

Integrating social aspects in microalgal biorefineries: a Product Social Impact Life Cycle Assessment (PSILCA) approach

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Abstract: The ongoing climate change phenomenon requires the reduction of atmospheric CO₂ concentrations. Microalgal biorefineries, which convert atmospheric CO₂ into chemical energy, offer a viable alternative to fossil fuel-based industrial systems. This study assesses the social impacts of microalgal biorefineries using the Product Social Impact Life Cycle Assessment database approach, focusing on an industrial facility located in Póvoa de Santa Iria, Vila Franca de Xira, Portugal. The foreground system involves the production of microalgae in cascade raceway systems, followed by their refinement into protein, lipid and carbohydrate fractions. Dedicated surveys were distributed to the local community to collect social data, which was then analyzed using the Product Social Impact Life Cycle Assessment (PSILCA) database and a newly designed evaluation schema. Preliminary data from approximately 300 valid responses indicated that the local community faces a medium risk of being unfamiliar with the concept of microalgae or its benefits but acknowledged the high probability of local economic benefits and job creation upon implementation. The study highlights a general lack of familiarity with microalgae among the local community, which could affect the acceptance of the biorefinery. Although the PSILCA approach identifies social hotspots effectively, reliance on generic data may not accurately represent the local context. The study underscores the need for enhanced information dissemination to improve community acceptance and support for microalgal biorefineries. Preliminary data collection and analysis highlight the potential for social benefits, but further research is required to address the identified limitations. © 2025 Society of Industrial Chemistry and John Wiley & Sons Ltd.

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Key words: microalgal biorefineries; social life cycle assessment (S-LCA); PSILCA; sustainability; community engagement; methodology