Input-output based hybrid sustainability analysis of bio-succinic acid production in northern Spain

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Spain has agreed to drastically reduce its climate impact and energy needs in the framework of the European Green Deal and the Paris Agreement (target of 42% renewable of final gross energy consumption). In this scenario, lignocellulosic biorefineries are claimed to play an important role, not only helping to provide low-carbon energy and fuels but also contributing to produce both high-value and platform products for the chemical industry.

In that connection, the U.S. Department of Energy identified 12 promising building blocks molecules based on bio-processes. One of them, succinic acid, has gained a great attention in the last years due to its potential to produce other industrial chemicals like butanediol, tetrahydrofuran, and biodegradable polymers which can have multiple uses: as solvents, resins, plasticizers, food additives, etc [1]. Moreover, in a recent optimisation-based study [2], our group demonstrated that the production of succinic acid was economically competitive with respect to other platform chemicals obtained from lignocellulosic residues. Eucalyptus harvesting residues are a large source of lignocellulosic material in the north of Spain, estimated on 0.7 Mt/year. They have been studied in literature as raw material for both bioenergy production and the production of high value-added compounds.

In this work, the impact of producing bio-succinic acid in northern Spain from lignocellulosic residues (eucalyptus) is analysed from the triple bottom line approach (economic, environmental, and social impacts). The methodology employed combines both detailed process analysis and input-output calculations to estimate the sustainability impact of the industrial technology proposed on a region-wide basis (Comunidad Autónoma de Galicia). At the process level, rigorous process design and simulations have been developed which are the basis of cradle-to-gate inventories for life cycle environmental impact analysis (LCIA). Then, the input-output analysis is applied to, on the one hand, extend the system boundaries in the LCIA (tiered hybrid LCA) and, on the other hand, to estimate total jobs created in the region as a proxy of the social impact.

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Bibliography

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