SUGAR INDUSTRY – GLOBAL OVERVIEW

1. History of Sugarcane and Sugar Beet

Sugarcane

Sugarcane *(Saccarum officinarum)* is indigenous to tropical parts of South and Southeast Asia. Originally, people chewed raw sugarcane to extract its sweetness. The earliest known production of crystalline sugar began in northern India and although the exact date of the first cane sugar production, it is widely accepted that Indians had mastered how to crystallize sugar during the Gupta dynasty, around 350 AD. There are records of knowledge of sugar among the ancient Greeks and Romans, but only as an imported medicine, and not as a food. For example, the Greek physician Dioscorides in the 1st century (AD) wrote: "There is a kind of coalesced honey called sakcharon [i.e. sugar] found in reeds in India and Yemen similar in consistency to salt and brittle enough to be broken between the teeth like salt. It is good dissolved in water for the intestines and stomach, and can be taken as a drink to help relieve a painful bladder and kidneys"

..

Around the 8th century, Muslim and Arab traders introduced sugar from South Asia to the other parts of the Abbasid Caliphate in the Mediterranean, Mesopotamia, Egypt, North

Africa, and Andalusia. It was among the early crops brought to the Americas by the Spanish, from their fields in the Canary Islands, and the Portuguese from their fields in the Madeira Islands.

In the 16th and 17th centuries, contemporaries often compared the worth of sugar with valuable commodities including musk, pearls, and spices. Sugar prices declined slowly as its production became multi-sourced, especially through British colonial policy. Once an indulgence of only the rich, the consumption of sugar also became increasingly common among the less affluent as well. Sugar production increased in mainland North American colonies, in Cuba, and in Brazil.

During the 18th century, sugar became enormously popular. Britain, for example, consumed five times as much sugar in 1770 as in 1710. By 1750 sugar surpassed grain as "the most valuable commodity in European trade — it made up a fifth of all European imports and in the last decades of the century four-fifths of the sugar came from the British and French colonies in the West Indies." Demand for sugar in Europe continued to increase: average annual consumption in Britain rose from 4 pounds per head in 1700 to 18 pounds in 1800, 36 pounds by 1850 and over 100 pounds by the twentieth century.

By the turn of the 20th century, sugar was such an important part of western economies that the American Sugar Refining Company was one of the original 13 constituents of the Dow Jones Industrial Average in 1896 and Tate & Lyle Ltd was one of the original 30 constituents of the FTSE-30 Index in 1935.

Until the advent of large-scale sugar beet production in the latter part of the 19th century, sugarcane, and the largely unrefined raw sugar derived therefrom, was the primary source of income for many British, French, Spanish, and Dutch colonies throughout the tropical and sub-tropical zones in both the Eastern and Western hemispheres. Later, as sugar prices fell, only the lowest cost producers, such as Cuba and Brazil, would be able to continue to thrive. The history of sugarcane in the 20th century has been one of sugarcane's constant competition with (often subsidized) beet sugar, along with the unreliable willingness of former colonial rulers to support their erstwhile territories through preferential access.

Sugar beet

Modern sugar beets date back to mid-18th century Silesia, where in 1747, Andreas Marggraf isolated sugar from beetroots and also demonstrated that the sugar which could be extracted from beets was identical to sugar produced from sugarcane.

The Silesian sugar beet was then introduced to France, where Napoleon opened schools in response to British blockades of cane sugar during the Napoleonic Wars, and which ultimately stimulated the rapid growth of a European sugar beet industry. In 1840 only about 5% of the world's sugar was derived from sugar beets, but by 1880 this number had risen more than tenfold to over 50% as sugar beets were introduced to Germany, Russia, and North America. By the turn of the 21st century, beet sugar would decline to between 20% and 30% of world sugar production.

Sugar beets being ideally suited to the temperate climates in Western Europe, they rapidly became a key crop for many farmers in France, Germany, and the Low Countries. European farmers' ability to secure protective tariffs from their governments as well as production subsidies ultimately placed downward pressure on world sugar prices and kept the vast European market as a mostly inaccessible market for cane producers.

Today, the sugar beet industry is in the early stages of a new era, as the EU, producer of some 50% of the world's total sugar beet output, faces a newly unregulated market since 2017. After liberalization, EU sugar beet production initially soared to higher levels at a time of global sugar oversupply, which contributed to the dramatically lower world sugar prices in 2018 and 2019. This in turn has led European sugar refiners to cut their fixed purchase prices for sugar beets, leading to what looks to be a multi-year phenomenon of lower sugar beet acreage in the EU. These trends will also create an environment where only the most efficient producers will be able to thrive in a very competitive global marketplace. Remembering the political influence of Europe's farming communities, it is not impossible to imagine that 2020 and beyond may see some very angry protests from Europe's sugar beet farmers, reminiscent of the dairy farmers protests in early 2017.

2. Sugar Industry today: Key Producers, Importers, Processors, and Price Data

The key supply & demand metrics for the sugar industry can be broken down into the largest sugarcane producers, the largest sugar beet producers, the largest sugar producers, the largest exporters, and the major processors (who are the principal buyers of raw sugar)

The 10 Largest sugarcane producers (2018/19 Estimates - USDA)

1)	Brazil:	628,000,000 MT
2)	India:	415,000,000 MT
3)	Thailand:	127,000,000 MT
4)	China:	83,000,000 MT
5)	Pakistan:	72,000,000 MT
6)	Mexico:	54,000,000 MT
7)	Colombia:	46,000,000 MT

8) Australia: 34,000,000 MT
9) Indonesia: 28,000,000 MT
10) Guatemala: 28,000,000 MT

Brazil is clearly the dominant global player, given that it produces over 40% of the entire world production of sugar cane. Of that production, some 80% is cultivated between 17° and 27° of South Latitude, astride the border between tropical and semi-tropical climate zones. Brazil has the unique ability to redirect significant portions of its sugarcane production to bio-ethanol production, such that when world sugar prices fall to unattractive levels, Brazil can convert sugarcane production to a petroleum substitute readily usable in its automobiles.

India is the second most important sugarcane producer, with sugar exports growing rapidly as the country improves yields and generates a rising exportable surplus compared with relatively stagnant internal demand. India's sugarcane production is mostly spread among a vast multitude (millions!) of small farmers operating on small holdings and frequently limited to manual labor and bullock drawn farm implements. India's sugar trade is still highly regulated, consistent with many of its governments post-independence preferences for a centrally controlled economy. Also, the many millions of Indians who derive their livelihood from cane farming make this sector politically sensitive.

Thailand has become an aggressive exporter, through a government price support mechanism that provides a strong production incentive to domestic cane farmers; the Thai government then supports the sale of excess sugar stocks on the international market, often at a significant loss. Brazil recently was successful in petitioning the WTO to declare the Thai government's sugar "dumping" policies as *Ultra Vires*, which has forced the Thai government to consider a new mechanism to assist domestic cane farmers.

China' entire sugarcane production is destined for domestic consumption; the country remains a significant net importer of sugar as its rapidly urbanizing population increases its per capita sugar intake. China's potential production is limited due to insufficient arable land with good precipitation within the optimum climate zones, leading it to have high production costs. Moreover, China's sugar trade remains closely regulated by the central government.

Pakistan produces almost entirely for its domestic market, although it allows the export, mainly to regional neighbors, of up to 1 million MT of raw sugar free of otherwise prohibitive export tariffs. Pakistan is not seen as a significant participant in the global sugar market despite its relatively high ranking in sugarcane production.

The remaining 5 producers represent only some 10% of global production, and all other producers represent less than 10% of global production, hence today's sugarcane industry, as it impacts sugar export markets, is dominated by the big 3 of Brazil, India, and Thailand.

The 10 Largest sugar beet producers (2016/17 – UN FAO)

1) Russia: 51,400,000 MT
2) France: 33,800,000 MT

3)	United States:	33,500,000 MT
4)	Germany:	25,500,000 MT
5)	Turkey:	19,500,000 MT
6)	Ukraine:	14,000,000 MT
7)	Poland:	13,500,000 MT
8)	Egypt:	13,300,000 MT
9)	China:	8,100,000 MT
10)	United Kingdom:	5,700,000 MT

The EU produced over 40% (about 112m MT) of the world's total 2016 sugar beet production (about 277m MT), led by its producing giants France, Germany and Poland, and consistently achieves superior yields through highly mechanized farming methods and close interaction with a broad network of processing mills. EU farmers have been bound in the postwar era by rigid EU regulations and quotas in the sugar beet sector.

