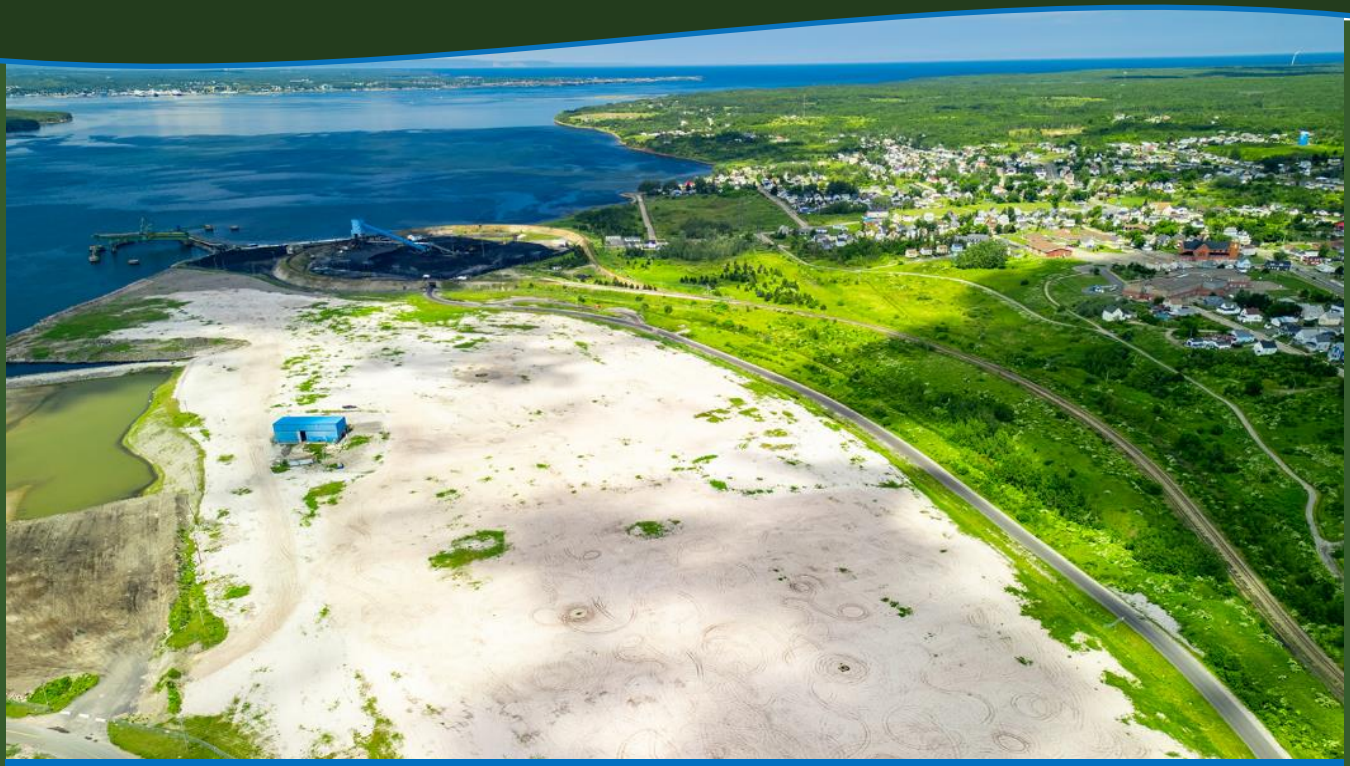
DMDE Engineering Limited



Conceptual Study

Green Cement Manufacturing Facility
Sydney Harbour, Nova Scotia

October 2024

This conceptual study was commissioned and supported by the Cape Breton Partnership through the CBRM Regional Enterprise Network (CapeBretonPartnership.com/CBRMREN) and the Cape Breton Regional Enterprise Network (CabeBretonPartnership.com/CBRREN)

Letter of Transmittal

October 2, 2024

Tyler Mattheis
President and CEO
Cape Breton Partnership, CBRM Regional Enterprise Network
285 Alexandra Street
Sydney, NS B1S 2E8

Attention Mr. Mattheis:

Subject: Conceptual Study for Potential Cement Manufacturing Facility, Sydney, Nova Scotia

Please find enclosed the above referenced study.

Pending your review of this study, if you have any questions or wish to further discuss, please contact the undersigned.

Yours truly,

Dan MacDonald, M.A.Sc., P.Eng., FEC, FCSSE
President
DMDE Engineering Limited
Phone: 902-565-7682
E-Mail: danmacdonald@dmde.ca

Disclaimers

Nova Scotia Power (NSP)

DISCLAIMER: Nova Scotia Power (NSP) assets are referenced in this report mainly to inform the reader that these assets could possibly be used. NSP has not made any decisions regarding these assets, and does not commit to the availability of these assets for this or any other project.

Glencoe Carbonate Corp.

DISCLAIMER: The proposed limestone resource described in this report is referenced mainly to inform the reader that this resource could possibly be used. Glencoe Carbonate Corp. does not commit to the availability of this resource for this or any other project.

Membertou Development Corporation

DISCLAIMER: Lands owned by Membertou Development Corporation are referenced in this report mainly to inform the reader that this land could possibly be used for the purposes described in this report. Membertou Development Corporation has not made any decisions regarding these lands, and does not commit to the availability of these assets for this or any other project.

Executive Summary

The Cape Breton Partnership has commissioned DMDE Engineering Limited to carry out a high-level conceptual study to investigate the potential of a green cement manufacturing plant in Sydney Harbour in Unama'ki – Cape Breton, Nova Scotia. The following are the key highlights of this study:

Sydney Harbour and Port Capabilities[1]

- Dredged channel of -16.5 metres.
- Access to the International Pier and Membertou waterfront (-14.5 metres).
- Access for Panamax vessels up to 90,000 DWT.

Proposed Site Location and Characteristics

- Owned by the Membertou Development Corporation.
- Brownfield site (former Sydney Steel Plant), rehabilitated and prepared for industrial development.
- 170 acres available for development.
- Electrical Infrastructure and Green Power Generation availability:
    - Site is adjacent to existing high-voltage electrical transportation grid infrastructure
    - As part of provincial legislation, Nova Scotia Power is required to be 80% renewable with wind and other renewable power sources by 2030. Upon the creation of a regulatory regime, offshore wind is likely to increase the availability of locally-generated green electricity dramatically over the next decade.
    - The regional assessment for Nova Scotia offshore wind[2] identifies one of the initial locations being the Sydney Bight, which is approximately 42 kilometers offshore to Sydney Harbour. This could be used to fire electric kilns. Also, Nova Scotia has two major developers moving forward with green hydrogen production facilities in Unama'ki – Cape Breton. Plants are in initial stages in the Strait of Canso region and there is a possibility of one in the Sydney Harbour region as well.

Local Limestone Deposit

- Large limestone deposit approximately 120 kilometers from the Proposed Site.
- Verified to have 680 million tonnes of cement grade limestone.
- Mine developer Glencoe has done considerable exploration and upfront investigations and are currently preparing to initiate the environmental permitting.

[1] Details on the characteristics and capabilities facilities in Sydney Harbour are available from the Port of Sydney Development Corporation: https://www.sydneyport.ca/port-information

[2] At the time this report has been finished, the Committee's work is continuing. The Interim Report, however, provides insight into the potential for Offshore Wind generation in Unama'ki – Cape Breton and the larger region as well. https://iaac-aeic.gc.ca/050/evaluations/document/156046?culture=en-CA (The Committee for the Regional Assessment of Offshore Wind Development in Nova Scotia, 2024)

Fly Ash Availability

- Nova Scotia Power has large reserves of fly ash from their coal fired generation stations
- The Lingan Generating Station has an estimated 6 million tonnes of fly ash, approximately 25 kilometers from the proposed site:
    - This stockpile of fly ash equates to an estimated 13 to 26-year supply at 225,000 tonnes (7.5% replacement) or 450,000 tonnes (15% replacement) per year depending on the cement "recipe" used by the project developer.

Rail Transportation

- From the proposed Glencoe Mine Site, the main rail line on Unama'ki - Cape Breton Island is approximately 15 kilometers from the mine site, this would necessitate a new spur line connector.
- The line is currently non-operational from Point Tupper to the Proposed Site; however, if the cement plant and mine go forward at 3,000,000 tonnes per year and 100 tonnes per rail car, calculations show 30,000 rail cars, which is a significant amount of rail business expected to enable a confident reinvestment the line by the current owner (CN)[3].

Port Infrastructure

- The International Pier in Sydney Harbour, adjacent to the proposed cement plant, is currently owned by Nova Scotia Power (NSP). It is utilized to import coal; however, as part of federal legislation, NSP is required to move away from the use of coal for electricity generation by 2030, possibly allowing this Panamax built loading facility and rail line to become available for the export of cement product.[4] Alternatively, a new bulk terminal could be constructed on the Membertou waterfrontage.
- The International Pier was originally an export trans-shipment facility and has an elevated rail loop and trestle that are designed to offload bottom dump railcars to below grade conveyors, which could transport limestone to plant silos. The rail loop can easily be connected to the CN mainline. Also, it is currently connected to the Lingan Generating Station and could back haul the fly ash to the International Coal Pier.

Socio-Political

- Canada is a stable country committed to growing a greener and more resilient economy[5], increasing exports, increasing Foreign Direct Investment[6], and increasing its capacity to build more housing and industry within its borders.
- Local First Nations communities, governments, and indigenous-owned privates sector corporations and industry organizations are all supportive of green manufacturing opportunities.

---

[3] 2023 Rail Study by Logistic Marketing Services Inc., AECOM Rail Freight Canada, Lonsdale Business Development Ltd., and DMDE Engineering Ltd. is available here: Economic Opportunities: Cape Breton and Central Nova Scotia Railway [PDF] Additional and related rail studies also available on the Cape Breton Partnership and Scotia Rail Development Society's Reports and Studies Page.

[4] NSP has not determined their future plans for these assets and cannot commit to their availability for use.

[5] Such as through the Regional Assessment of Offshore Wind Development in Nova Scotia.

[6] As per Invest in Canada FDI Report 2023.

- The Province of Nova Scotia is demonstrating its commitment to green energy and manufacturing in its Green Hydrogen Action Plan[7], and Offshore Wind Roadmap[8].
- Local green energy and green manufacturing supply chain development efforts are actively being pursued by private, public, and non-profit entities in the region.
    - The potential of a global centre of excellence for green cement manufacturing may be a good fit for local post-secondary institutions such as Cape Breton University or NSCC, or non-profit industry partners like the Verschuren Centre.
- The local CBRM municipal government is committed to economic growth, and specifically green and export-driven growth, as evidenced in the CBRM Forward Economic Development Strategy.[9]

Market Demand

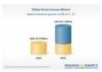
- Our research and analysis suggest a strong North American demand for green cement both in Atlantic Canada, across Canada, and in the US and most sources expect this demand to grow as other green-related industrial development, such as offshore wind turbines, drive demand for green cement.
- Even stronger demand for green cement in the international construction market is expected: "The global green cement market size reached US$ 34.9 billion in 2023. The market is projected to reach US$ 89.7 billion by 2032, exhibiting a growth rate (CAGR) of 11.07% during 2023-2032."[10]
- Also noted as appendices to this report, the following provide additional context to the market opportunity presented in this report:

> *"Canada is a leader in the green industrial revolution. Foreign direct investment (FDI) in this space is propelling Canada's clean energy capabilities and creating a surge in sustainable projects. Investments like these boost Canada's energy-efficient practices, introduce innovative technologies, and contribute to building a strong economy for Canadians. As Canada moves to net zero to address the climate crisis, sustainable FDI isn't just good for Canada, it's good for the world."*
>
> - Laurel Broten, CEO, Invest in Canada

1. *Green growth avenues in the cement ecosystem* (Hundertmark, Reiter, & Schulze, 2021)

2. *Holyoke zero-carbon cement maker lands 2,000-ton order from Vineyard Offshore wind developers* (Kinney, 2024)

3. *Green Cement Industry Report 2024: A $34.9 Billion Market in 2023 – Global Forecasts to 2032* (Research and Markets, 2024)



4. *Developing nations' booming cement demand may drive up CO2 emissions, research group says* (Stanway, 2024)

[7] Nova Scotia's Green Hydrogen Action Plan is available on the "Green Hydrogen webpage of the Government of Nova Scotia website.
[8] Nova Scotia's Offshore Wind Roadmap available on the "Offshore Wind" webpage of the Government of Nova Scotia website.
[9] The CBRM Forward Economic Development Strategy was co-developed by the CBRM REN, administered by the Cape Breton Partnership, and the Cape Breton Regional Municipality.
[10] *Green Cement Industry Report 2024: A $34.9 Billion Market in 2023 – Global Forecasts to 2032* (Research and Markets, 2024)

De-Carbonization

- It is intended that the plant be fuelled by green energy (i.e. wind and/or hydrogen)
    - Kilns are currently being researched and developed to use green electrical energy
- CO2 emissions from the process are expected, however current Carbon Capture and Storage (CCS) may offset these emissions.
    - For this application, further research is required, potentially in the aforementioned Global Centre of Excellence.

In the following pages, this report will demonstrate that Sydney Harbour meets all the requirements for a new, modern, green cement manufacturing facility and the authors recommend this project move to the next stages.

Image from the Port of Sydney Development Corporation.
https://www.sydneyport.ca/post/harbour-information

Table of Contents

Table of Figures

Introduction

The Cape Breton Partnership has commissioned DMDE Engineering Limited to carry out a high-level conceptual study to investigate the potential of a green cement manufacturing plant in Sydney Harbour, Unama'ki – Cape Breton, Nova Scotia.

The intent of this study is to determine the feasibility and to identify the advantages of this location for establishing the plant. The following is a list of the advantages we have evaluated; each one will be described in more detail in the following chapters of this study.

- A deep-water port on the East Coast of Canada with a channel depth of -16.5 metres, closest port from mainland North America to Europe, close proximity to the Eastern Seaboard of the United States, reasonable distance to the East Coast of South America, and close to the St. Lawrence Seaway. **Figure 1** shows shipping distances from the site, and **Figure 2** shows site specifics.
- Available dockside land. Membertou property on Sydney Harbour has 170 acres of industrial ready property.
- Adjacent to this property is a Panamax bulk loading dock. Currently owned by Nova Scotia Power for the import of coal, which with the move away from coal for electricity generation could become available for bulk shipping of cement.

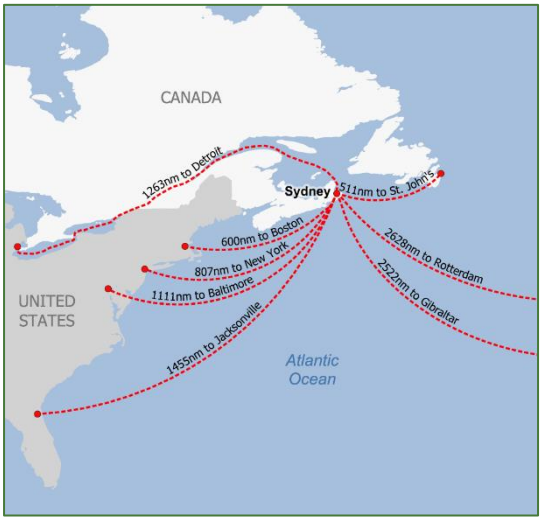


Figure 1 – Shipping Distances from the Proposed Site.

- Over 6 million tonnes of fly ash available from the Nova Scotia Power Lingan Generating Station, approximately 25 kilometres from the Port.
- Major reserves of limestone in the Cape Breton region, both at the current Kelly Rock facility and proposed new mine development in Glencoe, NS. The Glencoe reserve has over 680 million tonne of cement grade limestone.
- The proposed site has industrial size electrical power and water supply.

We believe that there is a high demand for green cement in North America and in particular the East Coast of the United States with booming construction industry and population growth. Having a deep-water port with available land in close proximity to the marked is a major advantage.

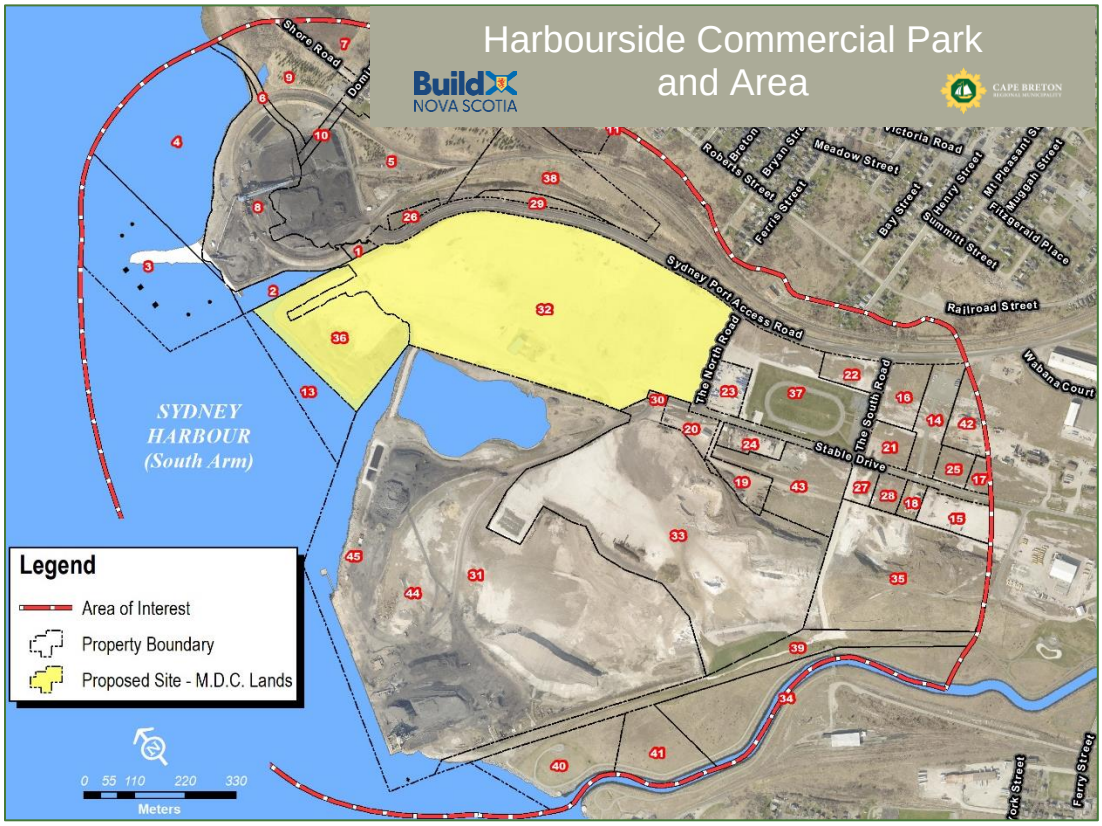


Figure 2 Proposed Site in the Harbourside Commercial Park in Sydney, NS. Details on Figure 2 can be found in Appendix 8.

This study will look at resources, facilities, port and transportation infrastructure, the synergies, and integration of these for a proposed green cement manufacturing facility.

It is not in this study's scope to present a business plan, or financial analysis. These will be the next steps in the evaluation of this project.

It is noted that the intention would be to construct a new modern green cement production plant.

The green cement plant would generate a number of well paying and year round jobs both at the mine site and cement plant and be major contributor to both Nova Scotia and Canada's GDP. With it being a green plant, it would be significant in the reduction of green house gases, not only from the plant, but in the replacement of what is dirty cement from older plants.

Key Elements of Study

Limestone Supply

The Cape Breton region has a massive amount of cement grade limestone in very close proximity to the proposed location at the Port.

Glencoe Limestone Deposit[11]

The following are key elements of this proposed mine:

- The Glencoe Project is strategically located just 130 km from the Sydney Harbour for year-round shipping.
- The Glencoe limestone consists of 1 billion tonnes of carbonate rocks of which 680 million tonnes are cement grade limestone (43-101).
- 15,000 meters of diamond drilling and core spending chemical analysis has been completed on the Project.
- The deposit is accessible by land on the 105 Trans Canada Highway and with close access to rail, this will be discussed in more detail later in this Study.

