BDO Zone Rating

'A'

Sarnia-Lambton County, ON, BDO Zone for corn stover is rated 'A'. The long-term outlook on feedstock quantity is deemed stable. Key supply chain risks can likely be addressed with reasonable mitigation measures.

Rating Parameters

Feedstock Quantity	Feedstock Form	Price Range ($/ODMT)	BDO Zone Radius
190,000 ODMT/yr	Square bales	$100-$140 delivered	140 km

BDO Zone Assets

- **No large-scale competition for corn stover.**
- **A stable long-term outlook on feedstock quantity.**
- **Ability to access larger supply basins at marginal increases in transport costs.**
- **Positively rated infrastructure asset profile.**

BDO Zone Liabilities

- **Low grower participation rates.**
- **Short harvesting window.**
- **Lack of corn stover collection and baling experience.**
- **High probability of the need to engage a third-party company to carry out harvest with square balers.**

BDO Zone Risk Rating

The Sarnia-Lambton County-Lambton County, ON, Bioeconomy Development Opportunity (BDO) Zone is rated 'A,' or *low risk,* for 190,000 ODMT/yr of corn stover at a price of $100 - $140/ODMT delivered.

Risk Rating Grades are defined as follows: AAA (*highest quality*), AA (very high quality), A (high quality), BBB (good quality).

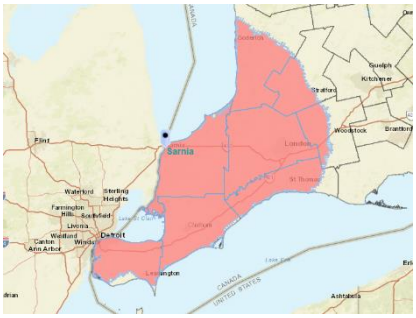
In assessing the biomass supply chain risk for the Sarnia-Lambton County, ON, BDO Zone, 52 Risk Indicators from the *Canadian National Standards for Biomass Supply* were applied. These BDO Zone Risk Indicators are the subset of Risk Indicators in the Canadian National Standards for Biomass Supply Chain Risk (CSA W:209:21) applicable to gauging feedstock risk within a BDO Zone.

Feedstock quantity is expressed in Oven-Dried Metric Tons (ODMT). Meanwhile, the feedstock price is expressed in Canadian dollars and delivered to the plant yard, assuming the plant is located centrally in the BDO Zone. The maximum transport distance is calculated assuming the maximum quantity in this BDO Zone Rating. Delivered feedstock costs for projects with lower volume requirements can be expected to be at the lower end of the BDO Zone's price range.

Scoring and Rating Methodology

The overall BDO Zone rating is based on an aggregation of the scores assigned to each BDO Zone Risk Indicator (RI) assessed in this report. First, each BDO Zone Risk Indicator is given a **Raw RI Score** based on the current undeveloped state of the supply chain and uncertainty drivers within it. Raw RI Scores are scaled between 1 (*low risk*) and 10 (*high risk*).

Next, each Risk Indicator is discounted, or "notched," based on the degree to which the uncertainty drivers are deemed to be addressable and whether there is a reasonable expectation that mitigation measures could be put into place within the price parameters of this rating. The **Notched Salience Score** corresponds to the likelihood of each Risk Indicator's described risk materializing, given the implementation of reasonable mitigation measures. To arrive at the Notched Salience Score, Raw RI Scores are reduced based on the efficacy of the proposed mitigation measures. If applicable, notching occurs at one of four levels: *moderate* (25%), *significant* (50%), *broad* (75%), or *comprehensive* (100%).



The potential impact of each Risk Indicator on the supply chain is assessed and scored on a 10-point **Impact Level** scale as either *low (3.33)*, *moderate (6.66)*, or *high (9.99).* Impact Level scores are based on the assumption that key measures were implemented to mitigate uncertainty drivers in the BDO Zone but failed to do so.

The **Loaded RI Score** for each Risk Indicator is calculated as the product of Notched Salience and Impact Level

scores. For example, *Risk Indicator 3.2.2: Low Historical Demand for Feedstock in the Supply Basin* has a Notched Salience score of 4.5, and its Impact Level is deemed *low* (3.33 out of 10). The final Loaded RI score for RI 3.2.2 is, therefore, 4.5 × 3.33 = 14.99 (out of 100).

Loaded RI scores of 33.33 or less are deemed *low risk*; scores greater than 33.33 and less than 66.66 are deemed a *moderate risk*; and scores of 66.66 to 100 are deemed *high risk*.

The total risk rating for the BDO Zone is the average of all Loaded RI scores. **The BDO Zone score for the Sarnia-Lambton County is 17.36 out of 100, resulting in an 'A' designation.** All scoring and rationale for each Risk Indicator are provided in Appendix A.