Beginning in the 2017/18 campaign, the EU lifted restrictions on the acreage of sugar beets which could be planted, which in turn saw an increase of some 17% in sugar beet plantings versus the above 2016 campaign data, as many farmers benefitted from sugar beet offtake contracts from processing mills with attractive fixed prices covering the 2017/18 and 2018/2019 campaigns. At the same time, the EU experienced unusually good weather in 2017/18, which led to record yields and total sugar beet production soaring 11% to 131m MT. So, for the first time in postwar memory, the EU generated a significant exportable surplus of sugar, as seen below. Most sugar beet offtake agreements in the EU are expiring after the 2018/2019 year, which should see a significant decline in sugar beet prices, and a likely decrease in plantings. As the graphs below show, after a precipitous decline the EU sugar price is now almost in line with international prices, which in turn is likely to negatively impact EU production levels over the next several years beginning in 2019/2020.

Russia and Ukraine's sugar beet production remain largely geared towards meeting internal demand, although both now produce a modest exportable surplus of sugar (Ukraine 900k MT) (Russia 600k MT). These surpluses largely go to regional neighbors. Here again, Russian and Ukrainian sugar beet farmers will be watching global prices as well as the impact of lower EU prices and will be likely more prudent with their sugar beet plantings going forward. While these countries unquestionably benefit from low land and labor costs, they face many infrastructure issues that can materially offset their core cost advantages.

The 10 Largest sugar exporters (2018/19 - USDA)

1)	Brazil:	19,600,000 MT
2)	Thailand:	11,500,000 MT
3)	Australia:	3,800,000 MT
4)	India:	3,400,000 MT
5)	Mexico:	2,100,000 MT
6)	EU:	2,000,000 MT
7)	Guatemala:	2,000,000 MT
8)	Pakistan:	1,200,000 MT
9)	South Africa:	1,200,000 MT

10) Colombia: 800,000 MT

Once again, Brazil dominates the field, and most major Brazilian cane processors have facilities that can easily redirect cane production to ethanol. Equally important, a significant portion (>75%) of Brazil's 35 million light vehicle fleet has "flex fuel" capability, which means that these vehicles can run indifferently on E27 blended gasoline or E100 pure ethanol. So, when market conditions are favorable Brazil changes its crush ratio between sugar and ethanol in response to price fluctuations. Moreover, as discussed below, Brazil is the low-cost producer of sugar cane, which gives it a unique competitive position and consolidates its position as the dominant market force in world sugar. Nonetheless, it was Brazil which triggered the WTO action against Thailand discussed below, so it is protective of its market dominance.

Thailand has pursued an active program to subsidize sugarcane farmers by providing price supports for both sugarcane and refined sugar. This program has caused a significant growth in Thailand's sugarcane and sugar production over the past two decades, without any significant growth in domestic consumption. This in turn has required the Thai government to promote export sales to liquidate excessive sugar stocks.

Australia is a major actor in the global sugar market as it possesses large areas of land which are well within the most suitable growing areas for sugarcane. Australia's biggest challenge is access to sufficient water, as typical annual rainfall in its main Queensland growing region is about 1,000mm, well below the 1,500mm to 2,000mm ideally required for optimum sugarcane cultivation. However, rivers and subterranean aquifers allow for irrigation, and Australian cane farmers achieve consistently high yields. They are also highly mechanized, which makes for cost efficient cane farming. Australia's sugar exports go almost entirely to its Pacific rim neighbors.

The 10 Largest sugar refiners (2017/18)

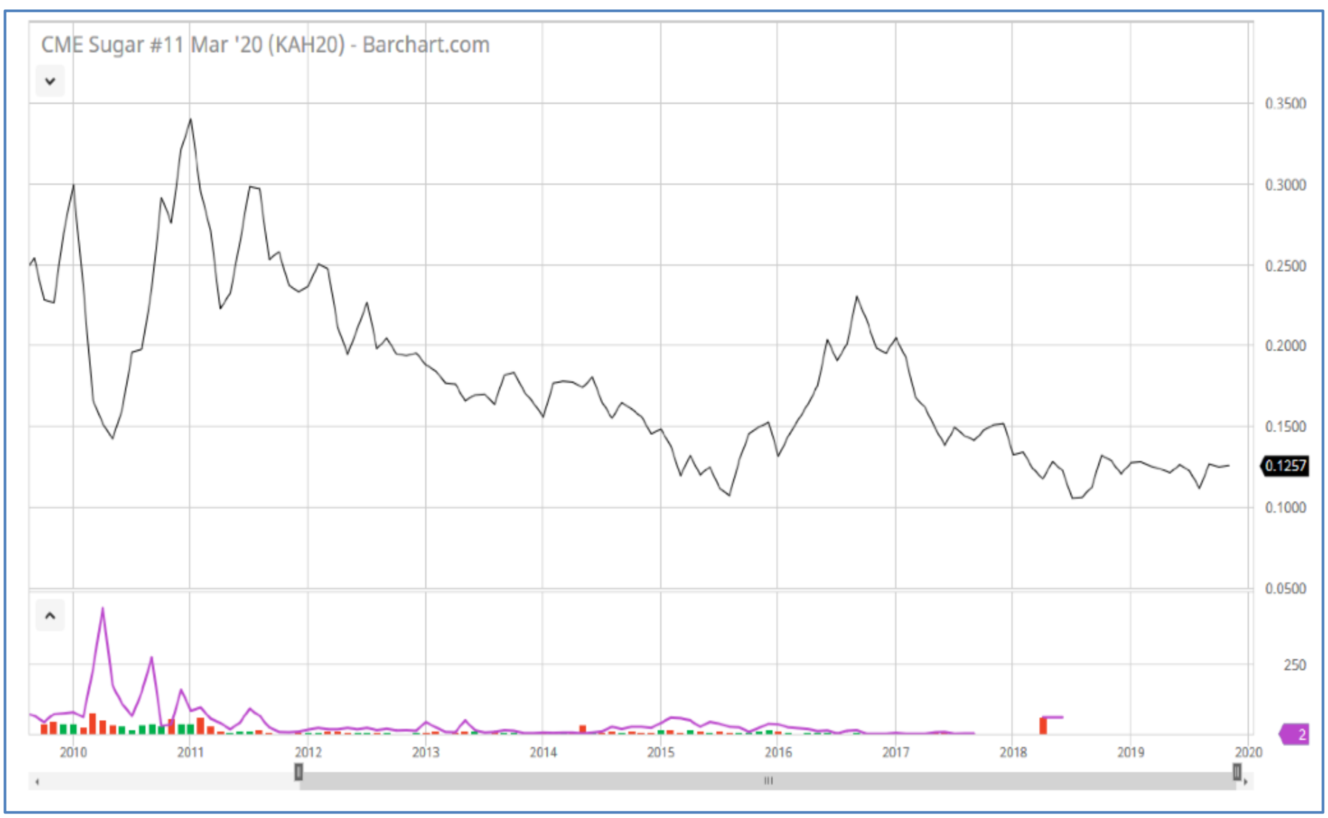
1) Suedzucker AG (DE): 5,600,000 MT
2) Tereos (FR): 5,300,000 MT
3) American Sugar (US) 5,100,000 MT
4) COSAN, S.A (BR): 4,700,000 MT
5) Nordzucker AG (DE): 2,500,000 MT
6) Sao Martinho S.A. (BR): 2,100,000 MT
7) Mitr Phol Group (Thai) 2,000,000 MT
8) Louis Dreyfus (FR): 1,800,000 MT
9) Wilmar Int'l (Singapore): 1,600,000 MT
10) British Sugar (UK): 1,500,000 MT

The above companies are the global trading giants who produce an important part of the refined sugar consumed today. Many of these companies operate on a hybrid basis, with some internally owned upstream production (sugarcane and sugar beet) as well as a substantial amount of product that is purchased either as a primary feedstock (sugarcane or beet) or raw sugar that is purchased from mills and refined into finished consumer products. These companies are typically present in most major markets as producers, traders, and distributors; they also represent a significant portion of commodity market trading. Many of these companies also own major subsidiaries that include well known retail brands (e.g. Tereos owns Béghin-Say of France and ASR owns Tate & Lyle of the UK).

