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Ground Calcium Carbonate

Limestone Investment Package

Jamaica's Limestone Industry
Value Chain Development Project

Prepared by PricewaterhouseCoopers



June 2020

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1.0 Executive Summary

Overview

Limestone is the largest mineral resource possessed by Jamaica and is an essential raw material for multiple industries such as steel, cement, agriculture, pharmaceutical and construction. It is estimated that there are over 150 billion metric tonnes in limestone reserves in Jamaica of which 50 billion metric tonnes are deemed recoverable. A significant portion of these reserves are of high purity limestone, which is defined by a high concentration (i.e. 95% to 98%) of calcium carbonate.

In Jamaica, the production of limestone is supported by one hundred and forty-six licenced mining and quarry operators situated in all parishes across the island. Over the past four years, the country's production has been increasing. Approximately 10% of extracted limestone is exported, while the remaining 90% is consumed domestically and the total value of limestone exports from Jamaica is just above 1% of the total value of limestone imported in the nearby regions. Although Jamaican limestone is used primarily as construction material and road base, limestone can be utilised in a wide range of sectors. The high value of import in prominent markets in North America, South America and the CARICOM region presents an opportunity for Jamaica to enter the value-added market of limestone which is significant in terms of value.

Why Jamaica?

The Government of Jamaica (GoJ), in its 'Vision 2030 Jamaica' document, has identified Mining and Quarrying as one of the key and strategic sectors to achieve its vision to make Jamaica a developed nation by 2030. The GoJ has secured funding from the World Bank to finance a project entitled Foundations for Competitiveness and Growth Project (FCGP) that is designed to enable private sector-led growth in the Jamaican economy, in an inclusive and sustainable way.

The limestone industry in regions near to Jamaica, namely CARICOM, North and South America has been primarily driven by the growth in construction activities in the residential and commercial building sectors and other infrastructure developments. In addition, low, stable economic growth, infrastructure development, increasing populations and rising disposable incomes have further increased the demand for value-added limestone products across sectors. The central location of Jamaica provides a strategic advantage where it is closer to the import destinations as compared to the countries from which limestone is currently imported. Other important indicators of the need for the development of Jamaica's value-added limestone industry and other key success factors are highlighted in the table below.

Table 1 Jamaica's limestone value-added success factors

The Value-Added Opportunity	Sustainable Growth Factors
<ul style="list-style-type: none">• Jamaica has large quantities of limestone reserves and high-purity limestone.• The export market for limestone as well as value-added products has been growing and there is opportunity for the development of higher products for export globally.	<ul style="list-style-type: none">• Increasing stability in the region• Increasing transparency both in governments and local authorities• Inflation stability• Decreasing unemployment levels• Strong relationship with international

The Value-Added Opportunity	Sustainable Growth Factors
<ul style="list-style-type: none"> Increased growth in limestone consumption in the Americas region presents an opportunity for Jamaica. The cost of labour in Jamaica represent one of the lowest in the Americas for accounting to the IDB Labour market division. Various trade agreements exist between Jamaica and the Caribbean and developed nations with growing demand such as the USA, Canada and the European Union (EU). 	<ul style="list-style-type: none"> development partners Increasing access to regional and world markets Jamaica's geographic location makes it is strategically placed to become a regional player in transshipment. Kingston Port has been predicted to become region's biggest transshipment hub. Growth is being driven by a more stable and increasing income and lower debt levels

Product Overview

Limestone has many industrial uses and can be processed into a variety of products. It is used as a filler in a variety of products, including paper, plastic and paint. The highest purity limestone is used in food and medicines such as breakfast cereals and calcium pills. Value-added limestone products such as Calcium Carbonate (i.e. Ground Calcium Carbonate (GCC) and Precipitated Calcium Carbonate (PCC)), Lime (Quicklime, Slaked Lime and Hydraulic Lime), Dimension Stones (i.e. stones, tiles, blocks.) and Cultured Marble are used across industries.

This Information package focuses on Ground Calcium Carbonate (GCC).

Table 2 Summary of GCC

Product	Description	Application/Industries
Ground Calcium Carbonate (GCC)	<p>GCC is white, finely crushed limestone with a flour-like consistency.</p> <p>It is produced via a series of processes that involves the crushing and grinding of the raw limestone to produce required size output. No chemical change is involved in the process.</p>	<ul style="list-style-type: none"> Food & Pharmaceuticals Paper and Pulp Plastic Paint Agriculture and Animal feed Rubber

Financial Highlight

An assessment of the valued-added production for GCC in Jamaica indicates that for a total production of 30,000 tonnes per annum, an investment in this product could be financially feasible. The analysis was conducted under two scenarios,

- I. On a standalone (start-up)
- II. An incremental basis (existing operation)

On an indicative basis, the internal rate of return (IRR) could range from 33.8% to 49.5% and net present value (NPV) range from US\$11.8M to US\$13.0M on a standalone and incremental basis respectively.

2.0 Introduction and Overview

The Jamaican Context

It is estimated that Jamaica has over 150 billion metric tonnes in limestone resources of which 50 billion metric tonnes are deemed recoverable. Over the past four years, the country's production has been increasing. Limestone is the largest mineral resource possessed by Jamaica and is an essential raw material for other industries such as steel, building and cement, agriculture and paper and pulp. It is usually extracted in open pits and predominantly used as a construction material and road base. The production of limestone is supported by one hundred and forty-six licenced mining and quarry operators situated in all parishes across the island.

As of 2019, Jamaica is exporting limestone valued at US\$4.0m per annum. The total existing export market in the region (Americas and CARICOM) stands at US\$300 million and is expected to grow by at least US\$7 million every year. The annual increase in limestone import in the nearby region is itself double the value of the existing export market of Jamaica.

The Limestone Value-Added Opportunity

Despite the vast quantity of limestone reserves and the large number of quarries operating in the island, the industry remains largely underdeveloped as many of the quarries operate under capacity, and the sector lacks financing. Approximately 10% of extracted limestone is exported while the remaining 90% of the production is used to meet local demand. Exports are directed to the USA, South America, Canada, and CARICOM. More importantly, the value of limestone exported from Jamaica is slightly above 1% of the total value of limestone import in the nearby regions.

A large proportion of Jamaica's limestone is considered to be "high purity" due to its concentration of calcium carbonate (<95%-98%). Geographical studies conducted on limestone deposits in Jamaica reveal large deposits of reserves in the parishes of Portland, St. Elizabeth and Trelawny, with high to very high purity limestone, as shown in Table 3 below, suitable for end use in multiple industries from construction to pharmaceuticals.

Table 3: Quality of limestone in Jamaica

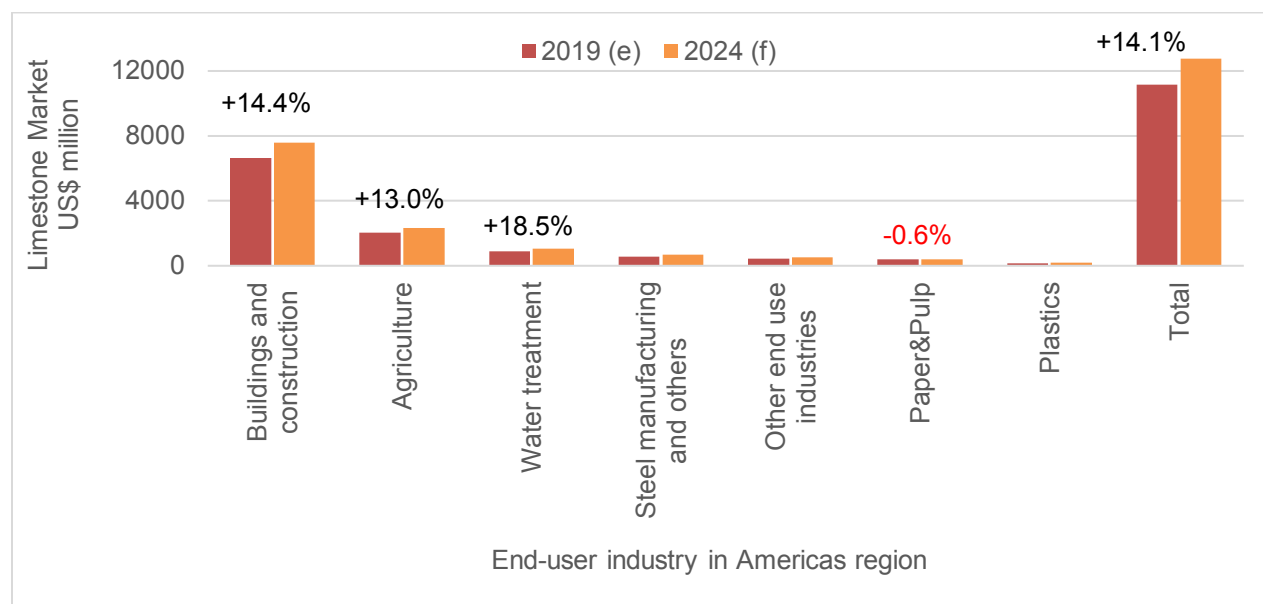
	Portland (Average)	Trelawny (Average)	St. Elizabeth (Average)
Calcium Carbonate, CaCO₃ (%)	>99	>99	>98
Magnesia, MgO (%)	~0.60	~0.2	~0.3
Silica, SiO₂ (%)	<0.20	0.50	<0.20
Iron oxide, Fe₂O₃ (%)	<0.10	0.05	0.20
Aluminium Oxide Al₂O₃ (%)	<0.10	<0.15	0.35

Source: PwC Research, MGD reports

Limestone is used in a wide variety of applications depending on whether it is crushed, ground or is converted to lime. These include construction materials, water treatment, food & beverage, pharmaceuticals, iron & steel, agriculture, plastics and paper. In the Americas region, all the end use sectors are set to grow with a Compound Annual Growth Rate (CAGR) in double digit value terms with an

exception of the paper and pulp industry which is expected to see a reduction in demand. The key end-use industries of limestone are collectively set to grow by 14.1% between 2019 and 2024.

Figure 1: Limestone end-use industry consumption in the Americas region



Source: Mordor Intelligence; e: estimated, f: forecasted

Global Trends

The global limestone market exceeded US\$5.7 billion in 2017 and is estimated to surpass US\$9 billion while growing at a CAGR of 6.5% over the period of 2019 to 2024. This growth is primarily due to an increase in consumption in iron & steel processing, building & construction and agricultural industries. As per International Trade Centre (ITC) Trademap statistics, the total quantity of limestone exported across the world in 2018 increased by 10 million tonnes from 47 million tonnes to 57 million tonnes.

Top Exporters and Importers of Limestone in 2018

As shown in Table 4, the five largest limestone exporters in 2018 were United Arab Emirates, Japan, India, Oman and Turkey. These countries represent 72% of world production.

