# Modelling the electricity value of Mauritius' sugarcane industrial ecosystem using Systems Dynamics Approach

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## Introduction

Current global energy systems have proven unsustainable amid effect of the cumulative greenhouse emissions (Jacob & Hilaire, 2015) and climate change (UNFCCC, 1997). Among several renewable energy options, sugar cane, grown widely in African countries, is known to be one of the most productive productive species in terms of its conversion of solar energy to chemical potential energy. However the supply of feedstock for electricity generation is limited to the crop harvest season. Let alone the supply is threatened by a wide range of factors among which includes declining sugar prices competing priorities for land and water which hinder growth of this sector. Nonetheless, the opportunity of harnessing electricity is becoming increasingly attractive.

Using Mauritius as an example this study seeks to optimize the electricity value of sugarcane production systems. The study develops an integrated energy model based on systems dynamics, and spatial analysis to:

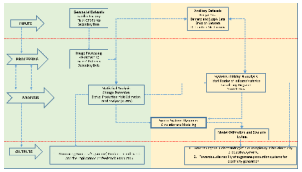
1): Assess the land use change dynamics in Mauritius

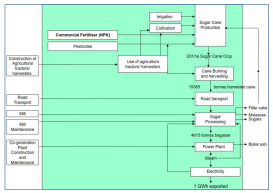
2: Examine the effects of land use change dynamics on the current and future potential of cogeneration feedstock supply.

3): Explore the potential of preserving surplus bagasse, and trash for off-crop season electricity generation.

4): Determine the emission avoidance from sugar based electricity production optimization.

## Methodology

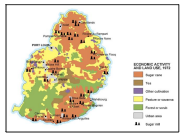


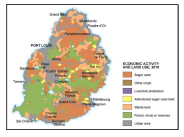


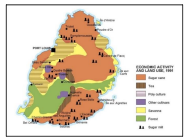
Process flow diagram for electricity generation from sugarcane bagasse based on Ramjeawon (2008)

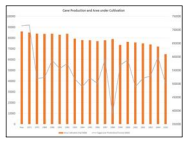
## Results

1: Assessment of the land use change dynamics in Mauritius

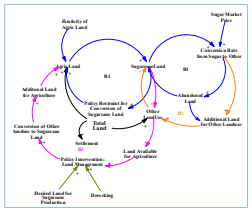


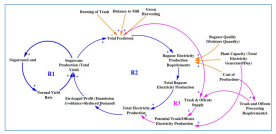




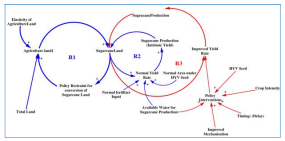


2: Mental Modeling unpacking the complexity in bio-electricity production.



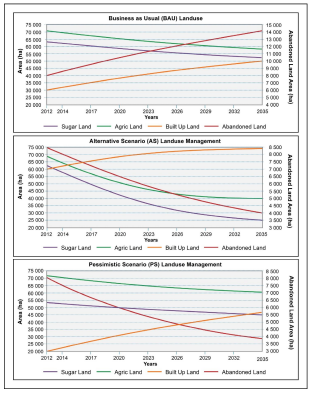



Conceptual causal loop diagram for Feedstock supply and electricity production

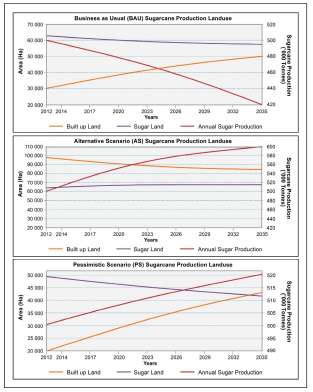


Conceptual causal loop diagram for sugarcane production

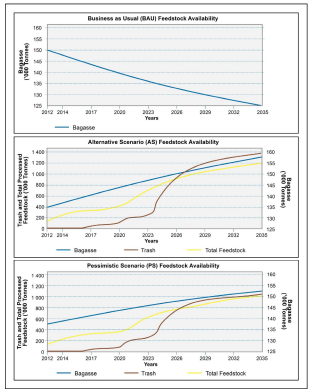
3: Simulated Scenarios for feedstock and bio-electricity production



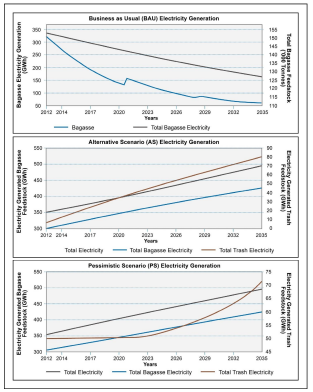

Land use change dynamics simulation scenarios




Land use change dynamics and sugarcane production

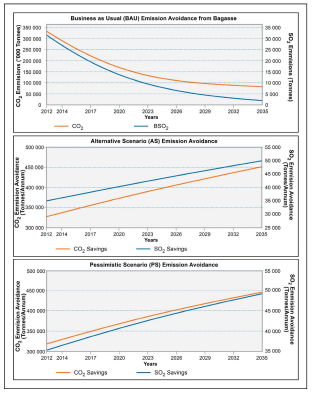



Bagasse and trash generation potential




Bagasse and trash electricity generation potential

4: Determine the net emission avoidance




Emission avoidance from sugarcane derived electricity production

## Conclusion

The simple system dynamics model of land use change, sugarcane production, harvesting and electricity production from bagasse and trash presented here has been proven to successfully simulate the main directions bagasse and trash derived electricity generation in Mauritius (a first phase characterized by change of land use systems, second phase in sugarcane production and green harvesting to maximise bagasse and trash supply as feedstock for electricity generation, and a third phase characterized by potential electricity generation and last the environmental benefits in terms of the avoided emissions).

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