10 Year Historical price charts

The main sugar trading contract used as a reference by the sugar industry is:

- CME (New York) Number 11 Contract – Raw Sugar



- The ten-year data show an average price around $0.20/lb.; over 75% of the time the price has been above $0.15/lb., which is above the assumption used in the CSA base case.

- The sharp 2016/2017 price spike was the result of overly wet conditions in Brazil and drought in India, Thailand and China**. It didn't take much of an imbalance to "spike the price" of sugar for two years…**

- The 2017/2018 price decline was driven by better harvests and ESPECIALLY the elimination of EU sugar beet quotas, leading to a large increase in plantings (now being at least partially reversed due to an expected sharp drop in sugar beet prices).

The key to prosperity in the volatile sugar world is to be among the <u>Low-Cost Producers</u>.

There is also an important benchmark tracked by producers/traders dealing with the EU:

World Bank – Sugar / European Union

A simple arbitrage calculation reveals that even in a "liberalized" trading environment, the EU offers a small premium to ACP/EBA countries like Belize that export raw sugar to the EU.

	EU Import Price	$ 0.36 / kg
Minus	Freight charges	$ 0.03 / kg
Divide 2.205 (Kg/Lb. conversion)	$ 0.1495 / lb.	
Compare	ICE #11 Sugar Contract	$ 0.1257 / lb.

While the premium for ACP/EBA exporters is measurable, around 15%-20%, it is considerably less than in the past…

Description: Sugar (EU), European Union negotiated import price for raw unpackaged sugar from African, Caribbean and Pacific (ACP) under Lome Conventions, c.i.f. European ports

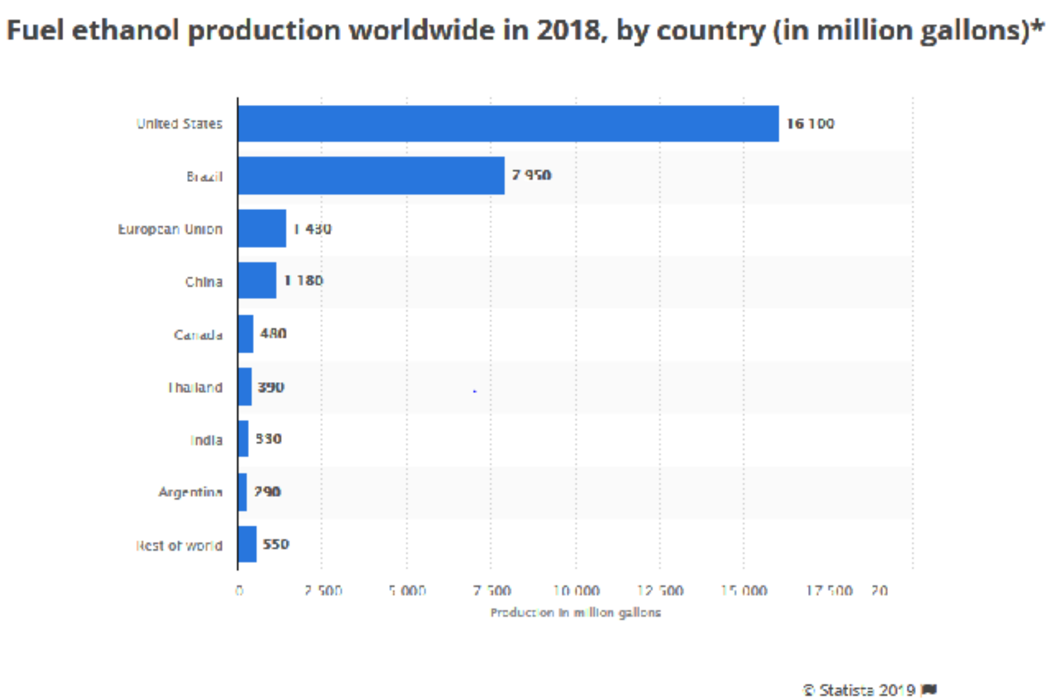
Unit: US Dollars per Kilogram

3. <u>Bio-Fuels: A new Major Demand Factor</u>

Understanding the role of bio-fuels, and more specifically ethanol, is essential to understanding the prospective supply / demand equilibrium points in the sugar market. Accordingly, before discussing sugar demand an important first step is to better understand bio-fuels.

The recent trend of bio-fuels becoming a "green fuel source," and the resulting diversion of foodstuffs, notably corn and sugarcane, into bio-fuel production is fundamentally altering the supply/demand equation in the corn and sugar sectors. It is also important to point out that as the oil price rises, and particularly as it reaches or exceeds $60 per barrel, bio-fuels become more competitive (Source: Nigatu et al., 2015), especially in periods of insufficient food sector demand (i.e., oversupply); accordingly, these periods should witness further corn and sugarcane being diverted to bio-fuels production.

The chart graph below shows how the US and Brazil, the world's largest corn and sugarcane producers, have become the dominant actors in the global ethanol market.



Section 5.2 details how the world's 3 largest sugarcane producers (Brazil, India, and Thailand) represent over 75% of global sugarcane production; Brazil's extraordinary success with its sugarcane bio-ethanol provides a clear pathway forward for India and Thailand, as discussed later in this section.

3.1. <u>US Legislation and the explosive growth of the US Bio-Fuels Industry</u>

The United States *Energy Independence and Security Act (2007)* ("EISA") is an extensive legislative mandate on renewable fuels (aka bio-fuels) that originally required that the use of renewable fuels reach 36 billion gallons by 2022, estimated to be 20% of forecast 2022 US transport fuel consumption. EISA further required that US ethanol production specifically from corn reach 15 billion gallons by 2015 and continue to grow thereafter, although the US Environmental Protection Agency ("EPA") has maintained the requirement at 15 billion gallons through 2019. US ethanol production relies heavily on corn, with an estimated 37% of the 2018 US corn crop used in ethanol production.

EISA led to explosive growth: US ethanol production rose ten-fold from about 1.6 billion gallons in 2000 to an estimated 16.1 billion gallons in 2018. As the above chart shows, the US now represents 58% of global ethanol production, followed by Brazil's 27%; these two giants represent 85% of global ethanol production. Moreover, the US is now exporting over 10% of its ethanol production.

The challenges facing US ethanol usage today are plateauing US gasoline consumption and the so-called "Ethanol Wall", which describes how older engines will not operate properly when more than 10% ethanol is blended into commercial gasoline. Unlike Brazil, almost none of the US's 276 million light vehicles are equipped to operate on high levels of ethanol, although vehicles built since 2001 can generally operate using up to 15% ethanol. Moreover, the US has a complex patchwork of state environmental regulations which has balkanized the adoption of higher ethanol blended fuel in the US.
The US is expected to play a major role going forward in the global ethanol market, as the US remains the world's largest producer of corn, which is produced in politically key states that help determine control of the US Senate. Ethanol's unquestioned role as the most viable renewable transport fuel combined with the power of the corn lobby should ensure that going forward a substantial amount of the US's corn crop will be used for ethanol production. And while a more favorable oil/corn price equation does not directly translate into higher US ethanol consumption, US ethanol exports would likely increase.

3.2. Brazil: A Global Leader in both Bio-Fuel Production **AND** Use

Brazil is the global leader in the development of renewable transport fuels. After the 1973 Oil Crisis, Brazil began a crash program to harness its renewable energy sources, notably hydro-electric power and ethanol, and has an outstanding track record. Today, Brazil produces over 75% of its electricity from hydro-electric sources. This success has provided major political support to Brazil's other industrial success: ethanol-based transport fuel powered by the country's vast sugarcane industry.

Understanding the role of ethanol as a bio-fuel is essential to understanding how Brazil's sugarcane production can affect the global sugar market.

The success of Brazil's ethanol initiative is a function of two main factors:

- Brazil has developed a massive sugarcane/ethanol industrial complex based on the country's vast sugarcane acreage which is in optimum production zones and its long history and experience with sugarcane and sugar production (see section 5).

- Brazil implemented tax policies supporting a domestic vehicle fleet equipped with motors that can run indifferently on flex fuel or pure ethanol, while at the same time maintaining a significant tax advantage for pure ethanol transport fuel.

In 2018 Brazil's government approved the **RenovaBio** program, based on commitments to the 2015 Paris Accords. It requires fuel distributors to gradually increase the amount of biofuels they sell from 2020. Brazil's Ministry of Mines and Energy expects RenovaBio to push 2028 demand to 47 billion liters from 27 billion in 2018. Given the dominant (>75%) role played by sugarcane in Brazil's bio-fuels sector (soybeans for biodiesel are second at ~15%), this new policy is likely to reduce sugarcane available for sugar production in the future, even if substantial new acreage is planted.

