

# Ontario Petrochemical Industry Study

## Executive Summary

### THE CHALLENGE FACING THE SARNIA-LAMBTON CLUSTER:

Climate Change and the global chemical industry's general plans to reach Net-Zero Carbon Emissions by 2050 are likely to transform the regional and global chemical industry and business structure. These changes have just begun and so their impact is currently unclear. However, based on the experience from previous large-scale changes, it is likely that the refining and chemical industries will become more concentrated in fewer sites. It is also likely that some secondary sites and industry clusters will be shut down or significantly curtailed over the coming years, as the industry concentrates its efforts and capital expenditures on the most economically advantaged sites and locations. In our judgment, the Sarnia area industry has never before faced such a serious threat.

### STUDY CONCLUSIONS:

Based on IHS Markit's comparative assessment of the five major North American petrochemical clusters and company survey results, we have identified some key issues and barriers faced by the Sarnia-Lambton cluster, impacting its investment attractiveness and long-term viability. Due to the missing elements and constraining regulations explained further in this report, the Sarnia Lambton cluster ranked less attractive than US Gulf Coast (USGC) or Alberta in terms of attracting petrochemical investments. More than half of companies surveyed do not view Sarnia as a primary investment target. As such, the Sarnia-Lambton cluster has not received the necessary anchor infrastructure renewal and modernization required to maintain its long-term competitiveness and viability. In addition to addressing the following key questions critical to understanding regional competitiveness, our report also provides recommended measures to improve the attractiveness and the long-term viability of the Sarnia cluster:

- Why have investments been mostly in the United States and Western Canada and not in Sarnia?
- What is Sarnia missing?
- What is the relationship structure/ level of integration across the C2/C3 value chain on a regional and producer basis? Do many of the products get transported elsewhere, or are they utilized in the area?
- Do the clusters have access to broad chemical customers and growth markets (mostly in Asia)?
- What is the long-term feedstock supply security?
- Do the clusters offer incentives to attract investments? Are taxes high? How is the regulatory environment?
- How does each cluster compare in terms of capital requirement for a similar petrochemical facility in the area to the basis (USGC)?

**Benchmarking Overview:** As part of the study scope, we benchmarked the Sarnia region against other regions with which it competes for new petrochemical investments such as Alberta, US Gulf Coast, US Midwest, and US Northeast. The purpose was to answer the “why?” question and identify the issues or missing elements in Sarnia.

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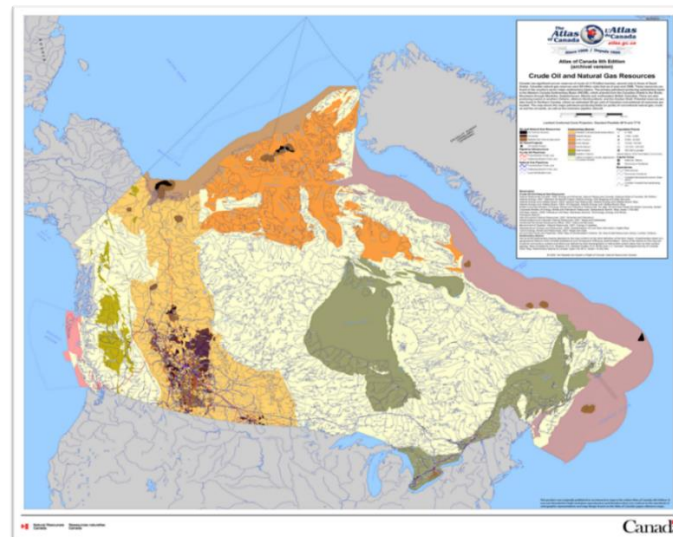
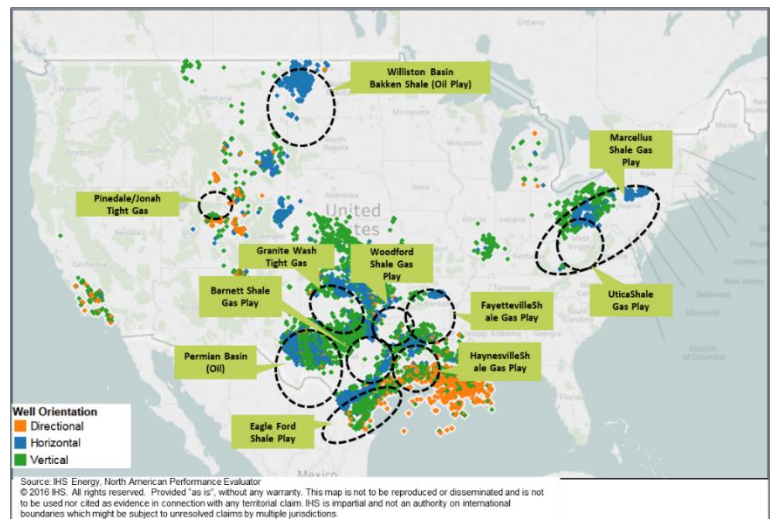
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As is evident from the cumulative petrochemical capacity additions, investments have been growing in North America, mostly in the United States. Except for Nova Chemical's expansion and investment, Sarnia has not seen any new investments in the petrochemical area in more than 10 years other than the standard "stay in business" maintenance spending capital investments.

Based on our evaluation of the various competitiveness criteria summarized below (e.g., feedstock pricing, regulatory environment, downstream integration, etc.), Sarnia ranked as Tier 3 compared to the USGC as Tier 1 (most attractive). Sarnia is not as competitive as the other regions evaluated in attracting petrochemical investments, especially compared to the USGC, and is missing several strong attractiveness factors. For example, Sarnia does not have local sources of feedstock for the industrial cluster even though Sarnia's feedstock is easily accessible via pipelines and other modes of transport from Western Canada and the United States. However, even though the price of feedstock sourced from the Dawn Hub and Marcellus or Bakken is comparable to the other jurisdictions in North America, feedstock security still has certain risks that the USGC and other regions with local feedstock sources do not have. For example, Line 5 might potentially be shut down which would pose a feedstock availability and price risk. Sarnia is also largely dependent on the US market for exports. In addition, much of the feedstock for Sarnia companies is sole sourced versus companies in the USGC that have the benefit of proximity to several feedstock sources. Other barriers that hamper the investment competitiveness of Sarnia compared to other jurisdictions included constraining regulations and time needed for approvals, policy uncertainty, high electricity costs, logistically disadvantaged to target high-growth markets, etc.

Regional Competitive Assessment of Each Cluster						
Category	Clusters	Sarnia	Alberta	USGC	US Northeast (Marcellus)	US Midwest
	Country	Canada	Canada	United States	United States	United States
Cost Competitiveness	NGL Feedstock Security					
	NGL Prices (Ethane)					
	Natural Gas Prices					
	Electricity Costs					
	CAPEX (Location factor)					
	Process technology vs. current standards					
	Age of Facilities (Ethylene Start-Up)					
Proximity to Markets (Domestic and Global)	Access to broad chemical customers and growth markets (like China)					
	Downstream Integration					
	Infrastructure (Logistics)					
Pro-Industry ("Ease of Doing Business")	Regulatory Environment					
	Incentives & Tax Credits					
	Taxes					
	Access to source of water/waste treatment facilities					
	Tier	3	2	1	2	3

**Raw Material Overview:** The US Gulf Coast has the most shale plays, and therefore continues to enjoy abundant low-cost feedstock compared to other clusters. It even exports some of its feedstock overseas due to its abundance and low cost. The US Gulf Coast region contains many different shale gas plays ranging from horizontal, directional, and vertical well orientations. Most of the shale gas resources are concentrated in Louisiana, Texas, and Oklahoma. Shell Chemical, on the other hand, is taking advantage of the Marcellus shale gas play and constructing an ethylene facility in Pennsylvania to start up in 2022.

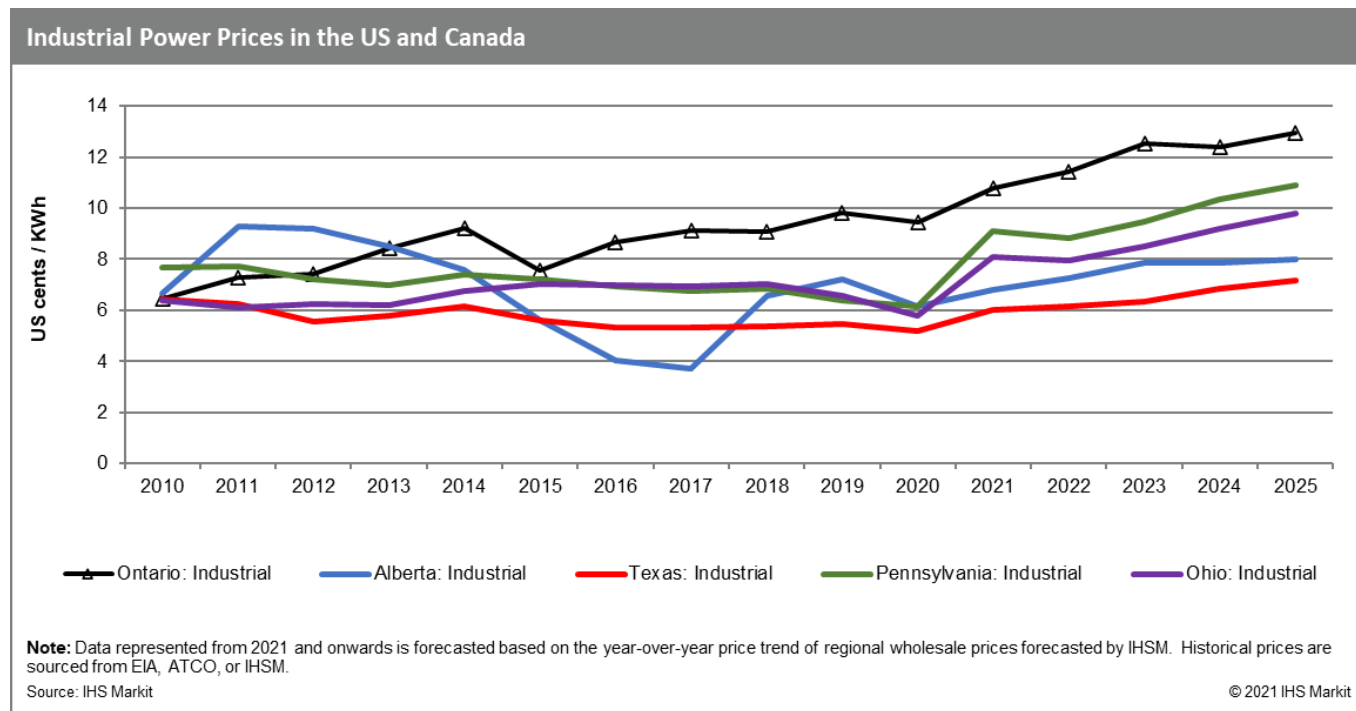


Source: Government of Canada Energy Maps - [Energy Maps \(nrcan.gc.ca\)](https://nrcan.gc.ca/energy/maps)