Table 4: Top Limestone Exporters

Rank	Exporters	Quantity Exported in 2018 (Million Tonnes)	Percentage of Global Export by Quantity	Export Value in 2018 Million US\$
1	United Arab Emirates	24.53	44.3%	229.90
2	Japan	5.15	9.3%	52.28
3	India	3.30	6%	61.55
4	Oman	2.95	5.3%	66.86
5	Turkey	2.60	4.7%	6.72

Source: ITC calculations based on UN COMTRADE and ITC statistics (accessed on March 24, 2020)

As shown in Table 5, the five largest limestone importers in 2018 were India, Germany, Bangladesh, Taiwan and Kuwait.

Table 5: Top Limestone Importers

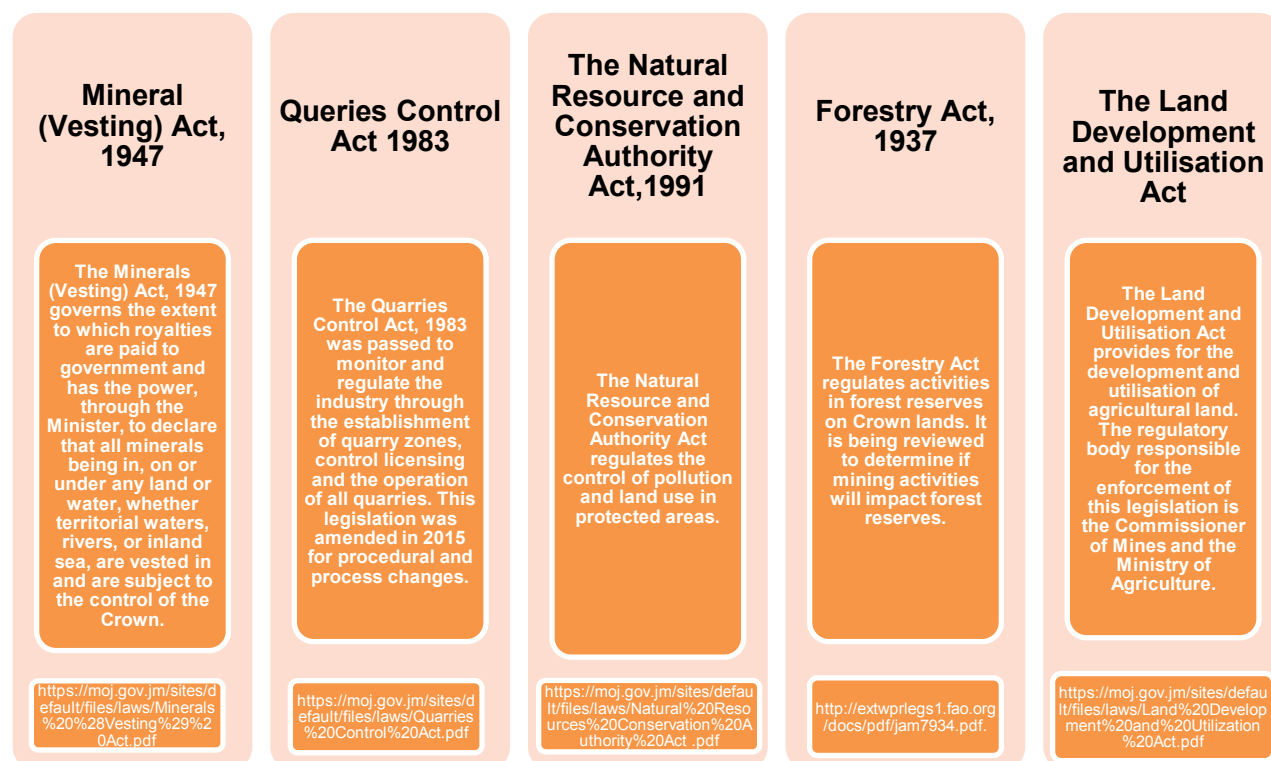
Rank	Importers	Quantity Imported in 2018 (Million Tonnes)	Percentage of Global Import by quantity	Import Value in 2018 Million US\$
1	India	22.85	39.6%	453.63
2	Germany	3.65	6.3%	43.11
3	Bangladesh	3.61	6.3%	43.23
4	Taiwan	3.21	5.6%	64.38
5	Kuwait	2.94	5.1%	31.74

Source: ITC calculations based on UN COMTRADE and ITC statistics (accessed on March 24, 2020)

Regulatory Environment

The main legislation / regulations that impact the mining and quarrying industry in Jamaica include:

Figure 2 Jamaica regulations for Mining & Quarrying



According to the Minerals Policy, the GoJ has separated its regulatory role through the Ministry of Transport and Mining (MTM) and its ownership in the mining industry and its operations through the Jamaica Bauxite Mining Limited (JBM) and Clarendon Alumina Production Limited (CAP). The Ministry's main responsibilities are the overall policy responsibility and development of the industry. The Mines and

Geology Division (MGD) has statutory authority under the Mining Act and the Quarries Control Act to exercise general supervision over all prospecting, mining and quarrying operations throughout the island. The MGD also manages the investigation, characterisation, documentation and release of information on all aspects on the geology of Jamaica.

Investing in Jamaica

As an emerging market Jamaica relies on foreign direct investment (FDI) to spur its growth and international competitiveness. Jamaica has welcomed FDI as a major part of the development of several industries. In 2018 the inflow of FDI to Jamaica valued approximately USD\$ 775 million. The ability to conduct business efficiently has been improving over the past 10 years. Jamaica's ease of doing business current ranking improved to 71 in 2019 from 75 in 2018, according to the latest World Bank annual ratings, Jamaica is ranked 71 among 190 economies

The Jamaican economy provides many benefits to foreign investors such as stable and positive economic growth and improved competitiveness in the region. Jamaica also boasts a strategic geographic location, stable democracy, a relatively large English-speaking market and access to major shipping paths such as the Panama Canal.

The limestone industry in the region is driven by construction in the residential and commercial building sectors and other infrastructural development. As the region continues to grow with the increased population, rising disposable incomes and continued infrastructural development the demand for value-added products across sectors is expected to rise.

With billions of limestone reserves and the strategic advantage of being closer than most import destinations such as India and Japan, Jamaica's value-added limestone industry is uniquely positioned to tap into the growing market. Table 6 below highlights the position of the market and other key success factors of limestone value-added production.

Table 6: Investing in Jamaica Limestone - The Opportunity

The Value-Added Opportunity	Sustainable Growth Factors
<ul style="list-style-type: none"> Jamaica has large quantities of limestone reserves and high-purity limestone. The export market for limestone as well as value-added products has been growing and there is opportunity for the development of higher products for export globally. Increased growth in limestone consumption in the Americas region presents an opportunity for Jamaica. The cost of labour in Jamaica represent one of the lowest in the Americas for accounting to the IDB Labour market division. Various trade agreements exist between Jamaica and the Caribbean and developed nations with growing demand such as the USA, Canada and the European Union (EU). 	<ul style="list-style-type: none"> Increasing stability in the region Increasing transparency both in governments and local authorities Inflation stability Decreasing unemployment levels Strong relationship with international development partners Increasing access to regional and world markets Jamaica's geographic location makes it is strategically placed to become a regional player in transshipment. Kingston Port has been predicted to become region's biggest transshipment hub. Growth is being driven by a more stable and increasing income and lower debt levels

Economic Profile

Jamaica has a mixed economy that is heavily reliant on services. Approximately 70% of the country's Gross Domestic Product (GDP) is derived from services, and most of its foreign exchange comes from tourism, remittances, and bauxite/alumina exports. Over the last decade, Jamaica's GDP (at market price) has grown by 88%. The country's GDP for FY2019 stood at JM\$ 2,053 bn, representing an increase of about 6.5% over FY 2018.

High public service debt obligation and vulnerability to frequent natural disasters are the key concerns to the macroeconomic stability of the island. In terms of the public service debt obligation to GDP, Jamaica was previously at 147% of GDP. In 2019 Jamaica successfully completed its economic reform programme supported by the International Monetary Fund (IMF) and through the programme the debt obligation to GDP ratio fell to 94%. This indicates strong political will and a strong future of economic growth and development.

Table 7: Key economic indicators for Jamaica

Indicator	FY 2016	FY 2017	FY 2018	FY 2019
Total Gross Domestic Product at Market Prices (JM\$ million)	1,688,754	1,787,954	1,927,202	2,053,185
Mining & Quarrying sector contribution to the GDP (JM\$ million)	32,845	35,246	46,852	60,573
Central government gross debt (JM\$ million)	2,068,760	2,158,846	2,028,154	1,998,668
Gross Debt to gross GDP (%)	123%	121%	105%	94%
Interest rates (Domestic currency, %)	3.51%	3.75%	2.85%	2.51%
Interest rates (Foreign currency, %)	1.65%	2.07%	1.90%	1.83%
Exchange rate (US\$ to JM\$)	118.75	127.13	127.99	130.60

Source: Statin, Bank of Jamaica

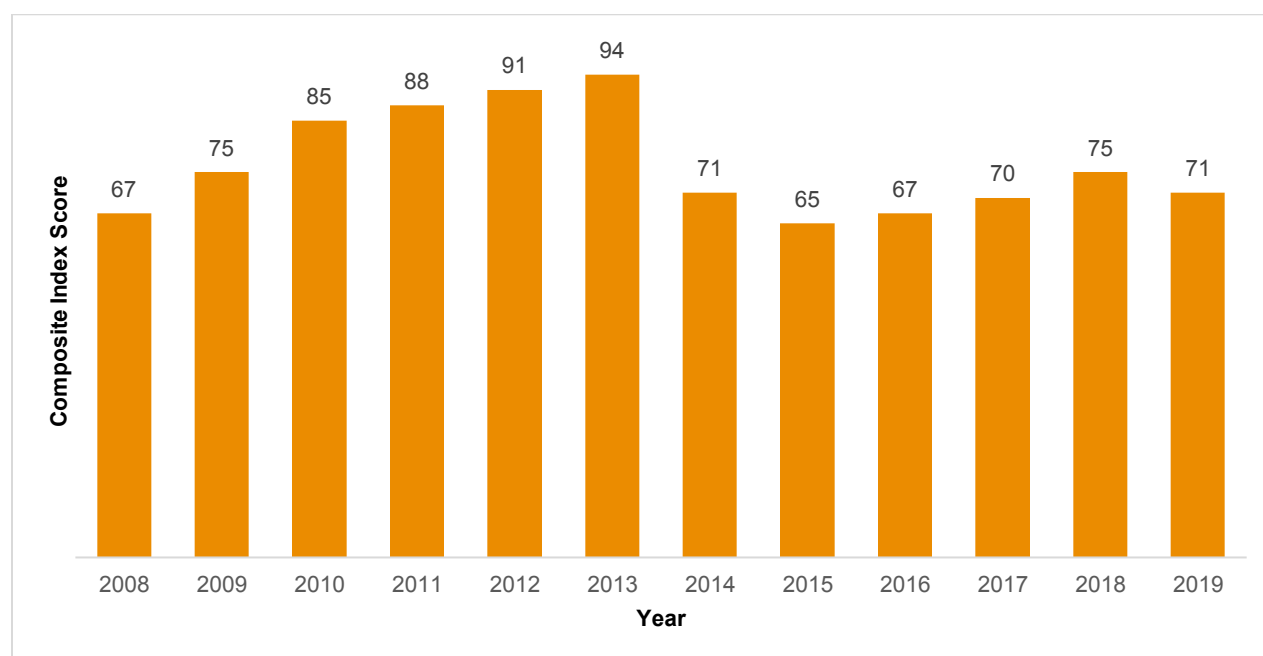
Table 8: Jamaica's credit rating by leading Credit Rating Agencies (CRA)

No.	CRA	Rating	Outlook	Date (as of)	Remarks on CRAs' ratings
1	Fitch	B+	Positive	January 29, 2020	For Fitch, a bond is considered investment grade if its credit rating is BBB- or higher. Bonds rated BB+ and below are speculative grade, sometimes also referred to as "junk" bonds.
2	Moody's	B2	Stable	December 11, 2019	For Moody's, a bond is considered investment grade if its credit rating is Baa3 or higher. Bonds rated Ba1 and below are speculative grade, sometimes also referred to as "junk" bonds.
3	Standard and Poor's (S&P)	B+	Stable	September 27, 2019	For S&P, a bond is considered investment grade if its credit rating is BBB- or higher. Bonds rated BB+ and below are speculative grade, sometimes also referred to as "junk" bonds.