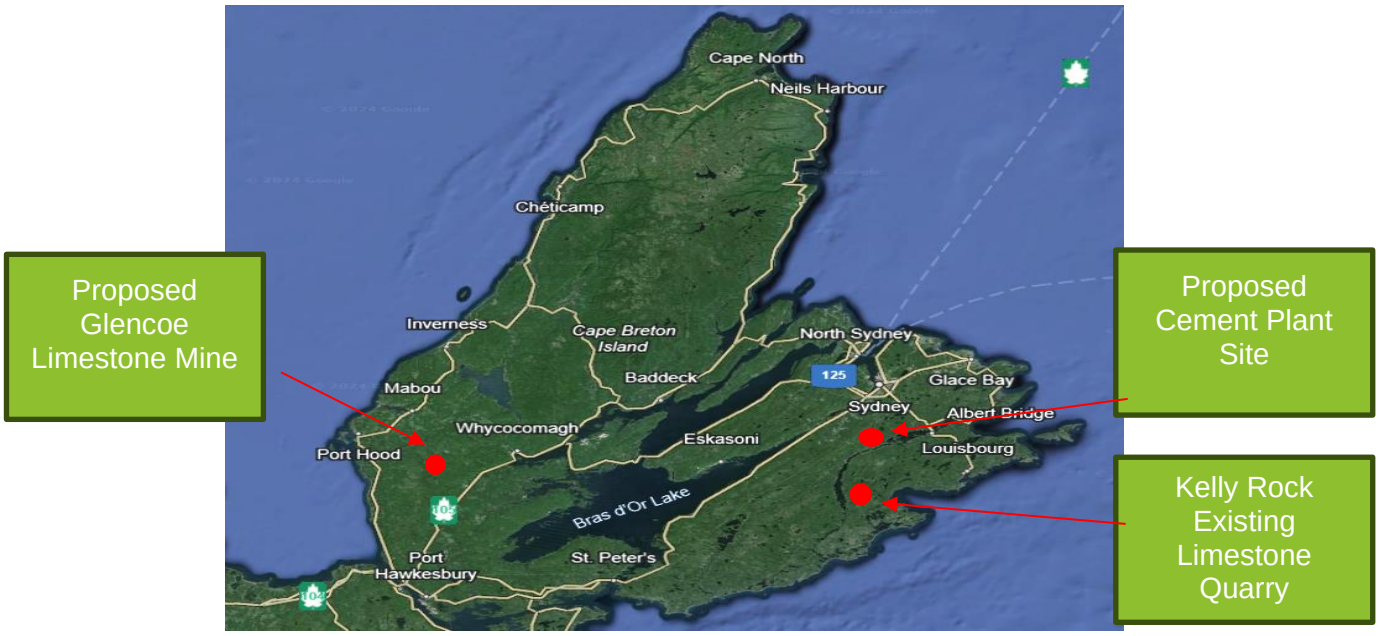


Figure 3 – Unama'ki – Cape Breton

[11] Atlantic Industrial Minerals - Glencoe Limestone Deposit: A Cement Plant Opportunity

Kelly Rock Deposit

The Kelly Rock Quarry is approximately 20 km from the Port site. It currently is owned by Nova Scotia Power to provide limestone to their Pt. Aconi Coal Fired Generating Station. The Pt. Aconi Plant has a fluidized bed, technology boiler, which uses limestone to react and extract the sulphur from the coal to reduce acid rain effects. The Plant uses approximately 200,000 tonnes of limestone per year.

It is conservatively estimated that this deposit has 30 years at this current rate of withdrawal, which estimates 6.0 million tonnes. It currently delivers limestone to the Pt. Aconi Plant via truck, there is no rail close, and it is envisioned that if this was to supply the cement plant it would be by truck. The Pt. Aconi Plant is currently schedule to close by 2030.

Fly Ash Supply

The Sydney area has ample supply of fly ash from the Nova Scotia Power Generating Station in the area. The Lingan Generating Station has approximately 6 million tonnes on their site. It is approximately 25 kms from the proposed port location. The Sydney Coal Railway, which transports coal from the International Coal Pier to the Lingan Generating Station, could delivery fly ash back to the Plant.

Using a rough estimate of the cement plant producing 2.0 million tonnes per year[12], there are two scenarios that demonstrate how the fly ash from the Lingan Generating Station could be used efficiently to enable a 13 to 26-year project, depending on the optimal cement recipe selected by the project developer:

Scenario	**Annual Cement Production** *(tonnes)*	**Cement Recipe**			**Estimated minimum number of years of production** *Based on local supply of Fly Ash*
		Limestone (aka Portland) *Available from the Glencoe Resource*	**Find Ground Limestone** *(to replace calcide)* *Available from the Glencoe Resource*	**Fly Ash**	
1	2.0M	85% *(2.55M tonnes annually)*	0%	15% *(450k tonnes annually)*	13 years
2	2.0M	85% *(2.55M tonnes annually)*	7.5% *(225k tonnes annually)*	7.5% *(225k tonnes annually)*	26 years

[12] The high-level cement "recipes" provided for context and discussion in this section are assuming that 3.0M tonnes of input materials are required to produce 2.0M tonnes of cement, due to process losses.

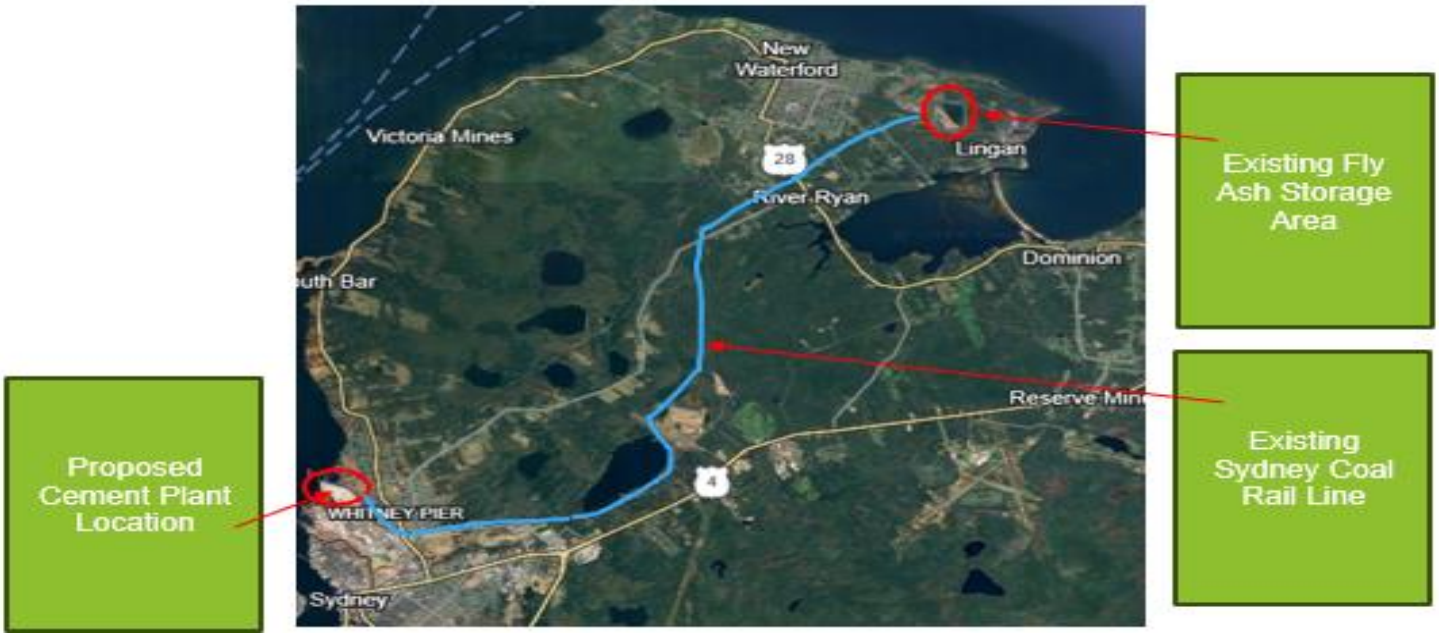


Figure 4 – Fly Ash Supply in Close Proximity to the Proposed Site

Note, there is approximately 1.5 million tonnes of fly ash at the Pt. Tupper Generating Station, 150 kms from the Port site and 3 million tonnes of fly ash at the Trenton Generating Station, 250 kms from the site; these could be considered if the rail line from Sydney is reopened. The Pt. Aconi Generating Station, with the fluidized bed boiler, does not have fly ash with the characteristics for limestone replacement in a cement plant.

Proposed Site Membertou Lands

Membertou Development Corporation is a First Nations corporate entity located adjacent to the City of Sydney. They own a large track of land on the Sydney harbourfront. These were the former lands of the Sydney Steel Plant, which ceased operation in 2000. The lands were remediated to a brownfield site. The area also included water lots that have been partially infilled by Membertou. The entire area of 170 acres was infilled and capped using blast furnace slag. This slag is an excellent structural fill as it contains large portions of limestone, which causes it to have cementitious characteristics. The site is bordered to the north by the International Coal Pier and to the south by the Atlantic Canada Bulk Terminal, see the following map. The harbour channel has a dredge depth of -16.5 meters, most likely the vessel loaded at this site would be a Panamax class draft with a maximum -14.5 metres.

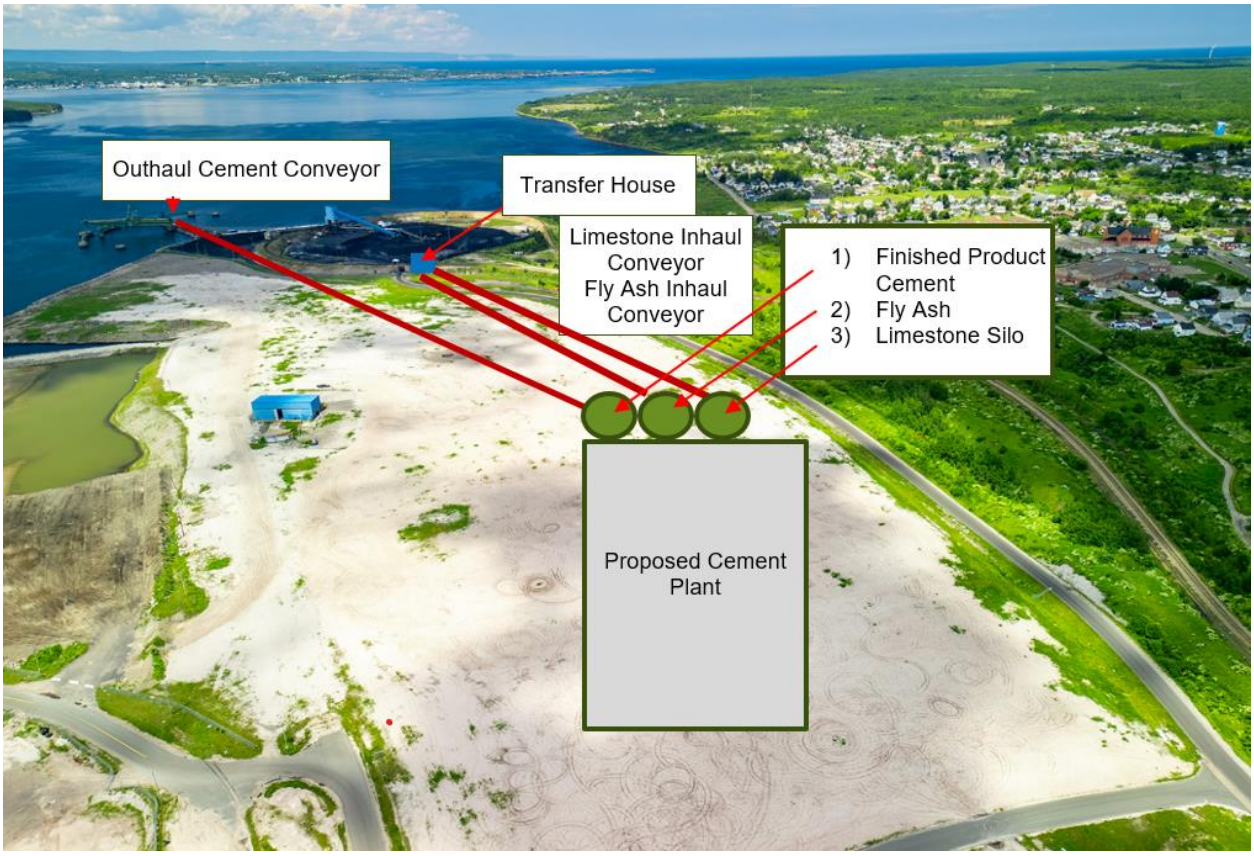


Figure 5 – Proposed Site owned by Membertou Development Corporation

Transportation

Rail Transportation

There are several rail systems which could provide raw materials to the proposed plant. There is a rail line on Unama'ki - Cape Breton Island from Point Tupper to Sydney, which currently is not in operation, but exists. Several studies have been carried out on the condition of the rail line which indicated it can be rehabilitated but would require significant investment. The proposed Glencoe Limestone Mine is approximately 15 kms from this line. A recent study[13] was carried out to determine if there was enough current business to justify reinstating the line. The results of the study were encouraging but fell short of the required number of cars per year. Should the plant described in this study be built, and should that plant be serviced by the Glencoe mine, the resulting demand for rail cars would far exceed the number of cars required to justify the revitalization of the line and the resumption of rail service from Port Tupper to Sydney. For example, if the green cement plant were to consume a reasonable estimate of 3.0 million tonnes of limestone a year 30,000 rail cars per year each carrying 100 tonnes would be required.

The second rail line to be considered is the Sydney Coal Line that is still in operation. It travels between the International Coal Pier and the Nova Scotia Power (NSP) Lingan Generating Station. The International Pier was originally a coal export terminal, exporting coal to central Canada, Europe, South America and Asia. In 2000 the Cape Breton Development Corporation, the coal mining entity in Unama'ki - Cape Breton, closed down. As NSP needed coal for their generating stations, NSP procured the International Coal Pier and the site was converted to an import terminal.

As part of federal legislation NSP is required to transition away from using coal by 2030 in Unama'ki – Cape Breton. This rail line and the adjacent International Coal Pier may become surplus, however NSP has not determined their future plans for these assets and cannot commit to their availability for use. These assets may be beneficial to the potential cement plant as the location of the fly ash storage pile is adjacent to the rail line at the Lingan Generating Station and would be useful for loading.

Past studies looked at using the fly ash as a backhaul to the International Pier with emptied coal cars. Most likely when this plant is completed, the Lingan Generating Station would be close to coming off coal; leaving the line still to be utilized for any NSP future requirements.

The coal export system is still in place, and was last operational in the year 2000. In our expert engineering opinion, this system can be rehabilitated to received product by railcars with minimal cost and time. This will be discussed in more detail in the marine shipping section of this study.

The export system consists of a continuous rail loop that can handle approximately 42 rail cars. The rail loop has an elevated 5 bay trestle for bottom dumping of the rail cars. Under the trestle is a sub grade reclaim tunnel for a reclaim conveyor. Note, the original conveyance system has

[13] 2023 Rail Study by Logistic Marketing Services Inc., AECOM Rail Freight Canada, Lonsdale Business Development Ltd., and DMDE Engineering Ltd. is available here: Economic Opportunities: Cape Breton and Central Nova Scotia Railway [PDF] Additional and related rail studies also available on the Cape Breton Partnership and Scotia Rail Development Society's Reports and Studies Page.

been removed. As the cement plant location being considered is adjacent to this facility, the product can be conveyed directly to the cement plant storage.

Considering the volume of 3.0 million tonnes of limestone per year to 450,000 tonnes of fly ash, it is considered this system would be used for the limestone as the Sydney Coal line passes close to the CN mainline location and could be attached possibly to another smaller rail loop constructed with a bottom dump receiving hopper and inhaul conveyor for fly ash.

Truck Transporation

Trucking can be an option, especially for startup where the rail system is not ready. For long term operation, however, trucking from Glencoe Mine is not considerably feasible for 3.0 million tonnes of limestone. Even using the largest trucks available, which can carry 35 tonnes, up to 85,700 trucks per year would be required which would not be feasible from economic, road availability or safety perspective.

For limestone from the Kelly Rock Quarry, the only way to deliver is by truck, there is no rail line and with the smaller quantity to be obtained from this facility, trucking could be economically practical.

Also, the fly ash from Lingan Generating Station is smaller and with the close proximity to the cement plant location, trucks could be an option; however, would have to be evaluated considering the rail line exists.

Marine Shipping

It is believed that the market for the cement product would be Central Canada, Europe, the United States and possibly South America, as shown in ***Figure 1 – Shipping Distances from the Proposed Site***.

As previously stated, the proposed Membertou Development Corporation property has water frontage and a new bulk handling dock could be built for purpose to ship out cement.

Alternatively, the International Pier could be a viable option as it is adjacent to Membertou lands. It was originally designed and built as a coal export terminal, although now being used as an import terminal. The current operation will become redundant with the closure of the Cape Breton Coal Generating Stations.

This site has a radial, luffing, and telescopic ship loader capable of fully loading a Panamax vessel without the requirement to move the vessel along the dock. It is capable of 5000 tonnes/hour loading rate. The ship loader has not operated in over 20 years; however, a recent evaluation by Logistec, Owner of the ship loader, indicated 3.0 to 5.0 million dollars could reinstate the ship loader for use. Currently Logistec is trying to sell the ship loader.

The dock consists of reinforced concrete caissons for breasting, mooring dolphins connected by walkways, and the dock face has Panamax draft. For a visual representation, see the following Figure 6 – International Coal Pier.

Figure 6 – International Coal Pier

Ancillary Services

Power Supply

The location has an abundance of power available. In the late 1990s, Sydney Steel converted from blast furnace / open hearth furnace operation to an electric arc furnace. This furnace required large amounts of electricity to make steel. Considering this, the area is serviced with a high voltage transmission line from the generating stations and although the plant was demolished, the two substations remain.

Water Supply

The Cape Breton Regional Municipality Water Utility provides water to the area, via a large capacity waterline originally constructed by the steel plant. Water is sourced from the Grand Lake reservoir.

Sydney Harbour Asset Map

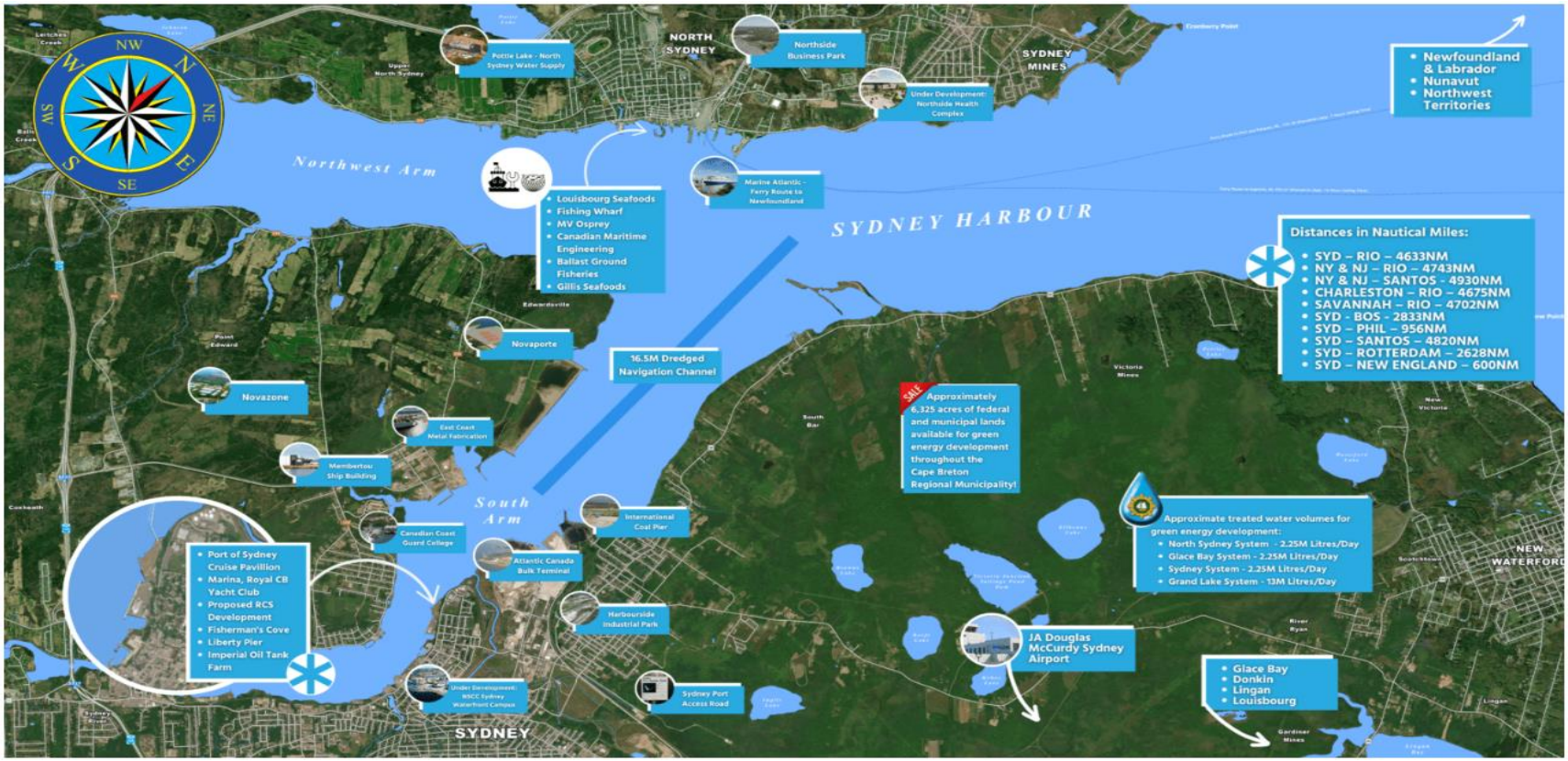


Figure 7 - Sydney Harbour Asset Map[14]

[14] *Click here to download pdf of the above Asset Map, originally prepared for Ports Day 2024, presented by the Port of Sydney.*

Market Demand

Our research and analysis indicate a robust and growing demand for green cement across North America, particularly in Atlantic Canada, throughout Canada, and in the United States. As industries focus more on sustainability, the need for environmentally friendly construction materials like green cement is increasing. This demand is expected to surge further as other green-related industrial developments, such as offshore wind farms, continue to expand. Wind turbine construction, along with other renewable energy infrastructure, is heavily reliant on green cement due to its lower carbon footprint and alignment with the industry's sustainability goals.

