry were provided.

This is the first such detailed analysis for the Irish dairy industry. It is important for the industry to move away from average data for impact management and to use site-specific data where possible. The allocation methodology, cascade structure of modelling, survey template, knowledge gaps identified, and the recommendations on conducting LCA with industry contributed to a general framework of LCA of dairy processing.

Keywords

Energy efficiency, life cycle assessment, cumulative energy demand, carbon footprint, dairy processing

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