Even Alberta has oil sands and is strategically situated in Western Canada's sedimentary-basin oil and gas reserves. However, even though Sarnia is located on the Eastern Cratonic basin, only minor onshore established reserves exist in Ontario. The natural gas resource in Sarnia is shallow shale with only small potential and can affect the water table. In addition, there are regulations in Eastern Canada (Quebec, etc.) with the effect that this area has not been utilized to provide feedstock to the Sarnia region. Shale development in Western Canada can potentially add more resources and may be piped into Sarnia; if Eastern Canada were to permit shale development, this would be a positive development for Sarnia.

**Other Comparative Factors:** Certain facilities in Sarnia are also subject to a rail monopoly which increases logistics costs. The cost of production in Sarnia is also expected to be higher than other regions due to electricity costs and the global adjustment rate. Power prices have a major variable impact on the cost of production. Generally, certain regions have a power cost advantage over others, however, these advantages can fluctuate greatly over time. Hourly Ontario power prices capture the short-run marginal costs of electricity production, which for most of Ontario's energy supply is very low-cost due largely to nuclear and hydro power with some wind and solar included.

Coal has been eliminated and natural gas plants run infrequently. Given that most of the energy supply is either provincially owned or under long-term contracts with the grid operator, the revenue to cover the costs of those plants comes from other sources (since the energy market is providing little revenue).



The revenue is collected from ratepayers via a charge termed “global adjustment.” This global adjustment accounts for renewable support costs and other variables that come into play that other markets explicitly price into the wholesale prices. Starting in January 2021, Ontario made regulatory changes to the global adjustment factor such that non-hydro renewable energy contract costs are now paid by the government (tax bill) instead of directly by retail electricity customers. This will reduce the factor by roughly 30% going forward. However, for industrial customers in the Sarnia cluster, this reduction is not expected to have much of an effect on their electricity prices. Electricity prices are high in Sarnia and will continue to increase into the future, which puts Sarnia facilities at a disadvantage for cost of production with other regions like Alberta and the US. Even though this captures the general industrial Ontario power price, several industrial sites in the Sarnia-Lambton hybrid cluster have obtained a regulatory amendment due to obtaining steam from the TransAlta cogeneration unit, which deems it “behind the fence”. Therefore, these sites do not have to pay the global adjustment rate, and they obtain their power at a discounted rate. New investments are likely to obtain this rate only if they get steam from the TransAlta cogeneration unit. However, at this moment, delays and a possible failure in obtaining the government contract for a portion of TransAlta’s power could impose a potential risk on the industrial site partnership in Sarnia-Lambton.

In general, Sarnia’s facilities are older and higher cost than those in the USGC, which tend to be at the first and second quartile of the cost curves due to feedstock availability and attractive prices. The infrastructure in Sarnia is also aging and has not been upgraded. The USGC is also where most new investments are being site selected due to the large infrastructure network, close access to ports for exports to growth markets like Asia, feedstock availability, and relatively more stable regulatory framework. While Alberta is landlocked, its products are easily transported to Western Canada, with easier access to Asia than other US regions (US Midwest, US Northeast).

**Location Factor:** IHS Markit assigned a 2021 location factor of 1.09 for Sarnia, Ontario, indicating that the cost to build a greenfield plant in Sarnia is 109% of that to build the same petrochemical technology and plant capacity in the USGC in 2021. In our analysis, the US Gulf Coast is set as the basis country. In general, it costs more to construct a facility in Canada than it does in the United States. Steel, civil material bulks (concrete, insulation, fire protection, and paint materials), and equipment are slightly higher cost in Canada than in the US, although electric equipment and materials are lower. The factors for which Canada (Sarnia) has a higher cost than the US are mainly: skilled labor costs and productivity, tariffs, and freight costs. Skilled labor cost is 15% higher in Canada than in the US. Productivity cost is 10% higher, and tariffs and freight costs are 12% higher. Sarnia, however, has a location factor lower than Alberta due to more favorable weather. During the winter season, the cold affects Alberta's working conditions immensely compared to Sarnia's weather conditions, and thus Alberta's location factor is at 1.30.

IHS Markit Location Factors (Relative to U.S.)	
<b>North &amp; South America</b>	
Texas	1.00
Louisiana	1.00
Other US	1.05
Alberta	1.30
Ontario	1.09
Mexico	0.80
Argentina	0.86
Brazil	1.06
Venezuela	1.45
Other South America	0.95

**Infrastructure:** Sarnia, Alberta, and the three regions in the US (Gulf Coast, Midwest, and Northeast) all have access to transportation and utilities infrastructure in varying degrees. Sarnia has rail access, highway access, local river and waterway access, pipeline access, and access to utilities like electricity, water, wastewater disposal, and more. Sarnia even has extensive hydrocarbon and liquid petrochemicals storage like other North American regions, especially the US Gulf Coast. Where it differs is that some producers on the site are captive to a rail monopoly (only one rail line has access), and it is far from ports with access to growth markets.

The US Gulf Coast has a large port terminal presence as well as hydrocarbon pipeline network, especially ethylene. Its ports are closest to much of the export production including access to growth markets like China via the Panama Canal. However, due to the busy traffic seen at its terminals, it does experience operational challenges. The Sarnia and US Midwest regions are similar in location, near or on the Great Lakes where access to export ports requires the transport of goods via rivers, rail, or truck over a long distance. Therefore, much of the exports are either interregional or local. The US Northeast contains the ports of Philadelphia, Delaware, Baltimore, etc. It's the shortest route to Europe, and there are increasing services to Asian growth markets via the Panama or Suez Canals. Alberta, although landlocked, is situated closer to the West Coast and its access to Asian markets. Even with a transport cost to get to the coast, Alberta fares better than other regions in that it's the shortest distance to Asia. These are the main reasons why Sarnia scored lower than Alberta, the US Gulf Coast, and the US Northeast regions.

The Sarnia cluster produces ethylene and propylene through either a cracker or FCC unit. However, some of the facilities are not as integrated as we have seen in the United States or Alberta. Sarnia lacks the extent of downstream integration seen in the US Gulf Coast and US Midwest. Sarnia does, however, have many customers and consumers in the Great Lakes region, which is servicing the local area near the cluster. Therefore, we have decided to grade it the same as the US Midwest since both regions are easily accessible to each other. Further downstream integration creates value and jobs due to generally higher margins. It also saves on logistics costs to export products out of the province.



**Economics/ Financial Incentives:** Every region (state) in our benchmarking analysis offers incentives and tax credits and abatements to attract investments. Sarnia's previous Jobs and Prosperity Fund also offered incentives that were around 5% of Nova Chemical's capital costs. The Invest Ontario fund will replace this grant but is still very attractive. As part of the 2021 Budget, the provincial government is committing \$400 million over four years to create the Invest Ontario Fund, which will support Invest Ontario and encourage investments in the key sectors of advanced manufacturing, technology, and life sciences. Sarnia's incentives and tax credits are similar to the USGC and other regions in offering not only a direct grant, but also tax credits for job creation, R&D, and other tax abatements/credits to attract investments. Sarnia also includes programs to help businesses save on energy costs and develop new export opportunities. In addition, the Accelerated Capital Cost Allowance (ACCA), providing enhanced depreciation by the Canadian government to match US treatment, is attractive for new investments. While meaningful, temporary ACCA measures were muted by the effects of COVID-19 pandemic and are currently scheduled to start phasing out in 2024 which will impair the competitiveness of both Sarnia and Alberta.

However, when comparing Sarnia's total incentive package, it falls short in comparison to the US Gulf Coast and the US Northeast. Both of these regions offer direct grants in addition to large tax abatements and credits over many years to reduce the costs for the producer. Sarnia lacks some of the tax abatements and credits that these regions have. When comparing regional incentive and tax abatements, ExxonMobil/SABIC and Shell received around 15 to 30% of capital investment from Texas and Pennsylvania, respectively. Shell received 0.2% of investment in direct grants, however, the tax credits it received totaled around \$1.6 billion US. Shell chose to situate its site in Pennsylvania instead of West Virginia or Ohio due to these attractive incentives. Alberta's petrochemical incentive program, which offers up to 12% of capital costs, is also very attractive and comparable to Texas' (US Gulf Coast) total incentive package which includes direct grants and tax abatements. Alberta also offers funding and support for oil and gas companies in reducing emissions and finding green solutions for the current and future regulatory compliances in Canada and offers funding for clean technology development.

