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## Fossil fuel co-combustion of lignocellulosic sugarcane biorefineries: Techno-economic analysis (TEA) and life cycle assessment (LCA)

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In this study, alternative lignocellulose biorefineries annexed to a typical sugarcane mill were investigated, which produce Ethanol (EtOH), lactic acid (LA) or Methanol (MeOH), or co-produce EtOH and LA, all with surplus electricity for sale, by the conversion of bagasse and harvesting residues (brown leaves). The energy demands of the combined complex (sugar mill and biorefinery) were not met by burning the residues of biorefinery therefore, a portion of feedstock or a fossil source (coal) were burnt along with residues in the centralized CHP unit. A thorough simulation was developed using Aspen Plus for each biorefinery scenario for which energy assessment, economic evaluation based on Monte Carlo simulation, and environmental life cycle analysis (LCA) were carried out, in a multi-criteria assessment of the desirability of each scenario. The lactic acid production process was found to be the most energy intensive process with highest chemical consumption and the highest conversion of biomass carbon input to products. Consumption of coal as an alternative source of energy enhanced the available biomass for valorization. Biorefineries with coal combustion producing ethanol or ethanol&lactic acid had better environmental performance than methanol producing biorefineries, based on 1 ton of product. The co-production of EtOH and LA showed the largest likelihood of economic success, while some of the EtOH producing scenarios could achieve a positive NPV. MeOH producing scenarios had a zero likelihood of a positive NPV without substantial financial incentives or improved market prices.

### Biography

M Ali Mandegari is presently a Postdoctoral Fellow in the Process Engineering Department at Stellenbosch University in South Africa, since August 2014. His current research work is being carried out to develop bio-refinery simulations annexed to an existing sugar mill in South Africa and these include a baseline bioethanol plant as well as the production of biobutanol, lactic acid, furfural, syn-crude, methanol and electricity. He has also conducted and cooperated in eight research projects, seven of which have been completed. The results of his research are summarized by six ISI published papers, three ISI papers and twenty two presented conference papers. He has more than 8 years industrial experience in the petroleum, gas and petrochemical plants as R&D Manager, Project Engineer and Engineering Manager and Energy Auditor.

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