In addition to strong demand in North America, the international market for green cement is projected to experience even more significant growth. According to industry forecasts, the global green cement market, valued at approximately US$34.9 billion in 2023, is expected to nearly triple to US$89.7 billion by 2032, representing a compound annual growth rate (CAGR) of 11.07% during the forecast period. This surge is driven by global efforts to reduce carbon emissions in the construction sector, stringent environmental regulations, and the increasing adoption of green technologies worldwide.

These trends underscore the importance of establishing a strong green cement production capability, positioning Atlantic Canada to take advantage of both domestic and international market opportunities. As countries and industries move toward greener solutions, the demand for sustainable building materials will likely continue to rise, offering a significant opportunity for growth and investment in this sector.

Socio-Political

Canada remains a stable and forward-looking country, dedicated to fostering a greener and more resilient economy. The federal government has articulated clear goals to increase exports, attract Foreign Direct Investment (FDI), and expand the nation’s capacity to develop housing and industry domestically. This commitment positions Canada as a reliable partner in global economic development, with a strong emphasis on sustainability and growth.

Local Indigenous communities, governments, indigenous-owned private sector corporations, and industry organizations have demonstrated their readiness to support green manufacturing opportunities. Their participation is vital in harnessing the potential of green energy projects and sustainable industries. This collective engagement underscores the importance of inclusive and diverse collaboration in advancing Canada's green economic agenda.

At the provincial level, Nova Scotia is demonstrating its commitment to green energy and manufacturing through strategic initiatives like the Green Hydrogen Action Plan and the Offshore Wind Roadmap. These frameworks provide a solid foundation for attracting investment, fostering innovation, and establishing Nova Scotia as a leader in renewable energy and sustainable manufacturing.

There is a concerted effort by private, public, and non-profit entities in the region to develop a robust green energy and green manufacturing supply chain. Notably, the prospect of establishing a global centre of excellence for green cement manufacturing aligns well with the strategic priorities of local institutions such as Cape Breton University and the Nova Scotia Community College (NSCC). Additionally, the Verschuren Centre, a non-profit industry partner, presents a unique opportunity to contribute to research, innovation, and sustainable practices in the green manufacturing sector.

The Cape Breton Regional Municipality is equally committed to economic growth, particularly in areas that promote sustainability and export-driven expansion. Their alignment with green and economic initiatives is evident in the CBRM Forward Economic Development Strategy which was co-developed by the CBRM REN, administered by the Cape Breton Partnership, and the Cape Breton Regional Municipality. This strategic plan highlights their dedication to fostering a green economy, expanding local businesses, and attracting new industries to the region.

Collectively, these efforts underscore a strong regional and national commitment to developing a greener economy, enhancing local capabilities, and creating sustainable growth opportunities. The support from all levels of government, industry, and local communities provides a solid foundation for attracting new investments and fostering innovation in green energy and manufacturing.

Discussion: Decarbonization of Cement Production

Cement production is considered a hard to abate sector, generating carbon dioxide from coal used to heat kilns and during the conversion of limestone to clinker. The projected long-term rise in demand for cement in the US, Canada, Europe and developing countries is driving the development of new technologies, including carbon capture, hydrogen, and electric kilns to decarbonize this sector.

Green Electric Power Availability

Green electric power, as stated previously in this report, is currently available at the site via the Maritime Link DC cable from the Muskrat Falls Hydroelectric Facility, and large amounts of diversely sourced local green energy from offshore wind, onshore wind, and solar from an array of projects whose preliminary in-service dates are currently planned for 2029 to 2034 (5 to 10 years from current date). As part of provincial legislation, Nova Scotia Power is required to have reached 80% renewable energy on the grid by 2030, which could coincide with the commissioning of a cement plant. Also, the Nova Scotia offshore wind industry could be a green source of electricity for a new modern cement production facility. The Committee for the Regional Assessment of Offshore Wind Development in Nova Scotia[15] has identified an initial potential development site as the Sydney Bight, which is approximately 42 kilometres offshore of Sydney.

Figure 7 – Sydney Bight (Map obtained from "Regional Assessment of Offshore Wind Development in Nova Scotia, Interim Report")[16]

[15] At the time this report has been finished, the Committee's work is continuing. The Interim Report, however, provides insight into the potential for Offshore Wind generation in Unama'ki – Cape Breton and the larger region as well. https://iaac-aeic.gc.ca/050/evaluations/document/156046?culture=en-CA (The Committee for the Regional Assessment of Offshore Wind Development in Nova Scotia, 2024)

[16] Ibid

Future Green Hydrogen Availability

World-leading hydrogen production facilitates are being developed in Nova Scotia. Two hydrogen facilities are being considered in the Strait of Canso area. Bear Head Energy and Everwind are two corporations proceeding with green hydrogen and green ammonia plants. Everwind has completed their FEED (Front End Engineering Design) and Bear Head has completed pre-FEED. Both of these plants are on tide water in the Strait of Canso and both are intending to build shipping terminals. As the proposed cement plant is on tide water in Sydney Harbour, hydrogen from the above production facilities could be shipped by sea a distance of approximately 150 kilometers. Alternatively, another hydrogen producing facility may be developed in Sydney Harbour itself, which could also provide hydrogen to a green cement manufacturing facility.

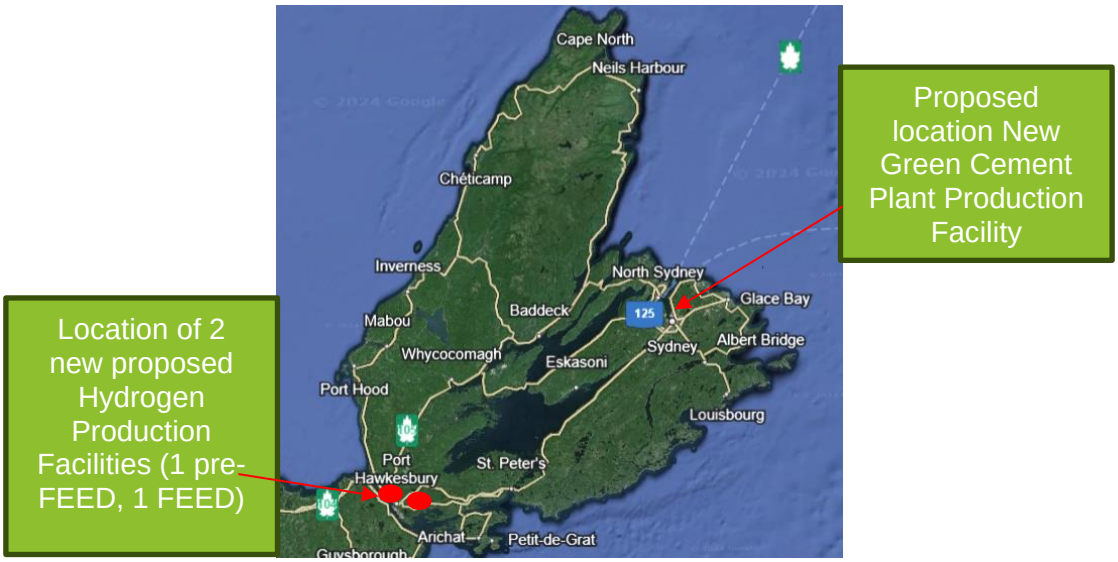


Figure 8 – Regional Hydrogen Production Facilities currently in planning or conceptual stages in Unama'ki – Cape Breton

Carbon Capture, Utilization and Storage (CCUS)

The opportunity to deploy Carbon Capture, Utilization and Storage (CCUS) technologies will require further research. However, there appears to be some opportunity to explore or re-explore sites and technologies such as depleted oil and gas infrastructure and sub-surface geology in the offshore of Newfoundland and Labrador, as well as Sable Island.

Concept: Global Centre of Excellence for Green Cement Manufacturing

The proposed plant could allow new production methods deployed right from the beginning rather than retrofitting old and inefficient plants.

The proposed facility would be green with significant CO_2 reductions, not only from the plant production, but also from the displacement of what is known as dirty cement from old coal fired kilns elsewhere in the world. Refer to Appendix 12 – Cement Plant that shows a photo of a cement plant, similar to the one proposed, which is estimated to cost approximately $2 billion to construct.

Therefore, with this project, Unama'ki – Cape Breton's post-secondary institutions (PSE) including Cape Breton University, Nova Scotia Community College; Sydney Waterfront Campus and Strait Area Campus, and private developing agencies, possibly in conjunction with the Verschuren Centre[17], could develop a Global Centre of Excellence for Green Cement Manufacturing. Such a centre could enable local Nova Scotia companies committed to Green Cement Manufacturing and related activities, such as CarbonCure Technologies[18] and alterBiota[19], to fully collaborate with each other and with like-minded non-profit, academic, institutional, and for-profit entities for local and global benefit, as well as local economic cluster development.

As Nova Scotia's goal is to phase out coal-fired electrical generation by 2030, establishing a Centre of Excellence could play a pivotal role in researching and developing sustainable alternatives for fly ash in cement production as local and global stockpiles of fly ash, largely the by-product of coal-fired electrical generation, is depleted. This Centre of Excellence could foster the innovation in the development of eco-friendly and high-performance building materials that align with the global shift toward greener construction practices.

[17] The Verschuren Centre Inc. (VC) is an independent clean technology development and deployment facility. We offer client-tailored services to support companies in developing sustainable solutions that meet industry needs. https://www.verschurencentre.ca/who-we-are.

[18] CarbonCure Technologies Inc. is a Nova Scotia based manufacturer of carbon removal or carbon utilization technologies that inject captured carbon dioxide into concrete where it is permanently stored. https://www.carboncure.com/

[19] alterBiota is an Unama'ki – Cape Breton based manufacturer of a natural admixture called hydrous Bio Graphene Oxide (hBGO) that enables concrete producers to use less Portland cement while storing stable, biomass derived carbon permanently in concrete infrastructure. https://alterbiota.com/

Summary and Conclusions

This conceptual study has evaluated the suitability of a new modern cement production plant in Sydney Harbour in Unama'ki – Cape Breton, Nova Scotia and concludes that this location has all the attributes for such a plant.

In summary, this location offers the following:

- Available Brownfield site prepared for industrial development.
- Location is on tide water in close shipping distance to Europe, East Coast US and Central Canada.
- Has over 50-year reserve of limestone within 120 kilometers from the proposed site.
- Has a source of fly ash of approximately 6 million tonnes, estimated as a 13-year supply.
- Has current green power sources and possible future green power sources which include offshore wind and hydrogen.
- Has all services, expertise and labour force available for construction and operations of this plant in Sydney Harbour, Unama'ki – Cape Breton, Nova Scotia.
- Local, regional, national, and international preference for green cement for the development off offshore wind and other green energy development, which therefore requires a modern green cement production plant.

Next Steps

As shown in this conceptual study, constructing this facility in Sydney Harbour has advantages. Considering this, the next step would be to complete a Feasibility Study, which would include, but not necessarily be limited to, the following:

- Conceptual engineering design.
- Development of high-level capital cost estimate.
- High level schedule for implementation.
- Environmental scoping.
- Stakeholder development meetings with Membertou (property owner), Nova Scotia Power (owner of International Pier and fly ash supplier), CN Rail Line Owner, and Glencoe (limestone deposit).
- Develop preliminary business plan.
- Discussions with all levels of governance.

The pre-feasibility study could be carried out by government, economic development agencies or by private cement manufacturing companies.

Appendices

Appendix 1 – Green growth avenues in the Cement ecosystem

Hundertmark, T., Reiter, S., & Schulze, P. (2021, December 16). *Green growth avenues in the cement ecosystem*. Retrieved from www.mckinsey.com: https://www.mckinsey.com/industries/chemicals/our-insights/green-growth-avenues-in-the-cement-ecosystem

NOTE: This is a virtual appendix, use the link above to access

Appendix 2 – Holyoke zero-carbon cement maker lands 2,000-ton order from Vineyard Offshore wind developers

Kinney, J. (2024, July 11). *Holyoke zero-carbon cement maker lands 2,000-ton order from Vineyard Offshore wind developers*. Retrieved from www.masslive.com: https://www.masslive.com/westernmass/2024/07/holyoke-zero-carbon-cement-maker-lands-2000-ton-order-from-vinyard-offshore-wind-developers.html

NOTE: This is a virtual appendix, use the link above to access

Appendix 3 – Green Cement Industry Report 2024: A $34.9 Billion Market in 2023 - Global Forecasts to 2032

Research and Markets. (2024, March 18). *Green Cement Industry Report 2024: A $34.9 Billion Market in 2023 - Global Forecasts to 2032*. Retrieved from Yahoo Finance: https://finance.yahoo.com/news/green-cement-industry-report-2024-095200134.html

NOTE: This is a virtual appendix, use the link above to access

Appendix 4 – Developing nations' booming cement demand may drive up C02 emissions, research group says

Stanway, D. (2024, March 21). *Developing nations' booming cement demand may drive up CO2 emissions, research group says*. Retrieved from Reuters.com: https://www.reuters.com/sustainability/climate-energy/developing-nations-booming-cement-demand-may-drive-up-co2-emissions-research-2024-03-21/

NOTE: This is a virtual appendix, use the link above to access

Appendix 5 – Regional Assessment of Offshore Wind Development In Nova Scotia – Interim Report

The Committee for the Regional Assessment of Offshore Wind Development in Nova Scotia. (2024, March). *Regional Assessment of Offshore Wind Development in Nova Scotia - Interim Report*. Retrieved from Government of Canada: https://iaac-aeic.gc.ca/050/documents/p83514/156045E.pdf

NOTE: This is a virtual appendix, use the link above to access

Appendix 6 – Economic Opportunities – Cape Breton and Central Nova Scotia Railway – Sydney Subdivision

Spearin, D., Falcetta, J., Lonsdale, K., & MacDonald, D. (2023, January). ECONOMIC OPPORTUNITIES - CAPE BRETON AND CENTRAL NOVA SCOTIA RAILWAY - Sydney Subdivision. Retrieved from Cape Breton Partnership: https://capebretonpartnership.com/wp-content/uploads/2023/12/November-2023-Rail-Study-Highlights-Report-and-Appendix.pdf

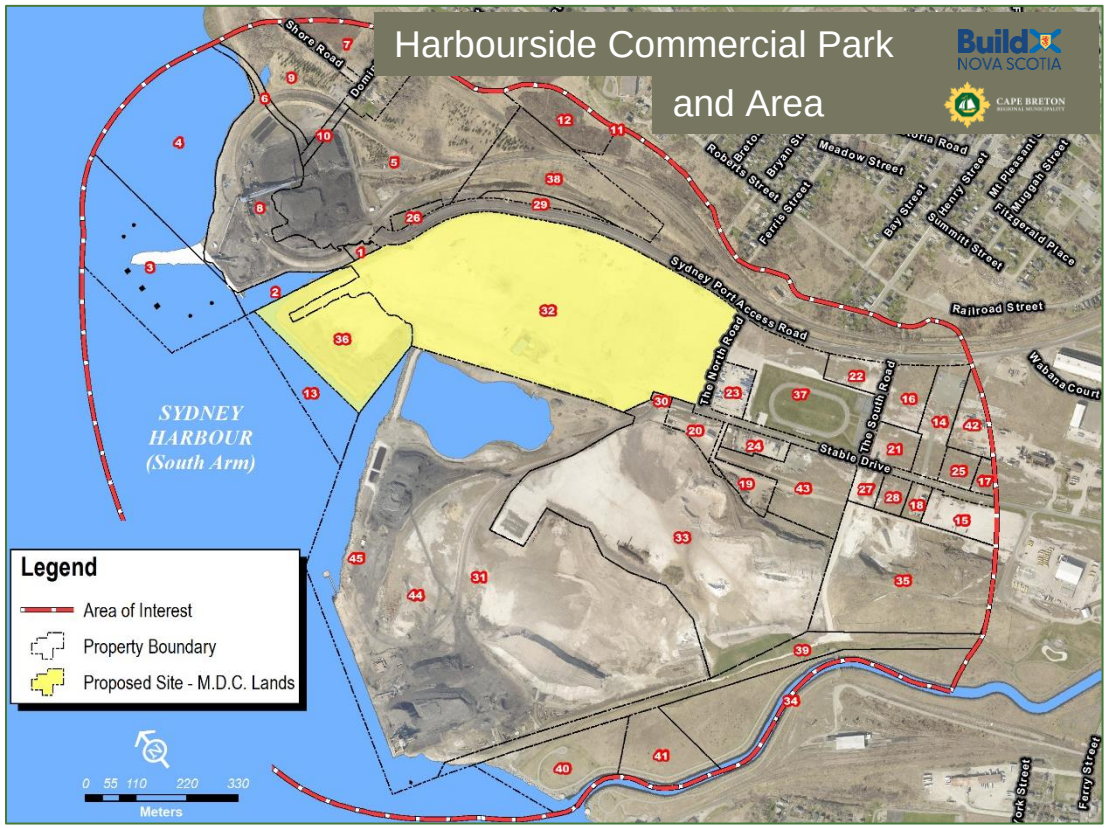
NOTE: This is a virtual appendix, use the link above to access

Appendix 7 – CBRM Forward

CBRM Forward Economic Development Strategy. Retrieved from Cape Breton Partnership: https://capebretonpartnership.com/research-report/cbrm-forward-economic-development-strategy/

- NOTE: This is a virtual appendix, use the link above to access

Appendix 8 – Harbourside Commercial Park Property Owners

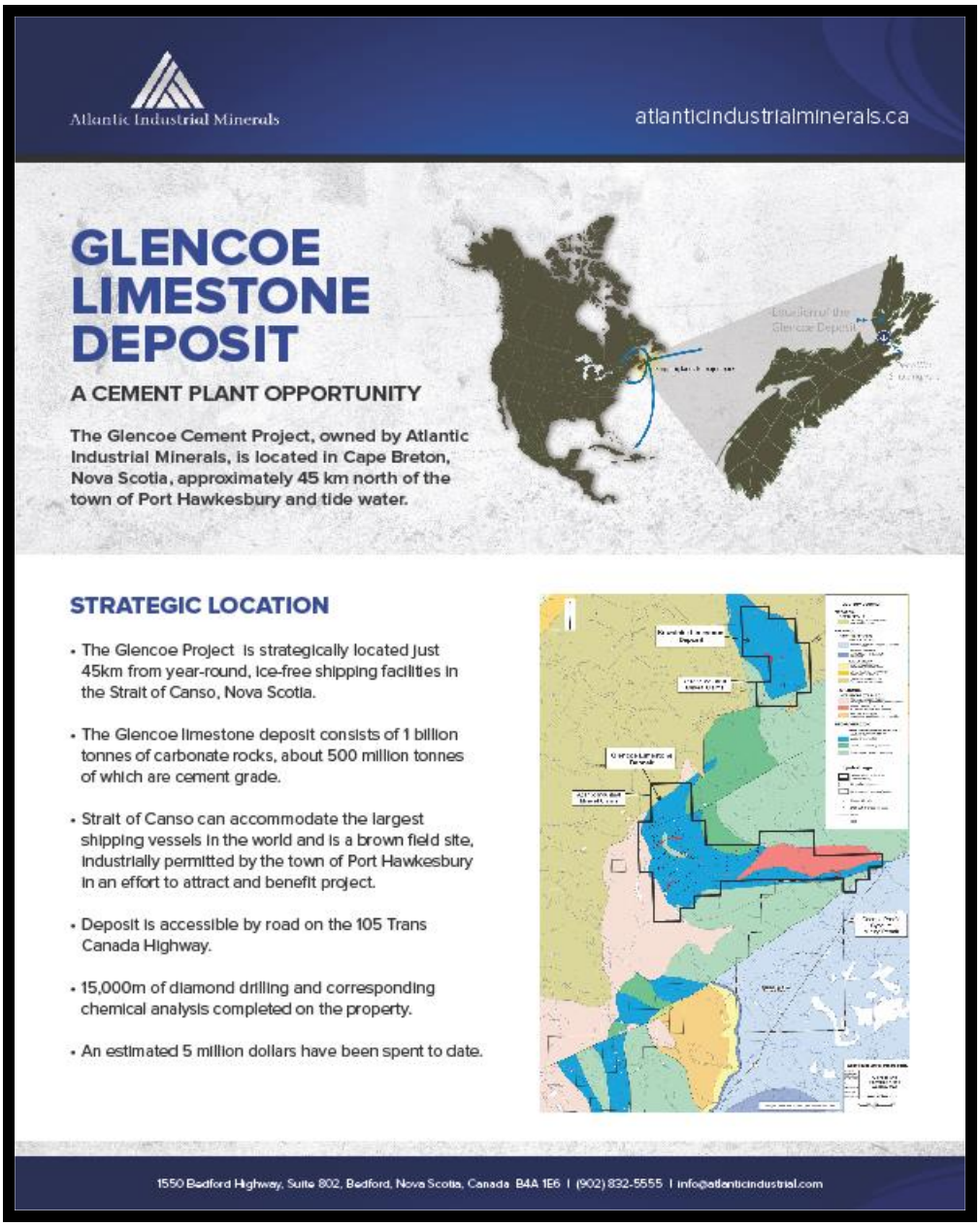


MAP_ID	PID	Owner	Type	Area_Hectares	Area_Sq. Metres
1	15625320	NOVA SCOTIA POWER INC.	Standard parcel	10.92675	1708.376028
2	15674161	MEMBERTOU DEVELOPMENT CORPORATION	Standard parcel	29.01	7951.779003
3	15793870	NOVA SCOTIA POWER INCORPORATED	Water Lot	12.71	73020.56778
4	15625403	NOVA SCOTIA POWER INCORPORATED	Land and Water	19.6	83676.28657
5	15625320	NOVA SCOTIA POWER INCORPORATED	Standard parcel	10.92675	111228.0454