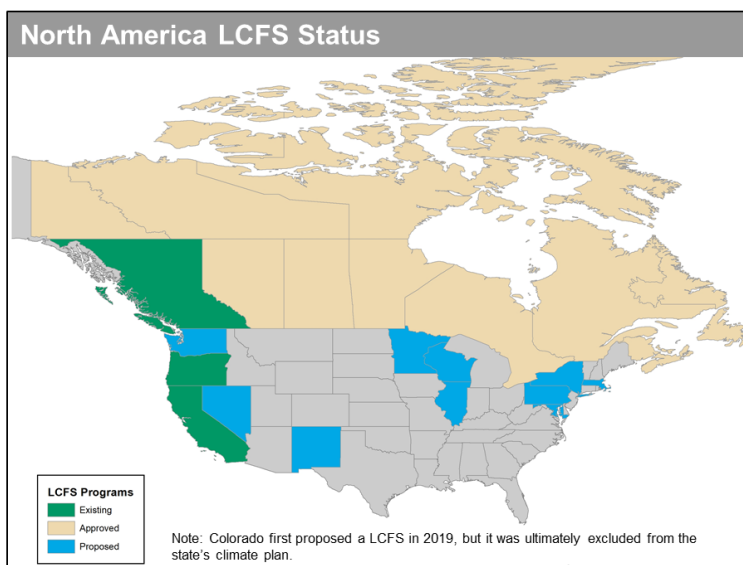
**Regulatory Landscape:** Finally, and most importantly, in our assessment of the regulatory environment, Sarnia (and Alberta) received a low ranking compared to the other regions in North America (mainly the US) due to the complex and continually changing regulatory environment. In particular, the annually increasing carbon tax and new Clean Fuel Standard that will be implemented December 2022 create additional pressure on current producers to bring their facilities to compliance (i.e. lower carbon footprint, reduction of greenhouse gas emissions, and lower carbon-intensity energy sources). For example, difficulty exists for many Canadian producers and future investors because the process technology to ensure compliance with environmental regulations might not exist yet, or the cost of additional infrastructure and carbon tax could sway a potential investor to select certain areas in the US which have a less stringent regulatory environment. In addition, for the existing producers, quick changes to meet compliance requirements are challenging because it requires either a process technology change, feedstock change, or other modifications to the facility that take time, qualifications, and other alterations. Additionally, producers may face conflicting federal and provincial regulatory requirements. Canada's generally pro-business environment is often complicated by the constitutional division of authority. Although the federal government normally dictates the business operating environment, several important items, such as local procurement contracts and the governance of natural resources, reside with the provinces.

Canada currently employs a carbon tax whereas the United States does not have one yet. Canada's carbon tax is two-fold: a carbon levy on fuel purchases and a big emitters program for industrial facilities. As of April 1, 2021, the Canadian carbon tax is CAD \$40 per ton. The big emitters program applies to industrial facilities that produce more than 50,000 tons of greenhouse gas a year. These facilities pay a price on some of what they emit, rather than on the fuels they purchase to operate.

Canada also recently drafted a Clean Fuel Standard (CFS) that will be implemented by December of 2022. Its goal is to reduce carbon emissions by 30 million tons by 2030, an amount equal to taking seven million cars off the road, as estimated by Clean Energy Canada. The CFS is another tool to help Canada to meet its target of net-zero emissions by 2050 and its revised Paris 2030 goals.

It aims to do so by requiring the suppliers (refiners, diesel importers, etc.) of hydrocarbons to reduce the overall lifecycle carbon intensity of those fuels. Both the carbon tax and CFS affect the petrochemical industries in Alberta and Sarnia and will continue to force investments by companies to comply with these regulations.

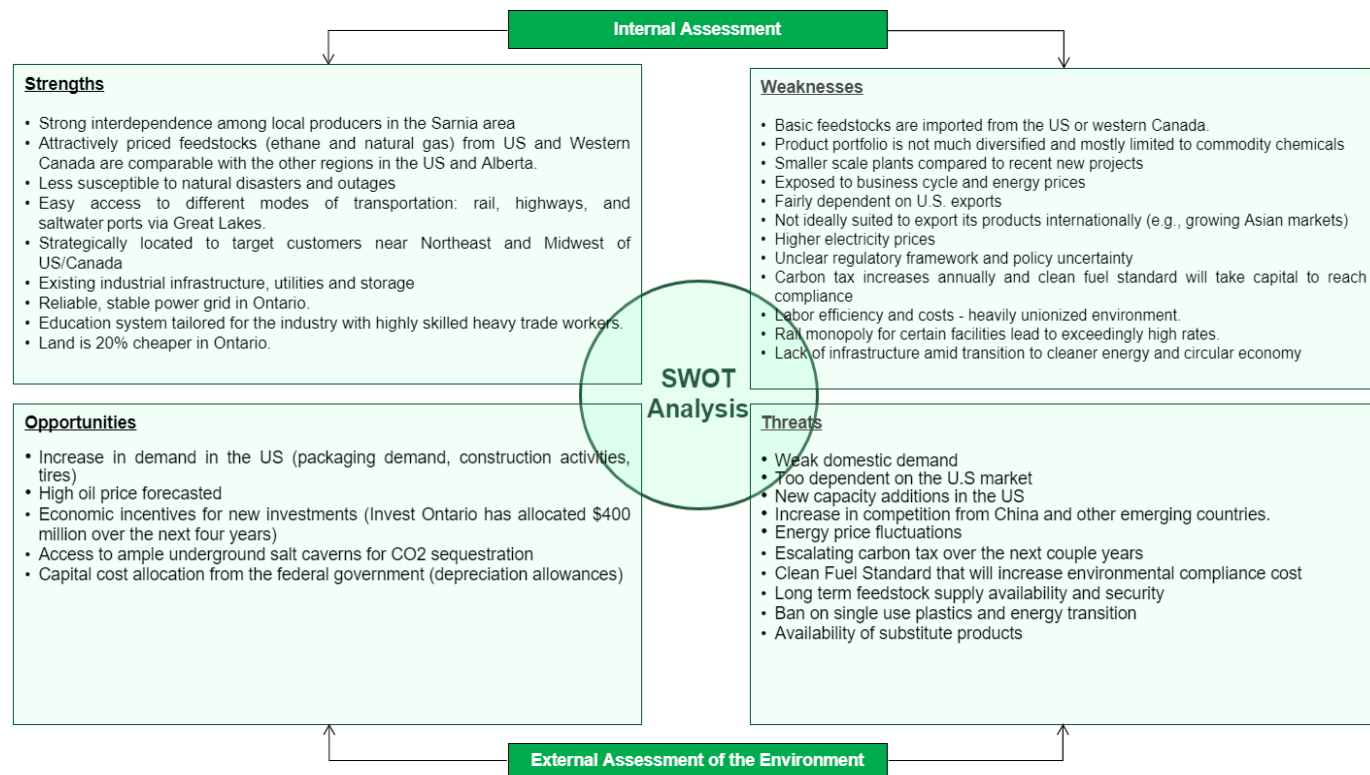
In comparison, the United States regulatory environment and policies vary by state. California has been among the most aggressive markets in the world in terms of carbon regulation, maintaining a Low Carbon Fuel Standard (LCFS) that has become a model for many other jurisdictions. The California LCFS calls for a 20% reduction in the carbon intensity of fuel sold in the state (vs the 2010 baseline) by 2030. Pennsylvania has a proposed LCFS program in the very early stages. In 2021, Illinois introduced legislation that would set a minimum biodiesel standard in its fuel supply, replacing a portion of petroleum with a cleaner-burning renewable fuel.



Energy legislation is also heating up in Illinois to reduce carbon emissions and transition Illinois to 100% renewable energy. Only Texas does not have carbon energy legislation, which is why it is ranked the highest in attractiveness for petrochemical investments.

In terms of environmental permitting, Canada and the United States have similar permits particularly around water and air. Canadian permitting does include an additional environmental assessment that involves consultation with other communities and stakeholders. Our interviews with industrial facilities in Sarnia have identified that permit approvals in this region take more time than in regions such as Alberta and the US which impacts Sarnia's pro-business attractiveness. The map above identifies Canada's progress on implementation of clean or low carbon fuel regulations compared to the United States. Layered with other regulations, this decreases Sarnia's investment attractiveness compared to other regions, however, there is opportunity for improvement in Ontario. For example, utilizing TransAlta's cogeneration unit's steam gives the potential industrial site a cost-effective electricity price. Also, Ontario has introduced a new investment fund that is on par with other chemical regions. Furthermore, the level of integration of shared utilities and infrastructure on the site as well as available land does lower the capital expenditure cost for an incoming investment.