Analyst Notes

The Sarnia-Lambton County BDO Zone presents several strong assets, including a lack of competition for corn stover and an expected stable long-term outlook on feedstock quantity, with strong inventory management practices. Several substantial, large growers exist in the region, enabling access to redundant quantities of feedstock at marginal increases in transport costs. The overall infrastructure is deemed "good" or sufficient to support most bio-based manufacturing.

We assume that bio-based projects that locate in the Sarnia-Lambton County BDO Zone will take measures to mitigate key risks. This expectation is indicated by the difference between Raw RI Scores and Notched Salience Scores for multiple Risk Indicators detailed in Appendix A.

Key Low-Risk Indicators

Most Loaded RI Scores are below 33.33 and are thus deemed *low* risk.

Risks related to competition are all scored as *low*. This is because no large-scale facilities consuming corn stover within the 280 km competition zone surrounding Sarnia-Lambton County are currently in operation. Animal bedding is the only regional consumer of corn stover, taking less than 1% of generated corn stover in the BDO Zone.

Most farms in the Sarnia-Lambton County BDO Zone are large. However, sizeable bio-based projects will still require supply chains made up of aggregations of numerous individual growers. The degree of management complexity for this is likely to be significant, although manageable. A large pool of suppliers will bring with it positive supply chain attributes, such as increased supply chain resilience.

Key Moderate-Risk Indicators

We assess the Loaded RI Score of *Risk Indicator 1.8. Feedstock Production Priority* is 39.96, or *moderate*. Historical grower outreach has indicated low participation levels primarily due to competition for the fall harvesting window leading to a lack of prioritizing corn stover harvesting and concerns regarding soil compaction from harvesting equipment. However, we find it reasonable to assume that much of these concerns would be mitigated and growers would become interested once a project is announced or commissioned.

The most significant risks in the Sarnia-Lambton County BDO Zone corn stover supply chain are related to harvesting and collection practices, scheduling, equipment access, and feedstock sustainability.

Harvesting and Collection

The RI score for 3.13 *Harvest and Collection Practices and Schedules* is 44.96, reflecting the short and unpredictable harvest window for corn stover and the risk to feedstock quality due to moisture content differences between the fall and spring baling seasons.

Due to a lack of markets for corn stover regionally, suppliers in the Sarnia-Lambton County BDO Zone are generally inexperienced in cost-efficient harvesting and baling. Differences in fall and spring baling and harvest practices among growers may result in high variations in delivered feedstock quality, especially ash content.

We assess a moderate risk for *Risk Indicator 3.30. Capacity of Supply Chain Components and Equipment to Scale* with a Loaded RI score of 39.96. The risks around harvesting and collection equipment scale-up parallel that of harvest collection practices and schedules. Therefore, we feel that both can be substantially mitigated by vertical integration of a bio-project with corn Stover harvest/baling processes or by engaging credible third-parties to conduct harvest/baling activities. Scoring in this rating assume that such measures will be implemented.

Feedstock Sustainability and Seasonal Feedstock Supply

RI 3.28 *Feedstock Sustainability*, including risks to soil quality and surface, is assessed as a moderate risk with a loaded RI score of 44.96. The risk of soil compaction during corn stover harvesting due to wet soil conditions during the harvest season is high. This risk can lead to a 3 bushel/ac yield loss on the following soybean rotation, making growers reluctant to participate in corn stover removal and posing a challenge to the sustainability of the feedstock supply chain. Optimizing harvesting logistics to reduce soil compaction, such as rotating with some winter wheat crops, and paying farmers adequate margins on corn stover to cover potential yield losses should reduce this risk to moderate.

RI 3.4. *Seasonal Feedstock Supply Variation* is assessed as moderate at a score of 39.96 due to the weather-dependent short harvesting window in the fall and spring, which can lead to variation between harvesting days.

BDO Rating Parameters

In the interest of avoiding undue market influences and prejudicing a project's ability to negotiate with suppliers, BDO Zone rating reports do not provide information on total feedstock cost breakdowns obtained during the assessment. This includes all costs associated with the engagement of a third party, as well as the development of a vertically integrated supply chain.

For this rating, we received feedback from growers in the area, which was augmented by corn stover availability studies in the region. Transportation costs were calculated using average distances based on supply curves and trucking costs typical for the region.

The rating of the Sarnia-Lambton County BDO Zone is based on total delivered costs of the feedstock in a price range of $100-$140/ODMT and at a distance range of 140 km for a total of 190,000 ODMT/yr. The rated quantity assumes a 20% participation rate, as well as 1.2x Biomass Availability Multiple (BAM).

Infrastructure Asset Profile

Overall, Sarnia-Lambton County has a profile of positively rated infrastructure assets, with an average score of 7.12 out of 100. This score supplements the Sarnia-Lambton County BDO Zone rating and supports its low-risk designation.

