Replacement of fossil fuels by biofuels has been considered an important alternative in the transition process to an economy based in higher proportion of renewable resources in several countries. It is recognized that large-scale production of ethanol, sugar and electricity from sugarcane in Brazil presents some environmental, economic, social and energy security benefits. However, new production routes for sugarcane biorefinery considering also the integral use of sugarcane biomass will be more and more important for the strategic plans of bioenergy production expansion in Brazil. Comprehensive studies of the environmental impacts of these novel biorefineries are important as the different routes/alternatives for use of lignocellulosic material contained in the sugarcane lignocellulosic material (bagasse and straw) are still not consolidated. These studies will require internationally competitive research, development and innovation to ensure sustainable production of the various products that may be obtained from sugarcane biorefinery. This research project will contribute to this scientific and technological demand evaluating the environmental impacts of different alternatives/routes for ethanol, co-products and derivatives production in a sugarcane biorefinery including processes for better integral use of available biomass. This assessment is based on the integration of Life Cycle Assessment with computer simulation platforms and will contribute to the constructions of a tool so called “Virtual Sugarcane Biorefinery”.

Figure 1. Simplified representation of ethanol and gasoline life cycle stages
SUMMARY OF RESULTS TO DATE AND PERSPECTIVES

Various sugarcane biorefinery pathways were evaluated including agricultural, transportation and industrial conversion stages. Significant advances were achieved in the environmental assessment of current and novel sugarcane agricultural production systems; straw recovery alternatives; different technological scenarios for first and second generation ethanol production; different products using green chemistry and thermochemistry routes integrated to a sugarcane biorefinery; and different technological options for second generation ethanol production. Other project results include application of different environmental impact assessment methods and methodological concepts involved in the life cycle assessment of sugarcane ethanol in Brazil. The main findings highlight the importance of comprehensive and reliable tools and methods for environmental impacts assessment applied to all the life cycle stages of different products can be obtained in a sugarcane biorefinery.


MAIN PUBLICATIONS


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