MAP_ID	PID	Owner	Type	Area_Hectares	Area_Sq. Metres
6	15793862	NOVA SCOTIA POWER INCORPORATED	Standard parcel	10.92675	1708.376028
7	15157761	NOVA SCOTIA POWER INCORPORATED	Standard parcel	6.879806	13686.67573
8	15625403	NOVA SCOTIA POWER INCORPORATED	Land and Water	19.6	65940.70002
9	15157753	NOVA SCOTIA POWER INCORPORATED	Standard parcel	4.856333	34801.59589
10	15780356	NOVA SCOTIA POWER INCORPORATED	Standard parcel	0.313	3171.4484
11	15691694	DEPARTMENT OF EDUCATION AND EARLY CHILDHOOD DEVELOPMENT	Standard parcel	2.630514	2.449389939
12	15162068	NOVA SCOTIA POWER INCORPORATED	Standard parcel	2.339134	17900.4936
13	15899198	MEMBERTOU DEVELOPMENT CORPORATION	Water Lot	2.14	21372.82542
14	15902992	PARKLAND CORPORATION / CORPORATION PARKLAND	Standard parcel	1.64	16436.79685
15	15868300	NOREEN GOOGOO	Standard parcel	1.622825	12052.21176
16	15902984	ISLAND MOVERS LIMITED	Standard parcel	1.19	11860.72364
17	15878945	BUILD NOVA SCOTIA	Standard parcel	1.07	3339.359583
18	15874795	BUILD NOVA SCOTIA	Standard parcel	0.36515	3650.23565
19	15879174	MATHJAM HOLDINGS INC.	Standard parcel	0.84	8503.6974
20	15882228	MEMBERTOU DEVELOPMENT CORPORATION	Standard parcel	0.822	8313.407
21	15902356	L&G CONSTRUCTION LTD.	Standard parcel	0.8096	8098.553669
22	15906803	BUILD NOVA SCOTIA	Standard parcel	0.8095	8101.620781
23	15896640	PMC ROOFING LIMITED	Standard parcel	0.809389	8093.949677
24	15879182	BUILD NOVA SCOTIA	Standard parcel	0.687981	6838.65905
25	15903016	4536163 NOVA SCOTIA LIMITED	Standard parcel	0.57819	5783.54005
26	15822935	N S SYSCO	Standard parcel	0.294497	2982.458672
27	15898711	MEMBERTOU DEVELOPMENT CORPORATION	Standard parcel	0.4942	4960.720031
28	15898729	MEMBERTOU DEVELOPMENT CORPORATION	Standard parcel	0.4877	4897.05595
29	15822927	N S SYSCO	Standard parcel	0.485633	4878.17969
30	15881741	BUILD NOVA SCOTIA	Standard parcel	0.078555	785.89695
31	15833205	3294807 NOVA SCOTIA COMPANY	Standard parcel	48.12	484218.1366

MAP_ID	PID	Owner	Type	Area_Hectares	Area_Sq. Metres
32	15674161	3294807 NOVA SCOTIA COMPANY	Standard parcel	48.12	484218.1366
33	15790652	MEMBERTOU DEVELOPMENT CORPORATION	Standard parcel	29.01	231194.6184
34	15517964	BUILD NOVA SCOTIA	Standard parcel	18.94	189486.5068
35	15867534	NS TRANSPORTATION AND INFRASTRUCTURE RENEWAL	Land and Water	20.2	52667.61514
36	15674161	BUILD NOVA SCOTIA	Standard parcel	8.88	86392.70104
37	15862865	MEMBERTOU DEVELOPMENT CORPORATION	Standard parcel	29.01	50999.80184
38	15625338	BUILD NOVA SCOTIA	Standard parcel	5	50799.36952
39	15906654	NOVA SCOTIA POWER INCORPORATED	Railway Parcel	4.71469	45671.39682
40	15872633	BUILD NOVA SCOTIA	Standard parcel	4.51	38565.04418
41	15872641	HER MAJESTY THE QUEEN IN RIGHT OF THE PROVINCE OF NOVA SCOTIA	Water Lot	4.3	35126.25806
42	15878937	HER MAJESTY THE QUEEN IN RIGHT OF THE PROVINCE OF NOVA SCOTIA	Water Lot	3.4	24204.34738
43	15870033	BUILD NOVA SCOTIA	Standard parcel	3.31	10952.95511
44	15772890	MEMBERTOU DEVELOPMENT CORPORATION	Standard parcel	3.027115	30400.84067
45	15828247	HER MAJESTY THE QUEEN CANADA	Standard parcel	0.003606	36.1289

Appendix 9 - Glencoe Limestone Deposit – A Cement Plant Opportunity (Syllagold)

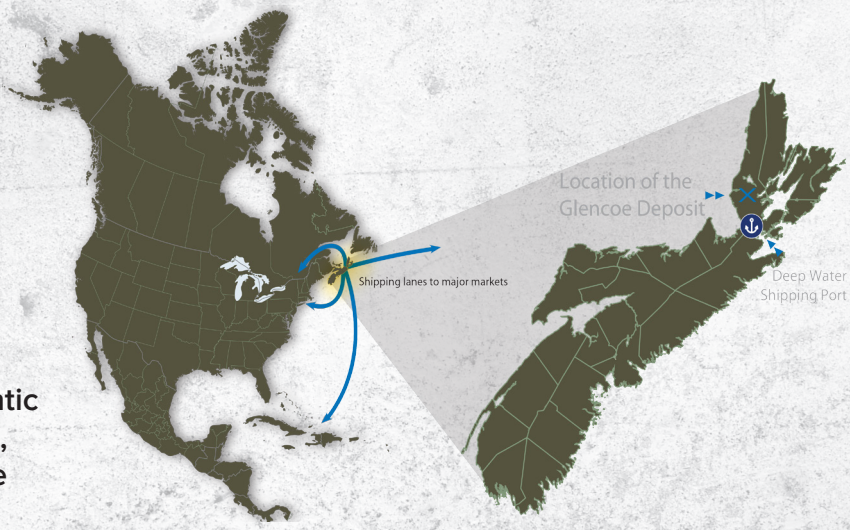


(2 page Document)

GLENCOE LIMESTONE DEPOSIT

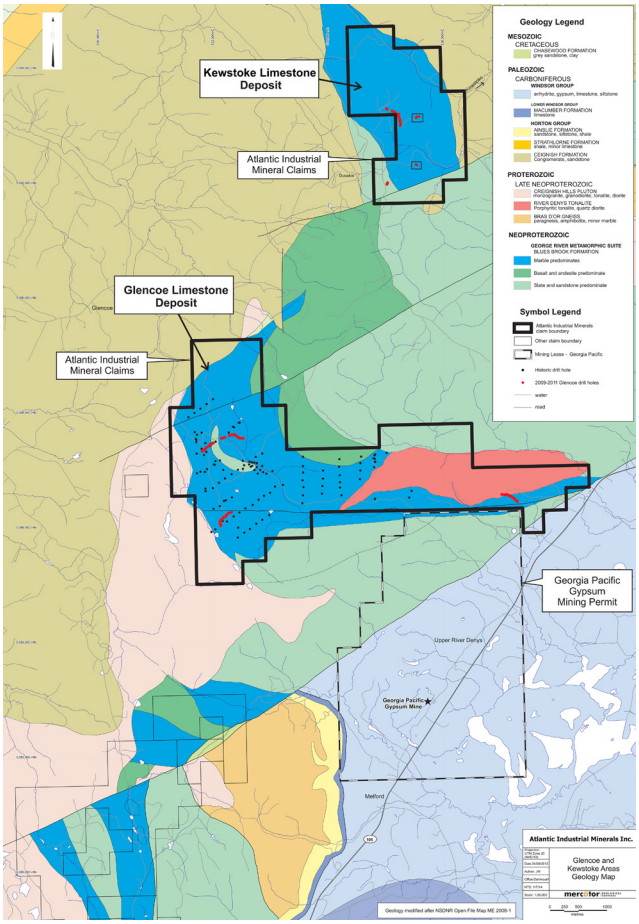
A CEMENT PLANT OPPORTUNITY

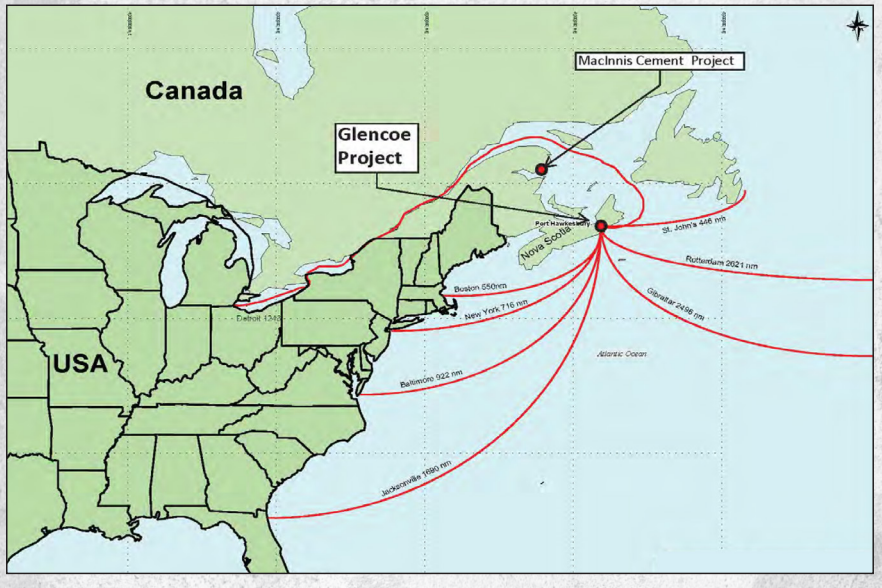
The Glencoe Cement Project, owned by Atlantic Industrial Minerals, is located in Cape Breton, Nova Scotia, approximately 45 km north of the town of Port Hawkesbury and tide water.

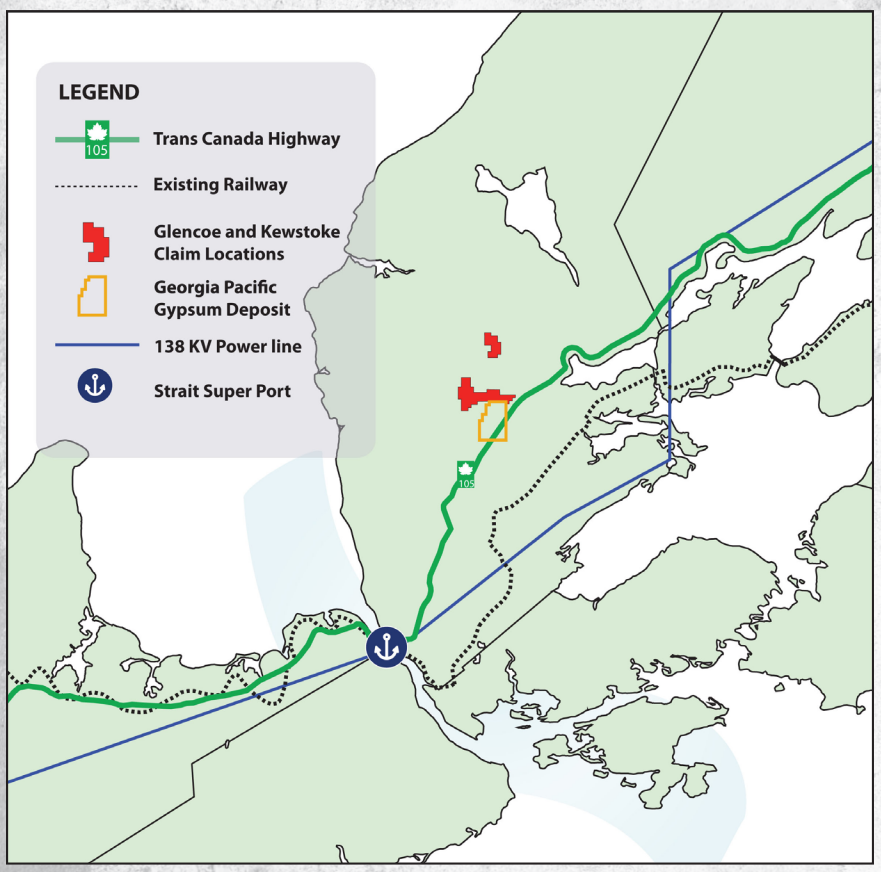


STRATEGIC LOCATION

- The Glencoe Project is strategically located just 45km from year-round, ice-free shipping facilities in the Strait of Canso, Nova Scotia.
- The Glencoe limestone deposit consists of 1 billion tonnes of carbonate rocks, about 500 million tonnes of which are cement grade.
- Strait of Canso can accommodate the largest shipping vessels in the world and is a brown field site, industrially permitted by the town of Port Hawkesbury in an effort to attract and benefit project.
- Deposit is accessible by road on the 105 Trans Canada Highway.
- 15,000m of diamond drilling and corresponding chemical analysis completed on the property.
- An estimated 5 million dollars have been spent to date.







STUDIES COMPLETED ON THE PROJECT

2006

• Detailed scoping study, commissioned by the provincial government, carried out by Consultec out of Toronto.

2014

• Conestoga Rovers (now GHD), positive permitting scoping study demonstrated the time frame, costs and likelihood of permitting the project from both environmental and industrial points of view.

• PWC market study, this study was meant to identify the trends of markets which could be easily reached by Glencoe product shipped out of the strait to the eastern seaboard of the US.

• FLSmidth conceptual study, a site-specific conceptual study based on a 2-million tonne-per-year plant capacity with FLSmidth as the designer and builder.

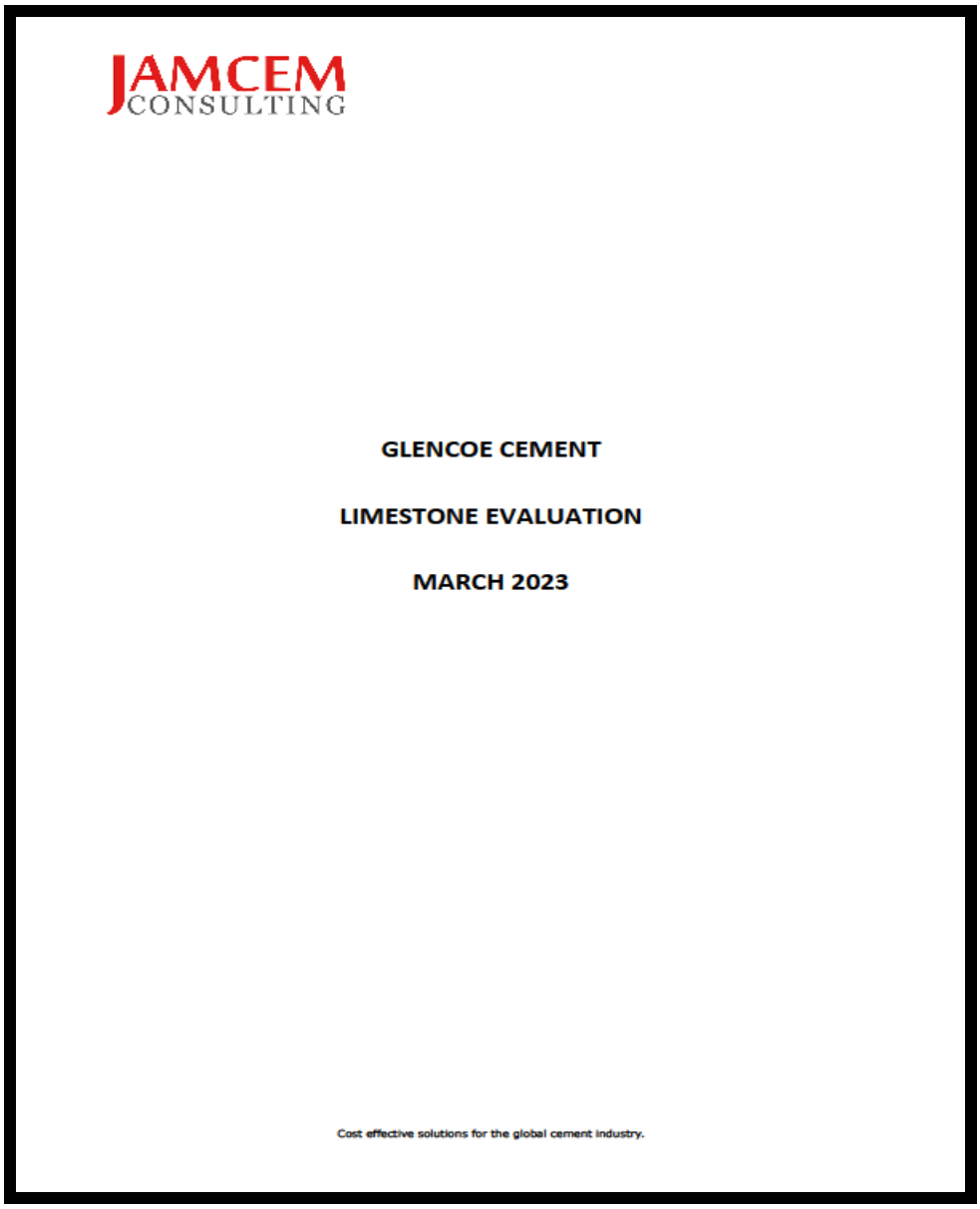
2015

• John Kline market study, a general outlook on the future of the cement industry in the United States and Canada.

All of these reports are readily available.

Atlantic Industrial Minerals is a publicly traded company on the NEX. There are currently 25 million shares of ANL outstanding which are tightly held. Management is open to discussion of multiple financing structures which would both advance the project and bring on a strategic partner who understands the benefit of owning a piece of a large project at such an early stage of development.

Appendix 10 – Glencoe Cement Limestone Evaluation (Jamcem Consulting 2023)



JAMCEM CONSULTING

GLENCOE CEMENT

LIMESTONE EVALUATION

MARCH 2023

Cost effective solutions for the global cement industry.

(24 page document)

JAMCEM CONSULTING

GLENCOE CEMENT

LIMESTONE EVALUATION

MARCH 2023

JAMCEM CONSULTING

EXECUTIVE SUMMARY

JAMCEM Consulting has completed this study into the limestone resources of Glencoe Cement – covering both the quality and quantity of material as well as the potential future CAPEX and operating costs – for use as a raw material for the production of cement. Within our assessment, we have considered the potential for the production of both grey and white cement.

It is clear from the information that has been provided to JAMCEM that the limestone reserve has been extremely well evaluated over many years. The results from our analysis of the information provided is that the deposit – in terms of both quantity and quality – is more than sufficient to support a cement plant of 1.8 million tonnes clinker/2 million tonnes per annum. The deposit is split into two areas – West and East. Both in terms of quality and quantity as well as apparent ease of exploitation, the West deposit is preferential to the East. There is more than sufficient limestone in the Western part of the Mineral Resource to support the operations for more than 50 years for the previously mentioned capacity.

In terms of the final quality of cement, the alkali levels on the limestone are suitable to produce low alkali cement, which is the type of cement that is preferred on the Eastern Coast of the USA to avoid adverse reactions in cement due to Alkali Silica reaction with aggregates found in that area. Production of white cement would appear to be more challenging, due to the level of iron oxide in the raw materials, with iron being the element that gives cement its grey colour. If white cement production were to be considered, a much more detailed knowledge of the Mineral Resource through more extensive drilling would be required along with selective mining or selection of materials.

We would suggest that any future testing of the Mineral Resource focuses on the West Area, with a smaller grid than that previously used in that area to increase the accuracy and certainly of the deposit. In addition, we would recommend that the materials tested for should be extended to cover other materials that could cause issues for the cement plant itself – for example heavy metals which could cause environmental emissions above permitted levels. Should this drilling go ahead, there would be no requirement to re-test the previous cores for additional species. We have suggested a drill grid sizing for the future drilling campaign as well as the different elements to be measured.

In addition to the assessment of the deposit, we have also calculated the cost of operation of the area of the Mineral Resource which we would expect to be the operational quarry following on from more extensive investigation, the sizing of the crusher and the size/cost of the required mobile plant. These costs will be used in the financial model that is also being developed by JAMCEM.

JAMCEM CONSULTING

TABLE OF CONTENTS

1. Introduction

JAMCEM Consulting Limited ("JAMCEM") has completed an evaluation of the geological characteristics of a mining deposit in Nova Scotia, Canada, for its potential future use as limestone feed to a cement integrated cement plant. The evaluation is based on the documents supplied by client, which were the results of the various investigations dating from 1974 through the current day.

The area of study is located in Glencoe, Inverness County, approximately 335 km from Halifax, the capital city of Nova Scotia, Canada. The deposit holds an exploration licence EL51626 issued in 1995. Drilling on the deposit in August 2022 with the exploration license renewed in September 2022 for a period of two years.