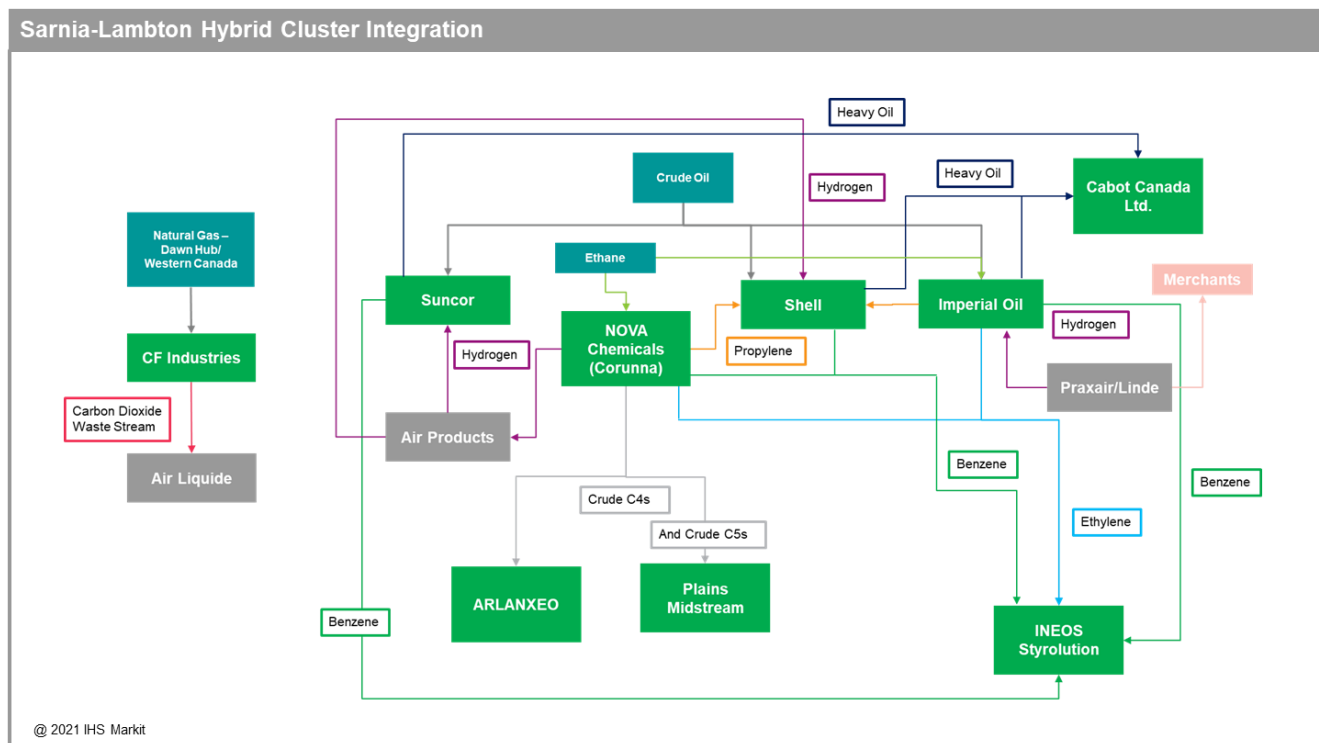
## SWOT ANALYSIS



IHS Markit utilized the SWOT (strengths, weaknesses, opportunities, and threats) methodology to discuss and analyze the strengths and weaknesses faced by the Sarnia-Lambton petrochemical cluster as well as any external threats and opportunities posed by the factors beyond Sarnia’s control. We incorporated the results from the benchmarking analysis done for Sarnia versus other petrochemical regions in North America as well as the feedback from interviewing several Sarnia corporations, in applying the SWOT methodology.



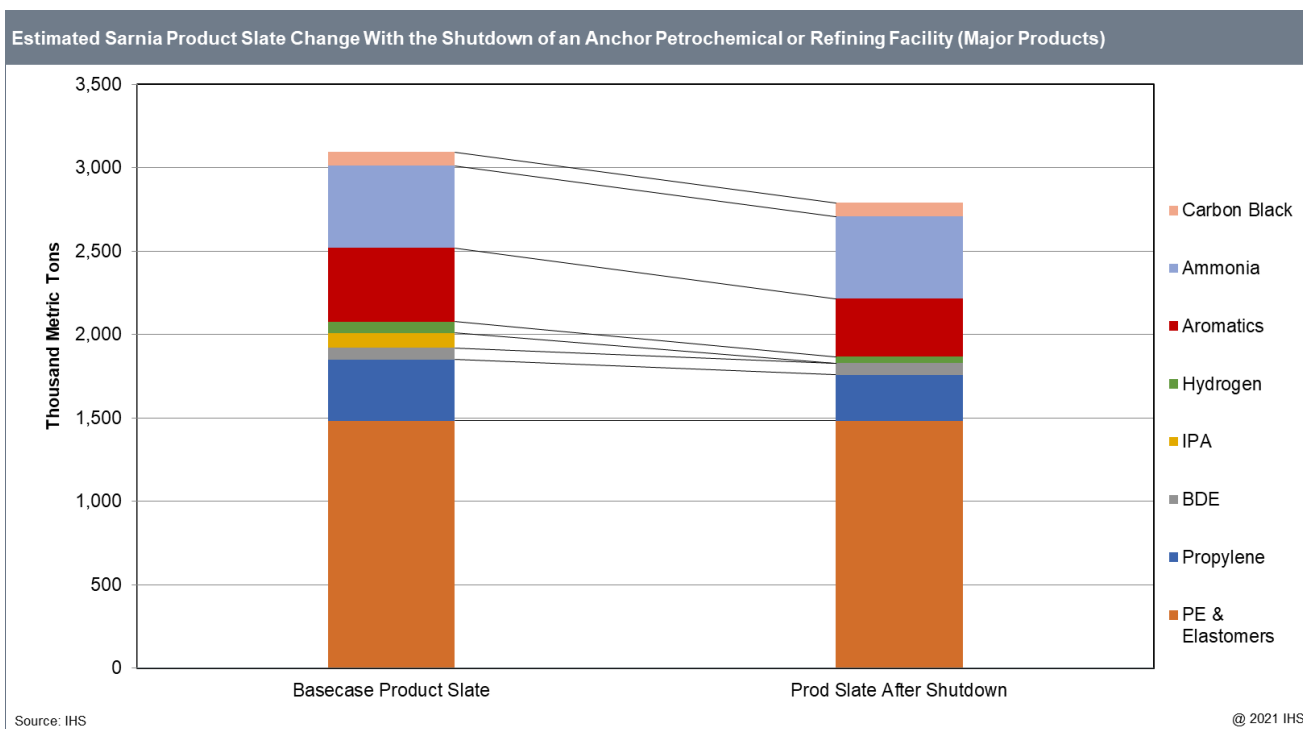
## INTERDEPENDENCY OF THE CLUSTER



The Sarnia cluster has a reasonable degree of integration. Every company depends on at least another company for either feedstock or revenue. The high-level Sarnia site integration map above clearly illustrates the close interdependency of the companies operating in the region. Because of the proximity and long-standing relationships with current feedstock suppliers nearby, Sarnia operations remain fairly competitive compared to the USGC locations. Sarnia chemical plants are cost competitive on a global basis as majority of production in Sarnia is in the top 30-35% globally in terms of cost position (second quartile), allowing them to compete in the export markets (the price setting region) and withstand market downturns. As such, it is paramount to ensure the continued operation of the existing manufacturers in the region.

On the flip side, the chemical products and feedstocks linked to the refineries (aromatics/propylene/carbon black/hydrogen) are only as viable as the integrated refinery operations. Chemical producers either supplying or sourcing from the local refineries include Cabot, INEOS Styrolution and Air Products or Linde. If one of the anchor facilities within the Sarnia cluster were to cease operations, overall chemical production in Sarnia is estimated to diminish by roughly 10% from the current projected volume of nearly 3.0 million metric tons by 2024, as shown in the chart below. Production of propylene and derivatives, EB/styrene, carbon black, and hydrogen would be impacted by varying degrees.

Based on the employment information provided by the Sarnia Lambton Economic Partnership, the loss of employment that would result from the shutdown of an anchor petrochemical or refining facility is estimated to be nearly 10% of total employed by the Sarnia chemical cluster or ~600 both direct and indirect labor. Besides the economic impact to the local Sarnia economy, the loss of local strategic feedstocks or a major customer would impair the competitive cost positions of the downstream producers and/or service providers.



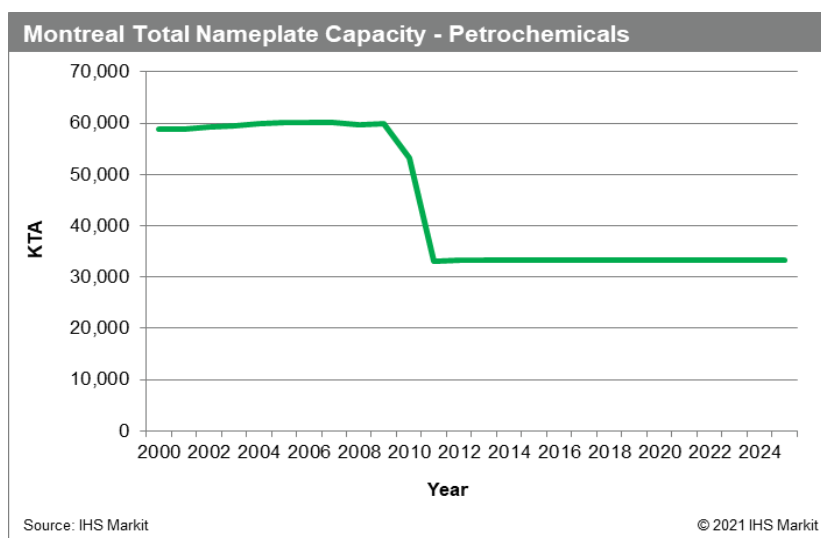
## MONTREAL CASE STUDY

Well before Calgary or Sarnia, Montreal was the hub of activity for oil refineries because Montreal was the principle consuming market for petroleum products in Canada. The first refinery in Montreal was constructed in 1916 by Imperial Oil Ltd. Esso, followed by Texaco in 1921, Gulf Oil Canada in 1931 and Shell Canada in 1933. Initially oil was transported by ship to the Port of Montreal from the Middle East. Later, the petroleum came mostly from Venezuela.

During the 1980s, many oil refineries in the Montreal area closed due to various factors including pressure from crude oil investments in the Middle East and China, economics of petroleum refining shifting toward larger and higher-complexity refiners in the US, and other reasons. As a result, Gulf, Texaco, BP, and Imperial Oil closed or sold their Montréal refineries in the 1980s.

