

# Potential of biogas production from biomass and waste materials in the Small Island Developing State of Mauritius



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## ARTICLE INFO

### Article history:

Received 4 July 2015

Received in revised form

9 October 2015

Accepted 11 December 2015

### Keywords:

Renewable energy

Waste

Anaerobic digestion

Agricultural residues

Biomass

Biogas

## ABSTRACT

Mauritius is heavily dependent on fossil fuels for its energy requirement while energy from renewables contributes only a small fraction of the total primary energy requirement of the island. As such, this study reviewed the potential of energy production from mesophilic anaerobic digestion (AD) of the different wastes or biomass available in Mauritius. Based on the review, the net energy available from AD of the various wastes/biomass studied amounted to 4685 TJ/year (2174 TJ/year of electrical energy and 2511 TJ/year of thermal energy), representing 12.6% of the final energy consumption of the island. Alternately, the 2174 TJ/year of available electrical energy would represent 20.8% of the total electricity generated in Mauritius. Among the different substrates reviewed viz. agricultural wastes/biomass, municipal wastes and industrial wastes, it was determined that sugarcane field-based agricultural residues (3790 TJ/year), organic fraction of municipal solid wastes (462 TJ/year) and vinasse (268 TJ/year) are the feedstocks having the higher energy potential from large scale AD in Mauritius. Although there is a huge potential for AD in Mauritius, the technology is not commercially exploited. Consequently, this study also reviewed numerous barriers that could be hampering the implementation of AD on the island. In addition, several recommendations were put forward to encourage the exploitation of AD in Mauritius. Nonetheless, strong commitment from the government is of utmost importance while the benefits of the AD process should be made more knowledgeable to potential stakeholders and investors.

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## 1. Introduction

Mauritius is a small island developing state located to the east of Madagascar in the Indian Ocean. The population of Mauritius in 2014 stood at 1,219,659, representing an increase of 0.13% compared to the preceding year [1]. Since its independence in 1968, the island has experienced rapid economic growth, evolving from a low income economy to an upper middle income economy [2]. Continuous population and economic growth directly affects energy requirement [3]. Consequently, this has resulted in an increase in the total primary energy requirement (TPER) of Mauritius from 59,774 TJ in 2010 to 62,309 TJ in 2014 as depicted in Fig. 1, representing an increase of 4.2% [4,5]. This corresponded to an increase of 4.4% in final energy consumption from 35,640 TJ in 2010 to 37,208 TJ in 2014 [4,5]. In addition, Mauritius is heavily dependent on fossil fuels for meeting its energy requirements. Out of the 62,309 TJ of TPER in Mauritius for 2014, 85.8% was obtained through fossil fuels [4,5]. It is worth noting from Fig. 1 that the contribution of renewables for meeting the TPER in Mauritius has continuously decreased from 16.9% in 2010 to 14.2% in 2014 [4,5]. This corresponded to a decrease in the share of renewables for total electricity generation from 21.6% in 2010 to 20.4% in 2014 [4,5]. Based on this trend, it will be impossible to achieve the target of 35% with regards to the share of renewables for total electricity generation by 2025 as proposed in the long term energy strategy developed for Mauritius [6].

Further to the anticipated increase in TPER due to higher economic growth and increase in population as well as higher standard of living in the future [3,7,8], the amount of fossil fuels required to meet the world's energy demand will keep on increasing if no alternatives are sought. Considering the highly volatile and fluctuating prices of fossil fuels and the negative ecological impacts of its use [9], heavy dependence on fossil fuels represents a big risk for any sustainable economy. A general trend that has been adopted by many countries is to shift from fossil fuels towards renewables; particularly the conversion of biomass

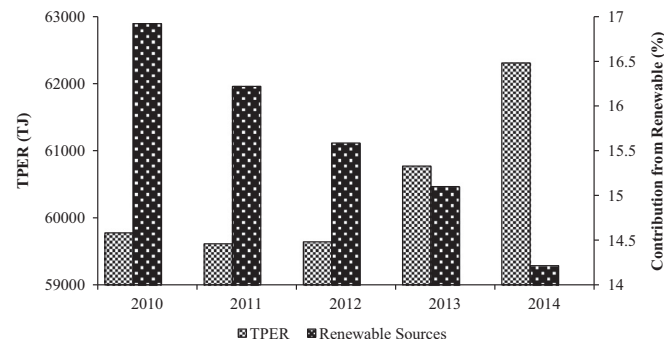


Fig. 1. Variation in TPER for Mauritius and contribution from renewable sources (Compiled based on data from Refs. [4,5]).

and waste materials to energy [9,10]. This interest towards renewables has also reached the developing world as evidenced by numerous studies performed on the potential of bio-energy in developing economies like Albania [11], Bangladesh [12], Brazil [13], Cameroon [14], China [15], Ethiopia [16], Ghana [17,18], India [19–21], Malaysia [22–25], Mexico [26], Nepal [27], Nigeria [28], Pakistan [29], Sri Lanka [30], Uganda [31] and Zimbabwe [32,33], among others.

As for Mauritius, it has been proposed that the energy from waste materials would contribute to 4% of the total electricity generation on the island by 2025, according to the long term energy strategy [6]. However, in 2014, electricity production from waste materials (from combustion of landfill gas) amounted to only 0.7% of the total electricity produced [5]. Besides, the total amount of solid wastes landfilled at the Mare Chicose sanitary landfill (the sole landfill in Mauritius) in 2014 was 417,478 t, representing a rise of 9.2% over the past 10 years [34,35]. Increases in waste generation are attributed to rise in economic growth, increase in population, higher standard of living and more industrialisation [36]. Since increases in all these factors are expected in the future, the amount of solid wastes generated in Mauritius is anticipated to increase to 510,000 t by 2034 [37]. Besides the 417,478 t of solid wastes landfilled [34], other wastes such as agricultural residues, animal manure and industrial wastes are also generated in considerable amount and as such, cannot be disregarded. Along with solid wastes, liquid and semi-solid wastes in the form of vinasse and sludge are also produced on a daily basis and all these waste materials represent potential sources of energy production. In addition, the cultivation of energy crops/biomass in Mauritius is gaining increasing interests for eventual bio-energy production.

Besides the fact that Mauritius faces a serious issue in terms of heavy dependence on fossil fuels resulting in future uncertainties and potential instabilities in various sectors of economic development, the island also faces another major concern with regards to management of the increasing amount of wastes generated daily. In addition, the targeted contribution of energy from waste materials in the long term energy strategy is 4% of total electricity generation by 2025 [6] while this value is currently 0.7% as previously mentioned [5]. As such, this study is investigating the potential of energy production from anaerobic digestion (AD) of various waste materials and biomass available locally (Fig. 2) in an attempt to alleviate the problems of waste management, heavy dependency on fossil fuels as well as increasing the contribution of energy from waste materials in the energy mix as targeted in the long term energy strategy for Mauritius. Besides, the article also highlights the main barriers to energy production from AD of waste materials/biomass in Mauritius while proposing some strategies that can facilitate the implementation of AD on the island.

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