Figure 1: Location of Glencoe property

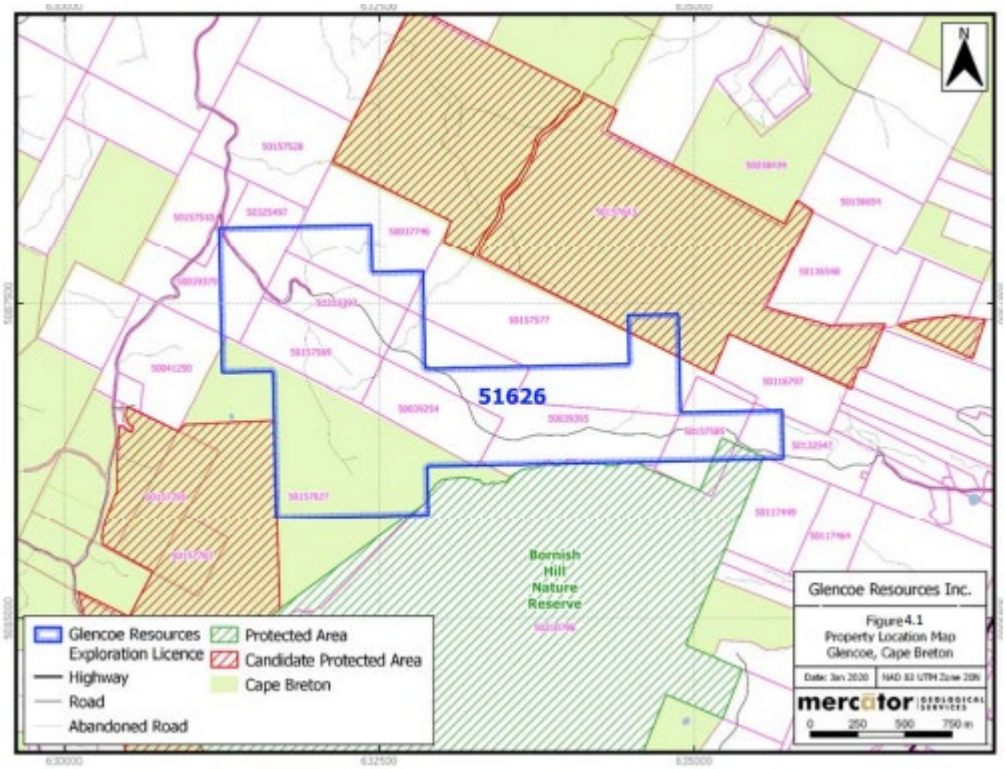


Figure 2: Perimeter of Glencoe exploration license

The area is forested with various type of vegetation softwood and hardwood, the morphology is quite flat, affected by local hills that reach a max elevation of 300 m above sea level. The area is not inhabited, and the closest houses are 5 km to the East, 3.5 km to the West and 5.5 km to the North of the deposit.

The climate in this area of Nova Scotia is temperate to cool, with moderately hot summers and cold winters, with average daytime highs below freezing. Winter conditions with heavy snow predominate from late December through to mid-March; spring and fall seasons are marked by moderate precipitation.

The access is guaranteed by a rural road that connects the Glencoe property to the Trans-Canada Highway 105 and a railroad is available 13 km from the deposit, not far from the Community of Orangedale. To complete the picture of the facilities, the Glencoe property is 55 km from the “ice free” deep water port of the Strait of Canso.

2. Raw materials for cement manufacture

To manufacture clinker for the use in the manufacture of grey cement, it is necessary to have four main elements in the correct proportion – these being calcium oxide, silicon oxide, iron oxide and aluminium oxide. The calcium oxide comes from calcium carbonate (limestone) which is decarbonated with the clinker manufacture process to produce calcium oxide and carbon dioxide; the silicon oxide is normally sourced as a clay or shale and the iron and aluminium is normally sourced either from naturally occurring rock or as by-products from other industries that are not used for any other purpose – for example spent catalyst.

Along with these four main elements, the naturally occurring rock will contain other materials such as magnesia (MgO), sulphates, alkalis, chlorides and heavy metals – all of which can influence the final properties of the cement as well as lead to processing problems (material build-ups within the process that reduce output and eventually lead to a kiln stoppage for removal) or adverse environmental emissions.

The manufacture of clinker for white cement differs to that of grey cement in both the raw materials requirements and the process equipment used, as follows:

- The colour of cement is influenced by the iron content, which gives cement it's grey colour. Therefore, to produce white cement, it is necessary to limit the input of iron oxide in the raw materials to 0.2%. As the clay – as well as the limestone - may also contain iron, it is necessary to have access to a low iron clay source such as kaolin.
- Generally, clinker for white cement is produced on a slightly different process to grey clinker, with a water cooler used for clinker cooling as opposed to an air cooler as well as a different firing system. White cement manufacture also relies on the fuel to be ash free, as the ash will contain iron – this limits the production of white cement to fuels such as gas, oil and petroleum coke. More recently, one of the equipment suppliers has come up with modifications that can be made to a grey clinker kiln from a white clinker kiln, but some process adaption is required each time the kiln is changed over from one product to the other.

3. Regional geology

The regional geology of the area is represented by late Precambrian age meta-sedimentary and igneous lithologies dominated by a thick, metamorphosed siliciclastic and carbonate succession also with the presence of monzonite and granodiorite.

The limestone deposit object of the study was, in origin, sedimentary and deposited under late Proterozoic marine conditions. Subsequently it was subject to regional deformation with intrusion of granite mineralization. Thus, the deposit can be classified as limestone metamorphosed deposit.

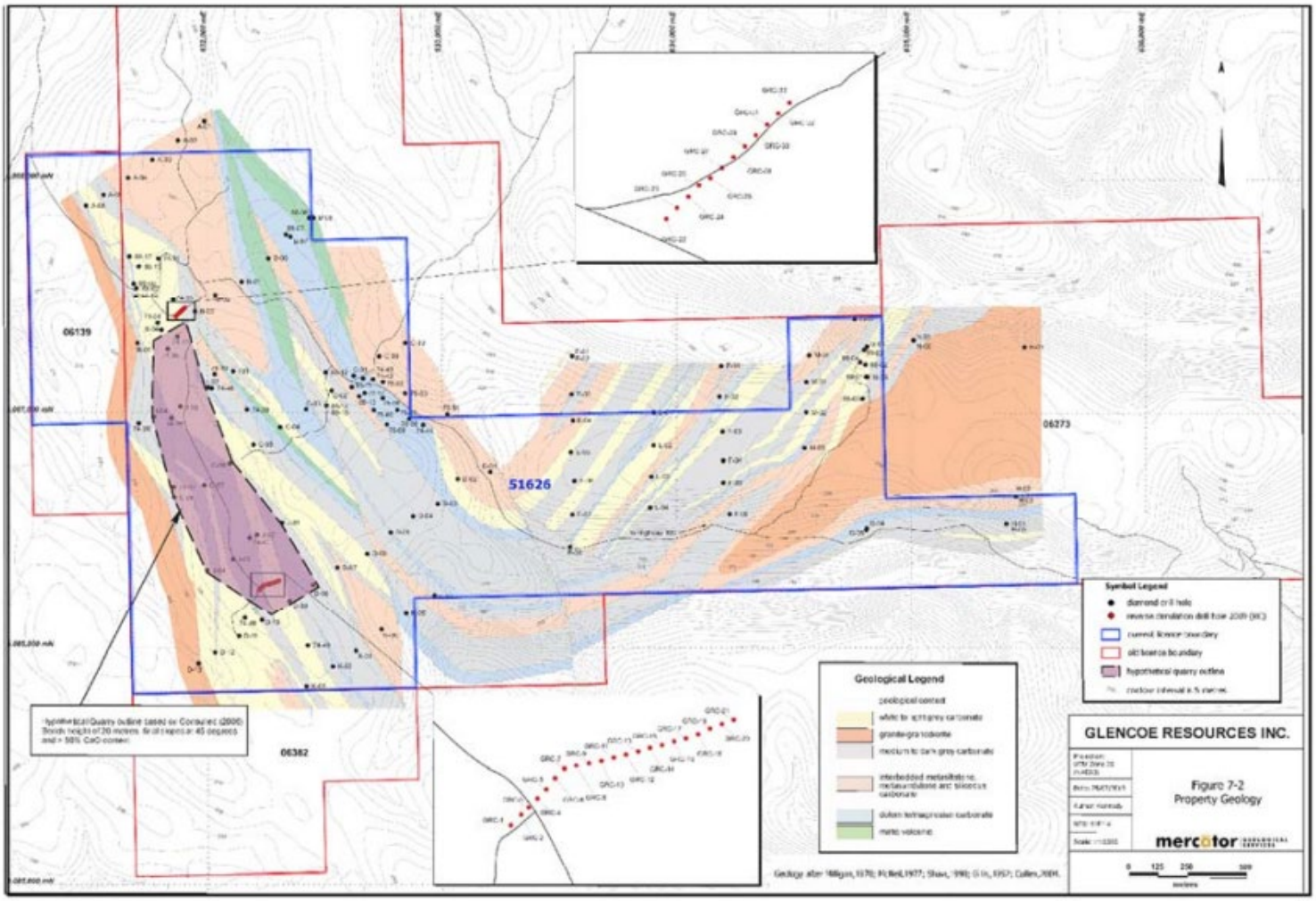


Figure 3: Geological map

The threshold of metamorphosed limestone having a potential use in cement industry is around 40% of CaO, corresponding to approximately 71% of $CaCO_3$ within which there are intercalations of high-grade limestone with CaO between 53% and 55%. The latter may have potential for application in chemical and lime industries.

4. Exploration drilling history.

The drilling campaign to investigate the carbonate deposit of Glencoe property was started in 1974 by NSDM (Nova Scotia Department of Energy and Mines) and Scotia Limestone Ltd. The exploration activities carried out by the government agency lasted until 1988.

After that period, Glencoe Resources Inc. and Atlanatic Industrial Minerals Ltd. carried out drilling campaigns from 2007 to 2022. Almost all of the drilling cores had reference samples stored in different facilities, which allowed a re-logging of the different geological studies.

The table below shows the numbers of holes, type of drilling and total meterage of the campaigns as summarised by Mercator Geological Services Limited.

OPERATOR	PERIOD	HOLE TYPE	NUMBER OF HOLES	TOTAL METERAGE
NS Government/Scotia Limestone/International Limestone Industries Ltd.	1974-1988	Core	121	17,466
Glencoe Resources Inc. or Atlantic Industrial Minerals Ltd.	2009	Reverse Circulation	33	984
Glencoe Resources Inc. or Atlantic Industrial Minerals Ltd.	2011	Open Hole Percussion	73	262
Glencoe Resources Inc. or Atlantic Industrial Minerals Ltd.	2007-2012	Core	3	551
Glencoe Resources Inc. or Atlantic Industrial Minerals Ltd.	2016	Core	3	303
Glencoe Resources Inc. or Atlantic Industrial Minerals Ltd.	2019	Core	3	46
Gregory P. Isenor	2022	Core	1	89
Total Drilling (All Types)	**1974-2022**		**237**	**19,700**
Total Drilling (Core)	**1974-2022**		**131**	**18,455**
Total Drilling (Open Hole Percussion or Reverse Circulation)	**2009-2011**		**106**	**1,245**

Table 1: Core drilling history of Glencoe deposit

The different borehole drilling campaigns carried out since 1974 have been considered acceptable by Mercator Geological Service, historical consultant of Glencoe company, for use in the mining deposit assessment and therefore we have considered that the results reported in the different geological studies are representative of the real situation of the limestone deposit.

In addition to the extensive drilling that has been completed on the deposit, a “Mine Permitting Scoping Study” was completed in January 2014 by local consultants Conestoga-Rovers and Associates. The consultants, through their work, felt that the site shows good potential for permitting through the Provincial Environmental Assessment (EA) Process with limited federal involvement….and that, with the proper level of effort and favourable results from the environmental baseline and public consultation components, a mine could be fully permitted within a 14-to-18-month period from initiating permitting activities”.

5. Geological studies history

In 2002, on the basis of chemical analysis of drilling boreholes completed up to 1991, Mercator Geological Service relogged the drilled cores that were archived at the provincial government's Stellarton core Library and develop an update the geological model of Glencoe Property, dividing it in 4 different areas:

- Cement grade potential carbonate (CaO > 40%).
- Area of high purity carbonate potential (53% < CaO < 55%), potentially useful for chemical industries.
- Area of white to light grey carbonate as source for filler and coaters products.
- Area of variably coloured carbonate having dimension stone potential.

The estimated quantities were as follows:

Carbonate for cement:	470 Mt
Carbonate high grade:	60 Mt
Carbonate for filler:	190 Mt
Carbonate for stone:	50 Mt

The figures reported above must be considered as estimates of exploration potential only and do not constitute a Mineral resource or Mineral reserve estimation as currently defined under NI 43-101 and CIM standards, because a Qualified Person has not carried out this estimation.

Subsequent to this in 2020, Mercator, through two Qualified Persons, issued a document (NI-43-101-2020), that certified the previously inferred mineral resources estimated by:

- Checking of digital drilling database records (40 drilling holes equal to 28% of drilled meterage available).
- Sampling a quarter of archived drill cores recovered during government drilling campaigns in 1975-1975 and completing XRF analysis for principal oxides.
- Reviewing data from a twin-hole core drilling programme carried out by Mercator on behalf of GRI in 2007.
- Field checking of the location coordinate for several historic and GRI drill hole locations against database records.
- Developing a digital block model for the principal oxides.

This report qualifies as a 43-101 Mineral Resource Estimate in accordance with CIM standards.

The geological model that was created, based on the previously mentioned work, used the Surpac 3D geochemical block-model software, covers the main carbonate section (taking into account only CaO > 43% as potential limestone for cement) that occurs in the western area of the property as well as additional significant carbonate deposits defined by historic drilling in the eastern area of property.

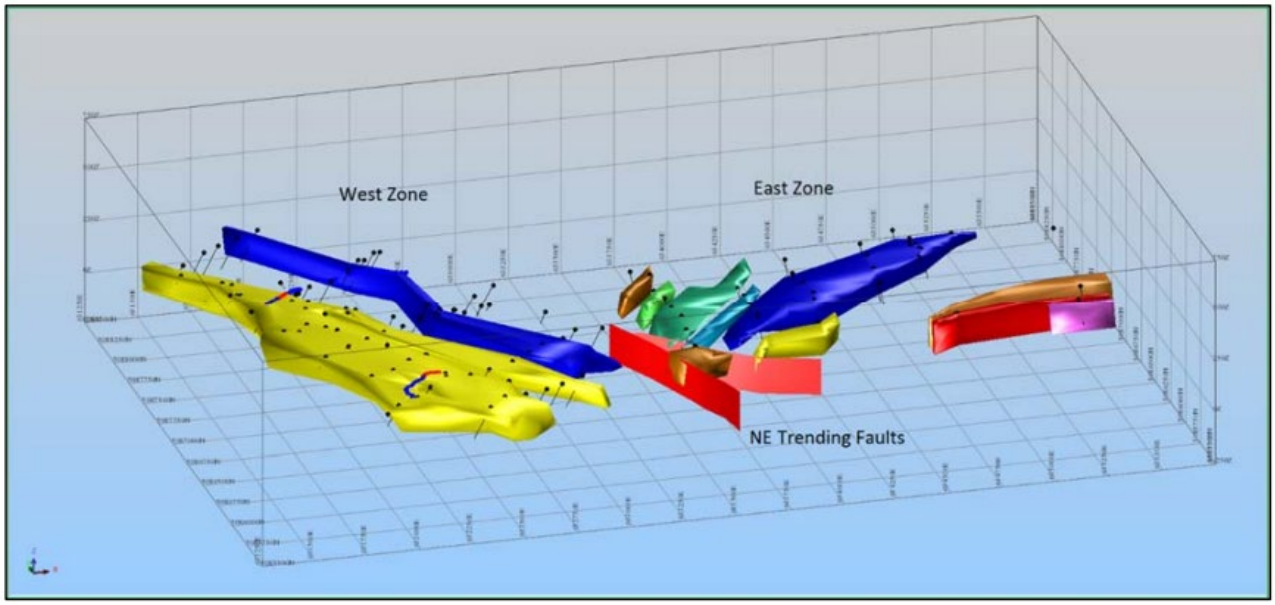


Figure 4: Surpac model of Glencoe deposit

In the West Zone two areas are identified as potential deposit for cement limestone (figure 6):

- The Southern area with a length of 2,300m along N-NW direction and a width of 600m, with a maximum depth of 175 m below surface.
- The smaller west zone, separated from Southern area by siliciclastic metasedimentary, with a length of 2250m, a width of 200m and depth of 175m.

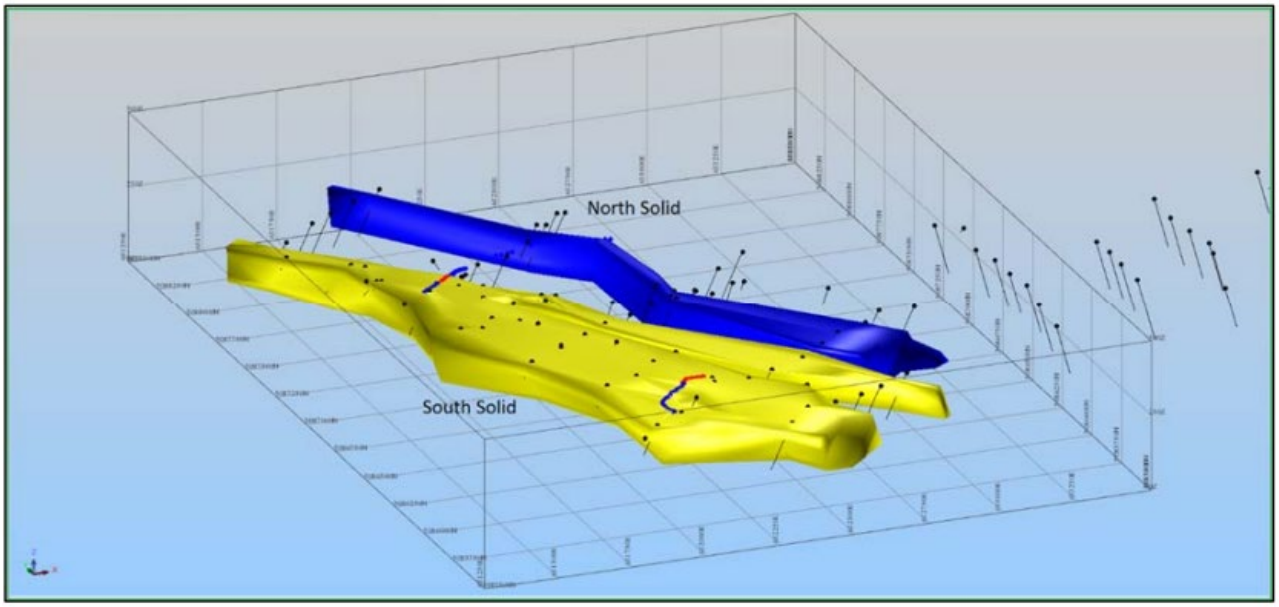


Figure 5: Surpac model of Western zone of Glencoe deposit

In the East zone (figure 7), five different models are defined, with lengths between 350 to 1500m, widths of between 40 to 100m and a depth of 175m.

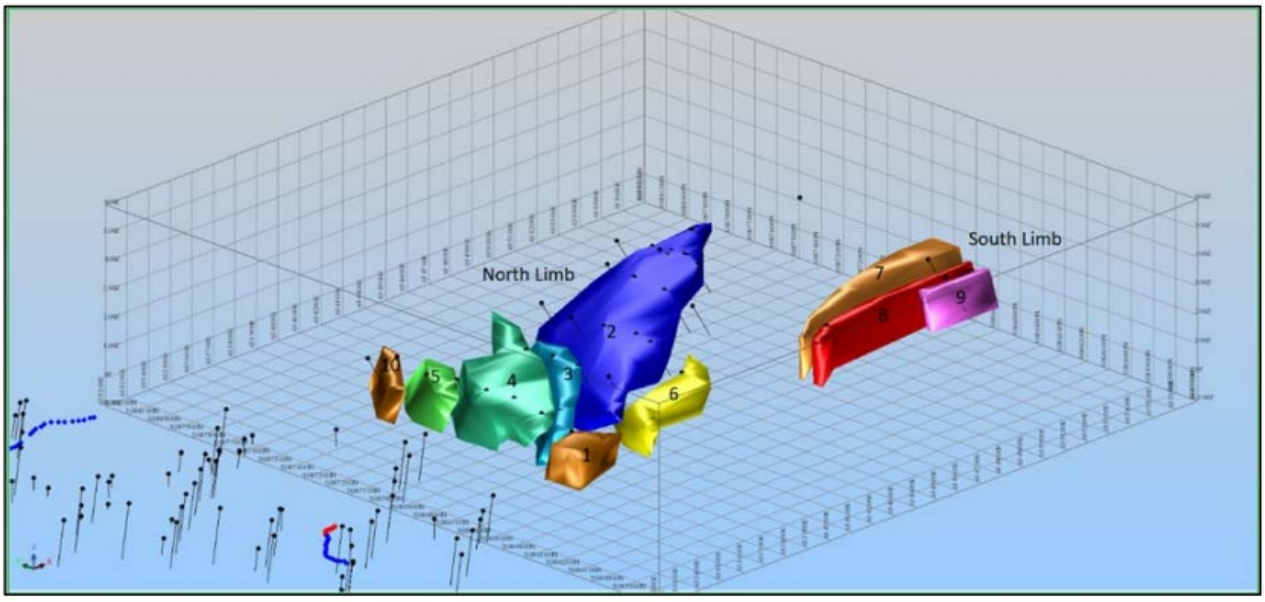


Figure 6: Surpac model of Eastern zone of Glencoe deposit

The chemical variation results of CaO and MgO in the geological model are presented in the tables below:

Glencoe West Zone solids: CaO% and MgO% statistics for 3.0 meter composites

Parameter	CaO	MgO
Mean Grade	49.63%	2.35%
Maximum Grade	56.50%	17.9%
Minimum Grade	3.67%	0.05%
Variance	28.45	5.01
Standard Deviation	5.33	2.24
Coefficient of Variation	0.11	0.95
Number of Composites	1928	1928

Glencoe East Zone solids: CaO% and MgO% statistics for 3.0 meter composites

Parameter	CaO	MgO
Mean Grade	47.57%	3.16%
Maximum Grade	57.24%	18.65%
Minimum Grade	3.75%	0.00%
Variance	33.87	6.53
Standard Deviation	5.82	2.56
Coefficient of Variation	0.12	0.81
Number of Composites	1043	1043

Table 2 and 3: CaO and MgO values for West and East Zones

Combined CaO% and MgO% statistics for 3.0 meter composites

Parameter	CaO	MgO
Mean Grade	48.91%	2.63%
Maximum Grade	57.24%	18.65%
Minimum Grade	3.67%	0.00%
Variance	31.33	5.70
Standard Deviation	5.60	2.39
Coefficient of Variation	0.11	0.91
Number of Composites	2971	2971

Table 4: Combined analysis of West and East Zones

6. Mineral resources estimation for cement manufacture

In order to consider the suitability of the deposit for cement manufacture, we have to consider the calcium content as well as other parameters such as the magnesia and other parameters that can affect quality and process design, as described in section 2.