Investor Friendly Reforms

Jamaica has been trying to attract investors to the island through business-friendly reforms. Since 2013, Jamaica's Parliament passed numerous pieces of legislation to improve the business environment and support economic growth through a simplified tax system and broadened tax base. This has allowed improvement in Jamaica's Doing Business Ranking as depicted in the figure below.

Figure 3: Jamaica's historical Ease of Doing Business ranking

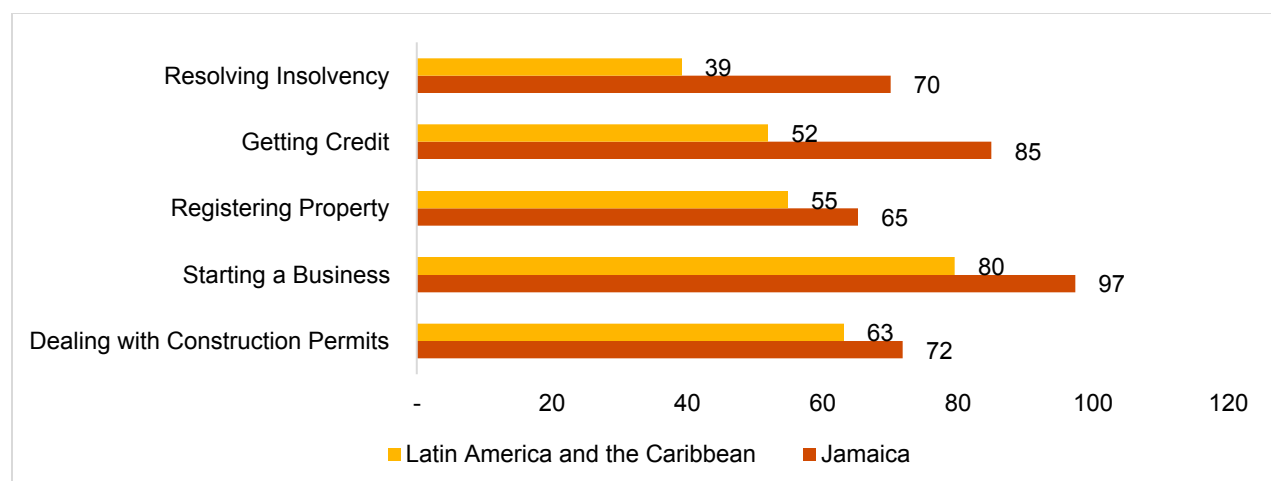


Source: The World Bank

The establishment of credit bureaus and a Collateral Registry under the Secured Interest in Personal Property (SIPP) legislation are improving access to credit. Jamaica made starting a business more streamlined by consolidating forms and made electricity less expensive by reducing the cost of external connection works. The GoJ is also open to foreign investment in all sectors of its economy and is currently in the process of developing a National Investment Policy to guide future FDI reform.

The graph below compares Jamaica's ranking in key doing business ranking factors within the region. Compared to the region, it is clear Jamaica has made significant gains in absolute terms, and there are further reforms currently in the works including process re-engineering for construction permits, as well as reforms around decreasing the length of time it takes to gain an electrical connection. Taken together, this demonstrates a focus on creating a further business-friendly environment in Jamaica.

Figure 4: Doing Business Indicators in Jamaica compared to the Latin America and Caribbean Region



Source: The World Bank

Enabling Environment

The Government of Jamaica provides vast support for the development and expansion of the sector, including:

- Incentives to investors including income tax relief, duty concessions on production-related imports
- Introduction of online registration for importers and exporters that allows access to all trade related agencies
- Provision of information on commerce and industry such as information on product marketing, trade statistics and government incentives
- Large scale improvements to the transport infrastructure and services

Taxation Environment

The incentive regime came into effect in Jamaica on January 1, 2014 and provides for varying levels of relief, via the following legislation:

Table 9: Key Legislations to Consider when Doing Business in Jamaica

Key Legislation	Summary
1 The Fiscal Incentives (Miscellaneous Provisions) Act, 2013	<p>The standard tax rate is 25% for non-regulated entities. This Act provides for:</p> <ul style="list-style-type: none"> • the reduction of the effective corporate income tax rate by applying an Employment Tax Credit (ETC) at a maximum value of 30%, which reduces income tax from standard rate 25% for unincorporated company to an effective tax rate of 17.5% • Capital Allowances that cover, among other things, a broadened definition of 'industrial buildings' to include Duty-free Importation of Equipment and Machinery, as well as revised tariff rates ranging from 0% to no higher than 20% (with some exceptions).

Key Legislation	Summary
	If designated as SEZ Reduced income tax from standard rate 12.5% for unincorporated company to an effective tax rate of 7.5% or 0%
2 The Income Tax Relief (Large Scale Projects and Pioneer Industries) Act, 2013	This provides for an improved and more attractive rate of income tax for projects that are considered to be large scale or of a pioneer nature. As of the date of this investment package the related regulations regarding how this benefit will be administered have not yet been promulgated.
3 The Customs Tariff (Revisions) (Amendment) Resolution, 2013	This Act provides for the duty-free importation of capital equipment and raw material.
4 The Stamp Duty (Amendment of Schedule) Order 2013	Provides stamp duty exemption on raw materials and non-consumer goods.

The above acts provide relief through tax credits, duty-free importation, stamp duty exemptions and capital allowances as it relates to specific industrial buildings. With the development of new manufacturing plants to process the limestone into value added products, the limestone industry can draw on these acts to mitigate the costs associated with manufacturing. Particularly, the income tax relief will improve profits and the customs tariff resolution will significantly reduce the heavy charges that are accompanied with importation of capital equipment.

Special Economic Zones

The Jamaica Special Economic Zone Authority (JSEZA) was created to implement and manage special economic zones within Jamaica. These zones are areas in which the regulations of the country do not apply or are modified to allow for increased investment, employment and job creation.

Under the SEZ Act, many reforms were introduced. Under the previous free zone regime, manufacturing entities were only allowed to supply up to 15% of production locally. Entities under the SEZ are now able to sell goods both locally and for export with no restrictions. It can be noted however that the JSEZA highly prefers exportation of locally produced goods. The SEZ also provides a number of additional tax benefits and incentives which includes a 12.5% reduction in income tax, no General Consumption Tax (GCT) on electricity and telephone services and stamp duty relief.

Implications for the Limestone Industry

Although an SEZ cannot be applied to mining and quarrying operations they can be applied to manufacturing and other related industries which would provide support for value-added products. JSEZA highly recommends Single or Multi-Occupancy for this purpose; however, there must be a clear separation of business from mining. The limestone industry can seize the opportunity offered by SEZ legislation to become Multi-Occupancy by setting up a Special Purpose Vehicle (SPV) for value-added products that they plan to market or export.

JSEZA has also introduced a business centre to facilitate quick application processing for prospective SEZs. Provided that the required regulations and licences are approved by the respective authorities the timeline for an application review is at least forty-five (45) days, with a pre-approval timeline of approximately thirty (30) days.

Trade Agreements

Jamaica has negotiated trade agreements with the world's major trading powers such as the European Union, Canada, and the United States, as well as in our important domestic CARICOM markets. These trade pacts provide a range of opportunities for Jamaican exporters. The main trade agreements that Jamaica is party to include:

Figure 5: Summary of Key Trade Agreements

The European Partnership Agreement
<ul style="list-style-type: none">• The accords immediate duty-free/quota-free market access for CARIFORUM goods into the EU except sugar.
Caribbean Basin Initiative (CBI)
<ul style="list-style-type: none">• The CBI comprises the Caribbean Basin Economic Recovery Act of 1983 (CBERA) and the Caribbean Basin Trade Partnership Act of 2000 (CBPTA). The CBI Act was established by the US in 1984 to provide economic aid to Jamaica (and 23 other countries in the Caribbean and Central America) through the waiver of tariff benefits. Most products manufactured or grown in CBI beneficiary countries are eligible for duty-free entry into the United States.
Caribbean-Canada Trade Agreement (CARIBCAN)
<ul style="list-style-type: none">• CARIBCAN is a preferential arrangement guaranteeing duty free access to Canada for a wide range of products excluding textiles and apparel, footwear, luggage and handbags, leather garments, lubricating oils and methanol.
Caribbean Single Market Economy (CSME)
<ul style="list-style-type: none">• Established by CARICOM to create economies of scale in the region. It offers Jamaicans the right to establish a business in another territory in the CSME without restriction. Jamaican goods that have already entered a CSME country will also be eligible for export/import into another CSME territory without duty. Capital from Jamaica can also 11 circulate freely in other CSME countries. Jamaica has also negotiated and signed Free Trade Agreements (FTA) with Argentina, Colombia and the Dominican Republic.

Potential risks and constraints

Jamaica has a world class quality and abundant quantities of limestone. The limestone in Jamaica is readily accessible but there is a need for evaluation of reserves along with improved mining techniques, upgraded state-of-the-art machinery and equipment and modernization process. The industry also faces several risks to the limestone market such as:

- Inadequate record keeping
- High cost of energy
- Lack of bulk shipping of products
- Lack of security of the precious material

The Jamaican government is willing to provide an enabling environment to reduce these risks and have started the process through active engagement with stakeholders, implementing the Draft Minerals Policy and improving access to finance. JAMPRO has a specialist to assist investors and market players with entering the value-added industry.

The table below highlights common issues associated with limestone and respective factors used to mitigate them.