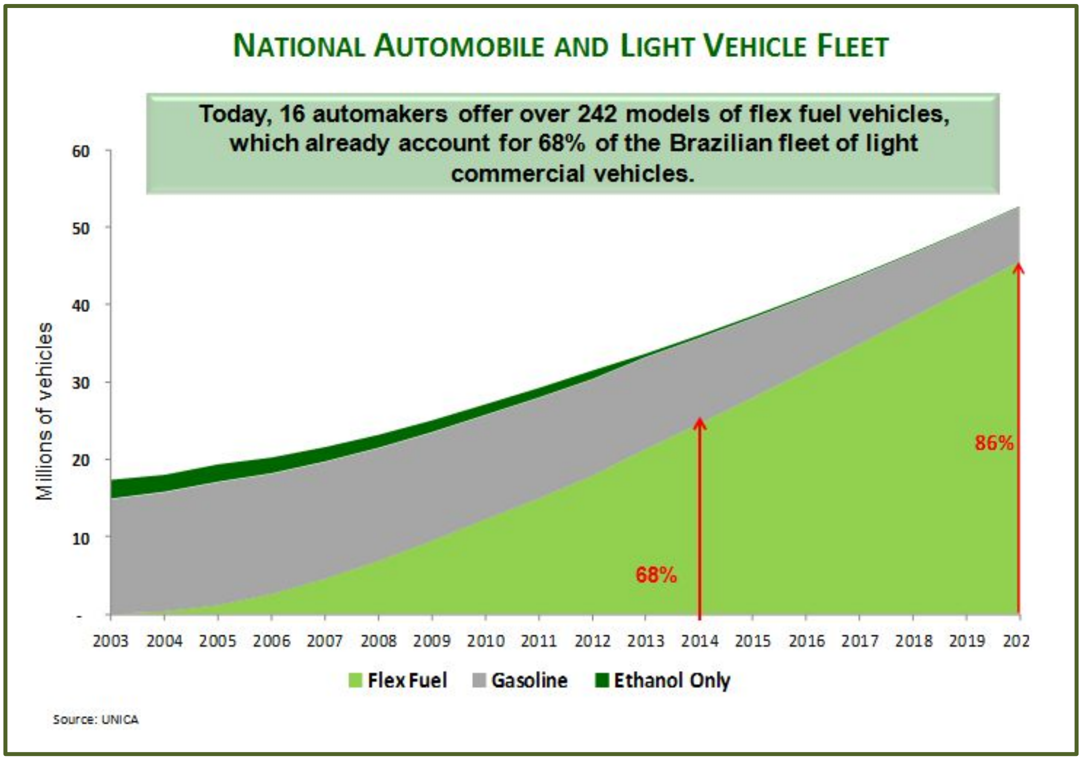
Brazil has some 9.3 million hectares planted in sugarcane in the 2019/20 year, expected to produce about 627 million tons of sugarcane. This sugarcane supplies feedstock to some 380 refineries, many of which are co-located with sugar mills, such that producers can indifferently direct sugarcane feedstock for ethanol or sugar production, depending on market dynamics.

In 2018, ethanol consumed over 63% of Brazil's sugarcane production, a percentage expected to grow due to the RenovaBio initiative. Looking forward, ethanol is also expected to consume all additional sugarcane plantings in Brazil.

See Section 5 for a more detailed discussion of Brazil's sugarcane industry

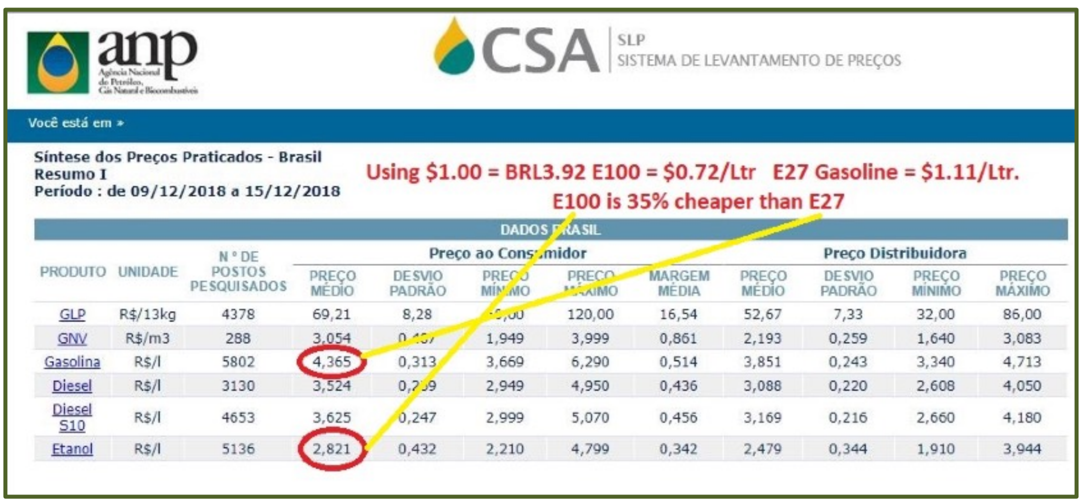
Due to consumer demand driven by fiscal policies, over 90 percent of new cars sold today in Brazil are flex fuel, that is they can run on E27 gasoline or E100 (100%) ethanol.

Flex fuel vehicles are forecast to make up 86% of Brazil's light vehicle fleet by 2020.



Brazil has transport fuel policies that have created three main categories: E27 Gasoline (which has a required blend of 27% anhydrous ethanol), E100 Hydrous ethanol, and B10 Diesel (which has a required blend of 10% biodiesel, produced mostly from soybeans).

E100 ethanol has 70%-75% of the fuel efficiency of E27 gasoline, so when the E100 price is < 70% of the E27 price, Brazilian ethanol use rises: local drivers are savvy!



DADOS BRASIL												
			Preço ao Consumidor					Preço Distribuidora				
PRODUTO	UNIDADE	N ° DE POSTOS PESQUISADOS	PREÇO MÉDIO	DESVIO PADRÃO	PREÇO MÍNIMO	PREÇO MÁXIMO	MARGEM MÉDIA	PREÇO MÉDIO	DESVIO PADRÃO	PREÇO MÍNIMO	PREÇO MÁXIMO
GLP	R$/13kg	4378	69,21	8,28	[illegible]	120,00	16,54	52,67	7,33	32,00	86,00
GNV	R$/m3	288	3,054	[illegible]	1,949	3,999	0,861	2,193	0,259	1,640	3,083
Gasolina	R$/l	5802	4,365	0,313	3,669	6,290	0,514	3,851	0,243	3,340	4,713
Diesel	R$/l	3130	3,524	[illegible]	2,949	4,950	0,436	3,088	0,220	2,608	4,050
Diesel S10	R$/l	4653	3,625	0,247	2,999	5,070	0,456	3,169	0,216	2,660	4,180
Etanol	R$/l	5136	2,821	0,432	2,210	4,799	0,342	2,479	0,344	1,910	3,944

Ethanol = ~45% of Brazil's non-diesel transport fuel. (2018 USDA/ANP data)

3.3. <u>India: World's #2 sugarcane producer begins to use bio-ethanol</u>

India is a giant in sugarcane production, although historically almost all of its sugarcane has been used for sugar production. Moreover, India considers food supply stability and national self-sufficiency in sugar as its primary goals (see Sections 5.2 and 5.4).

India formalized goals for increasing the use of bio-fuels in 2009, and more recently expanded them in the 2018 National Policy on Bio-fuels. The previous goal of 10% bio-ethanol blend by 2022 was increased to 20% by 2030. India currently faces two major challenges with its bio-ethanol plans: 1) It remains illegal to use cane juice for ethanol distillation; only residual molasses may be used; 2) India has a shortage of bio-ethanol production capacity, likely a result of 1) and India's often impenetrable maze of bureaucratic permitting requirements.

In 2018 India's blend rate only reached a paltry 3.2%, so there is clearly room for dramatic growth; indeed, **as long as India prohibits the use of cane juice for ethanol distillation, it is unlikely to reach even the halfway mark of its goals**. India has, however, set a clear goal of reducing its dependence on foreign oil, and if sugarcane supply can be increased, it may revise its policies. To achieve a 20% blend rate by 2030 would require 4 billion liters of additional bio-ethanol production capacity, a 600% increase compared with 2018 production. It would also consume over 15% of India's total sugarcane crop (cane juice and molasses).