The parameters considered for the mineral resources estimation for cement manufacture that were included in the Mercator 43-101 MRE are as follows:

- Block density: 2.60 t/m^3
- CaO cut-off: 43%
- Max MgO grade: 3.5 %
- SiO_2 value*: ≤ 25%

*SiO2 content was not interpolated into the block model because it was not present in the database of drill holes at the time of original Mineral Resource estimation.

The limit level for CaO was selected to ensure that acceptable quality clinker can be produced from the raw mix and the limit value for MgO was selected to ensure that no cement will be produced that could risk expansion in concrete.

The volume of material in each of the Mineral Resource locations meeting the limit values and the total is presented below.

West Zone Glencoe Deposit Cut-off Sensitivity Report

CaO % Cut-Off	Category	Tonnes (rounded)	CaO %	MgO %
40	Inferred	469,650,000	49.79	2.22
***43**	**Inferred**	**462,850,000**	**49.91**	**2.20**
47	Inferred	400,570,000	50.57	1.99
50	Inferred	244,460,000	51.80	1.55
53	Inferred	41,920,000	53.53	0.77

East Zone Glencoe Deposit Cut-off Sensitivity Report

CaO % Cut-Off	Category	Tonnes (rounded)	CaO %	MgO %
40	Inferred	233,730,000	47.82	3.32
***43**	**Inferred**	**217,180,000**	**48.27**	**3.15**
47	Inferred	147,270,000	49.68	2.45
50	Inferred	61,130,000	51.30	1.85
53	Inferred	2,470,000	53.49	1.13

Global Glencoe Deposit Cut-Off Sensitivity Report

CaO % Cut-Off	Category	Tonnes (rounded)	CaO %	MgO %
40	Inferred	703,380,000	49.13	2.59
***43**	**Inferred**	**680,040,000**	**49.38**	**2.50**
47	Inferred	547,850,000	50.33	2.11
50	Inferred	305,590,000	51.70	1.61
53	Inferred	44,390,000	53.53	0.79

Tables 5,6 and 7: Quantity of material meeting cement plant quality criteria

The limestone of East Zone has an average CaO content of 48.27%, slightly lower than that of West Zone having an average grade of 49.9%. Similarly, the West Zone has an average content of MgO of 2.2%, lower than the East Zone with an average MgO average content of 3.1%.

From the analysis of chemical database supplied by the client (73 boreholes with complete chemical analysis), the content of Alkali Equivalent (AE) in several boreholes is lower than 0.6% with some exception in certain intervals of sampling. The global database value average of AE is 0.33%. Then we can affirm that the limestone of the deposit is suitable to produce low alkali clinker. The requirement to be able to produce low alkali cement is particularly important for Glencoe Cement, as low alkali is produced on the East Coast of the USA (a target export market for the plant) to avoid alkali silica reaction in concrete, which causes expansion and cracking in concrete.

The chloride level in the limestone has also been evaluated, with the histogram of results shown below. Generally, chloride above 0.02% in the raw materials will require a bleed system to be installed as part manufacturing system to remove some of the chloride, which can give build-up issues. The bypass system results in a higher overall fuel consumption per tonne of clinker compared to a system without a bypass as well as having to either dump the dust from the bypass system or incorporate the bypass dust into the cement. Fortunately, the level of chloride is not as high as seen in some plants and therefore the level of bypass required (and the impact on fuel consumption) as well as the quantity of dust produced should be low.

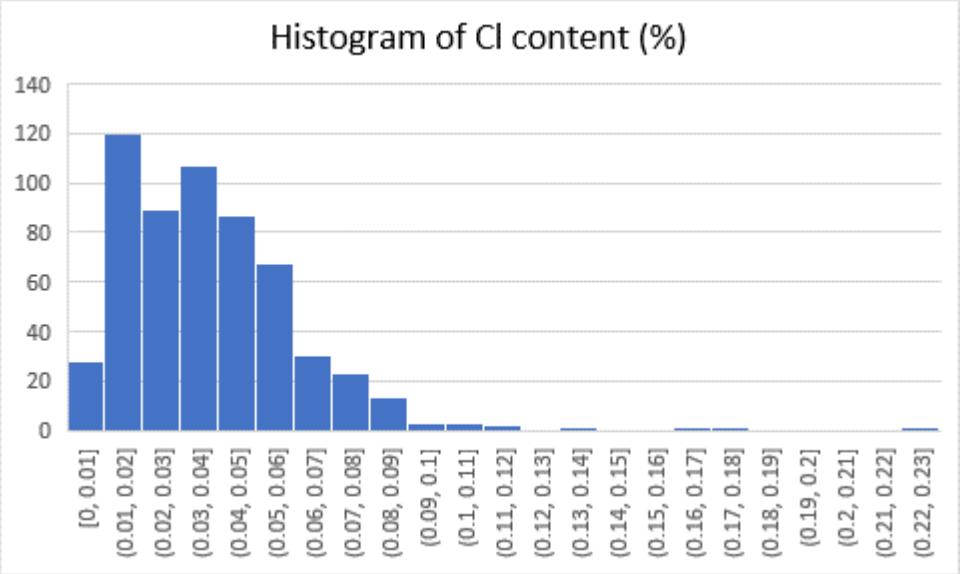


Figure 7: Histogram of chloride content in limestone

The manufacture of white cement does not appear to be favourable with the raw materials that have been studied, due to the high average grade of Fe_2O_3 (0.87%), which is the component which gives cement its grey colour and therefore needs to be absent for the manufacture of white cement. Typical levels of iron that would be considered as a maximum level for white cement production are around 0.2 – 0.3%. As with the chloride, we have presented a histogram of the iron content of the limestone.

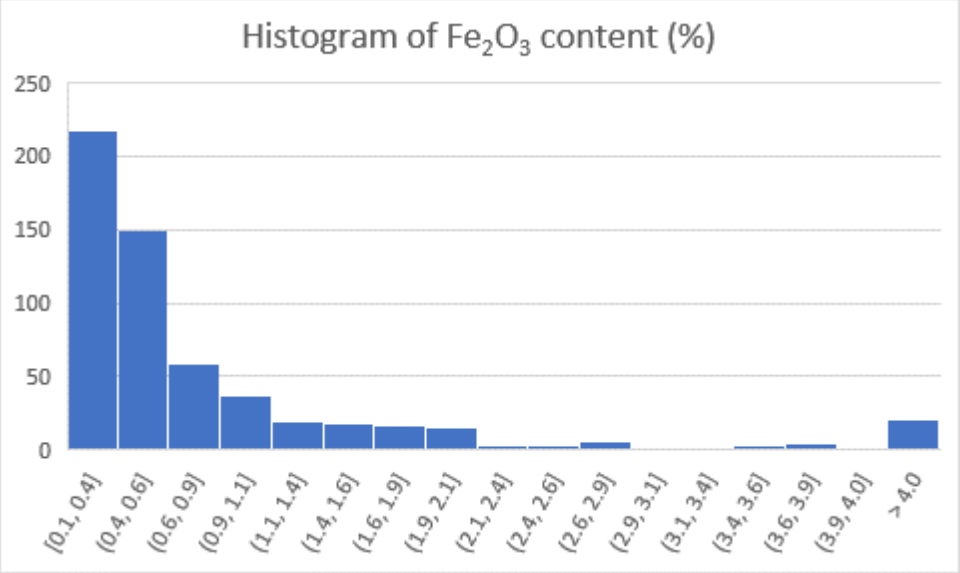


Figure 8: Histogram of iron oxide in limestone

Whilst the iron oxide up to 0.4% may be acceptable as an upper limit, if white cement were to be considered a very detailed block model and very selective mining or selection of stone for the white cement would be required.

7. Geological recommendations

Should the initial financial model indicate that there is a possibility of a new cement plant to be built by Glencoe, we could suggest carrying out a new drilling campaign with a narrower spacing in order to upgrade the category of reserves from inferred to indicated or measured. This will be the base to make a feasibility study, transforming the mineral resources in mineral reserves. As the requirement for production for 50 years of cement from the plant is around 125 million tonnes, the extended geological evaluation should focus on this volume of material. As the West area of the Mineral Resource appears to be simpler to mine compared to the East, we would suggest focusing on the West part; this area contains more than enough material for the lifetime of the cement plant, is of a slightly higher grade than the East and has already been more extensively drilled.

More specifically, we would recommend further investigation in the Southern part of the Western area by:

- Putting the positions of the boreholes carried out until now an updated topographical survey map.
- Inserting the position of the new boreholes with core recovery method within the current grid to obtain a new regular grid of 200 x 200 m.
- Ensuring that the boreholes reach a depth of at least 180 m below ground level (the level at which the bottom of the deposit is estimated to be).
- Complete chemical analysis to cover all the major (SiO_2, AL_2O_3, Fe_2O_3, CaO, MgO and loss on ignition) and minor elements (SO_3, Na_2O, K_2O, TiO_2, MnO_2, P_2O_5, SrO, Cl, Cr, Cd, Tl, Hg, NH4, Total organic carbon, F, I). We would also recommend that the moisture content of the cores is checked.

In terms of the chemical analysis that has been completed to date, the core samples have been analysed covering the main compounds as well as materials such as sulphur, chloride, strontium, titanium oxide and barium. The additional species that have been suggested mainly relate to potential issues relating to final product quality although some such as the heavy metals relate to environmental emissions. From our research of the environmental standards and regulations of Canada, it would appear that the more stringent limits are voluntary, non-regulatory limits that are followed when alternative fuels are used in the kiln. If the new boreholes are drilled, then we do not believe that it will be necessary to retest the old cores which have been stored.

8. Mining exploitation pre-feasibility study

Within this section of the report, we have provided some technical information for a hypothesis of pre-feasibility study for the exploitation the limestone deposit considering the production requested. Whilst throughout the document we have referenced the Mineral Resource, we have used the term "quarry" within this section based on the assumption that the investigation work will be completed and that the boundaries of the area to be mined will be defined to give the operating quarry.

8.1. Crusher sizing

All the following assumptions will have to be assessed by the future executive project will add further information that could be update this hypothetical study. Base data for the project is as follows:

Daily clinker production	5,500 tpd
Kiln running time	330 days/y
Clinker production	1,815,000 tpa
Raw meal to clinker factor	1.56
Raw meal required	2,831,400 t

Table 8: Plant project design basis

The raw mix calculation, as per Consultec in June 2006 report, is as follows:

Limestone	77.75%	2,201,413 tpa
Shale	14.55%	411,969 tpa
Iron Ore	0.85%	24,067 tpa
Silica corrective	6.85%	193,950 tpa
Total	100%	2,831,400 tpa

Table 9: Raw mix design

In addition to the limestone required to produce raw meal for clinker production, we have also planned that cement will contain 10% limestone; therefore, the total required limestone – on both wet and dry basis is shown below.

Limestone for cement (10%)	181,500 tpa
Total dry limestone	2,382,913 tpa
Total wet limestone (Assumed 3% moisture)	2,454,400 tpa

Table 10: Limestone requirements (dry and wet)

To consider the sizing of the crushing plant of the plant, we have used the following assumptions:

Months/year	9
Days/month	20
Shift/day	2
Hours/shift	8
Hours/day	16
Hourly efficiency	83%
Net hours/day	13.28
Total working year (days)	180
Total working hours	2.880 (gross)
	2.390 (net)

Table 11: Quarry working hours calculation

9-month operation of the quarry was advised by Glencoe in communications with JAMCEM. This equates to the following crusher sizing, which would most likely equate to a standard crusher size of 1500 tpd.

Limestone/week	68,178 t
Limestone/day	13,636 tpd
Limestone/hour	1,027 tph

Table 12: Limestone crusher sizing

8.2. Drilling and blasting design

JAMCEM has taken the weekly required tonnage of limestone to calculate the weekly required blasting volume/tonnage as follows:

Blasted limestone/week	68,178 t
	26,222 m^3
Number of blasts/week	4
Limestone/blast	6,555 m^3
	17,044 t

Table 13: Blast design volume

We would propose the following drilling pattern for the Glencoe quarry.

Bench height	25 m
Sub-drilling	1 m
Hole diameter	120 mm
Spacing	4.5 m
burden	4.0 m
Surface drilling grid	18 m^2
Limestone/hole	450 m^3
Number of holes/blast	15
Drilled meters/blast	379
Blast events/year	144

Table 14: Drill pattern design

We would expect the following performance for the drilling of blastholes.

Net drilling speed	25 m/h
Net drilling hours/blast	15 hours
Hourly efficiency	83%
Mechanical availability	92%
Gross drilling hours/blast	20 hours
Net drilling hours/year	2,182 hours
Gross drilling hours/year	2,857 hours
Numbers drilling unit	2
Total fuel consumption	71,428 l

Table 15: Drilling efficiency calculations

Finally, we have calculated the following use of explosives and detonators on an annual basis.

Total blasted limestone	1,022,667 m^3/year
	2,454,401 t/year
Specific consumption	140 g/t
Total explosive	343,616 kg
ANFO (80%)	274,893 kg
Emulsion (20%)	68,723 kg
Number of Non-electric Detonators	2.273

Table 16: Explosives use calculation

8.3. Loading and dumping

The following parameters have been used for the sizing of the mobile fleet for loading and dumping.

Travel distance (one way)	1,500 m
Average grade	4%
Average speed	30 km/h
Cycle time	
- Loading	4.95 min
- Manoeuvring	0.70 min
- Travelling (full)	2.80 min
- Return time	1.8 min
- Total cycle time	10.25 min
Numbers cycle/ hour	5.85
Hourly efficiency	83%
Mechanical availability	92%
Effective cycle/ hour	4.46

Table 17: Dumper cycle time calculations

For the dumper performance we have calculate the following:

Payload	90 t
Backhoe capacity	56.25 m^3
Transported ton/unit/hour	366.53 t
Numbers dumping unit	3
Total fuel consumption	448,074 l

Table 18: Dumper fuel consumption

Similarly, the loader performance has been calculated as follows:

Backhoe capacity	6.8 m^3
Cycle time	0.45 min
Numbers of passes	11
Loading time	4.95 min
Class excavator 95-100 t	1
Total fuel consumption	187,200 l

Table 19: Loader fuel consumption

8.4. Manpower

Based on our experience and the operating mode as defined above, we propose the following manning.

Working role	Numbers per position
Quarry manager	1
Quarry Assistant	2
Drilling operator	2
Blaster	2
Blaster assistant	2
Truck driver	6
Excavator operator	2
Mechanics	3
Crusher assistant	2
General services	2
Total units	24

Table 20: Proposed quarry manpower

8.5. Mining equipment

In order to meet the requirement of the above operation, we propose the following equipment would be required. It should be noted that these costs are estimates based on our most recent experience but with all similar equipment, costs are highly variable at this time due to changes in energy costs, steel costs etc.

Equipment	Number	Cost (CAN $)
Drilling units DTH Ø 120 mm	2	1,225,000
Off-road truck 90 t	3	6,540,000
Hydraulic excavator 90-100 t backhoe 6.8 m^3	1	1,430,000
Dozer type CAT 9D	1	1,225,000
Hydraulic excavator 40 t with hammer	1	816,000
Motor-grader type CAT 120 AWD	1	410,000
Wheel-loader bucket 6 m^3	1	1,090,000
Pick-up	3	102,000
Water tank truck	1	160,000
Total		18,788,000

Table 21: Mobile plant capital cost

8.6. Mining cost

The assumptions for the unit consumption of manpower, explosives and fuel on the basis of the working hours of the quarry and the limestone production carried out are shown below.

Manpower	0.02 hrs/t
ANFO	0.11 kg/t
Emulsion	0.027 kg/t
Non-electric detonator	0.00092/t
Fuel for drilling	0.029 l/t
Fuel for dumping	0.19 l/t
Fuel loading	0.08 l/t

Table 22: Unit cost calculation

On the basis of standard cost for mining units in Canada received from Glencoe and Cost Reference Guide for Construction Equipment (Equipmentwatch), a hypothetical production cost has been estimated below.

Items	CAN $/t
Drilling & Blasting	1.50
Loading & Hauling	1.50 – 2.00
Crushing	3.00
Indirect Manpower	0.50
Sub-total	**6.50 – 7.00**
General cost	1.30 – 1.40
Sub - total	**7.80 – 8.40**
Contingency	0.78 – 0.87
TOTAL	**8.58 – 9.27**

Table 23: Cost of production of limestone to plant

The following comments are made with respect to the costs shown in the table:

- Cost for crushing includes power for the crusher, maintenance and manpower
- Indirect manpower covers Quarry Manager and Assistant, mechanics and general services.
- General cost includes stripping of overburden, road maintenance, hammering, stockpile management, ancillary works etc.

8.7. Quarry opening

Without seeing the quarry, it is impossible to estimate the cost of the opening of the quarry; however, the terrain does not appear to be especially challenging compared to some limestone quarries and therefore we would suggest a budget figure of CAN $1,000,000 to be included in the capital cost of the project, which can be later adjusted once a site visit has been completed.

JAMCEM CONSULTING

9. Conclusion

It is clear from the information that has been provided to JAMCEM that the limestone deposit has been extremely well evaluated over many years. The deposit is split into two areas – West and East. Both in terms of quality and quantity, the West deposit is preferential to the East. There is more than sufficient limestone in the West of the Mineral Resource to support the operations for more than 50 years for a 1.8 million tpa clinker plant. From the Surpac model, it would also appear that the West deposit would be easier to exploit.

In terms of the final quality of cement, the alkali levels on the limestone are suitable to produce low alkali cement, which is the type of cement that is preferred on the Eastern Coast of the USA to avoid adverse reactions in cement due to Alkali Silica reaction with aggregates found in that area. Production of white cement will not be possible due to the level of iron oxide in the raw materials, with iron being the element that gives cement its grey colour.

We would suggest that any future testing of the Mineral Resource focuses on the West Area, with a smaller grid than that previously used in that area to increase the accuracy and certainly of the deposit. In addition, we would recommend that the materials tested for should be extended to cover other materials that could cause issues for the cement plant itself – for example heavy metals which could cause environmental emissions above permitted levels.

More specifically, we would recommend further investigation in the Southern part of the Western area by:

- Putting the positions of the Boreholes carried out until now an updated topographical survey map.
- Inserting the position of the new boreholes with core recovery method within the current grid to obtain a new regular grid of 200 x 200 m.
- Ensuring that the boreholes reach a depth of at least 180 m below ground level (the level at which the bottom of the deposit is estimated to be).
- Complete chemical analysis to cover all the major (SiO_2, AL_2O_3, Fe_2O_3, CaO, MgO and loss on ignition) and minor elements (SO_3, Na_2O, K_2O, TiO_2, MnO_2, P_2O_5, SrO, Cl, Cr, Cd, Tl, Hg, NH4, Total organic carbon, F, I)

In addition to the assessment of the deposit, we have also calculated the cost of operation of the extraction of the limestone for the manufacture of clinker, the sizing of the crusher and the size/cost of the required mobile plant.