Table 10: Common Issues associated with Limestone

Problems associated with Limestone		Constraint Mitigating Factors
Weathering	Limestone is more prone to chemical weathering than other stones, such as granite, owing to the presence of calcium carbonate which readily reacts with rainwater. Rainwater gets acidic when it combines with carbonic acid and causes weathering in limestone walls.	After extraction mined limestone can be stored to prevent weathering by rain and other atmospheric elements.
Erosion	Limestone walls when exposed to continuous air or water, is prone to erosion. The airborne abrasives floated by wind cause erosion on limestone.	Erosion can be mitigated by planting in areas surrounding limestone walls.
Staining	Staining is also known as discolouring of limestone. Different types of organic and inorganic oils that limestone absorbs, organic matters, such as leaves, flowers or tea and coffee, animal droppings, and metals, like copper or iron, which causes rust, are the major reasons of staining on the limestone.	Limestone surfaces can be cleaned to prevent long-term stain.
Crumbling	The most critical problem of limestone and limestone materials is crumbling. Limestone has a brittle structure and inherent weakness of the stone along with external factors and gradual breakdown of the binders used in the building affects the durability and strength of the stone, thus causing crumbling in the limestone walls.	Potential sources of crumbling can be repaired if detected early.

3.0 Product Overview – Ground Calcium Carbonate

Overview

GCC is finely ground high-purity limestone product. GCC is processed through naturally occurring high purity calcite ores (like high purity limestone) containing calcium carbonate material as a major component. The selected raw material is washed, crushed, ground into fine particles and then classified accordingly. GCC production is a mechanical process and therefore, does not involve any chemical process or reactions.






Figure 6: A typical representation of GCC





Key Applications of GCC

GCC can be used in wide range of applications. There is a tailor-made product for each end use, where the distribution of fineness, particle size and purity are optimised to satisfy the technical requirements of that specific product.

The end-uses for GCC are described in the table below.

Table 11: Key Applications of GCC

Product		Uses
Agriculture (fertilizers)		GCC is used as topsoil for agriculture, stabilising the acidity of soil and providing essential calcium for the support of crops.
Animal and Pet Feeds		GCC is incorporated into animal feed as a dietary supplement and antacid.
Paper		GCC in fine grades is used in paper manufacturing. As an alkaline material, it reduces the acidity of paper, improving the brightness and durability of the printed material.

Product		Uses
Plastic		GCC is used as a filler in plastic products, adding density, improving rheology and reducing cost. GCC is often blended with additives to aid bonding within the plastic.
Paints and Surface Coatings		GCC is used to bulk out or extend the resins and polymers in paints. GCC is used as an aid to pigmentation and to help control the finish (matte or gloss).
Rubber and Elastomers		GCC is used as an extender and in controlling the flow properties of products that are to be moulded. A widespread application is in latex carpet backing materials.
Food, Pharmaceuticals and Household		GCC is used as a dietary calcium supplement and antacid, or as a chemical binder. It can be used in less obvious ways, for example in polishing and cleaning rice or a cleaning component in shoe polish.

In addition to the applications mentioned in the table above, GCC is also used in buildings and construction, food and physical health, adhesive and sealants, environmental protection and glass and ceramic industries.

Production Process

The production process for GCC is detailed in the table below.

Table 12: GCC Production Process

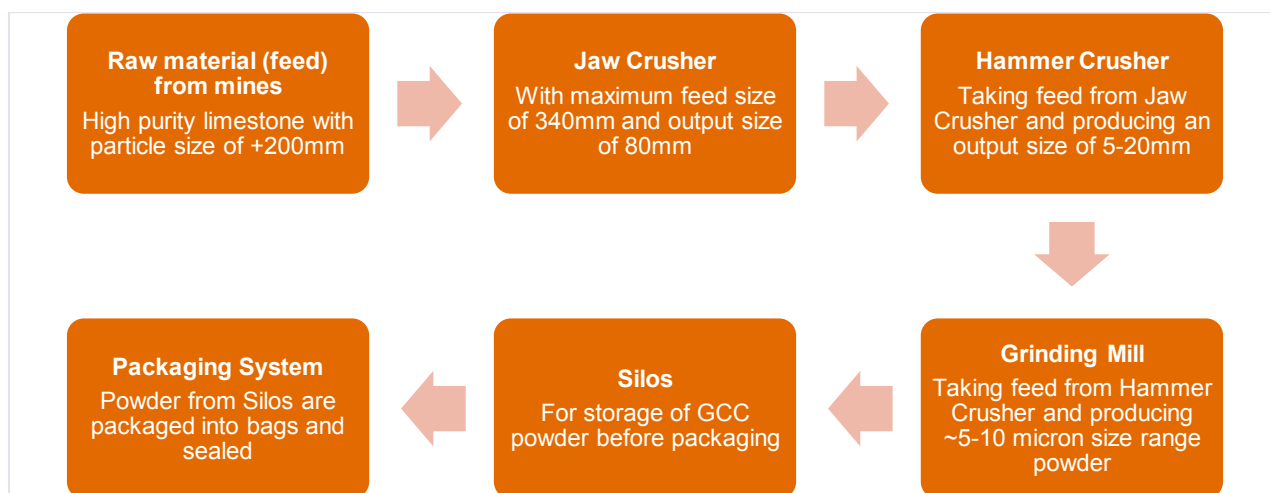
Production	Process
Transportation and storage of raw material (feed)	High purity limestone is transported to the GCC plant location after primary crushing and stored in a storage yard inside the plant boundary. General sorting may be done to ensure that the maximum feed size of the limestone does not exceed rated intake capacity of the Jaw crusher (~340mm).
Two stage crushing	The two-stage crushing system is used to reduce the size of feed suitable for input to the grinding mill system. The raw material from the storage yard is fed to the hopper with the help of a wheel loader. The hopper discharges the limestone feed to a vibrating feeder which is capable of continuously and evenly sending materials to the jaw crusher and roughly screening them. The jaw crusher crushes the limestone feed to about 40mm to 80mm size. The output of the jaw crusher is fed to the hammer crusher with the help of a

Production	Process
	belt conveyor. The hammer crusher further reduces the size to about 5mm to 20mm which can be fed to the grinding system for further processing/ size reduction.
Grinding	After the two-stage crushing, the crushed limestone is transported to a feed hopper with the help of a bucket elevator. Through a belt feeder, the crushed limestone from the hopper is fed to the grinding mill system. A system of rings with rotating grinding rollers is used for size reduction. The grinding process reduces the particle size from 5mm to 20mm particle size to about 10 microns to 15 microns (powder size). The mill also contains classifier, blower, screw conveyor, discharge valve, off-line pulse filter and an air compressor.
Storage and packing	The ground powder produced after the crushing and grinding stages is taken to storage silos or a semi-mechanised packaging system with the help of an enclosed pneumatic conveyor. The powder bag, properly sealed, will be stored at a nearby storage shed before dispatch to customers.

Process Flow

A dry process line involves a series of crushing and fine milling stages followed by classification that produces a fine micronised GCC product. It is suitable for producing powder with a particle size of more than 3 microns. The process generally provides flexibility in production at a lower production cost and capital investment relative to wet process lines. This is reflected in the figure below.

Figure 7: Process flow for GCC



Waste Generation and Pollutants in a GCC Production Line

Due to the mechanical dry nature of the production process, waste and pollutants are generated mainly in the form of dust (consisting of Particulate Matter (PM)) and noise. In addition to waste/ pollutants generated from the direct production process, drainage channels around the processing plant & storage yard area and pollution due to machinery may also cause environmental disturbances.

Although these pollutants are not significant or hazardous at a nation or global level, they can be a source of pollution within communities in which the operation resides.

Therefore, best industry practices shall be followed during the plant operation to minimise or control pollution within permissible limits as regulated by NEPA.

Some of the key areas leading to the generation of unwanted wastes in the production line of GCC are stated below: –

- **Raw material (limestone) storage yard** – handling, sorting, water sprinkling, and storage of raw material may lead to the dust generation (fugitive emissions) and wash out of limestone fine dust particles in the drainage line. The dust leads to the deterioration of air quality whereas the wash out of fine limestone particles in drainage lines may lead to the deterioration of water quality if it gets mixed with natural water streams or the ground water table.
- **Crushing and grinding process** –The crushing and grinding of raw material from about 300 mm lumps size to microns size requires exhaustive size reduction equipment and thus it leads to the dust and also loud noises which may disturb nearby communities.
- **Transfer and conveying of material** – involve mechanical or pneumatic means, including the use of a hopper, bucket elevators, vibrating feeders and belt conveyors. This may lead to generation of dust and particulate matter in the process.
- **Storage, packaging and dispatch** – storage is mainly done in product silos. Packaging is done through semi-automatic to fully automatic means and dispatched through trucks. Although adequate measures should be taken care while selecting and designing processes to curb dust particles, it may still lead to the generation of very fine dust or particulate matter (fugitive emissions).

General Industry Best Practices for Minimising Environmental Footprint of GCC Operations

Focus area (Emissions)	Best Industrial Practices (Control Measures)
Particulate Matter or Dust	<ul style="list-style-type: none"> • Use a simple and linear layout design to reduce number of transfer points. • Store raw material, intermediate and final products in covered silos or enclosures. • Utilise a closed shed for major equipment like crusher, screen, grinding mill and conveyors. • Use dust separators like cyclones or bag filters for removing and collecting dust generated during crushing, grinding and material handling operations. • Store raw material and the waste generated during the process in an environment protected from wind and weather conditions. • Use a dust extraction system in conjunction with hoods and enclosures covering transfer points and conveyors. • Minimise material drop distances by the use of adjustable conveyors. • Automate the cleaning of material handling systems such as conveyor belts and bucket elevators while on their return path. • Use bag filters for collecting dust generated from product silos. • Utilise a semi-automatic or fully automatic system for packaging finished products. • Suppress fugitive dust emissions by using a vertical tube air filters or Dry Fog Dust Suppression System. The dust recovered from it can be re-

Focus area (Emissions)	Best Industrial Practices (Control Measures)
	<p>circulated in the process.</p> <ul style="list-style-type: none"> • Curb dust on roads and pavements by using a vacuum type or brush type sweepers. • Use proper personal protective equipment (PPE) such as safety goggles and respiratory masks. • Install air quality detectors at strategic locations of the plant to keep a regular check on the air quality and take preventive measures accordingly.
Industrial Wastewater	<ul style="list-style-type: none"> • Investigate the landscape, geology and groundwater in the area. • Utilise surveillance and continuous monitoring of ground water quality. • Use techniques such as sedimentation using thickeners or clarifiers to remove suspended solid particles. • Use neutralisation methods (Effluent Treatment Tank) for pH adjustment before water recirculation into the process. • Design a proper drainage system for the collection and processing of rainwater • Monitor plant drainage and disposal measuring the pH level, conductivity, solid dissolution, hardness, calcium and sulfide content
Noise	<ul style="list-style-type: none"> • Design appropriate acoustics to limit the amount of noise which reaches nearby communities. • Install vibration-dampening mounts and concrete foundations for the installation of heavy equipment such as crushers and mills. • Use a muffler in the grinding mill to arrest noise pollution. • Select machines which generate less noise (if practically feasible). • Use silencers for fans, room enclosures for mill operators and noise barriers. • Use of PPE like noise cancelling ear headphones. • Select a site away from communities (if possible) otherwise install outdoor silencers at site to prevent noise from affecting local people. • Install noise level sensors for continuous monitoring.