If India fully implements its bio-ethanol plan, all future sugarcane supply growth will likely to be diverted to bio-ethanol production rather than to human sugar.

3.4. Thailand: WTO sugarcane issues create a new bio-ethanol industry

Thailand is a distant #3 in sugarcane production but is the clear #2 in terms of sugar exports, which have grown rapidly in the past two decades, notably through government subsidies to sugarcane farmers, a large and politically powerful group (Section 5.2).

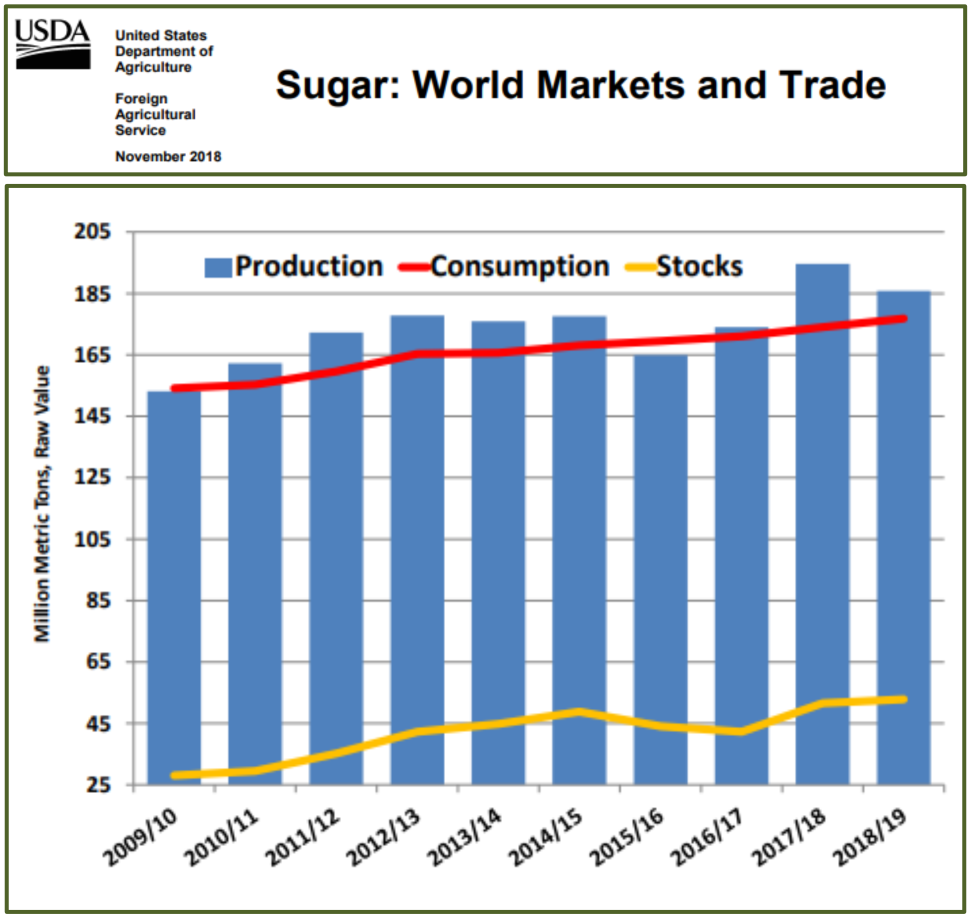
In 2017 the Thai government presented an ambitious update to its 2015 Alternative Energy Policy, which includes a major emphasis on ethanol production: grow annual ethanol production capacity 300% over the next 20 years, from 1.4 billion to 4.2 billion liters, almost a 6% compound annual growth rate. **Thailand is currently amending its 1984 sugar laws to allow cane juice to be used for bio-ethanol production, which is, as with India, currently prohibited.** The dramatic increase in Thailand's sugarcane production, creating large exportable sugar surpluses currently dumped on world markets, make the need for this protection unnecessary. This change should materially increase the diversion of sugarcane production to bio-ethanol, which could begin to absorb substantial amounts of Thai sugarcane in the coming decade.

Brazil led a 2016 WTO case against Thailand, which Thailand recognized in 2017 as lost. Thailand agreed to dismantle subsidies and is looking to work with Brazil to improve its ethanol technology/capacity to secure a long term, viable market for its sugar surplus.

Implementation of bio-ethanol goals could sharply reduce Thai sugar surpluses

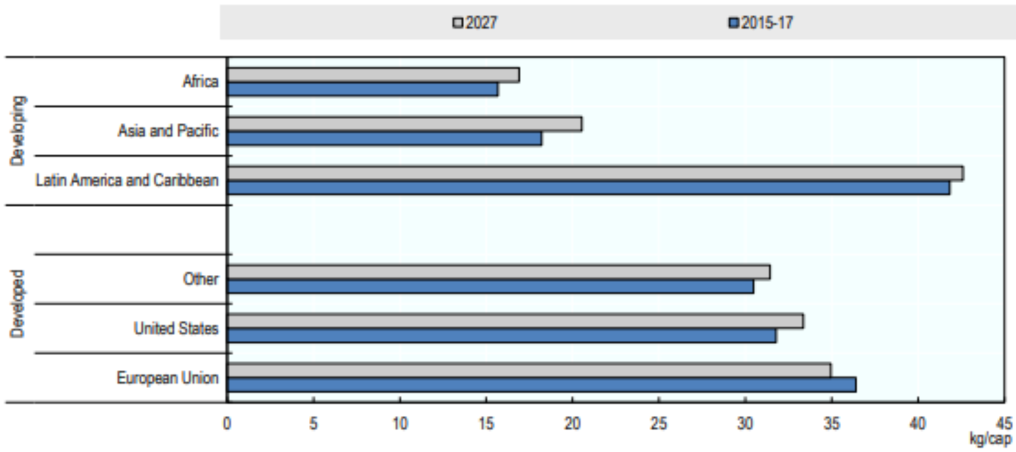
4. Global Demand for Sugar: Overview

Global demand for sugar is forecast by the USDA at about 178 million MT in the 2018/19 harvest year and has grown at a modest 1.7% annual rate over the past decade, which has recently decelerated to 1.5% from a 2% growth rate at the beginning of the decade.



Looking forward, the UN FAO forecasts that global sugar demand will continue to grow at about 1.5% annually over the next decade, with developed countries growing at a reduced annual rate of 0.3% and developing countries continuing to grow at a more rapid, but modestly declining 1.9% annual rate.

Figure 5.5. Per capita sugar demand in major countries and regions



Source: OECD/FAO (2018), "OECD-FAO Agricultural Outlook", OECD Agriculture statistics (database), http://dx.doi.org/10.1787/agr-outl-data-en.

StatLink http://dx.doi.org/10.1787/888933743233

While demand for sugar for human consumption is forecast to grow modestly, growth in demand for sugarcane, as opposed to sugar, is expected to be much higher. As sugarcane is the primary feedstock for almost 85% of the world's sugar in 2018/19, this is an important data point.

Brazil's EPE Agency recently forecast 2030 demand for Ethanol as a result of RenovaBio. Using a medium growth scenario (more conservative than the Government's), 2030 fuel ethanol demand would rise to 45 billion liters from 27 billion liters in 2018, a compound growth rate of 4.4%. Even assuming above trend growth in sugarcane farming yields, ethanol production would require 700 – 750 million MT of sugarcane by 2030, which compares with TOTAL 2018 Brazilian sugarcane production of ~630 million MT.

Table 2: Demand scenarios results for 2030

Scenarios	Fuel ethanol (billion litres)	A Gasoline (billion litres)	Hydrous ethanol market share on Flex Fuel (%)
Low growth	38.7	38.1	33
Medium growth	45.3	33.7	43
High growth	50.0	30.6	50

Source: Empresa de Pesquisa Energética

CONCLUSION: Global demand for sugar is expected to grow modestly over the next decade, but global demand for sugarcane should grow at a much higher rate.

5. Key Economics of Cane and Beet Sugar

Understanding the relative competitive cost position of major producing countries is a key element in attempting to understand at what price points marginal supply may be added or removed from regional and global markets.

It is assumed that while producers can operate below their "total" cost (including land rent and capital costs) for some period of time, they will typically not operate below their "cash" cost for more than a season or two before taking lower yielding land out of production.