Appendix 11 – 2021 Market Demand John Kline Consulting (2021)

(14 page document)

2021 Market Predictions

John Kline Consulting

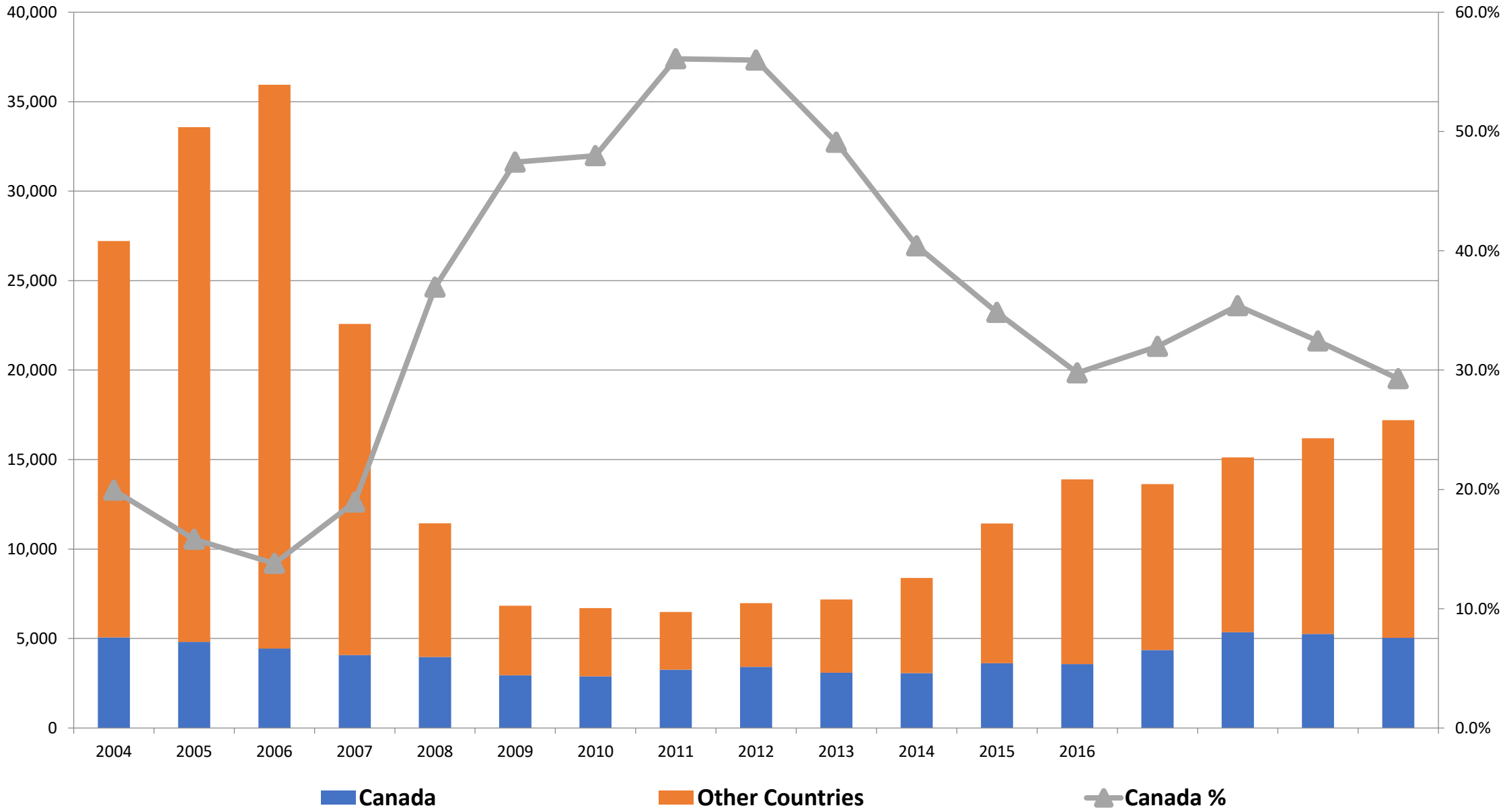
Impact of US Infrastructure Bill on Cement Consumption

Cement Consumption by Legislation Category

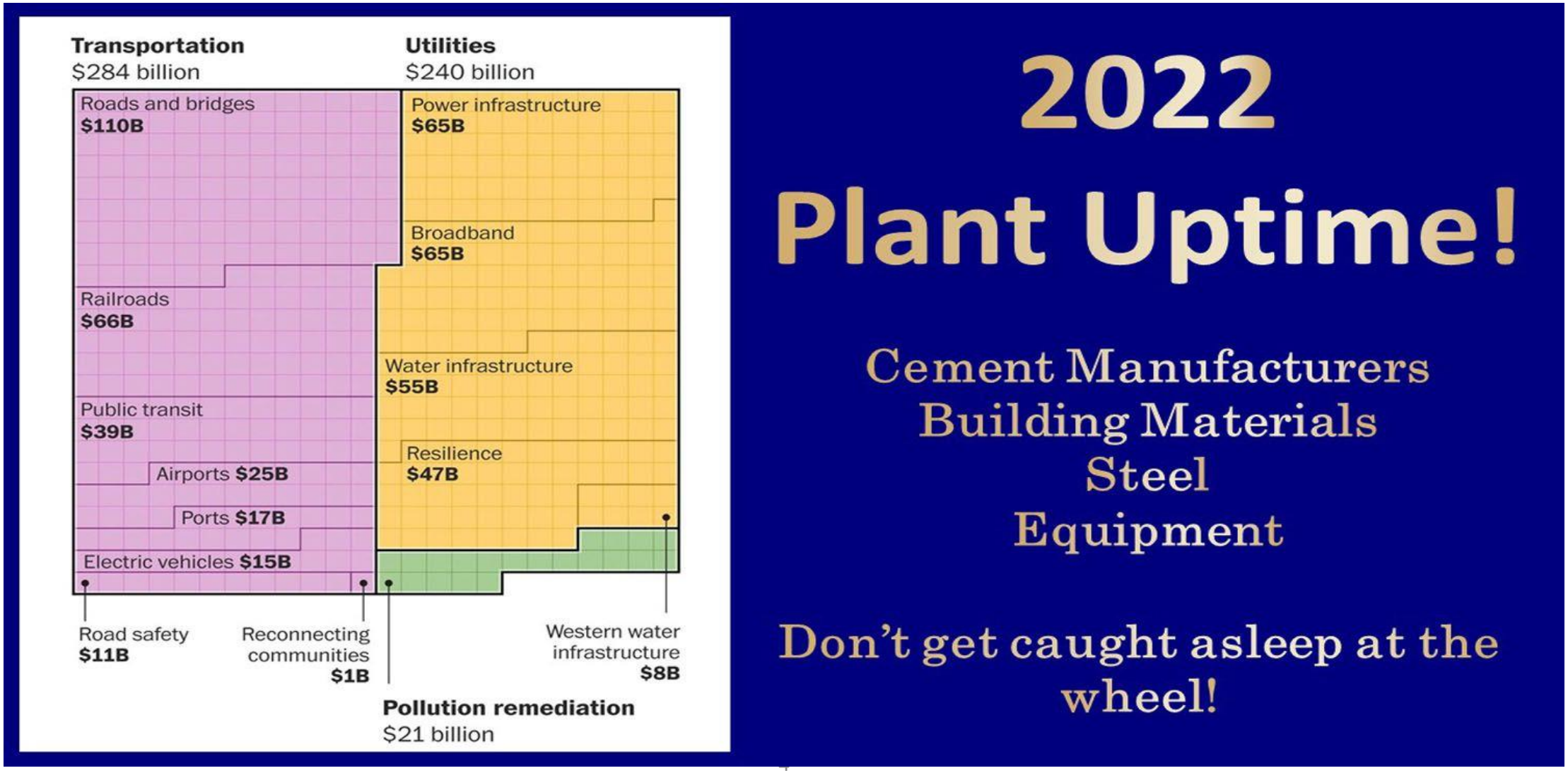
$Billions; (000) Metric Tons

ID	Description	Spending	Cement Intensity	Cement Consumption
A	Roads, Bridges & Major Projects	$ 110.74	168	18,628
B	Passenger and Freight Rail	$ 66.20	6	373
C	Safety	$ 10.51	5	50
D	Public Transit	$ 39.15	9	361
E	Broadband	$ 65.00	1	94
F	Ports and Waterways	$ 17.42	172	2,991
G	Airports	$ 25.00	231	5,780
H	Water Infrastructure	$ 55.00	126	6,927
I	Power and Grid	$ 66.88	20	1,360
J	Resiliency	$ 47.59	169	8,064
K	Clean School Buses and Ferries	$ 7.50	-	-
L	Electric Vehicle Charging	$ 7.50	4	30
M	Reconnecting Communities	$ 1.00	319	319
N	Addressing Legacy Pollution	$ 21.00	37	775
O	Western Water Infrastructure	$ 8.30	218	1,812
	Total	**$ 548.78**	**87**	**47,563**

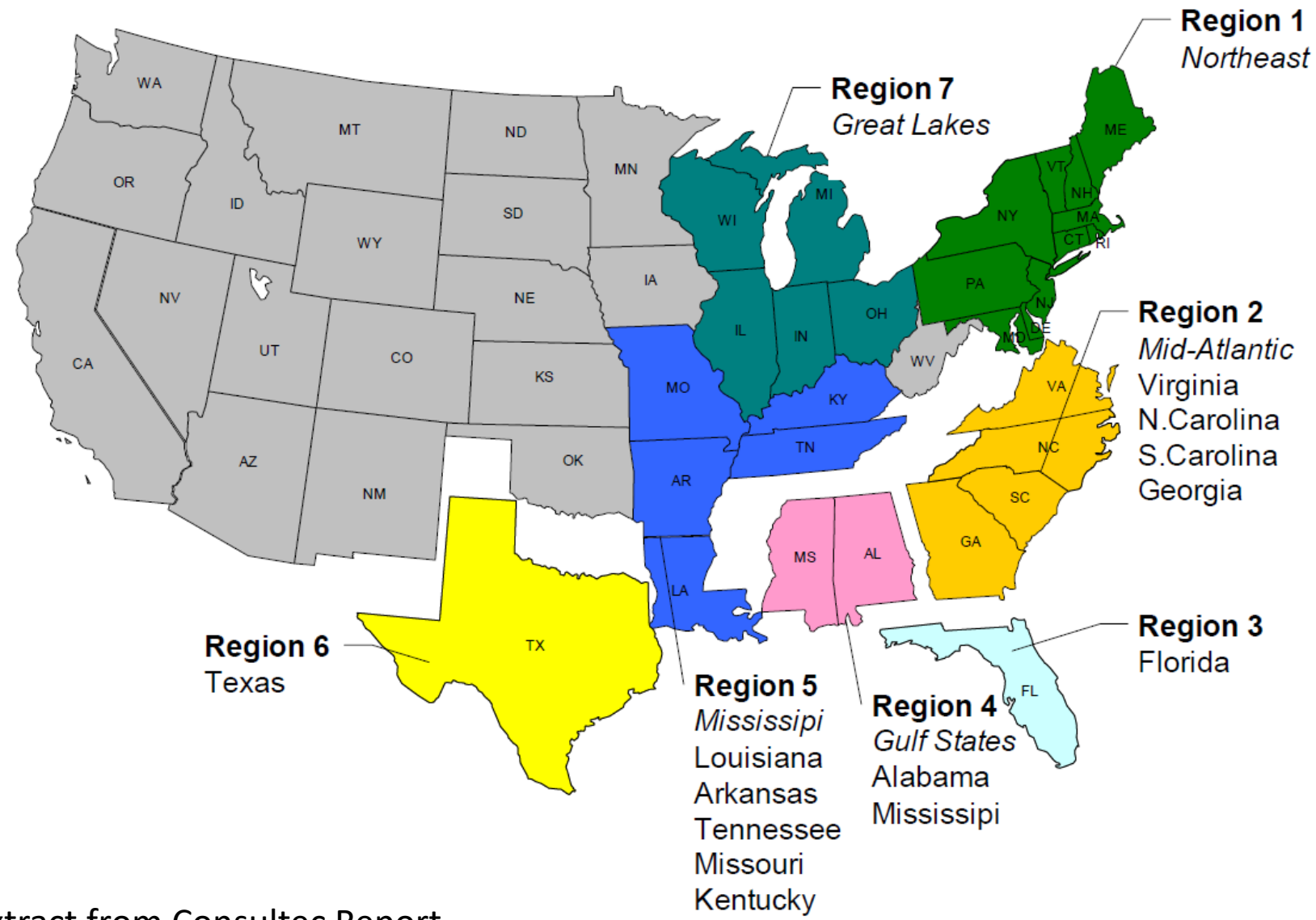
Source: PCA


US Cement Imports from Canada and All Other Countries (000 mt)
40,000
35,000
30,000
25,000
20,000
15,000
10,000
5,000
0
60.0%
50.0%
40.0%
30.0%
20.0%
10.0%
0.0%
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
Canada
Other Countries
Canada %

Sold-Out Ahead ?



Potential target Markets in Order of Preference



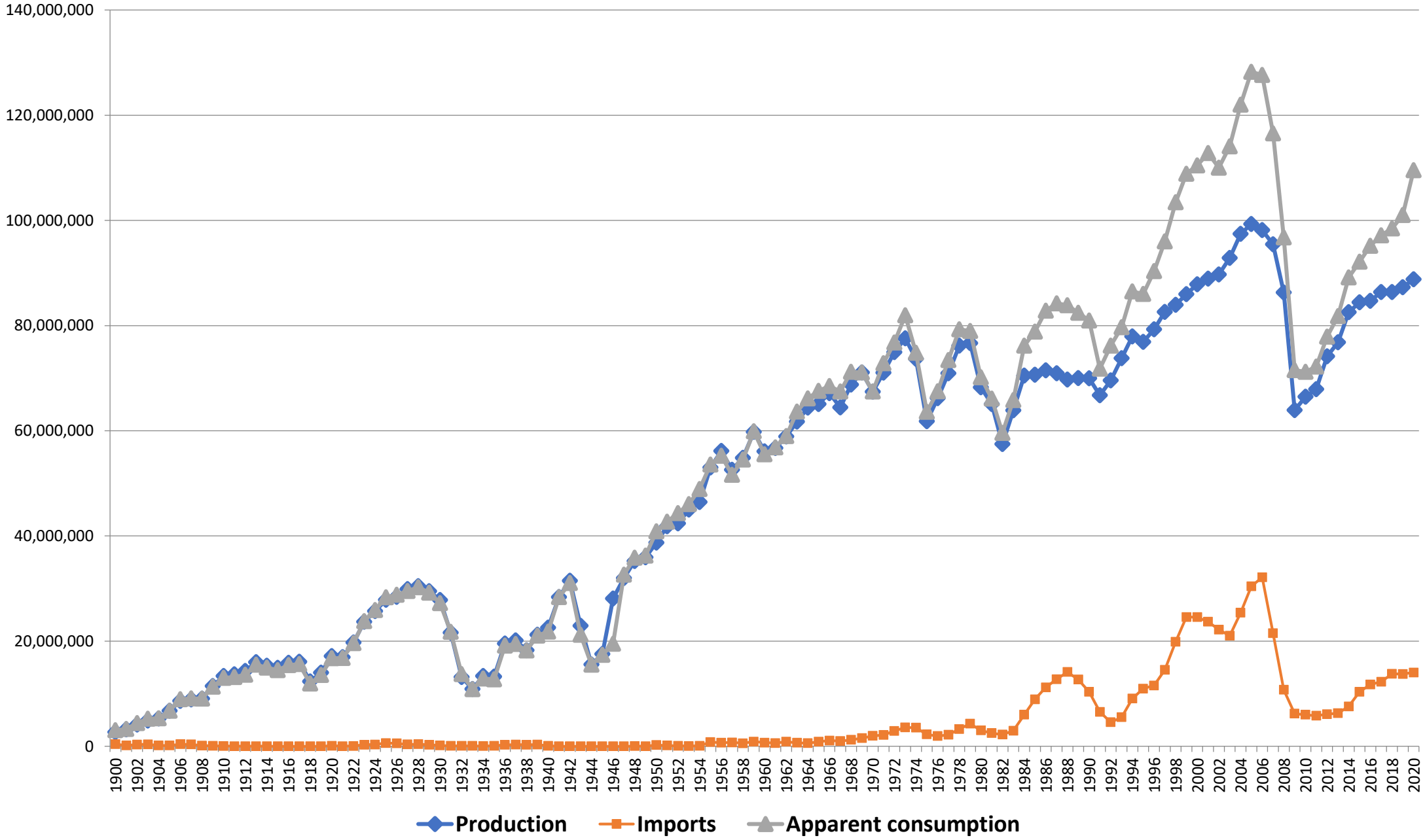
Extract from Consultec Report

PORTLAND CEMENT SHIPMENTS, BY DESTINATION, 2012 - 2020

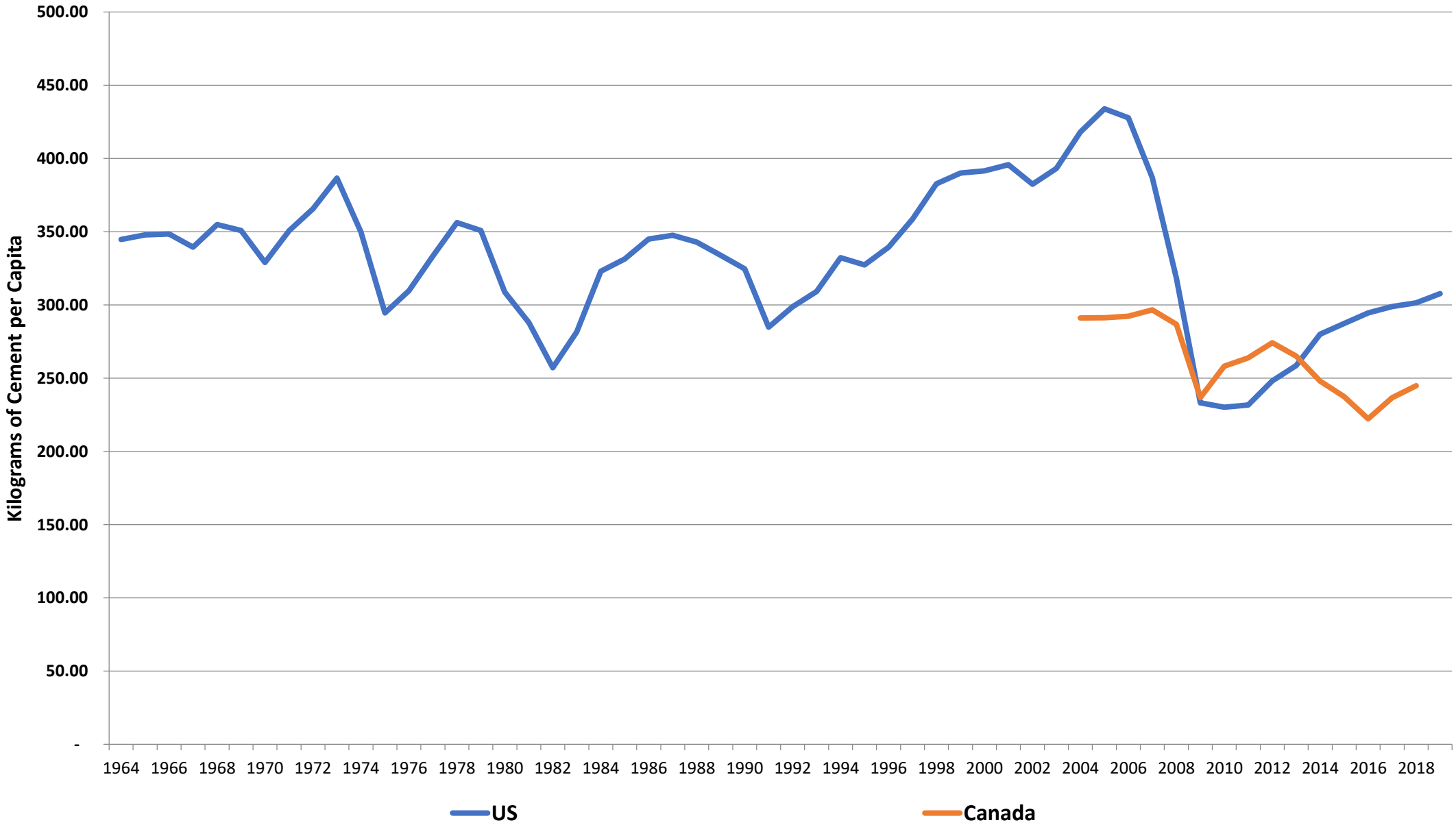
(Metric tons)