Equipment Required for GCC Production

The type of equipment required for production of GCC includes:

- Crushing Unit - Charging Hopper, Primary Crusher (Jaw Crusher), Vibrating Chute, Secondary Crusher
- Grinding Unit - Ball Mill, Classifier
- Packaging Unit - Product Silos
- Other Units – Blower, Elevator, Feeder, Discharge Screen Conveyor, Pulse Dust Collector, Air Compressor

4.0 Potential Markets for Jamaican GCC and Competitive Profile

Limestone trade in the Americas

The core markets for limestone exports from Jamaica are CARICOM, North America and South America. The import trend in prominent markets in North America, South America and CARICOM region presents an opportunity to Jamaica to enter the value-added market of limestone which is significant in terms of value.

Table 13: Limestone import in Americas and CARICOM

Markets	Total Limestone Import (in Million US\$)	Import of Aggregates and Stones (in Million US\$)
USA	99.9	13.0
Canada	79.2	11.5
Mexico	4.6	0.0
Brazil	29.5	6.9
Chile	81.3	0.0
CARICOM excluding Jamaica	5.2	0.6
Total imports in the region	300	32
Jamaica's exports	3.8	3.78

Source: ITC Trademap (accessed March 24, 2020)

The total value of imports of the studied markets in Americas was estimated at more than US\$300 million while Jamaica is currently exporting approximately US\$3.8 million (approximately 1% of the regional value).

Calcium Carbonate Market in Global Perspective

Calcium Carbonate is available commercially in two types, namely ground calcium carbonate (GCC) and precipitated calcium carbonate (PCC). Both GCC and PCC have the same chemical formula (i.e. CaCO_3) and are traded under a common HS code. However, the two products are different in their production process, purity, and end uses.

For the analysis of potential markets of GCC, calcium carbonate (having a Harmonized System (HS) code of 283650 and product name: calcium carbonate) was used which combines the data of GCC and PCC. It is to be noted that GCC has no separate HS code for import-export analysis hence the combined code (Product HS code: 283650) was used.

As per ITC Trade map data, global imports of calcium carbonate were estimated at 5.65 million tonnes in 2019, an increase of 15% from quantity imported in 2018. In terms of value, the global imports were estimated at US\$ 844.8 million in 2019. The imports mainly are driven by countries in Asia and Europe. The leading global importers of calcium carbonate are presented in the table below:

Table 14: Global import statistics of calcium carbonate

Country	2017		2018		2019	
	Quantity, thousand tonnes	Value, thousand US\$'000	Quantity, thousand tonnes	Value, thousand US\$	Quantity, thousand tonnes	Value, thousand US\$
World	4,688	848,948	4,908	881,294	5,647	844,802
India	800	95,933	1,021	120,138	1,171	127,435
Netherlands	102	17,611	91	17,014	792	62,414
Germany	428	84,323	541	93,353	541	88,779
Belgium	341	29,760	279	33,505	487	47,142
Saudi Arabia	392	31,344	224	31,156	280	37,101

Source: ITC Trade map accessed on 20th April 2020

India leads the import market of calcium carbonate accounting for 15% of the total import value in 2019. India is followed by key European countries such as Netherlands, Germany and Belgium which together accounted for 23% of the total global imports.

The global export of calcium carbonate appears to be fragmented and competitive in nature with Vietnam leading the exports accounting for 10% of total exports value followed by Malaysia (9% of total export value) and Belgium (7% of total export value).

In Jamaica's context, it is important to observe that some of the leading importers of calcium carbonate source their products from countries in the Americas region, mainly the USA. Also, some of the key importing countries source their products from distant countries, for instance Netherlands importing from Japan. These observations coupled with availability of high purity limestone indicate the possibility of market entry for Jamaica in global calcium carbonate supplier market, provided Jamaica can scale-up and remain cost competitive.

Calcium Carbonate Market from a Regional Perspective

The Americas region has been selected for the assessment of a potential market for calcium carbonate for Jamaican exports. The region's total import of calcium carbonate accounted for 10% of the global total imports by value in 2019. As per ITC Trade map data, Americas imports of calcium carbonate were estimated at 319 thousand tonnes, a decrease of 7% from quantity imported in 2018. In terms of value, the global imports were estimated at US\$ 87.5 million in 2019. The leading importers of calcium carbonate in Americas region are presented in the table below: -

Table 15: Americas' import statistics of calcium carbonate

Country	2017		2018		2019	
	Quantity, thousand tonnes	Value, thousand US\$	Quantity, thousand tonnes	Value, thousand US\$	Quantity, thousand tonnes	Value, thousand US\$
America Aggregation	318	91,720	344	92,303	319	87,525
USA	40	28,653	46	29,240	42	29,210
Canada	54	29,210	26	14,740	25	15,013
Brazil	15	5,849	25	7,972	30	7,891
Chile	47	5,709	79	7,620	60	6,706
Ecuador	12	8,532	15	5,126	13	5,333
Guatemala	9	3,295	11	4,009	14	4,721
Peru	88	4,474	92	4,725	87	4,648

Source: ITC Trade map accessed on 20th April 2020

The imports mainly are driven by USA, Canada and Brazil together accounting for almost 60% of the total imports in the region; while, other key importing countries include Chile, Ecuador, Guatemala and Peru which together contributes about 25% to the total regional imports.

The major suppliers of calcium carbonate to the America region are segmented in the table below: -

Table 16: Major suppliers of calcium carbonate to the Americas

S.N.	Supplier by geography	Value in 2019 (in US\$ thousand)
Suppliers within the Americas region		
1	USA	16,626
2	Canada	5,133
3	Mexico	3,879
4	Brazil	2,623
5	Guatemala	1,573
6	Dominican Republic	1,343
7	Argentina	959
8	Others	1,165
	Total	33,301
Suppliers outside the Americas region		
1	Vietnam	6,726
2	Spain	6,154
3	Japan	5,693
4	France	5,304
5	United Kingdom	4,908
6	China	4,619
7	Malaysia	3,607
8	Others	17,215
	Total	54,226

Source: ITC Trade map accessed on 20th April 2020

About 38% of imports of calcium carbonate is derived from within the Americas region; while, 62% of total imports coming into the Americas region is contributed by countries outside the region. Some of the major suppliers to the region are far-flung countries such as Vietnam, Spain, Japan and France. The Dominican Republic with five integrated cement plants and two grinding plants is currently a major player in the region and is currently exporting to these markets. Jamaica could replicate this model once it increases its exporting capacity. Jamaica's central location and proximity, coupled with its availability of high purity, raw material (limestone) may enable it to penetrate the regional market and increase its share of exports, provided it can scale up and be cost competitive with other export competitors within as well as outside the region.

Potential Markets in Caribbean Community (CARICOM)

CARICOM accounts for 3% of the total import value in the Americas region. Albeit, low in import value, CARICOM's import was estimated at US\$ 2.3 million in 2019, showing an increase of more than 50% from import value in 2018. The vast growth in import was mainly contributed by increased imports of calcium carbonate in Suriname.

Table 17: CARICOM's import statistics of calcium carbonate

Country	2017		2018		2019	
	Quantity, thousand tonnes	Value, thousand US\$	Quantity, thousand tonnes	Value, thousand US\$	Quantity, thousand tonnes	Value, thousand US\$
CARICOM Aggregation	6.00	1,398	7.02	1,495	10.01	2,301
Suriname	0.20	116	-	-	4.47	1,190
Trinidad and Tobago	2.31	516	2.39	623	1.75	395
Jamaica	0.11	116	0.11	58	0.66	338
Barbados	0.33	140	0.20	129	0.18	119
Guyana	0.93	161	1.11	285	0.77	102
Rest of countries in CARICOM	2.13	349	3.21	400	2.18	157

Source: ITC Trade map accessed on 20th April 2020

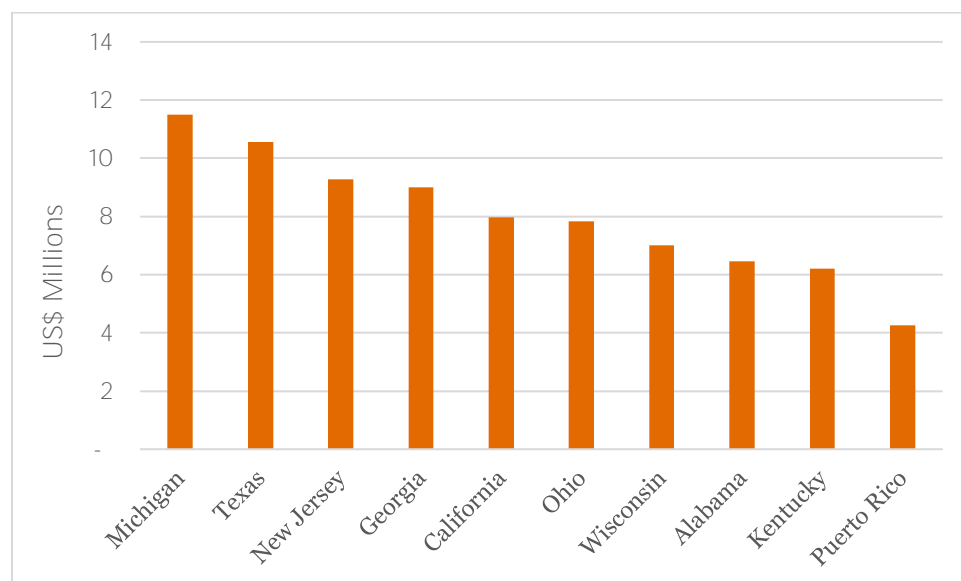
In CARICOM, approximately 70% of the total imports by value in 2019 were contributed by Suriname and Trinidad & Tobago. In addition, Jamaica's import value of calcium carbonate rose by more than five (5) times the value in 2018 to US\$ 338,000 in 2019. The consistent import dependency of Jamaica in calcium carbonate gives an opportunity for local producers to capture the local market. In addition, easier access (trade partnership) to the CARICOM markets can allow Jamaica to capture the entire nearby market which has an estimated total import value of US\$ 1.6 million (in 2019).

Potential Markets in the United States

The chart below represents the top ten (10) states that import Calcium carbonate¹, these states represent 76.7% of total demand/importation within the US. Calcium carbonate products such as GCC and PCC are mainly used as fillers, additives and processing aids for various industries such as paper and pulp, plastics, construction, food and pharmaceuticals and iron and steel. The table below shows the top 10 US state importers of Calcium Carbonate.

¹ For the analysis of import data of Calcium carbonate, Harmonised System (HS) code: 283650 was used.

Figure 8: Top 10 importers of Calcium Carbonate



States such as Texas, Ohio, Georgia and Kentucky have naturally occurring limestone that is mined/quarried for production of calcium carbonate. Inclusive of Michigan, New Jersey these states are all automobile manufacturing states. Car manufacturing requires plastic, paints and tyres which is possibly driving the usage for GCC/PCC.