A second wave of oil crisis shut down more facilities in the 2000s. Several factors had increased the challenge associated with keeping current petrochemical production in operation, let alone attracting new investment to the sector. Among these factors were record high petroleum prices and the relative strength of the Canadian dollar. In addition, North America was then one of the world's highest priced markets for natural gas, and the industry in Quebec lacked price-competitive petrochemical feedstocks. As in the rest of Canada and globally, environmental regulations on product quality required refiners to invest in new process hardware and technologies.

Pressure also abounded in the global refining and chemical industries with 60% of new capacity investments by 2016 being made in the Middle East or China. As a result, Petromont, a 50/50 joint venture between Dow Chemical and the Société générale de financement du Québec (SGF) suspended its operations of polyethylene and ethylene in Quebec in April 2008 and PTT Poly Canada's polytrimethylene terephthalate plant (JV between Shell and SGF) closed permanently in 2009. On June 4, 2010, Shell Canada officially announced that it would downgrade its Montreal refinery to a terminal, following 11 months of unsuccessful attempts to find a buyer to take over the facility.



In summary, Quebec, like Sarnia, had core advantages for basing a business in the region. Quebec had a skilled workforce, access to transportation, and a developed infrastructure, similar to Sarnia. Quebec also had a favorable tax incentive with the introduction of the investment tax credit of 5% in 2007 for the purchase of manufacturing and processing equipment for all of Quebec’s manufacturers to realize significant savings. The decision to extend for three years the accelerated depreciation for manufacturing and processing equipment created additional stimulation. However, Quebec’s weaknesses and external factors like the growth in the Middle East and China, rising strength of the Canadian dollar, and the oil crisis closed many facilities in Montreal and led to its decline.

High feedstock costs due to high North American gas prices and escalating oil prices had a significant negative impact on Quebec’s oil-based industries. Maintaining competitive feedstock and energy costs is essential for overcoming other disadvantages a region might have compared to other jurisdictions. The higher exchange rate of the Canadian dollar vs. the United States dollar coupled with a tight labor supply and reduced flexibility in the workforce put Quebec’s chemical manufacturers at a disadvantage. Even with the support of SGF, an investment agency to support businesses on behalf of the Quebec government, it was not enough to combat the external and internal factors that led to the decline in the 2000s. SGF itself was absorbed into another investment agency in 2010.

Except for NOVA’s planned expansion, the Sarnia chemical cluster has been starved of new investment for expanded production capacity for a long time due to the same issues and barriers faced by Montreal. Reflecting these factors, a majority of the companies surveyed for this study said that Sarnia operations are not of primary or strategic importance to their parent organization. If the above issues are not addressed over the short-to-medium term, Sarnia will likely remain unattractive for new petrochemical investment and its competitive position will likely continue to degrade relative to the North American and global competitors, potentially resulting in capacity rationalizations or plant closures during any prolonged industry or economic contraction.

Even without such an industry or economic contraction, coming environmental regulations could also result in closures in the Sarnia-Lambton cluster as refiners and petrochemical companies would need to invest large amounts of capital to address the needs for both plastics recycling and carbon capture and sequestration. We foresee a likely trend that the major companies would focus this capital investment in their major plant sites, i.e. the “Energy and Chemical Park” concept. This could, arguably, start to occur between now and 2030.

## SUMMARY OF THE SURVEY RESULTS

Our survey of 10 companies based in the Sarnia Lambton cluster identified the key issues that need to be addressed in order to improve Sarnia's competitiveness and long-term viability. Analysis of the survey responses reveals common concerns and obstacles faced by the major companies operating in the region. The companies' responses and inputs to our questions have been aggregated and presented in the chart below.

From the interviews conducted, we have identified two types of companies operating in the Sarnia Lambton cluster. Less than half of the companies surveyed perceived the business outlook as generally positive, provided the current access to critical feedstocks remains uninterrupted. More than half of those surveyed viewed Sarnia less positively. They view Sarnia as secondary importance now, and that its relative strategic importance within the corporate organization has not improved over the last 15 years. As such, Sarnia has not been considered by these companies for new investments or expansion opportunities, which have been implemented outside of Sarnia in North America or other regions they deemed more strategic.

When asked about the issues faced by the Sarnia region, over 70% of the companies surveyed identified the following as the key barriers for Sarnia to attract new investments and compete with other jurisdictions:

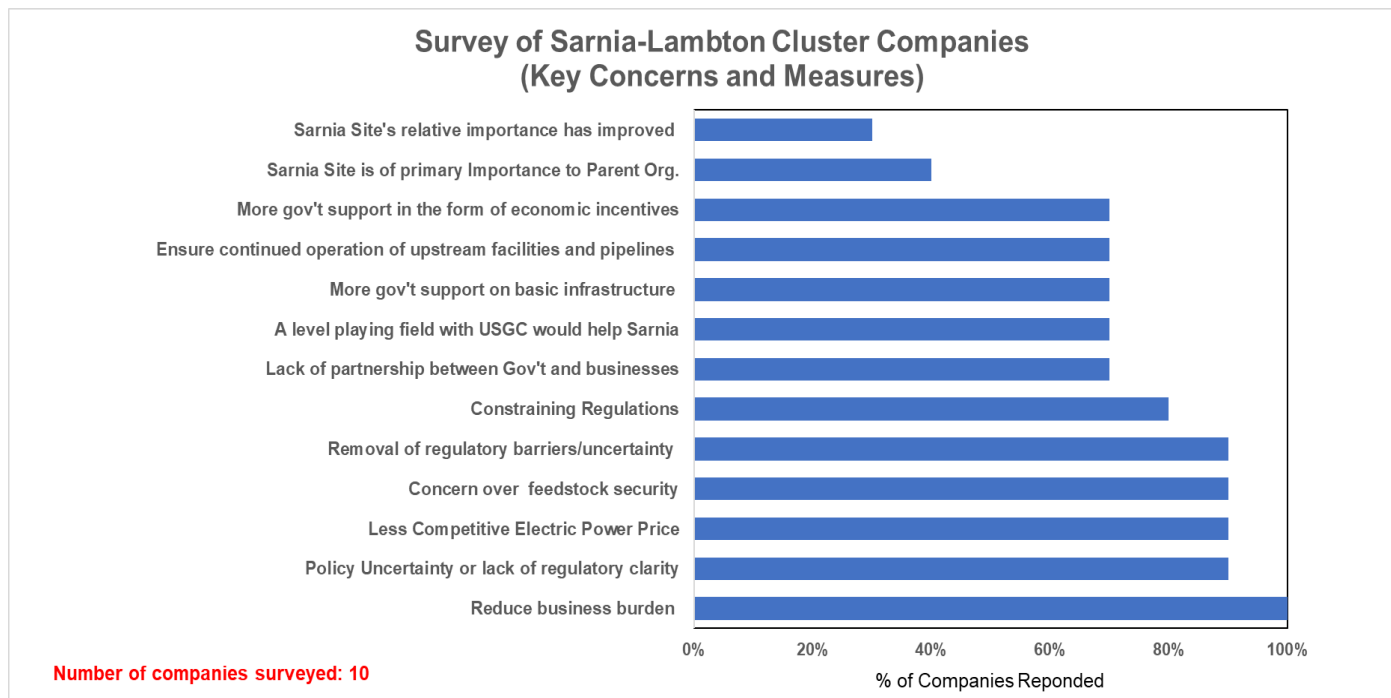
- Policy uncertainty or lack of regulatory clarity
- Constraining regulations
- Concern over feedstock security
- Less competitive electric power price
- Lack of an effective partnership between government and businesses

The majority of companies surveyed viewed locations in the US and Alberta as more favorable for petrochemical production and more business friendly than Sarnia. Until the above issues are addressed, capital investment is expected to continue to avoid Sarnia. When asked about what needs to be done to improve Sarnia's attractiveness and viability, 70% or more of the companies surveyed said the following measures would help strengthen Sarnia's competitive position and long-term viability:

- A level playing field with the USGC
- Removal of regulatory barriers and uncertainty
- More government support on basic infrastructure
- More government support in the form of economic incentives
- Reduce business burden (e.g. lower electricity cost, carbon tax, clean fuels standard, etc.)

Government can play a role in incentivizing new investments in Sarnia by removing some of the regulatory hurdles (e.g. expediting the permitting process), offering economic incentives, and reducing business burden, particularly the high electricity price. A strong partnership between government and industry, as well as a government-led infrastructure program, would be steps in the right direction. If given more favorable conditions, most of the companies surveyed expressed that they would continue to invest in Sarnia to maintain the market share and for reliable and safe operations.

In conclusion, policies and investments over next few years may reshape the global and regional industry structure for the long-term. If the Sarnia cluster does not get helpful policies and investments, the long-term outlook may be seriously threatened.