	Actual								
Destination	2012	2013	2014	2015	2016	2017	2018	2019	2020
Connecticut	472,865	494,144	516,380	539,618	563,900	569,525	558,111	538,312	589,973
Maine	182,575	190,791	199,376	208,348	217,724	214,809	208,387	220,510	241,273
Massachusetts	700,537	732,061	765,004	799,429	835,403	999,994	998,987	992,254	1,007,234
New Hampshire	192,125	200,771	209,805	219,247	229,113	197,880	193,266	195,489	208,443
New York, metropolitan	1,170,466	1,223,137	1,278,178	1,335,696	1,395,802	1,786,848	1,810,231	1,811,184	1,736,143
Rhode Island	106,410	111,198	116,202	121,431	126,896	116,161	121,032	120,231	110,872
Subtotal Zone 1	2,824,978	2,952,102	3,084,947	3,223,769	3,368,839	3,885,217	3,890,014	3,877,980	3,893,938
Delaware	135,650	141,754	148,133	154,799	161,765	86,992	72,527	77,665	132,396
District of Columbia	178,105	186,120	194,495	203,247	212,394	234,991	219,771	209,685	247,888
Maryland	964,462	1,007,863	1,053,217	1,100,611	1,150,139	1,183,726	1,140,337	1,261,094	1,175,973
New Jersey	1,065,655	1,113,609	1,163,722	1,216,089	1,270,813	1,399,887	1,291,240	1,401,996	1,397,874
New York, eastern	423,044	442,081	461,975	482,763	504,488	459,638	448,598	489,238	29,063
North Carolina	1,704,208	1,780,897	1,861,038	1,944,784	2,032,300	2,547,242	2,519,220	2,742,594	2,829,841
Pennsylvania, eastern	1,464,608	1,530,515	1,599,389	1,671,361	1,746,572	1,536,304	1,429,207	1,652,890	1,535,562
Vermont	95,538	99,837	104,330	109,025	113,931	98,821	111,611	109,231	100,903
Virginia	1,441,533	1,506,402	1,574,190	1,645,029	1,719,055	1,853,610	1,724,938	1,868,809	1,965,553
Subtotal Zone 2	7,472,803	7,809,079	8,160,488	8,527,710	8,911,457	9,401,211	8,957,449	9,813,202	9,415,053
Florida	3,360,398	3,511,616	3,669,639	3,834,772	4,007,337	6,497,817	6,934,744	7,100,029	6,737,204
Georgia	1,695,979	1,772,298	1,852,051	1,935,394	2,022,487	3,038,610	3,125,237	3,270,952	3,306,914
New York, western	693,346	724,547	757,151	791,223	826,828	685,918	615,161	605,691	634,946
Pennsylvania, western	1,005,226	1,050,461	1,097,732	1,147,130	1,198,751	1,094,210	1,021,117	941,037	910,600
South Carolina	956,770	999,825	1,044,817	1,091,834	1,140,966	1,643,601	1,609,206	1,672,999	2,829,841
Subtotal Zone 3	7,711,719	8,058,746	8,421,390	8,800,352	9,196,368	12,960,156	13,305,465	13,590,708	14,419,505
Total All Zones	18,009,500	18,819,928	19,666,824	20,551,831	21,476,664	26,246,584	26,152,928	27,281,890	27,728,496

United States Cement Market 1900 - Present



Source: USGS

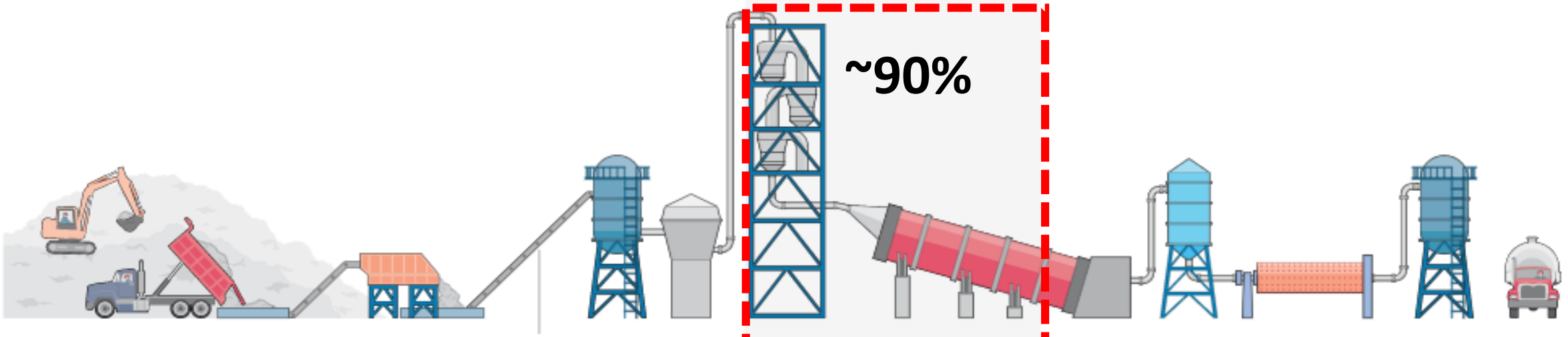

Per Capita Cement Consumption - US and Canadian
Kilograms of Cement per Capita
500.00
450.00
400.00
350.00
300.00
250.00
200.00
150.00
100.00
50.00
-
1964 1966 1968 1970 1972 1974 1976 1978 1980 1982 1984 1986 1988 1990 1992 1994 1996 1998 2000 2002 2004 2006 2008 2010 2012 2014 2016 2018
US
Canada

Cement manufacturing is a highly complex process.

McKinsey & Company

Raw materials, energy, and resources

Clinker and cement manufacturing

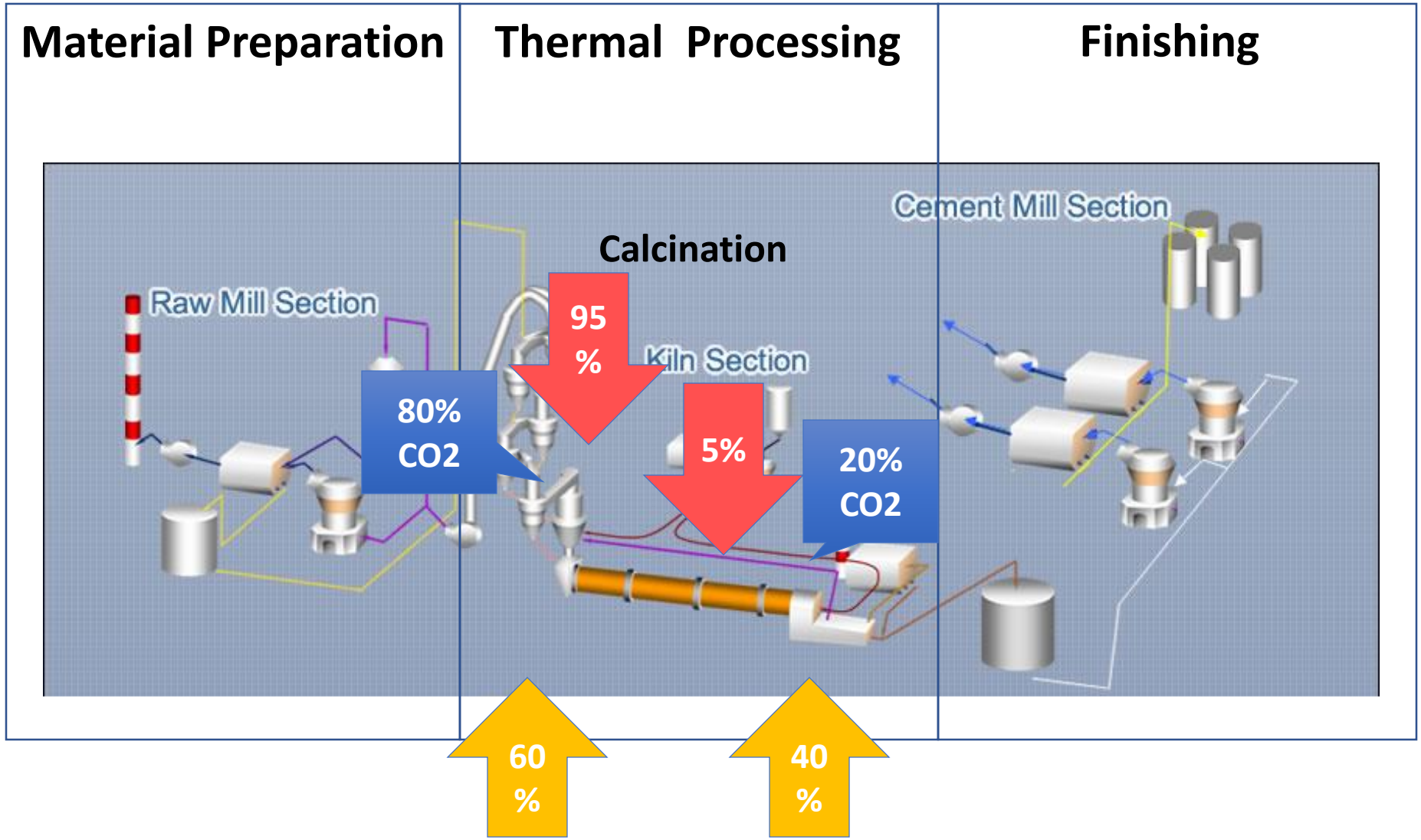


	Quarry	Crusher	Transport[1]	Raw mill	Kiln and preheater/ precalcinator[2]		Cooler[3]	Cement mill	Logis-tics[4]	**Total**
Energy, mega-joule/ton	40	5	40	100	3,150		160	285	115	3,895
CO_2, kilogram/ton	3	1	7	17	479 Calcination process	319 Fossil fuels	28	49	22	925

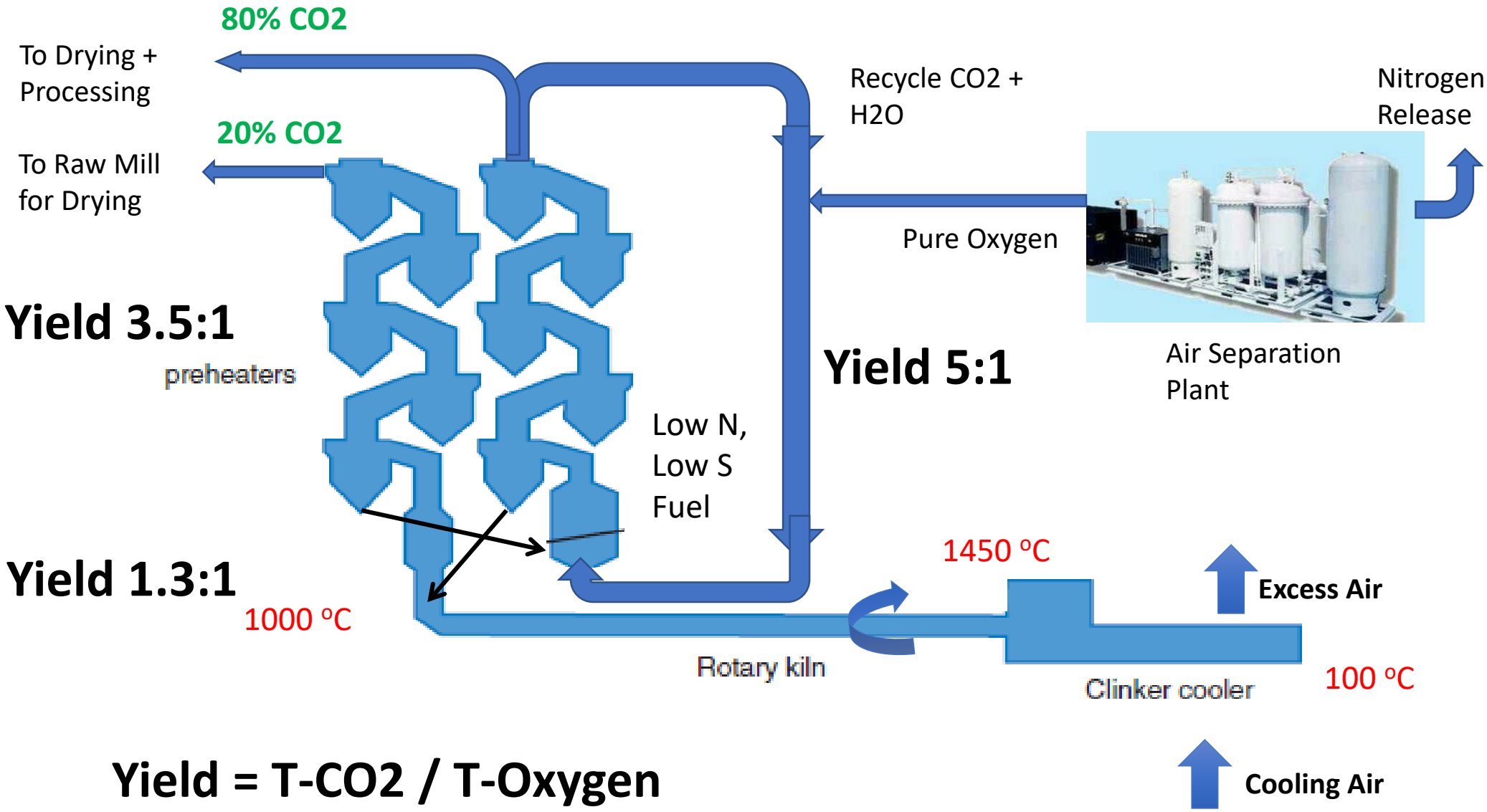
$CaCO3 + Heat => CaO + CO2$

$C + O2 + Heat => CO2$

Cement Manufacture - Precalciner



Potential Oxy-Calcination (80%)



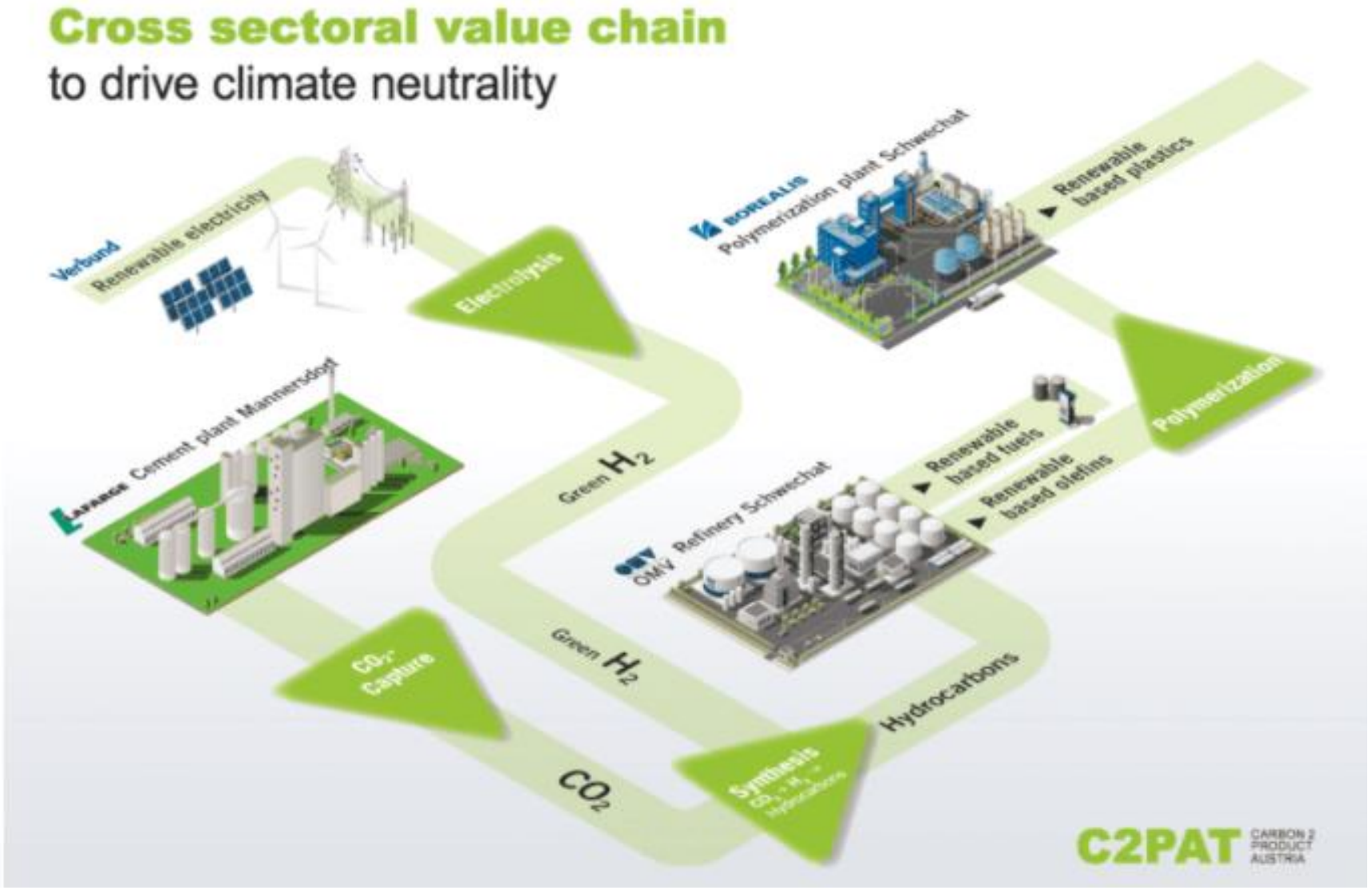
Yield = T-CO2 / T-Oxygen

Potential Uses of CO2

- Short Term
  - CO2 Industrial Gas market (Eastern Canada & US) - Partial
  - Enhanced Oil Field Recovery (Off Shore)
  - Geological Sequestration
- Longer Term
  - Conversion to chemicals and fuels

Heidelberg – Brevik – Aker Solutions' Advanced Carbon Capture - 400,000 tpy liquid for EOR

Oxy-Combustion & Green Hydrogen Mannersdorf, Austria (LH)



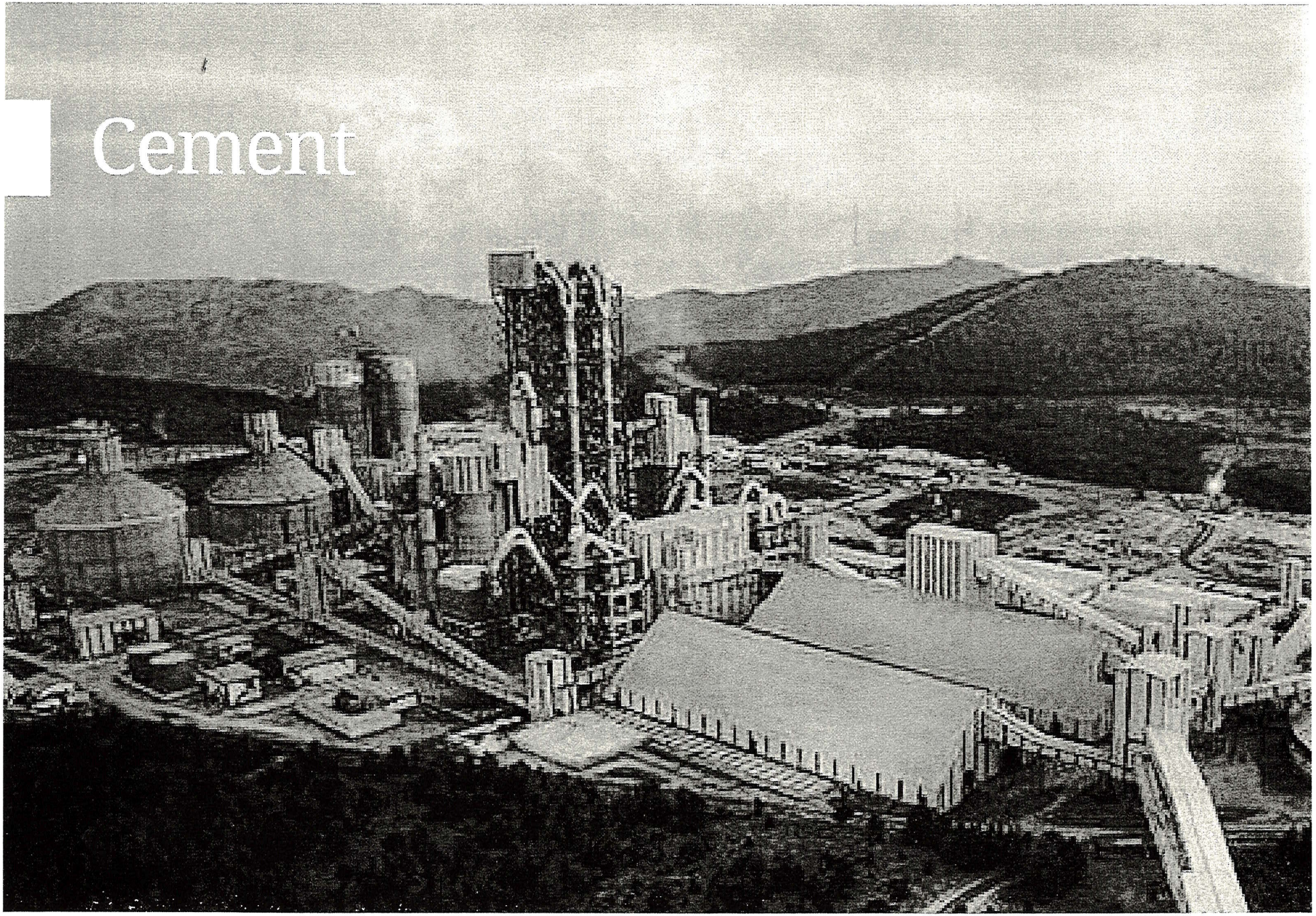
synthetic fuels, plastics or other chemicals.

Appendix 12 – Cement Plant Example

Photo Credit:

Royal White Cement (2024, April 16). *Fortera opens new 'green' cement plant in California*. Retrieved October 15, 2024, from Royal White Cement: https://www.royalwhitecement.com/news/fortera-opens-new-green-cement-plant-in-california/

Cement



DMDE Engineering Limited

This conceptual study was commissioned and supported by the Cape Breton Partnership through the CBRM Regional Enterprise Network (CapeBretonPartnership.com/CBRMREN) and the Cape Breton Regional Enterprise Network (CabeBretonPartnership.com/CBRREN)