New Jersey also contains top pharma life sciences companies such as Novartis, Johnson & Johnson, Merck & Co., Pfizer, Bristol-Myers Squibb, Novo Nordisk and Bayer Healthcare. Key global producers of value-added calcium carbonate such as American Elements, United States Lime and Huber Carbonates are all located in the top ten (10) importing states. Key importers of calcium carbonate are shared in the table below.

Table 18: Key Importers of Calcium Carbonate

S.N.	Competitor	Location
1	American Elements	Bluffdale, Utah
2	Graymont LLC	Superior, Wisconsin
3	Lhoist North America Inc.	Lhoist North America Ariz Inc: Fort Worth, Texas Lhoist North America Tenn Inc: Brentwood, Tennessee (Multiple operations across USA, Canada)
4	Carmeuse Lime Inc	Pittsburgh, Pennsylvania
5	United States Lime and Minerals	Dallas, Texas (Operations in Arkansas, Colorado, Louisiana, Oklahoma and Texas)
6	Mississippi Lime	St. Louis, Missouri (Operations in Missouri, Alabama, Kentucky, Mississippi, West Virginia, South Carolina, Illinois, Pennsylvania)
7	Legacy Vulcan LLC	Vestavia, Alabama

8	Shelly Materials Inc	Thornville, Ohio
9	Omya Industries Inc	Blue Ash, Ohio
10	Wendling Quarries Inc	De Witt, Iowa

End Use Industries and Market Forecasts

As stated, GCC is a versatile product which is widely used in several industrial and pharmaceutical applications. The suitability of GCC in different industries mainly depends on particle size, colour and chemical purity. The key major applications of GCC in various industries are mentioned below:

- In agriculture and farming, GCC finds its use as an active ingredient in agricultural lime as it helps in neutralising soil acidity. It is also used in animal feed; specifically, it is used to boost milk production from cows, in pig feed to provide essential calcium and it also helps in robust egg development.
- In terms of industrial use, GCC is commonly used as a filler and binder in paper, plastics, paints, sealant, adhesive and coating industries.
- In personal health and food industries, GCC is used as an effective dietary calcium supplement, antacid, phosphate binder, or as base material in medicinal tablets. In addition, it is also used in manufacturing of toothpaste, baking powder, dessert mixes, doughs and wine.
- In addition to above, GCC is also used in buildings and construction industry.
- It is also used in the production of other limestone value-added products such as quicklime and slaked lime.

Key End Use Industries of GCC and Quality Requirements

Agriculture and Animal Feed

GCC with a calcium carbonate content of >92% can be quarried and used by the agricultural sector. By crushing the raw limestone, various grades (based on particle size) can be produced. These products are marketed as 'agricultural lime'.

Soil acidity is one of the factors that can influence plant growth and can seriously limit crop production. By spreading agricultural lime onto the soil, the calcium carbonate content of the limestone is capable of neutralising a portion of the acid in the soil. This also has the effect of releasing soil minerals, such as phosphates, and making them available for absorption into plants.

In animal feed, GCC serves as a supplemental source of calcium. Specifically, it is used to boost milk production from cows, in pig feed to provide essential calcium and in chickens support robust egg development.

Table 19: Quality parameter of limestone for usage in agriculture and animal feed

Quality parameters	Mean	Range
Calcium Carbonate, CaCO ₃ (%)	95.55	92 - 99.35
Lime, CaO (%)	54.09	51.55 - 55.67
Magnesia, MgO (%)	0.66	0.22 - 0.96
Silica, SiO ₂ (%)	1.28	0.06 - 4.5
Iron oxide, Fe ₂ O ₃ (%)	0.01	0.037 - 0.1

Quality parameters	Mean	Range
Brightness (%)	81.8	70 - 95.5

Paper and Pulp

In the pulp and paper industry, GCC is used as a filler to fill the grooves in the sheets of cellulose produced, forming a smooth surface. GCC is also used to neutralise the acid that is used to break down the wood and widen the paper during the manufacturing process. GCC is also used as a constituent in the pigments that are used to coat certain types of paper in order to give colour and gloss to the surface.

In 2019, the paper and pulp industry contributed an estimated US\$408.4 million, accounting for approximately 3.7% of the Americas total limestone market by value. The value is further estimated to remain stable at US\$ 406 million in 2024.

The North and South American regions have significant paper production capacities and the pulp, paper, and paperboard capacities of the USA, Canada and Brazil were valued at 51.98 million tonnes per annum (MTPA), 9,900 tonnes per annum, and 23,530 tonnes per annum, respectively. The overall demand for limestone in paper and pulp industry in the region has declined, due to a gradual decline in the USA in recent years owing to the decline of manual, paper-based processes in favour of automated, digital processes. However, countries outside of the USA are still seeing growth including Canada and Mexico. The growing need for cardboard packaging and increasing e-commerce activities are the key driving factors for the paper industry in these countries.

Table 20: Quality parameters for limestone to be used in Paper Industry

Quality parameters	Mean	Range
Calcium Carbonate, CaCO ₃ (%)	98.46	96 - 99.35
Lime, CaO (%)	55.17	53.79 - 55.67
Magnesia, MgO (%)	0.45	0.15 - 1.2
Silica, SiO ₂ (%)	0.11	0.05 - 0.4
Iron oxide, Fe ₂ O ₃ (%)	0.04	0.01 - 0.1
Brightness (%)	96.7	93.5 - 99

Plastic

GCC is added as a filler in plastic and is used, in part, to modify the material's physical behaviour under certain conditions. In 2019, the plastic industry contributed an estimated US\$169.2 million, accounting for approximately 1.5% of Americas total limestone market by value. The value is further estimated to grow at a CAGR of 2.4% reaching US\$ 190.4 million in 2024.

The North American plastics industry has grown in recent years. According to the American Chemistry Council (ACC) and Plastics Industry Producers Statistics (PIPS) Group, North American plastic resin production grew by 5.85% from 113 billion pounds to 119.6 billion pounds during 2017-18. The growth of plastic production in North America is due primarily to the capacity expansions of petrochemical producers in the USA.

The plastic market in South America is expected to contract, as a result of shrinking global economic and political uncertainties, as well as the shift in consumer trends to use materials which are biodegradable.

The expansion in North American operators' ethylene/polyethylene capacity has resulted in lower prices offered to Mexico and South American plastic markets. Given this, despite a drop in the growth rate, the South American plastic industry is expected to witness a positive growth rate in the coming years. The overall demand for limestone in the plastic industry in the region is expected to show marginal growth, however the USA and Canada can be a potential target market where the demand is growing.

Table 21: Quality parameters for limestone to be used in Plastic Industry

Quality parameters	Mean	Range
Calcium Carbonate, CaCO ₃ (%)	97.97	92 - 99.35
Lime, CaO (%)	54.89	51.55 - 55.67
Magnesia, MgO (%)	0.46	0.15 - 1.2
Silica, SiO ₂ (%)	0.46	0.05 - 4.5
Iron oxide, Fe ₂ O ₃ (%)	0.04	0.01 - 0.1
Brightness (%)	92.7	75 - 98.1

Paint

GCC is commonly used in paint and coating applications. It is used as an extender, an agent to either reduce or enhance gloss, an extender/spacer for titanium dioxide, a rheology modifier and as a paint and coating additive to increase the density of the product.

GCC used in paints and coatings has a spatial steric effect. It can increase the whiteness and lustre of the paint film without reducing covering ability. These performance-enhancing qualities have ensured the large-scale acceptance of ultrafine calcium carbonate by the paint industry.

Table 22: Quality parameters for limestone to be used in Paint Industry

Quality parameters	Mean	Range
Calcium Carbonate, CaCO ₃ (%)	97.80	92 - 99.35
Lime, CaO (%)	54.80	51.55 - 55.67
Magnesia, MgO (%)	0.42	0.15 - 1.2
Silica, SiO ₂ (%)	0.72	0.05 - 4.5
Iron oxide, Fe ₂ O ₃ (%)	0.04	0.01 - 0.1
Brightness (%)	92.8	78 – 99

Rubber

Ultrafine GCC is primarily used as a filler by the rubber industry as it increases processing performance. It does not influence vulcanisation and gives the product a smooth surface. Ultrafine GCC can be used together with other reinforcing agents such as carbon black, white carbon black, clay and activated calcium carbonate for oil resistance.

Table 23: Quality parameters for limestone to be used in Rubber Industry

Quality parameters	Mean	Range
Calcium Carbonate, CaCO ₃ (%)	97.37	92 - 99.35
Lime, CaO (%)	54.56	51.55 - 55.67
Magnesia, MgO (%)	0.62	0.15 - 1.2
Silica, SiO ₂ (%)	0.82	0.05 - 4.5
Iron oxide, Fe ₂ O ₃ (%)	0.04	0.01 - 0.1
Brightness (%)	90.6	75 - 98.5

Food, Pharmaceutical and Household

GCC may also be used in production of dairy, healthcare, and consumer goods. In the food industry, high purity GCC is used as an additive to cereals. High-purity calcium carbonate, which is made from dissolving limestone in acid, is used in manufacturing pharmaceutical products, such as milk of magnesia, pills, antacids and calcium supplements. In the consumer goods industry, calcium carbonate made from limestone is applied in several everyday items, such as cleaning products, washing powder, cosmetics and toothpaste.

Table 24: Quality parameters for limestone to be used in Food and Pharmaceutical Industry

Quality parameters	Mean	Range
Calcium Carbonate, CaCO ₃ (%)	98.29	97 - 99.5
Lime, CaO (%)	55.07	54.35 - 55.75
Magnesia, MgO (%)	0.29	0.24 - 0.42
Silica, SiO ₂ (%)	0.11	0.1 - 0.12
Iron oxide, Fe ₂ O ₃ (%)	0.06	0.011 - 0.1
Brightness (%)	96.5	90-99

Qualitative Assessment of Jamaica's Limestone and Its Suitability for Manufacturing of End Use Products using GCC

MGD reports reveal large deposit of limestone reserves in the parish of Portland, St. Elizabeth and Trelawny. These deposits are located within the white limestone group, and the research revealed that both the surface and subsurface geology yielded high to very purity limestone (i.e. calcium carbonate concentrations of 97% and above) suitable for the different end use applications.

Table 25: Quality of limestone found in Jamaica

Quality parameters	Portland (Average)	Trelawny (Average)	St. Elizabeth (Average)
Calcium Carbonate, CaCO ₃ (%)	>99	>99	>98
Magnesia, MgO (%)	~0.60	~0.2	~0.3
Silica, SiO ₂ (%)	<0.20	0.50	<0.20
Iron oxide, Fe ₂ O ₃ (%)	<0.10	0.05	0.20
Aluminium Oxide Al ₂ O ₃ (%)	<0.10	<0.15	0.35

Source: Mines and Geology Division (MGD) report

From the existing quality data, it is observed that there is presence of high purity, white limestone formations in many areas with very low to trace concentrations of iron (Fe) and other impurities. In addition to data from MGD, Jamaica already has value-added limestone producers situated in the parishes of St. Ann and St. Elizabeth. Therefore, comparing the quality requirements of different end use industries and MGD's quality data along with existing value-added producers in the island, it is may be inferred that the limestone found in the island is suitable for various value-added products.