Brazil

According to both Brazilian and USDA analyses, Brazil's larger sugarcane growers have consistently achieved low cost producer status among major producing countries (followed by Guatemala). These analyses currently estimate Brazil's "cash" cost of sugarcane production at ~$20/MT and "total" cost of production at ~$28/MT. Assuming typical mill yields, this places Brazil's breakeven cost of "cash" sugar production at around $200/MT ($0.09/lb.) and "total" sugar production cost at around $280/MT ($0.127/lb.). These costs are materially impacted by the USD/BRL exchange rate as a significant portion of Brazilian sugarcane growers' costs are of a purely domestic nature and therefore a weaker Brazilian Real typically reduces Brazil's production costs relative to other countries.

India

Understanding India's cost of production can be challenging as a first pass analysis based on domestic Indian publications places cash production costs at a surprisingly low $10/MT. However, this level is predicated on family contributed labor, land preparation being provided by "the family bullock" and cane output being hauled, again by the family bullock, to a nearby mill. Moreover, it is assumed that the family either owns the farm, which is typically in the 2-4 Ha size, or pays only a nominal rent. By contrast, the Indian government, which maintains a high degree of centralized control over the Indian sugar industry, set a 2018 floor price for sugar cane, as defined by its "Fair and Remunerative Price" system to be paid by mills at Rs. 2,750/MT, or about $39/MT. It is difficult to imagine why the Indian Government would feel compelled to place such a high floor price on farmer deliveries of sugarcane to mills if farmers' "cash" production costs were truly as low as $10/MT.

However, given typical Indian farm sizes of 2-4Ha, annual gross revenues from sugarcane sales, assuming 70MT/Ha yields, would be in the $5,500 to $11,000 range. One can assume that there are many "inefficiencies" at such small scales of operation that materially increase production costs, even if these are not captured in government production cost models.

Equally curious is the Indian government's decision to place a floor (which in many respects becomes a cap) for refined sugar at $408/MT, which leaves mills with a very small operating margin; their sugarcane cost & milling expenses will exceed $400/MT.

Thus, under the current pricing structure, Indian mills have to rely on their molasses and bagasse by-products to generate any meaningful profit.

Also, as with Brazil, most of Indian cane farmers' costs are domestic in origin, thus a weaker Rupee makes Indian producers more competitive as local mills generate higher revenues from sugar export sales.

Finally, what is clear in terms of India's production costs is that at current (relatively high) floor price levels, Indian sugarcane farmers are receiving a subsidy which in turn is encouraging them to produce a growing (exportable) sugar surplus. This surplus is being directed mostly to Asian markets, especially China which contracted to buy 2 million MT in 2018/19, and more going forward. Moreover, it is unlikely that, given the several million Indian farmers who rely on sugarcane directly or indirectly for their livelihoods, there will be any near-term changes to India's government-controlled sugarcane and sugar markets. India will likely therefore continue to generate a significant exportable sugar surplus.

Thailand

Thailand follows India in having a government managed sugar cane and sugar refining industry. Each year the Thai government sets the price that mills must pay cane growers for their deliveries, based on a specified sugar content. The Thai government also sets a production cost price, and if the cane price is below the government's production cost benchmark, an industry fund called the "Cane and Sugar Fund" makes payments to cane growers. While this fund is nominally a private sector industry fund, its ability to secure credit facilities from banks and other lenders is based on the implicit backing of the Thai government.

Sugarcane farming is one of Thailand's most important crops, although far behind rice. Some 100,000 small holders, representing upwards of half a million laborers, deliver sugarcane to Thailand's mills, none of which have significant internally controlled cane farms. Accordingly, Thailand's sugarcane pricing structure is a politically sensitive area.

For the 2017/18 year, and using a $1=33 Baht exchange rate, the Thai government set the sugarcane purchase price at $26.67/MT, and set the production cost benchmark at $32/MT. It is very difficult to obtain reliable data on what true sugarcane production costs are in Thailand. However, based on Thailand's low level of mechanization, relatively low labor costs ($1.25/hr.), small landholdings (<10Ha), and concentrated producing area, we estimate that "cash" production costs are at least $24/MT and "total" production costs are at least $30/MT (Thai interest rates are much lower than Brazil's).

As with Brazil and India, most of Thailand's cane farmers' costs are domestic in origin, thus a weaker Thai Baht makes them more competitive.

On a par with India, it is unlikely that, given the estimated half a million Thai farmers who rely on sugarcane directly or indirectly for their livelihoods, there will be any near-term changes to Thailand's current government-controlled sugarcane and sugar markets. Despite the recent agreement with Brazil regarding subsidies, Thailand will likely continue to generate a significant exportable sugar surplus.

Guatemala

While Guatemala is a relatively modest actor in terms of global sugar exporters, it is the largest Central American and second largest Latin American exporter.

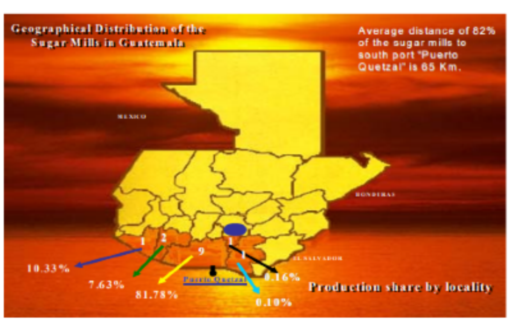
Guatemala is a valuable example of what Belize can achieve in terms of production costs assuming Belize uses mechanized farming and strengthens its infrastructure.

Guatemala has advantages in terms of its costs of production, including notably: 1) an ideal climate area for sugarcane production as most of its producing areas are located around 14° of North latitude with annual precipitation around 1,500mm; 2) predominantly large growing estates, with an estimated 70% of Guatemala's 255,000 Ha of sugarcane belonging to some 20 major sugarcane producers; 3) low labor costs ($1.25/hour) and an increasing level of mechanization; 4) a well-connected fabric of sugar mills within cane producing areas that are mostly very close (<40 miles!) to the modern maritime export facility at Puerto Quetzal.

USDA and Guatemalan estimates put Guatemala's production costs at the second lowest level in the world after Brazil, with an estimated "cash" production cost of $21/MT ($0.095/lb.) and an estimated $28/MT ($0.127/lb.) "total" production cost (interest rates in Guatemala are also much lower than in Brazil). Perhaps Guatemala's only negative in terms of production costs is the remarkable stability of the GTQ (Guatemalan Quetzal) versus the US Dollar. Over the past 10 years it has hovered around $1=GTQ7.5/7.75 with less than 5% fluctuations. By comparison, the Quetzal has strengthened some 50% compared with the Brazilian Real over the past 5 years.

Guatemala has almost no government regulation of its sugar industry, outside of general agricultural labor and environmental requirements. The industry is managed by a small group of oligopolistic producers through the national sugar association ASAZGUA.

Figure 1
Geographical Distribution of the Sugar Mills in Guatemala



Source: Guatemalan Sugar Association, ASAZGUA, 2011

Belize

Belize is a minor actor in the global sugar market but is the ultimate subject of this analysis and it is therefore apposite to consider its position in the global competitiveness rankings. Belize has two very different sugar producing environments: 1) Historic sugarcane smallholders in the northern Orange Walk and Corozal Districts who deliver cane to their local BSI/ASR mill; 2) New large estate producers in Cayo District who deliver cane to their local Santander Sugar mill.

Belize traditionally had a tightly regulated sugar industry governing smallholder sugarcane production in the north of the country. In 2015 regulations were loosened to allow the development of sugarcane production in the central part of the country; today, although many regulatory guidelines and restrictions remain, there are no government subsidies provided to sugarcane growers and sugar processors.

Belize's smallholders are estimated to have "cash" production costs of $24-$26/MT ($0.12-$0.13/lb.) and total production costs in the $31-$33/MT range ($0.155-$0.165/lb.).

There are no publicly available data points for the small number of new large estate sugarcane farmers in the Cayo District, although as the analysis below will show, a large cane estate that farms in a scientific and mechanized fashion should be able to achieve cash costs well below $20/MT ($0.10/lb.) which would make it competitive even with the leading Brazilian producers.

6. <u>Belize specific considerations</u>

There are a number of factors which particularly impact sugarcane production in Belize, most of which are either currently positive or have the potential to become so in the coming years.

