

SUSTAINABLE GAS PATHWAYS FOR BRAZIL: FROM MICROCOSM TO MACROCOSM

Both in Brazil and globally, gas (gaseous energy sources composed predominantly of methane), is at a crossroads. On one hand it is abundant, has an increasing share in global energy supply, is relatively clean-burning and is often an economically competitive fuel. On the other hand the gas supply chain and its combustion emit climate forcing CO₂ and methane, alongside having non-trivial life cycle interactions with natural capital and ecosystem services. The balance between these opposing attributes will determine the role for gas in future energy systems.

The objective of this project is to comprehensively assess the most challenging issues concerning a future sustainable role of gas in the Brazilian energy system, covering the technical, environmental and socio-economic factors.

The research considers gas futures at both the technology, process and community level (i.e. the MICROCOSM, focused production of biogas from residuals of the Brazilian bioethanol industry) and at the national whole systems level (the MACROCOSM), by the analysis of biomethane and electricity technologies linked with the broader systems view and opportunities.

PRINCIPAL INVESTIGATORS

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ABOUT THE PROJECT

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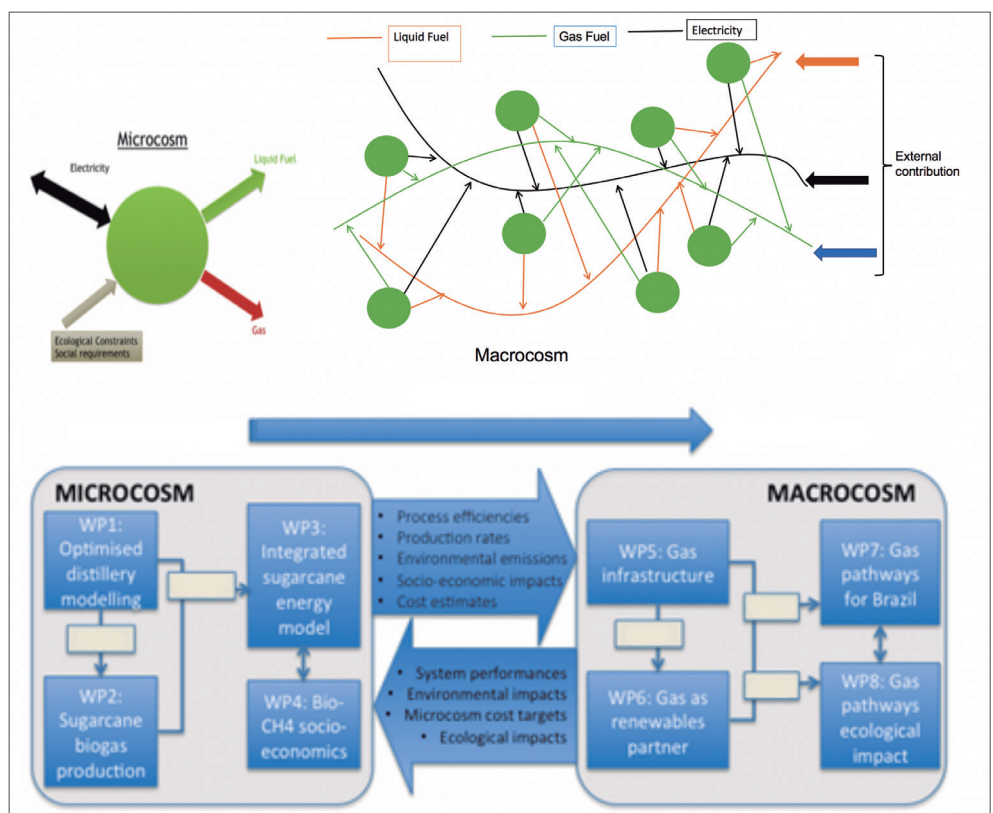
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Thematic Project

UKRI – NERC (Newton Fund)

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Project Structure (work packages integration and information flow)

SUMMARY OF RESULTS

At the microcosm level we developed and applied models of bio-refinery processes concerning the process to produce sugar and ethanol. Two approaches were studied: the overall mass and energy balances considering the industrial data of sugar/ethanol yield and the more detailed phenomenological models of all processes of the sugar-cane industry. An open platform for sugarcane process simulation was developed.

At the macrocosm level, the analysis of the economic impacts of biogas insertion in the product mix of sugarcane mills (ethanol, sugar, and electricity) was developed using a portfolio model, robust optimization techniques, and conditional-value-at-risk, accounting for all operational constraints and uncertainties (market and price volatilities). A portfolio optimization model was also developed to estimate investor's willingness to increase their bioenergy generation, taking into account financial risks associated with all products in their portfolio, sugar, ethanol and bioenergy generated from residues. The current state of the gas and electricity supply system in Brazil has been studied and forecasting models for energy demand were developed to analyze the government's policies for electricity dispatch.

MAIN PUBLICATIONS

Dutenkefer RM, Ribeiro CO, Mutran VM, Rego EE, 2018. The insertion of biogas in the sugarcane mill product portfolio: A study using the robust optimization approach. *Renewable and Sustainable Energy Reviews*. **91**: 729-740.

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