Investment opportunity: Growth in the key end use industries

Except for the paper and pulp industry, the key end use industry segments of GCC such as building and construction, agriculture, water treatment, food and beverage, and plastic are estimated to grow between 2019 to 2024 period.

Table 26: Americas limestone market by key end-use applications segments of GCC

End use Industry	2016 (in US\$ million)	2017 (in US\$ million)	2018 (in US\$ million)	2019 (est.) (in US\$ million)	2024 (f) (in US\$ million)	% Growth (2019- 2024)
Building and Construction	6,106	6,247	6,465	6,643	7,602	14%
Agriculture	1,822	1,902	1,982	2,046	2,312	13%
Water Treatment	761	806	850	887	1,051	19%
Paper and Pulp	404	407	411	408	406	-1%
Dairy, Food and Beverage, etc.	385	406	426	441	501	14%
Plastics	151	158	164	169	190	13%
Total	9,628	9,925	10,297	10,595	12,063	14%

Source: Mordor Intelligence

Strengths, Weaknesses, Opportunities and Threats (SWOT) Analysis

To assess the growth potential of GCC in Jamaica, a SWOT analysis was conducted. The high-level results of the analysis are contained in the figure below. Findings and primary source interviews and surveys suggest Jamaica is in a strong position to be able to develop the GCC industry due to availability of vast high-purity limestone raw material and export potential in nearby region. In addition, there are opportunities in bringing in new types of financing agreements as well as incentivising new entrants with Special Economic Zones (SEZ) for the manufacture of GCC.

Figure 9: Summary SWOT Analysis for Jamaica's GCC industry



5.0 Financial Highlights

The following discussion contains forward-looking statements that involve risks and uncertainties. A potential investor's actual results may differ materially from those discussed in the forward-looking statements as a result of various factors. Although JAMPRO and its independent advisors, believe that in making any such statements its expectations are based on reasonable assumptions, such statements may be influenced by factors that could cause actual outcomes and results to be materially different from those projected. Prospective investors are cautioned not to place undue reliance on these forward-looking statements, which speak only as of the dates on which they have been made and should conduct their own due diligence. Future events or circumstances could cause actual results to differ materially from or anticipated results.

Financial Highlights

A financial assessment of the valued-added production for GCC in Jamaica was conducted under two scenarios, that is (i) on a standalone basis (start-up) and (ii) an incremental basis (existing limestone operation). The financial results demonstrate positive trends, and therefore a business will have the liquidity to finance the growth potential and ongoing initiatives. The expected financial performance below reflects the position once the plant has become operational (i.e. Year 1).

Table 27: Scenario 1: Summary Incremental Financial Performance

Projected Incremental Financial Performance					
(In US\$M)	Year 1	Year 2	Year 3	Year 4	Year 5
Revenue	2.4	2.5	2.6	2.7	2.8
% Growth	N/A	3.8%	3.8%	3.8%	3.8%
EBITDA	1.3	1.4	1.4	1.5	1.6
% Sales	54.8%	55.4%	56.0%	56.7%	57.3%
Net Income	0.8	0.9	1.0	1.0	1.1
% sales	35.2%	36.1%	36.9%	37.8%	38.6%
Net Debt	1.2	1.0	0.8	0.6	0.5

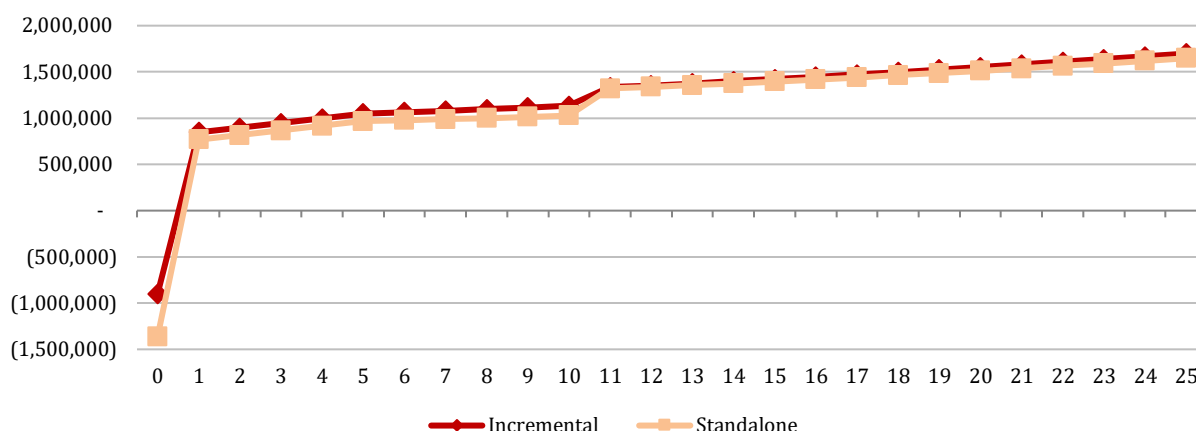
For GCC the projected net income margin generated is expected be in excess of 35% and is expected to be adequate to finance assumed debt.

Table 28: Scenario 2: Summary Standalone Financial Performance

Projected Standalone Financial Performance					
(In US\$M)	Year 1	Year 2	Year 3	Year 4	Year 5
Revenue	2.4	2.5	2.6	2.7	2.8
% Growth	N/A	3.8%	3.8%	3.8%	3.8%
EBITDA	1.3	1.4	1.4	1.5	1.6
% Sales	54.3%	54.9%	55.5%	56.2%	56.8%
Net Income	0.8	0.8	0.9	0.9	1.0
% sales	31.9%	32.9%	34.0%	35.0%	36.0%
Net Debt	1.8	1.5	1.2	1.0	0.7

For GCC the projected net income margin generated is expected to be in excess of 30% and is expected to be adequate to finance assumed debt.

Figure 10: Forecasted Cash Flow



Net cashflow in Year 0 of (US\$0.9 million) includes investment in incremental setup of US\$2.3 million and debt finance US\$1.4 million (60%). The average cash position over the projected period will be +US\$1.31 million.

Net cashflow in Year 0 of US\$1.4 million includes investment in incremental setup of US\$3.4 million and debt finance of US\$2.0 million (60%). The average cash position will be +US\$1.26 million

Investment Cost

The investment required to produce 30,000 tonnes of GCC on a standalone (start-up) basis and on an incremental basis is US\$ 3.4 million and US\$2.2 million respectively. (See Appendix 1 for details).

Revenue Forecast

GCC is projected to be sold at a price of USD\$81.2 per tonne in year one (1). Growth in sales is expected to remain between 3.5%-4% in line with market CAGR. For consistency, the price of GCC has been increased in line with the current price inflation within the Americas that produce and sell similar value-added products.

Projected Profit and Loss

Scenario 1: Stand-Alone Basis (start-up)

Table 28 below shows a five (5) year analysis of a start-up operation. The production of GCC on a stand-alone basis is expected to yield a net profit of US\$761,352 in year one (1) and this is projected to increase to US\$997,358 by year five (5). Gross and net profit margins are forecasted to average 92% and 34% respectively over the 5-year period.

Table 29: Proforma financial performance for GCC on a stand-alone basis

Amounts in USD\$'	Year 1	Year 2	Year 3	Year 4	Year 5
Revenue:					
Unit Sales (tonne)	29,450	29,465	29,479	29,494	29,509
Price per (tonne)	81.2	84.2	87.3	90.5	93.9
Total Revenue	2,390,265	2,479,944	2,572,988	2,669,523	2,769,679
Cost of Sale:					
Raw material	124,000	128,588	133,346	138,280	143,396
Variable Labour	62,000	64,294	66,673	69,140	71,698
Total Cost of Sales	186,000	192,882	200,019	207,419	215,094
Gross profit	2,204,265	2,287,062	2,372,969	2,462,103	2,554,585
Operating Expenses					
Total Operating Expenses	907,190	925,334	943,840	962,717	981,972
EBITDA	1,297,075	1,361,728	1,429,129	1,499,386	1,572,614
Net Profit / (losses)	761,352	815,297	873,677	934,163	997,358

Scenario 2: Incremental Basis (existing limestone operation)

Table 29 below shows a five (5) year analysis on an incremental basis. The production of GCC on an incremental basis is expected to yield a net profit of US\$842,419 in year one (1) and this is projected to increase to US\$1,069,193 by year five (5). Gross and net profit margins are forecasted to average 92% and 37% respectively over the 5-year period.

Table 30: Proforma financial performance for GCC on an incremental basis

Amounts in USD\$'	Year 1	Year 2	Year 3	Year 4	Year 5
Revenue:					
Unit Sales (tonne)	29,450	29,465	29,479	29,494	29,509
Price per (tonne)	81.2	84.2	87.3	90.5	93.9
Total Revenue	2,390,265	2,479,944	2,572,988	2,669,523	2,769,679
Cost of Sale:					
Raw material	124,000	128,588	133,346	138,280	143,396
Variable Labour	62,000	64,294	66,673	69,140	71,698
Total Cost of Sales	186,000	192,882	200,019	207,419	215,094
Gross profit	2,204,265	2,287,062	2,372,969	2,462,103	2,554,585
Operating Expenses					
Total Operating Expenses	895,010	912,910	931,168	949,792	968,788
EBITDA	1,309,255	1,374,152	1,441,801	1,512,312	1,585,798
Net Profit / (losses)	842,419	894,691	950,593	1,008,619	1,069,193

Return on Investment

On an indicative basis over a projected duration of 25 years, the internal rate of return (IRR) could range from 33.8% to 49.5% and net present value (NPV) range from US\$11.8M to US\$13.0M on a standalone and incremental basis respectively when future cash flows were discounted using a discount rate of 14.3%

Table 31: Investment appraisal results

Scenario	NPV	IRR	Payback Period
Stand-Alone Basis	US\$11.8M	33.8%	1.8 years
Incremental basis	US\$13.0M	49.5%	1.1 years

Sensitivity Analysis

A sensitivity analysis was conducted to ascertain the variability and vulnerability of the investment to macro or micro environmental factors. The result is presented in Table 31 below.

