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Integrating Life Cycle Assessment and Input-Output Analysis for the Assessment of Ethanol Greenhouse Gases Emission in Brazil

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Abstract

The increasing ethanol production in Brazil is deeply related to the global demand for alternative energy sources which can both decrease the reliance of economic sectors on non-renewable energy and drive global energy production towards a more sustainable situation. Simultaneously, it is important to improve techniques that allow the assessment of environmental impacts from different scenarios of biofuel production, aiming to improve its sustainability. The Life Cycle Assessment (LCA) is recognized as a powerful methodology that provides detailed information about the environmental impacts related to agricultural production, industrial stage and consumption phase of sugarcane-based products and co-products. However, LCA has some limitations regarding the definition of system boundaries and also requires huge effort during the data collection for Life Cycle Inventory. In this sense, a different technique such as the LCA integration with Input-Output Analysis (IOA) emerges as an alternative approach which allows expanding the boundaries of LCA studies to the country's economy without losing important information provided in the life cycle inventory. This approach is based on the country's input-output matrix, which allows calculating the direct and indirect impacts related to all production sectors of a country. In this paper, such integrated approach will be used to simulate the greenhouse gases emission related to different technological scenarios of bioethanol production in the Virtual Sugarcane Biorefinery (VSB), under development by the Brazilian Bioethanol Science and Technology Laboratory (CTBE). Data for the assessment were obtained from literature and computing simulation. Preliminary results show that integrated first and second generation ethanol production (1G2G) has the lowest global warming potential (measured in $CO_{2\text{-eq}}$) when compared with first generation ethanol production technologies in Brazil.

Keywords: *life cycle assessment, input-output analysis, ethanol production, greenhouse gases emission*