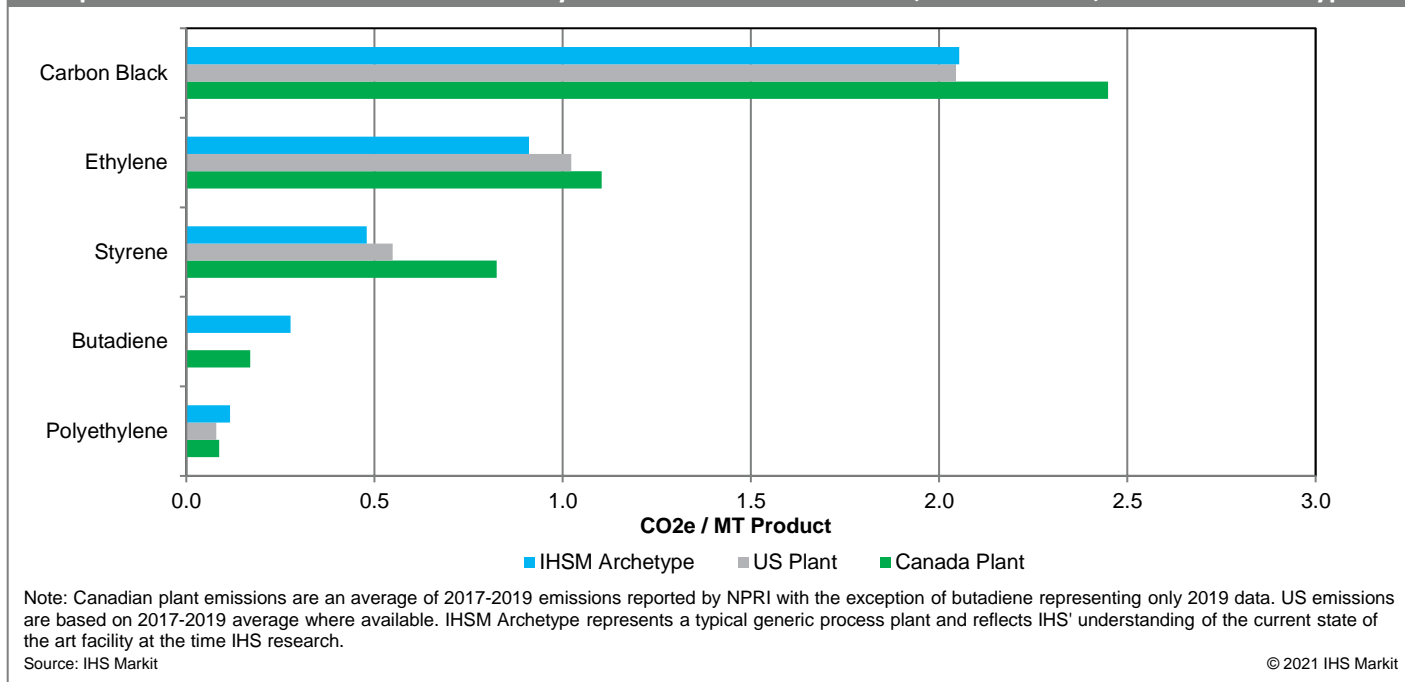
## SARNIA'S ENVIRONMENTAL PERFORMANCE

While a key overall environmental goal within the chemical industry is to reduce emissions, it is critical to understand that the process by which this occurs will shape the competitive environment for the various producers. Therefore, any greenhouse gas (GHG) emissions policy put in place by the government should be a collaborative effort between industry producers/experts and the lawmakers with an understanding of how other global regions may handle the transition towards a greener future.

The following graphic summarizes the greenhouse gas emissions for the selected Sarnia-Lambton facilities. It also includes for comparison the emissions of the US facilities located in US Gulf Coast as well as IHSM archetype technology (estimated using IHSM PEP database of chemical process technologies). These US and Sarnia figures are actual reported emissions of greenhouse gases on a per metric ton basis of chemical produced. To determine the amount of chemical produced, internal IHSM capacity and country average operating rate data were utilized.



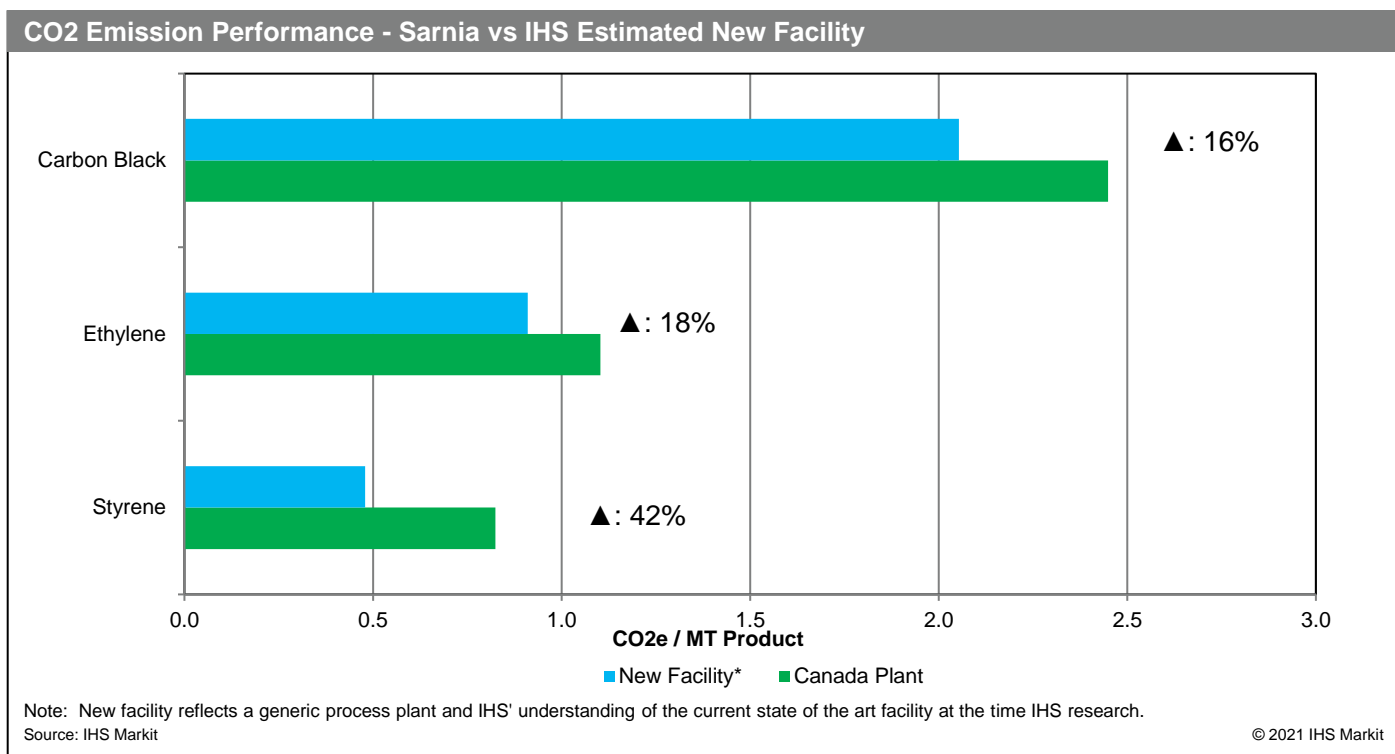
**Comparison of Greenhouse Gas Emissions by Product for Sarnia-Lambton, US Gulf Coast, and IHSM Archetype**



Based on our analysis, Sarnia plants appear to be within expected ranges of North American chemical facilities. From the five products evaluated in this study, carbon black production on a per ton basis shows the highest GHG emissions, followed by emissions from ethylene, styrene, butadiene, and, lastly, polyethylene. This can be explained by the differences in process technology, variations in feedstock, the energy requirements of the chemical reaction, etc. Also, emissions may vary from year-to-year due to variations in operations such as shutdowns due to unforeseen circumstances, unplanned downtimes, supply issues, etc.

The processes used to produce carbon black, ethylene, and styrene are very energy intensive and involve the use of furnaces and high temperatures. The carbon intensity can range from 0.5 to 2.5 tons of CO<sub>2</sub> per metric ton of product. As for the lower emitters analyzed, polyethylene and butadiene, the carbon intensity was found to be below 0.3 ton of CO<sub>2</sub> per ton of product.

**New State-of-the-Art Facilities versus Existing Plants:** Comparing the first three highest emitters (on a per ton basis), especially for carbon black and styrene, the current state-of-the-art facilities were found to be more energy efficient and emit on average 16 to 40% less GHGs than the Sarnia facilities evaluated, as shown in the chart below. However, this differential is not a sign of great concern as the emissions for the Sarnia facilities are reasonable. Actual emissions can vary from year-to-year due to operational inefficiencies, differences in feedstock (i.e., naphtha cracker (more energy intensive) vs. ethane cracker (less energy intensive)), scale of the facility, and differences in process technology. In the case of ethylene, technologies vary minimally from licensor to licensor. Nevertheless, any GHG policy that is put into place may have an impact on the production cost of the chemical, and therefore, on the competitive position of the producers. Depending on the details of such policies, there could be significant impacts on the companies in Sarnia.



Over the years, improvements on energy efficiency and emissions have been approximately in the range of 10-40% for the products studied. Generally, improving energy efficiency does translate to a reduction in direct emissions. From the emissions standpoint, Sarnia plants are reasonable and generally within the expected ranges of North America chemical facilities. Since NOVA has recently upgraded their facilities, the GHG emissions for ethylene and PE facilities in Sarnia studied are comparable to the US recent new facilities. Butadiene production is less energy intensive, so it is not of a major concern. The GHG emissions for styrene and carbon black facilities in Sarnia are higher than current state of the art but appear reasonable.