Domestic Legislation

Belize's sugar legislation began in 1959 with the Sugar Industry (Control) Ordinance, leading to several acts which were consolidated into the Sugar Industry Act 2003, which in turn was substantively amended in 2015.

Belize's legislation originally established a rigid production quota system that defined the relationship between the large number of smallholder growers in the Orange Walk and Corozal Districts and the sole sugar mill operated by Belize Sugar Industries ("BSI"), which was acquired by ASR in 2012. While the government of Belize provided no subsidies, it did manage access to the preferential sugar quotas granted into the European Union (all Belize sugar typically was sold to Tate & Lyle in the UK) which in turn allowed BSI to pay higher prices to Belize's cane growers.

With the advent of the Santander Sugar project in 2015, and the 2017 end of European Union sugar quotas, Belize amended its sugar legislation to allow more flexibility for additional processors (e.g., Santander) and considerably more farmers in other Districts to grow sugarcane. While Belize does not yet have the level of government *laissez-faire* prevalent in Guatemala, the sugarcane growing/processing industries are today far less regimented than in other emerging market economies. This more benign approach should allow Belize's competitive sugarcane growers to prosper even in competitive markets.

EU Access

Belize as a signatory of the 2008 EU-CARIFORUM Trade Agreement benefits from the preferential access granted to Africa-Caribbean-Pacific Countries. This means that Belize can ship sugar (WCO Code 1701), typically in unrefined raw form, duty free to the EU. This compares with comparable sugar from leading global exporters (as described in 5.2 above) being almost entirely subject to duty of €339/MT (a rate of over 100% at current prices), the balance (CXL Quotas) paying a still significant duty of €98/MT.

This duty-free EU access has historically been a valuable asset for Belize's sugar industry, as Europe's cane sugar refiners, led by Tate & Lyle of the UK, are significantly short of non-dutiable raw cane sugar in order to operate their refineries at optimum capacity as they attempt to compete with the major German and French beet sugar refiners (see 5.2 above). However, the value of this preferential market access will likely decline as the EU sugar price is likely to sharply narrow its premium to world sugar prices post the 2017 EU liberalization. Belize will continue to have a strong market for its cane sugar in the EU, but its production costs will need to become more competitive for this market access to be valuable.

Sugar Mill Proximity

Logistics costs for moving sugarcane from production fields to a sugar mill can represent a significant part of the mill's overall feedstock costs. Indeed, countries like Brazil and Guatemala that have tightly integrated sugarcane grower / sugar mill networks are able to lower their production costs materially. The difference between a sugar mill whose suppliers are within a 5-mile versus a 15-mile average radius can alter sugar cane costs by $2/MT, which would represent 7%-8% of sugarcane supply costs in the current market environment.

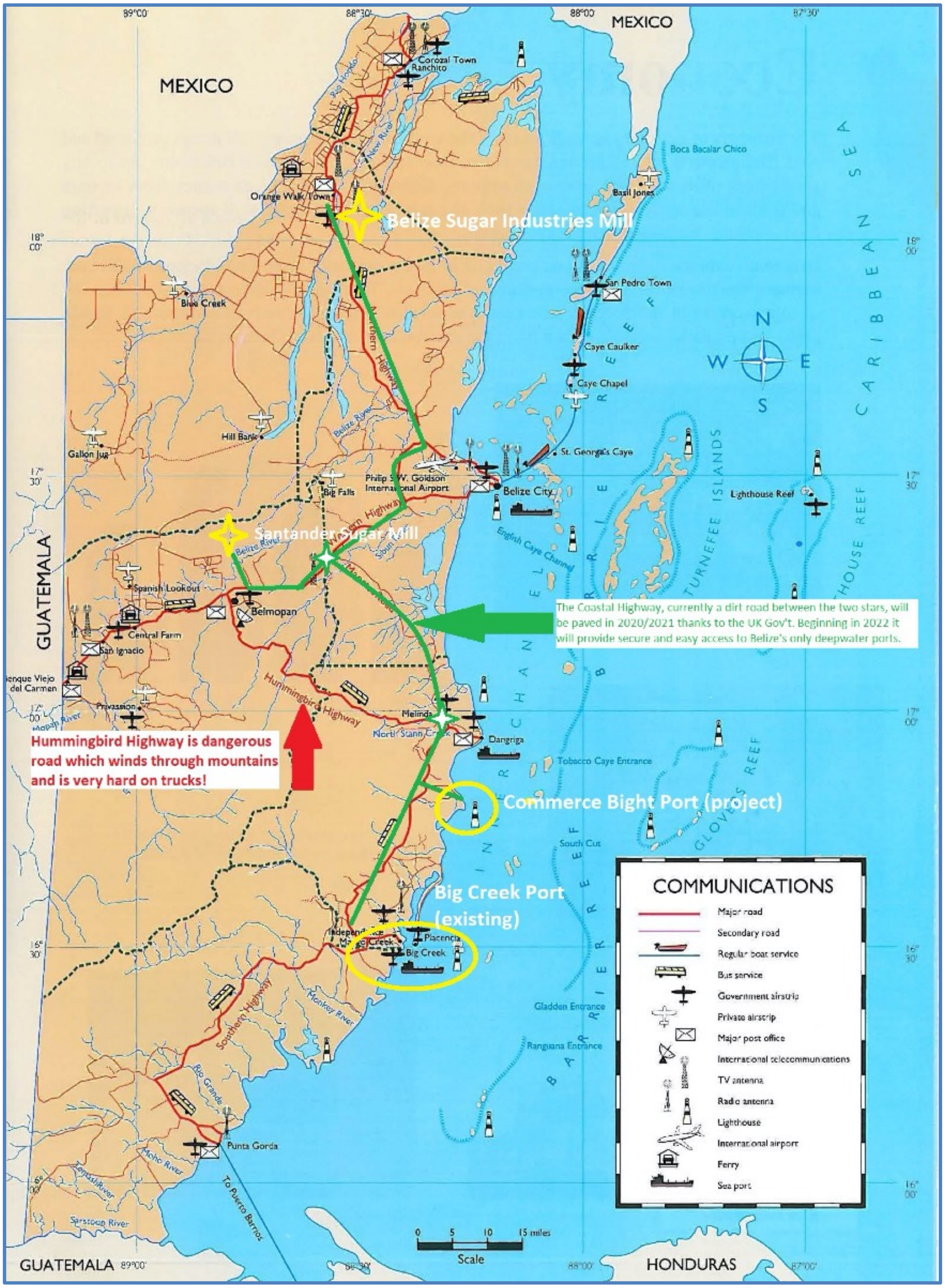
While Belize's northern sugarcane farmers are likely closer to being in a 15-mile radius from the BSI/ASR mill, often on unpaved public roads (which limits the weight and volume which can be hauled at any one time), more of the Cayo District suppliers to the Santander Sugar mill are likely to be within a 5-mile radius, much of it on private roads. This should provide the Santander Sugar mill, over time, with a material competitive advantage, in many respects similar to that enjoyed by Guatemala's leading, and highly efficient, sugar industry.

Improving Road and Port Infrastructure

Once sugarcane has been milled and converted to raw sugar, the remaining challenge is to move the bulk sugar efficiently and cost effectively to an export terminal where large bulk carriers can be readily loaded quayside. An excellent example of such optimization can be found in Guatemala's Expogranel storage/loading facility located at Puerto Quetzal, on the country's Pacific Coast (https://expogranel.com/?lang=en). This modern integrated facility is located within 40 miles of most of the country's leading sugar mills, almost entirely on modern paved roads capable of bearing heavy goods vehicles. Brazil's main sugar producing mills in the South-Central part of the country are also frequently within 50-200 miles of major export terminals such as the port of Santos, and some of them benefit from rail access.

Belize has historically suffered from poor port facilities, especially the very shallow draft port of Belize City. Belize's only port with the ability to berth smaller "Handysize" bulk carriers quayside is Big Creek, located in the Toledo District. However, Belize's limited north-south road network has made access to Big Creek from either Santander Sugar or BSI/ASR challenging, as the paved road network required a 50-mile drive through the tortuous mountains of the Hummingbird Highway. Thanks to a major grant from the UK's Caribbean Infrastructure fund, Belize's "Coastal Highway" should be paved by 2022, which will put Big Creek within 2.5 hours from Santander Sugar's Mill and 4.0 hours from the BSI/ASR mill, with all travel on level, modern paved highways. This will provide a significant competitive advantage to Belize's sugar exporters. There is also a project being considered to develop a port at Commerce Bight, which would provide 8+ meter channels direct to quayside; this channel depth would allow 30,000MT bulk sugar freighters easy access to a new export terminal.

