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DRAFT: SUGARCANE BAGASSE IN BELIZE: AN ECONOMIC ASSESSMENT AND OVERVIEW OF POTENTIAL OPPORTUNITIES

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ABSTRACT

Sugarcane is the most important crop for the economy of Belize. With sugarcane deliveries exceeding 122 thousand metric tons in the fourth quarter of 2015, sugar is Belize's largest contributor to the agricultural sector with exports approximating BZ$140,000,000 for the year 2015. With commissioning of the Belize Co-generation Energy (Belcogen) plant completed in December 2009, sugarcane bagasse has been used for electric energy production. Currently, the single co-generation plant in the country contributes about 15% *of electricity to the national grid. Belize currently imports about* 45% *of its electric energy needs from Mexico, and to date, this is the country's most reliable energy source. With energy needs of the country projected to rise at a rate of* 4% *per annum, and with the costly import of energy, there exists the need to explore the expansion of co-generation energy technologies to increase local energy generation output to the national grid. The aim of this paper is to demonstrate the positive conditions which support such an expansion by analyzing the current co-generation technologies in the context of necessary economic, regulatory and technical pathways toward this increase of output. This is done through a discussion of various economic and technical scenarios with recommendations made for the most feasible option. The introduction of a new sugar plant in Belize with projections of annually producing 100,000 metric tons by 2020 and with intentions of introducing co-generation technologies could lead to* 20% *of local electrical energy being supplied to the national grid. It is projected that a new sugar plant of this size would grow the agricultural gross domestic product of the country by approximately* 4%. *These benefits further support the need for a discussion of co-generation technologies and the associated positive conditions supporting the expansion of the aforementioned technologies. Additionally, it is also relevant to mention the feasibility of alternative renewable energy technologies that could contribute to Belize's national goal of increasing energy efficiency, sustainability, and resilience over the next 30 years.*

INTRODUCTION

The increasing demand for energy is a global conundrum with challenges in areas of security, the environment, and economic and social development. [1] Population growth throughout the world has brought with it the continuous surge in energy demand. Though small, the Central American nation of Belize is no exception to this issue. With a population of about 350,000, growing at a rate of 2.4%, the country's energy demand is expected to rise at a rate of 4% per annum [2]. It has been estimated that within the next 20 years, Belize will need to increase energy generation by about 80% to satisfy this growing demand [3]. The country currently receives majority of its electricity supply from Mexico through a direct line into its national grid. This source constitutes 42% of the demand for electricity, and is to date, the country's most reliable source of energy. For its size, Belize has a relatively high electric energy demand. The country's peak demand is approximately 96 MW [4]. The costly import of electricity from Mexico has prompted the country to explore several renewable energy initiatives. This started with the Chalillo and Mollejon hydro-electric systems. These systems contribute about

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37 MW of power to the Belize's national grid which is 39% of the grid's total demand in peak hours [5].

Belize's finances are rooted in the agricultural industry. The sugar industry in Belize is over 150 years old and in the mid 1990's substantially upgraded its capacity to 120, 000 tonnes of sugar per year [7]. Section # of this paper briefly presents a historical perspective of the Belize sugar industry and its establishment as an imperative proponent in supplying Belize's energy demand.

The Belize Sugar Industry reported that over 1.1 million tonnes of ground sugarcane were cut in the 2015-2016 crop with approximately 140,000 tons of raw sugar being produced. The plant operated at a factory time efficiency of 97% with a 95% Pol extraction for the same crop year [8]. With the production of sugar from ground sugarcane, approximately 3 tons of wet bagasse is produced for every 10 tons of sugarcane crushed[9]. This would amount to approximately 330,000 tons of wet bagasse produced by the plant for the 2015-2016 crop year. As a result of the quantity of bagasse produced and support of renewable energy sources, 35,500,000 US dollars were invested in the construction of the country's first bagasse fired co-generation plant (Belcogen) [10]. The plant was successfully commissioned in 2009 and has a design output of 32.5 MW with approximately 13 MW of electricity supplied to the national grid, which is approximately 14% of the national grid's needs [6]. Section # of this paper outlines the economic, regulatory and technical factors affecting the sugar cane plant owned by the Belize Sugar Industry. Recommendations for improvements in these areas are presented and their potential effect on the Belizean economy are outlined.

With efforts in further expanding the agricultural sector, the Santander Group in 2008 began an investment of 150 million US dollars in the construction and operation of a new sugar mill in Belize. The sugar mill became fully operational on dd/mm/yy and it is projected to contribute x% to Belize's economy. Moreover, they intend to further invest in a co-generation power plant which could lead to a supply of 20% of local electricity to the national grid [12]. Section 4 of this paper outlines, in a similar fashion, the economic, regulatory and technical pathways toward growth of the Santander plant, and the corresponding effects on the Belizean economy.

Recent economic strains have prompted the rise in electricity rates in the country. In that regard, the discussion to improve and expand on the current renewable energy sources, especially as it relates to energy produced from sugarcane bagasse, has been at the forefront of the country's outlook. The paper attempts to contribute to the field by exploring recent technical developments in the renewable energy sector of Belize and forming correlations to the economy of the country, thus, presenting an argument for continued development of renewable energy technologies in the country.

BELIZE'S SUGAR INDUSTRY

Sugarcane is a crop rooted deep in Belize's history. The crop was introduced to the country by Mexican immigrants fleeing the Caste War in 1847. For a period of time, these immigrants, mostly in the north of the country, continued to grow sugar for local consumption. Initially interested in logwood export from Belize, British colonists at the time began to take notice of the increasingly popular crop, and took over sugarcane growth and sugar production in the country. By 1857, the first 100 barrels of sugar produced in Belize was exported to Liverpool, England. The industry continued growing marginally until the late 1990s. Technological advances in the milling, and production process bolstered the sugar production over the years. Today, optimal output results in approximately 123,000 tons of sugar being produced each year by the main factory in the country [13].

Sugar plays a large role in the economy of the country. In 2012, the economy was projected to grow by a very optimistic 5.2% due to technological improvements in agricultural practices and very favorable sugar prices within the EU market. Unfavorable weather conditions that year severely affected the agricultural output, and despite a growth in the tourism industry that year the actual economic growth was recorded at only 0.7%. The economy of Belize has been in decline in recent years. For the past two quarters, the gross domestic product of the country has fallen by approximately 1.6%. Due to the limited diversity in export products, the economy is heavily reliant on its agricultural output. The growth of the sugar industry, the country's main export crop, is therefore vital to economic growth [14].

Despite experiencing such a large growth in recent years, Belize's sugar industry faces several difficulties many of which are related to the economic, regulatory and technical considerations highlighted in this paper. One striking concern lies in the fact that Belize's sugar cane productivity is among the lowest in the world. Compared to other countries in Central America, Belize's sugar cane yield is about 50% less [15].

Recent investments by the Santander group has resulted in the a second sugar production site being recently formed in the country. The group's sugar mill began operations in February 2016, and the first export of 6,250 tonnes of raw sugar was made in July 2016. It is expected that continued growth in the country's production have a direct impact in the growth of the Belizean economy. Santander also has intentions of investing in a co-generation plant which will increase the production of electric energy from sugarcane bagasse from 15% to 20% thus reducing the need to import large amounts of costly electric energy from Mexico.

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[2] Avoid footnotes if at all possible.

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Appendix A: Head of First Appendix

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Appendix B: Head of Second Appendix

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$$a = b + c. \tag{2}$$

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