## CONCLUSIONS AND RECOMMENDATIONS

In summary, our assessment of the attractiveness and long-term viability of the Sarnia-Lambton cluster to attract new petrochemical investments in North America has identified Sarnia as Tier 3 when compared to the USGC (Tier 1). Sarnia is not as competitive as the other regions evaluated in attracting petrochemical investments, especially compared to the USGC, and is missing several key attractiveness elements. One critical element in site selection is the long-term availability of low cost (advantaged) feedstock. Even though the price of feedstock is comparable to the other jurisdictions in North America, it is still relatively higher than other regions due to the fact that it is being transported from other jurisdictions. As for the issue of feedstock security - there continue to be risks that other jurisdictions such as the USGC and Alberta do not have. Certain facilities in Sarnia are also captive to a single rail service provider, which generally increases the logistics cost for those facilities. In contrast, most USGC facilities generally have dual-source rail services and are able to negotiate lower prices. Some feedstock in Sarnia is also largely dependent on US supply given there is no local source of feedstock. Consequently, the cost of production in Sarnia for a majority of the industrial sites is higher than the other locations in North America due to the higher cost of feedstock and the cost of electricity, which is another significant contributor to cost of production. Due to the global adjustment rate, the cost of electricity can sometimes be up to half of the cost of production for some facilities as noted in the company interviews. In addition, much of the feedstock for Sarnia companies is sole-sourced from a single supplier versus competitors in the USGC which have the benefit of proximity to several feedstock suppliers. The USGC, where most of the new investments are being located, also scored higher than Sarnia on other key areas of investment attractiveness, such as large infrastructure network, close access to ports for export to growth markets like Asia, feedstock availability, and a relatively more stable regulatory framework.

Most importantly, as seen in our benchmarking analysis and also identified during the interviews, the USGC also tends to have less restrictive environmental regulations compared to Canada and other regions of the US, which adds to its investment attractiveness. The USGC is viewed as being more supportive of industry and companies generally find it easy to conduct business there, which is also important when selecting new investment sites. Sarnia and Canada's regulatory environment, in general, is complex, changes frequently, and in the case of carbon tax, has annually increasing targets. While some parts of the US are putting regulations in place to decrease carbon intensity and to improve long-term sustainability, these are still not as advanced compared to Canada and the rest of the world. For example, the USGC, especially, does not yet have the low carbon fuel regulations that we see in Canada and California.

Our analysis and survey of the major companies operating in the Sarnia-Lambton cluster have identified the following key barriers and challenges faced by the Sarnia region for investment attraction and improved competitiveness. Our work has also identified opportunities/strengths and key measures, that if implemented, would help strengthen Sarnia's competitive position and long-term viability:

### **Issues and barriers**

- **Policy uncertainty** – Policy changes by the government are still being developed to this day, especially in relation to the Clean Fuel Standard in Canada. Compliance guidelines have been given and will be implemented December 2022. However, there is a lack of clarity or certainty of how suppliers can reach these targets by the deadline. Penalties and purchasing credits will cost primary suppliers when these funds could instead be directed to maintain or invest in their existing facilities. Primary suppliers raised concerns about a current lack of available low-carbon biofuel supply to meet the demand for fuel blending that the Clean Fuel Standard will create. The biofuel industry sees a big increase in demand for its fuels (and for the planting of crops to provide them), but farmers have concerns because current proposals from Environment and Climate Change Canada (ECCC) contain land-use restrictions.

- **Lack of regulatory clarity** – Currently, there is confusion and a complexity regarding different policies and guidelines in the regulatory environment in Canada. The federal government created a federal backstop for its carbon tax and has introduced the Clean Fuel Standard. However, the provincial governments also have their own carbon policies, some of which have received federal government approval foregoing the need to implement the backstop. For example, for the carbon tax policy, Alberta and Ontario have adopted the federal policy for consumers but use their own policies for large emitters approved by Ottawa.
  - It is unclear if both Alberta and Ontario's larger emitter programs will remain in effect beyond 2022 as the federal government unveiled a more aggressive emissions reduction plan - to more than quintuple Canada's carbon tax by 2030.
- **Constraining regulations** – The timelines implemented by the federal government are optimistic and aggressive. In many instances, the technology does not yet exist. In order to comply, sites will have to switch their process, feedstock, or other methodologies to meet requirements. However, this change will not be quick to implement even as the targets continue to increase annually. This constrains the existing sites and prevents new investments. Also, as learned from the Montreal case study, labor work rules also impact the Sarnia Cluster in comparison with other industrial regions in North America. Labor market regulations, which deal with interactions among unions, employees and employers in Sarnia, need to promote an economic and productive work environment.
- **Lack of an effective partnership between government and businesses** – From the interviews, a statement that echoed among companies was the desire for a stronger and mutually beneficial partnership with the Ontario government. All companies wish to reduce carbon-dioxide emissions and improve the environment for a sustainable world in accordance with the United Nations Sustainability Development Goals (SDGs). Moreover, working together with the government would greatly benefit companies and accelerate their ability to reach these goals and new standards. Providing a realistic timeline and obtainable goals would prevent carbon leakage and improve the viability of the Sarnia-Lambton Cluster (as well as other industrial clusters in Canada).
- **Greater regulatory burden than competing jurisdictions** – While Alberta is subject to similar regulatory burdens as Ontario, environmental regulations in the United States are generally less restrictive, particularly in the USGC. Therefore, in terms of new investments, these would find their way to jurisdictions where companies can maximize returns and minimize risk.
- **Concern over feedstock security** (dependency on pipelines, cross border shipments) – Due to the lack of locally produced crude oil and/or natural gas, the Sarnia-Lambton site is dependent on other regions like Western Canada and the United States for feedstock. Ontario may lose this favorable access should pressure from state regulators result in a shut-down of Enbridge's Line 5. Line 5 poses one of the largest threats to feedstock security for refineries in Sarnia as well as the downstream facilities that rely on feedstocks from the refineries. If this happens, contingency plans need to be put in place to obtain feedstock via more expensive alternatives. Concern about feedstock security is a significant factor in any future investment decisions and creates uncertainty in terms of investing.
- **Less competitive electric power price** – In terms of electricity pricing, governments are the price setters. To incentivize green electricity production, wind and solar are heavily subsidized, but Ontario industry bears the brunt of the costs. Due to the global adjustment rate, Ontario's electric power price is estimated to be about 40% higher than other jurisdictions in North America, unless the producers can have access to "behind the fence" power from a cogeneration facility.

- **Lack of local crude oil and/or natural gas production** – Sarnia is located on the Eastern Cratonic basin where minor onshore established reserves exist in Ontario. However, Sarnia’s natural gas resource is a small amount of shallow shale that affects the water table. As a result, and because of regulations in Eastern Canada (Quebec, etc.), this area has not been utilized to provide feedstock to the region.
- **Cost-disadvantaged to access fastest growth markets** – The facilities in Sarnia mostly supply domestic and nearby US demand (Midwest and Northeast United States and local Canadian regions) instead of international export markets. The USGC and Alberta are more strategically located to access the faster growing Asian markets.

### **Opportunities and Strengths**

- **Strong interdependence among local producers in the Sarnia area** – Availability of cost advantaged feedstocks and utilities is a critical element for petrochemical production. Almost every company relies on another company for feedstock or service within the Sarnia cluster to remain competitive. Hence, the long-term viability of the firms in the Sarnia Cluster depends on the continued operation of the other nearby firms.
- **Attractively priced feedstocks (ethane and natural gas) from US and Western Canada are comparable with other regions** – Enbridge Gas’s Dawn Hub storage facility located in Southwestern Ontario is one of North America’s largest liquid natural gas trading hubs. It provides Sarnia with cost-effective ethane and natural gas prices. Ethane feedstock from Bakken and Marcellus gas regions are also favorably situated and attractively priced. Hence, access via pipeline to low-cost feedstock allows Sarnia producers to compete.
- **Less susceptible to natural disasters and outages** – Sarnia is a safe location protected against natural disasters and its infrastructure has been shown to be more reliable and stable compared to that in the USGC. With recent power outages and past disruptions due to hurricanes in the USGC, having manufacturing assets in Sarnia helps to mitigate supply chain risks.
- **Easy access to different modes of transportation: rail, highways, and saltwater ports via Great Lakes** – Sarnia has rail access mostly via CN and CSX, highway access, local river and waterway access, and pipeline access. Sarnia-Lambton is served by a network of highways that connect the region to the Great Lakes industrial corridor. It is also located on the banks of the St. Clair River and via the St. Lawrence Seaway System, ships can navigate from Sarnia to the Atlantic Ocean. Sarnia also accesses the Enbridge pipeline network and the Mariner West pipeline system.
- **Strategically located to target customers near Northeast and Midwest of US/Canada-** Demand for fertilizers, plastics/elastomers and tires in North America is concentrated in the US Northeast and Midwest regions. Sarnia producers are logistically advantaged to supply customers in these regions.
- **Existing industrial infrastructure, utilities, storage, and available land support opportunities for expansion in Sarnia** - Access to ample underground salt caverns for CO<sub>2</sub> sequestration provides a medium-term solution as carbon emission regulations tighten. Additionally, ARLANXEO and TransAlta have infrastructure and utilities available for new investments which will lower the capital expenditure for these projects.
- **Education system tailored for the industry with highly skilled industrial trade workers** – Local industries have formed an Industrial Educational Cooperative (IEC) to provide industrial training support through relevant construction, operation, maintenance, and safety programs. Furthermore, Lambton College has supplied the Sarnia-Lambton cluster with specialized skilled employees.



- **Increase in demand in the US** (packaging demand, construction activities, tires) – Recovering and continued chemicals demand growth forecast in the US driven by healthy GDP presents an opportunity for Sarnia producers, which rely heavily on the US market.
- **High oil price forecasted** - Over the forecast period, the rising differential between crude and natural gas prices is expected to incentivize the growth of cost advantaged capacity in North America. The spreads between North American and Asian feedstock prices (linked to crude oil) are significant, favoring chemical production in North America.
- **Economic incentives for new investments** – Invest Ontario is the central agency for businesses and investors to drive economic growth, support domestic firms and attract businesses from around the world. As part of the 2021 Budget, the provincial government is committing \$400 million over four years to create the Invest Ontario Fund, which will support and encourage investments in the key sectors of advanced manufacturing, technology and life sciences. In addition to this fund, there are other tax abatements and credits available to help attract more investments. For example, Canada has the ACCA depreciation measure that will start phasing out in 2024. In the meantime, this measure (implementation of a 100% depreciation rate for certain manufacturing and processing equipment) is comparable to incentives in the US.