Belize communications map showing access to main sugar mills



7. Sugar Cane Farming: Discussion and Risk Analysis

Sugarcane has been grown for several millennia, today represents over $50 billion in annual product sales, and plays an important role in the economy of many countries in the tropical and sub-tropical zones. As we have seen, sugar producing colonies played an important role in the conduct of War and Peace from the 16th through the 19th centuries. Accordingly, sugarcane's cultivation has been carefully studied and continuing improvements in where and how sugarcane is planted, cultivated, harvested, and processed have allowed sugar to evolve from a luxury product for the very rich to a low-cost food source available to all.

7.1. Climate and Soil Requirements

Sugarcane cultivation requires a tropical or subtropical climate, with a minimum of 1,000 mm (40 in) of annual moisture, although the plant only thrives (in rain fed cultivation) where annual precipitation rates exceed 1,500mm (60 in). It is one of the most efficient photo synthesizers in the plant kingdom. It is a C4 plant, able to convert up to 1% of incident solar energy into biomass. In prime growing countries/regions, notably: Australia, Brazil, Colombia, Cuba, Dominican Republic, Eswinti, Guatemala, Guyana, India, Indonesia, Jamaica, Pakistan, Philippines, and Thailand, sugarcane crops can often yield 100MT/Ha and can even reach commercial yields of 150MT/Ha. Once a major crop of the southeastern region of the United States, sugarcane cultivation has declined there in recent decades, and is now primarily confined to Florida, Louisiana, and South Texas.

Sugarcane is cultivated in the tropics and subtropics in areas with a plentiful supply of water for a continuous period of more than six to seven months each year, either from natural rainfall or through irrigation. The crop does not tolerate severe frosts, which can be problematic in the southeastern US. Therefore, most of the world's sugarcane is grown between 22°N and 22°S, and some up to 33°N and 33°S. When sugarcane crop is found outside this range, such as the Natal region of South Africa, it is normally due to anomalous climatic conditions in the region, such as warm ocean currents that sweep down the coast. In terms of altitude, sugarcane crop is found up to 1,600 meters close to the equator in countries such as Colombia, Ecuador, and Peru.

Sugarcane can grow on a range of soil types from sandy to clay soils but grows best on fertile, well-drained soils with an ideal pH of 6.5 **(Cayo One's soils average 6.5 pH)**, however it can tolerate a degree of acidity or alkalinity and is moderately sensitive to soil salinity. Sugarcane can be grown on many soils ranging from highly fertile well-drained mollisols, through heavy cracking vertisols, infertile acid oxisols, peaty histosols, to rocky andisols. Both plentiful sunshine and water supplies increase cane production. This has made desert countries with good irrigation facilities some of the highest-yielding sugarcane-cultivating regions.

7.2. Planting / Harvest Cycle

Although some sugarcanes produce seeds, modern stem cutting has become the most common reproduction method. Each cutting must contain at least one bud, and the cuttings are sometimes hand-planted. In more technologically advanced countries like Australia, Brazil, and the United States, billet planting is common. Billets (i.e. stalk sections) harvested by a mechanical harvester are planted by a machine that opens and recloses the ground. Once planted, a stand can be harvested several times; after each harvest, the cane sends up new stalks, called ratoons. Successive harvests give decreasing yields, eventually justifying replanting. Two to ten harvests are usually made depending on the type of culture, with many of the more productive countries that implement scientific farming methods replanting at least every five to seven years. In a country with entirely mechanical agriculture looking for a high production of large fields, like in North America, sugar canes are replanted after three to four harvests to avoid a lowering in yields. In countries with a more traditional type of agriculture with smaller fields on hillier terrain and hand harvesting, like in the French island la Réunion, sugarcane is often harvested up to ten years before replanting.

The crop cycle varies between 10 and 24 months. In modern, fully mechanized cultivation areas, where temperature and precipitation rates are optimal, and cultivation, plant nutrition, and pest management are more scientific, the growing period is often considerably shorter, with plant cane harvested 9 months after spring emergence, and 7-8 months for ratoon crops.

8. <u>Weed, Pest, and Disease Management</u>

Weeds can cause a number of problems for a sugarcane crop: competing for nutrients, sunlight and moisture; making harvesting difficult and reducing cane quality due to contamination; and some weeds can release compounds that are toxic to sugarcane growth. Examples of weeds found in cane fields are:

- Grasses – generally prolific, germinate in the early stages of a cane crop and compete vigorously with the crop

- Sedges – generally occur in wetter areas, the main sedge is nutgrass which is difficult and expensive to control

- Broadleaf weeds – generally regional and soil specific

- Vines – climb up and entangle themselves in the sugarcane, tend to germinate later in the season, can be difficult to control and manage, can impede harvesting and contaminate product leading to a lower price for the farmer

Hooded Sprayer applies herbicide carefully!

Cultivation improves weed management

Methods used to control weeds in sugarcane crops are mechanical cultivation, herbicides, and the retention of post-harvest residues. A combination of these methods is typically used in an integrated management system. A challenge for the sugar industry and for growers is ensuring that there are no environmental impacts off-farm from the chemicals used. Herbicides must be applied by trained staff and the appropriate safety procedures followed.

The cane beetle (also known as cane grub) can substantially reduce crop yield by eating roots; it can be controlled with imidacloprid (Confidor) or chlorpyrifos (Lorsban). Other important pests are the larvae of some butterfly/moth species, including the turnip moth, the sugarcane borer (Diatraea saccharalis), the African sugarcane borer (Eldana saccharina), the Mexican rice borer (Eoreuma loftini), the African armyworm (Spodoptera exempta), leaf-cutting ants, termites, spittlebugs (especially Mahanarva fimbriolata and Deois flavopicta), and the beetle Migdolus fryanus. The planthopper insect Eumetopina flavipes acts as a virus vector, which causes the sugarcane disease ramu stunt. The best control methods for these pests include aerial insecticide spraying, reducing available food, and cultivation.

Cayo One's onsite airstrip/dedicated crop-duster make spraying faster, easier and cheaper

Various pathogens can infect sugarcane, such as sugarcane grassy shoot disease caused by Phytoplasma, whiptail disease or sugarcane smut, pokkah boeng caused by Fusarium moniliforme, Xanthomonas axonopodis bacteria causes Gumming Disease, and red rot disease caused by Colletotrichum falcatum. Viral diseases affecting sugarcane include sugarcane mosaic virus, maize streak virus, and sugarcane yellow leaf virus. The best control methods for these pathogens include planting disease resistant cultivars, strategic use of fungicides in the crop cycle, and regular field inspections with prompt aerial fungicide spraying when issues are detected.

9. <u>Harvesting / Transport</u>

Sugarcane is either harvested by hand or mechanically. Hand harvesting accounts for more than half of global production and is dominant in the developing world. In hand harvesting, the field is first set on fire. The fire burns dry leaves, and chases away or kills any lurking venomous snakes, without harming the stalks and roots. Harvesters then cut the cane just above ground-level using cane knives or machetes. Various studies estimate that a skilled harvester can cut up to one half MT (500 kg/1,100 lbs.) of sugarcane per hour.

Hand Cutting Sugarcane

Post cutting hand sorting and stacking

Mechanical harvesting uses a combine, or sugarcane harvester. The Austoft 7000 series was the first modern harvester design, but versions are now produced by other leading agricultural companies, including Cameco and John Deere. The machine cuts the cane at the base of the stalk, strips the leaves, chops the cane into consistent lengths and deposits it into a transporter following alongside. The harvester then blows the trash back onto the field. Such machines can harvest as much as 100 MT per hour (50MT/hour is a more common rate); however, harvested cane must be rapidly processed. Once cut, sugarcane begins to lose its sugar content, and damage to the cane during mechanical harvesting accelerates this decline. This decline is offset because a modern chopper harvester can complete the harvest faster and more efficiently than hand cutting and loading. Mechanized farmers use a series of hydraulic high-lift infield transporters to work alongside their harvesters to allow even more rapid transfer of cane to waiting carts for rapid transfer to processing mills. This mechanical harvesting doesn't require the field to be set on fire; the remains left in the field by the machine consist of the top of the sugar cane and the dead leaves, which act as mulch for the next round of planting.