Table 32: Sensitivity Analysis – Impact of Change in Sales growth

Scenario	NPV	IRR	Payback Period (years)	NPV	IRR	Payback Period (years)
	Stand-Alone Basis			Incremental Basis		
-0.75	-4.2	-	-	-2.8	-	-
-0.50	-2.4	-	-	-1.1	-	14.0
-0.25	2.4	16.0%	2.4	3.5	28.2%	1.2
0.00	11.9	33.8%	1.8	13.1	49.5%	1.1
+0.25	30.5	50.9%	1.6	31.9	69.4%	1.1
+0.50	62.9	67.5%	1.5	64.5	88.4%	1.1
+0.75	114.7	83.8%	1.4	116.8	106.7%	1.1

Key Assumptions

To assess the indicative feasibility of the production of GCC as a value-added product in Jamaica, the following key assumptions were made:

Input	Inputs/ Assumptions	Source for Information
Production Capacity	Peak production capacity has been considered to be 30,000 tonnes per annum	The peak production capacity is considered based on typical start-up level plant set-up or an incremental build up to an existing operation.
Sales Volume	sales volume is estimated at 95% of production level. It is assumed that the Jamaica could take 0.1% of the market share of the sales volumes within the Americas for GCC end user products.	
Revenue	US\$ 81.16 per tonne. Growth in revenues are expected to remain at 2% plus indexation in line with market CAGR.	This represent average prices derived from primary researched in North America and the Caribbean
Cost of Sales	Raw Material US\$ 2.0 per tonne Variable Labour US \$2.0 per tonne	Average cost is determined by market survey of operators for cost to produce limestone within the local market.
Operational Expense	US\$ 29.8 to US\$30.2 per tonne (includes: Environment Management Cost Power Cost, Plant Cost Admin Cost, Logistics and Transfers Advertising and Corporate Social Responsibility, Other Utilities, Other Expenses)	This represents the average cost derived from primary market research.
Financing Option	Debt Vs Equity Mix of 60%/40%. Interest rate 6% Debt tenure- 10 years.	These assumptions represent cost to finance investment both on a start-up and incremental level. Capital Expenditure (CAPEX) replacement is assumed to be financed by working capital thereafter.



Role of JAMPRO

JAMPRO is the national trade and investments promotions agency in Jamaica. One of our key functions is the packaging and promotion of investment opportunities and the conversion of investment prospects into viable projects. JAMPRO was first established in 1988 to stimulate, facilitate and promote the development of trade and industry, export and investment activities in all sectors of the island's economy. The agency drives this process through focusing on a number of targeted sectors which include tourism.

JAMPRO works closely with local and global entrepreneurs seeking to tap into the many investment and trade opportunities in Jamaica. In facilitating both local and foreign direct investment, JAMPRO guides investors through the necessary processes and offers support in partnership with key government agencies and ministries, even after their investments are operational.

JAMPRO also provides an array of services to the export community – including export registration and provides export development advice and export promotion (exposure for goods and services entering the export markets). JAMPRO is also an integral partner in Jamaica's implementation of the World Trade Organizations (WTO's) Trade Facilitation Agreement that will ensure the country reaps the benefits of standardized trade/border practices that will result in reduced transaction costs.

6.0 Appendices

6.1. Appendix 1: Financial Model

Input	Inputs/ Assumptions	Source for Information
Land Cost	Land acquisition cost has been arrived at based on cost of each hectare of land as obtained through primary research (US\$ 30,000/hectare).	Where the mine/ quarry establishments will already be there plant set-up, one (1) hectare of additional land has been considered for GCC. The land estimate typically includes area required for plant facility, workshop, storage area, waste dump, worker camps, etc.
Equipment Cost	The vehicles required for transportation within plant premises will be procured. The vehicles considered for capital investment includes truck and wheel loader. Further, it is considered that for in-bound and out-bound logistics, hired vehicles will be used and the associated costs will be covered in operating expenses.	For truck and wheel loader, the landed cost in Jamaica is estimated after considering the equipment cost in the USA with provisioning and contingencies added for transportation cost and duties. No additional cost is considered for these for where facility already exist.
Processing Capital Cost	Crushing, Screening, Grinding and Packaging systems along with supporting plant equipment has been considered under processing capital cost for GCC	For GCC the processing equipment has been assumed to be procured from China (due to lower procurement cost of the required equipment when compared to the procurement cost from the USA) with provisioning and contingencies added for transportation and duties. In addition, a semi-mechanised packaging facility will be used, due to the very fine mesh size of the grounded limestone which is not suitable for manual packaging.
Power	It is considered that power will be available from grid. However, in case of power cuts, the plant will be operated using a Diesel generator.	It is considered that grid connection will already be in the establishment along with backup generators and hence no incremental cost is taken for power connection/ set-up for financial analysis.
Infrastructure	This will cover the necessary infrastructure required for operations covering shed, laboratory facilities and other relevant infrastructure facilities.	The infrastructure cost is based on typical industry standard costs for additional infrastructure required for setting up of the value-added plants.
Laboratory	A laboratory is considered for testing basic mineral content and size. A capital expenditure of US\$ ~0.43 Million would be sufficient for basic grade testing in Jamaica.	Based on industry standard cost for basic laboratory testing equipment.
Contingency	A 5% contingency on total capital cost is applied to cover the budgetary effect of project threats or uncertainties	-

Table 33: Estimated capital expenditure for a GCC Plant

#	Description	Stand alone Capital Cost (US\$ Millions)	Incremental Capital Cost (US\$ millions)
1.	Land cost	0.39	0.08
2.	Equipment cost (truck, wheel loader, etc.)	0.64	0.50
3.	Processing set-up cost	1.00	1.00
4.	Power cost	0.68	-
5.	Infrastructure cost	0.10	0.07
6.	Laboratory set-up cost	0.43	0.43
7.	Contingency @5%	0.17	0.10
Total Estimated Capital Expenditure		3.41	2.18

Source: PwC Analysis

Table 34: Summary Pro Forma Income Statement Summary – Incremental Basis

Ground Calcium Carbonate (GCC)						
Income Statement Summary						
Incremental Case						
		Year 1	Year 2	Year 3	Year 4	Year 5
	Income	2,390,265	2,479,944	2,572,988	2,669,523	2,769,679
	Cost of Sales	186,000	192,882	200,019	207,419	215,094
	Gross Margin	2,204,265	2,287,062	2,372,969	2,462,103	2,554,585
	Operating Expenses					
	Staff cost	115,122	117,425	119,773	122,169	124,612
	Technical consultancy	11,512	11,742	11,977	12,217	12,461
	Insurance	22,500	22,950	23,409	23,877	24,355
	Logistics and transfers	192,403	196,251	200,176	204,180	208,263
	Equipment	69,491	70,881	72,299	73,745	75,220
	Plant expenses	131,855	134,492	137,182	139,925	142,724
	Power	193,561	197,432	201,380	205,408	209,516
	Other Utilities	48,663	49,636	50,629	51,641	52,674
	Advertising	58,731	59,906	61,104	62,326	63,572
	Security	5,756	5,871	5,989	6,108	6,231
	Other Expenses	42,480	43,329	44,196	45,080	45,981
	Total Operating Expenses	892,073	909,915	928,113	946,675	965,609

Ground Calcium Carbonate (GCC)						
Income Statement Summary						
Incremental Case						
		Year 1	Year 2	Year 3	Year 4	Year 5
	Environmental	2,937	2,995	3,055	3,116	3,179
	Depreciation	105,652	105,652	105,652	105,652	105,652
	Loan Interest	80,378	75,579	68,691	61,835	54,556
	Total Non-Operating Expenses	188,967	184,226	177,398	170,603	163,386
	Profit Before Taxes	1,123,225	1,192,921	1,267,458	1,344,825	1,425,590
	Taxes	280,806	298,230	316,864	336,206	356,398
	Net Income	842,419	894,691	950,593	1,008,619	1,069,193

Source: PwC Analysis

Table 35: Summary Pro Forma Income Statement Summary – Standalone Basis

Ground Calcium Carbonate (GCC)						
Income Statement Summary						
Standalone Case						
	Year 1	Year 2	Year 3	Year 4	Year 5	
Income	2,390,265	2,479,944	2,572,988	2,669,523	2,769,679	
Cost of Sales	186,000	192,882	200,019	207,419	215,094	
Gross Margin	2,204,265	2,287,062	2,372,969	2,462,103	2,554,585	
Operating Expense						
Staff cost	115,122	117,425	119,773	122,169	124,612	
Technical consultancy	11,512	11,742	11,977	12,217	12,461	
Insurances	34,100	34,782	35,478	36,187	36,911	
Logistics and transfers	192,403	196,251	200,176	204,180	208,263	
Equipment	69,491	70,881	72,299	73,745	75,220	
Plant expenses	131,855	134,492	137,182	139,925	142,724	
Power	193,561	197,432	201,380	205,408	209,516	
Other Utilities	48,663	49,636	50,629	51,641	52,674	
Advertising services	58,731	59,906	61,104	62,326	63,572	
Security services	5,756	5,871	5,989	6,108	6,231	
Other Expenses	43,060	43,921	44,799	45,695	46,609	
Total Operating Expense	904,253	922,338	940,785	959,601	978,793	

Ground Calcium Carbonate (GCC)					
Income Statement Summary					
Standalone Case					
	Year 1	Year 2	Year 3	Year 4	Year 5
Environmental	2,937	2,995	3,055	3,116	3,179
Depreciation	160,122	160,122	160,122	160,122	160,122
Loan Interest	121,817	114,544	104,105	93,714	82,682
Total Non-Operating Expenses	284,876	277,661	267,282	256,952	245,982
Profit Before Taxes	1,015,136	1,087,063	1,164,902	1,245,551	1,329,810
Taxes	253,784	271,766	291,226	311,388	332,453
Net Income	761,352	815,297	873,677	934,163	997,358

Source: PwC Analysis

6.2. Appendix 2: Excerpts from Mordor Intelligence Report

Americas Limestone Market, By End-user Industry, 2016-2024 (in US\$ Million)

End-user Industry	2016	2017	2018	2019 (est.)	2024 (f)	(%) CAGR (2019- 2024)
Paper and Pulp	403.62	406.53	410.59	408.35	405.87	-0.12%
Water Treatment	761.01	806.11	850.26	886.88	1,051.24	3.46%
Agriculture	1,821.85	1,901.76	1,981.71	2,046.36	2,312.14	2.47%
Plastics	150.77	157.51	163.96	169.22	190.44	2.39%
Building and Construction	6,105.74	6,247.16	6,464.50	6,642.60	7,601.84	2.73%
Steel Manufacturing and Other Industries (including Energy)	493.14	527.14	557.89	579.96	687.40	3.46%
Others	384.94	405.76	425.77	441.45	501.47	2.58%
Total	10,121.08	10,451.96	10,854.68	11,174.84	12,750.40	2.67%

Americas Limestone Market, By End-user Industry, 2016-2024 (in kilometric tonnes)

End-user Industry	2016	2017	2018	2019 (est.)	2024 (f)	(%) CAGR (2019- 2024)
Paper and Pulp	19,179.25	18,901.78	18,595.46	18,263.53	17,847.98	0.46%
Water Treatment	36,609.73	37,772.54	38,884.27	39,960.22	46,038.91	2.87%
Agriculture	73,742.33	74,963.56	76,211.45	77,535.55	85,583.14	1.99%
Plastics	6,853.15	6,997.10	7,127.19	7,253.24	7,949.25	1.85%
Building and Construction	449,940.35	450,210.95	456,097.43	461,806.59	17,059.20	2.29%
Steel Manufacturing and Other Industries (including Energy)	25,226.35	26,403.56	27,363.07	27,990.61	32,276.74	2.89%
Others	17,488.10	17,902.65	18,297.19	18,693.00	20,736.89	2.10%
Total	629,039.25	633,152.13	642,576.06	651,502.74	727,492.11	2.23%

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