Given the above advantages and opportunities in the Sarnia region, the major companies operating in the Sarnia-Lambton cluster are expected to remain viable, provided that the flow of critical feedstocks remains uninterrupted. Notwithstanding, with the exception of NOVA's planned expansion, the Sarnia chemical cluster has been starved of new investment for expanded production capacity for a long time due to many of the same issues that were faced by Montreal and led to its decline. We found that more than half of the companies surveyed do not view Sarnia as one of their primary investment targets, and that its relative strategic importance within the corporate organization has not improved over the last 15 years. As such, Sarnia has not been considered by these companies for new investments or expansion opportunities, which have mainly taken place in other jurisdictions in North America or other regions deemed more strategic. The majority of companies surveyed viewed the US and Alberta as more favorable for petrochemical production and more business friendly than Sarnia.

If the above issues are not addressed over the short-to-medium term, Sarnia will remain unattractive for new petrochemical investment and its competitive position will continue to degrade relative to the North American and global competitors, potentially resulting in capacity rationalization or plant closures during any prolonged industry or economic contraction.

Even without such an industry or economic contraction, coming environmental regulations could also result in closures in the Sarnia-Lambton cluster as refiners and petrochemical companies will likely need to invest large amounts of capital to address the needs for both plastics recycling and carbon capture and sequestration. We foresee a trend that major companies would focus their capital investment in their strategic major plant sites, i.e. the "Energy and Chemical Park" concept. The environmental and cost pressures could lead to numerous plant closures in many locations. This could, arguably, start to occur between now and 2030.

Based on our analysis and survey of the Sarnia region, the following measures if implemented, would improve Sarnia's competitive position and attractiveness as well as incentivize companies to invest for the long-term.

## **Recommended Measures**

- **Achieve a level playing field with the USGC**

- Minimize feedstock disadvantage by mitigating supply security risks. This includes a contingency plan for a Line 5 shut down. However, even if Line 5 is not shut down, having multiple sources of feedstock will help strengthen Sarnia's feedstock security and long-term viability.
- Shale development in Western Canada can potentially provide more cost competitive resources and be pipelined into Sarnia; if Eastern Canada could permit shale development, that would also be a positive development for Sarnia. For example, shale development could be integrated with carbon sequestration and supporting infrastructure projects.
- Any policies and regulations implemented by the federal or Ontario government have to take into consideration the implications they will have on Sarnia's competitive position and attractiveness relative to the US. It would help to conform policies and regulations as much as possible with those in the other refining and petrochemical production areas in North America, so as not to imperil Sarnia's competitiveness and investment attractiveness.

- **Removal of regulatory barriers and uncertainty**

- Government regulations have resulted in higher costs of operation; the capital investment required to meet compliance could be used towards new capacity additions or modernization of existing facilities. If environmental regulations further tighten up in Canada, then production could move to the US.
- There is a significant civil society advocacy against increased industrial production in Canada that is making inroads with the federal government.
- The environmental permitting process is complex. In many instances, permitting requires extensive stakeholder consultation which could potentially add costs and time to the process. The addition of government resources to expediting the permitting process would improve attractiveness.
- The government should work with current industry players as opposed unilaterally setting environmental targets that may be too ambitious for any industry to meet. A government-funded single point of contact liaison (or concierge) would help companies navigate the complex regulatory process.
- To incentivize green production, long-term contracts with solar/wind companies are heavily subsidized, but the industry bears the brunt of these costs. The government should provide a "green" rate similar to a program in BC or amortize the spend over a longer period and treat industrial customers differently.
- Some industrial sites benefit from the "behind the fence" electricity prices when sourcing steam from the TransAlta cogeneration unit. However, due to current negotiations with the government, this regulatory amendment is at risk, which could result in higher electricity prices for certain facilities. Expedited permit approval would help make this option more practical.

- **More government support on basic infrastructure**

- The lack of industry infrastructure to access more feedstocks makes Sarnia less attractive for new investments.
- As the industry transitions to lower carbon emissions and a circular economy, more government support and partnering on the basic infrastructure for hydrogen production, carbon sequestration, CO<sub>2</sub> offset programs, and a complete plastics recycling and separation system, could position Sarnia for the long-term.
- A regional approach and structure to promote infrastructure development and appropriate pricing of natural gas, electric power and sequestration assets is strongly recommended, to achieve the economies of scale that would allow Sarnia to compete with other regions/clusters in North America.
- Many facilities are captive to a single rail service provider resulting in higher rates and rendering them more susceptible to labor strikes which can be commonplace. The addition of other rail service providers could lower the cost through competition. Governments could also deem rail an “essential service” which would provide for more reliable service to companies.

- **Reduce business burden**

- Lower electricity costs - The government lowered the global adjustment rate by 30% starting at the beginning of 2021 for retail customers. Industrial users should be treated differently to reduce their power costs.
- Carbon Tax and Clean Fuel Standard:
  - The government should work collaboratively with industry players as opposed to unilaterally setting environmental regulations that may be too ambitious – the government should also set reasonable timelines to achieve sustainability targets.
  - Ontario is considering adapting to a whole hydrogen economy to decarbonize the sector. However, hydrogen infrastructure (such as pipelines) are costly. Government incentives or supports will be helpful in this transition.
  - Primary suppliers raised concerns about a present lack of available low-carbon biofuel supply to meet the demand for fuel blending that the Clean Fuel Standard will create, given that this is expected to be the primary GHG credit creation mechanism overall.
  - Many of these standards require new technology or environmentally friendly processes and products that have yet to be developed.
- Corporate taxes – The Fraser Institute (Montreal case study) had recommended that provinces improve their public policies to attract investments. Some of these include competitive tax rates, labor laws that promote flexibility and balance, and appropriate cost-effective regulations. Ontario’s corporate tax ranks third behind Texas (USGC) and Alberta. If G7 agreement on 15% tax rate were to materialize, then it would directionally disadvantage Canadian attractiveness for investments. Reducing the corporate tax rate to match these jurisdictions will help attract investments.

- **Offer economic incentives**

- Government can play a role in incentivizing new investments in Sarnia by offering economic incentives on par with other jurisdictions. For example, businesses in Alberta can qualify for a 12% CAPEX back while the US has a \$45 tax credit to incentivize carbon capturing and sequestration. Given the right conditions, most of the companies surveyed expressed they would continue to invest in Sarnia to maintain market share and for reliable and safe operations.
- Additional tax credits would also be beneficial. Currently, Ontario has several tax credits and support/fund programs but no large tax abatements. For example, ExxonMobil/Sasol in Texas and Shell in Pennsylvania were each offered a total of over \$1 billion in tax abatements over time to lower costs and attract these investments into the respective areas.
- Canada does have the ACCA measure for capital investment for either a 100% depreciation rate for Class 53 manufacturing and processing equipment the year these assets are put into use or an Accelerated Investment Incentive for capital assets not covered under Class 53. However, this benefit will start to phase out in 2024. It would be beneficial to either keep this benefit going in the future or to implement a similar depreciation measure for future investments in Ontario.

- **Create environment that brings best-in-class environmental and operating cost performance**

- Reported emissions for Sarnia facilities appear to be reasonable and within expected ranges of North American chemical facilities. From the five products evaluated in this study, carbon black production on a per ton basis shows the highest GHG emissions followed by emissions from ethylene, styrene, butadiene, and, lastly, polyethylene. This can be explained by the differences in process technology, variations in feedstock, the energy requirements of the chemical reaction, etc. Also, emissions may vary from year-to-year due to operational factors such as shutdowns caused by unforeseen circumstances, unplanned downtimes, supply issues, weather events, etc.
- The processes used to produce carbon black, ethylene, and styrene are very energy intensive, involving the use of furnaces and high temperatures. The carbon intensity can range from 0.5 to 2.5 tons of CO<sub>2</sub> per metric ton of product. As for the lower emitters analyzed, PE and BD, the carbon intensity was found to be below 0.3 ton of CO<sub>2</sub> per ton of product. Comparing the three highest emitters (on a per ton basis), especially for carbon black and styrene, the current state of the art facilities were found to be more energy efficient and emit on average 16 to 40% less GHGs than the Sarnia facilities evaluated. This difference would not be of great concern when the industry structure is stable. However, we expect that the industry is entering an era of dramatic change and transition.
- While the overall environmental goal within the chemical industry is to reduce emissions, it is critical to understand that the process by which this takes place will influence the competitive position for the various producers. Therefore, any GHG and local air quality policy put in place by the government should be a collaborative effort between industry producers/experts and the lawmakers with foresight as to how other global players may handle the transition to a greener future. It would help to align policies and regulations as much as reasonable with those in the other refining and petrochemical production areas in North America, in order to not imperil Sarnia's competitiveness and investment attractiveness.

- **Ensure continued operation of upstream facilities and pipelines**

- The Sarnia cluster has a strong interdependency – The chemical products and feedstocks linked to the refineries are only as viable as the integrated refinery operations. Every company depends on at least one other company for feedstock or service.

Because of the proximity and long-standing relationships with current feedstock suppliers, Sarnia operations remain fairly competitive compared to the USGC locations. It is paramount, therefore, to facilitate the continued operation of the existing manufacturers and pipelines in the region.

- **Incentivize downstream industry for value and job creation**

- Promote and incentivize a robust downstream industry for value creation and job creation since then product movements will become more local. This will create higher valued products and employment and also save on logistics costs compared to exports out of the province.



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