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Figure 1 - Risk Indicators (sorted by risk level)

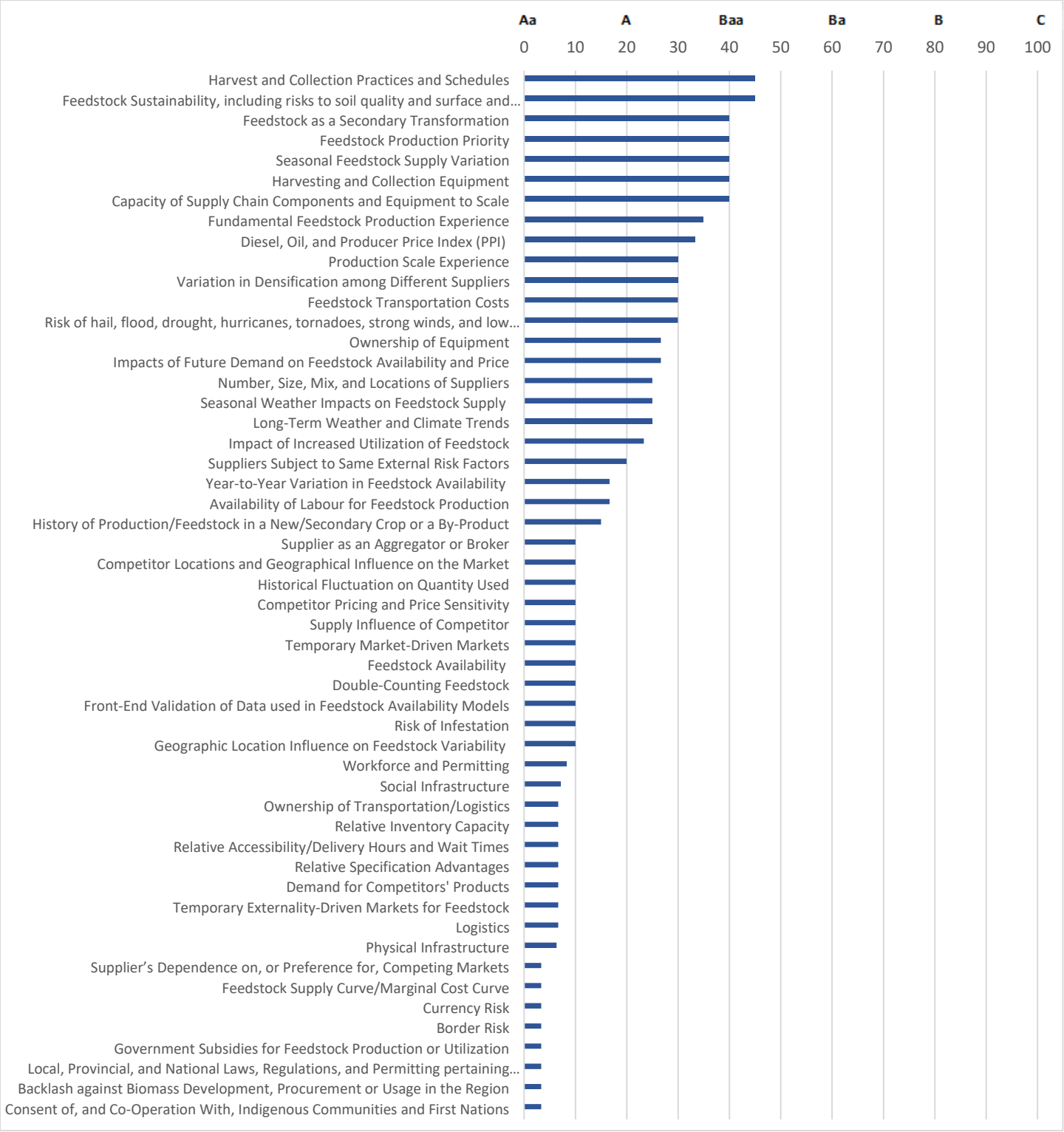


Table 1 - Risk Indicators

	Feedstock Supply Chain Risk Indicators	Raw RI Score	Notched Salience	Impact Level	Loaded RI Score
	Category 1: Supplier Risk				
1.1	Supplier's Dependence on, or Preference for, Competing Markets	1	1.0	3.33	3.33
1.2	Ownership of Equipment	8	4.0	6.66	26.64
1.3	Ownership of Transportation/Logistics	2	2.0	3.33	6.66
1.4	Supplier as an Aggregator or Broker	1	1.0	9.99	9.99
1.5	Feedstock as a Secondary Transformation	8	4.0	9.99	39.96
1.6	Fundamental Feedstock Production Experience	7	3.5	9.99	34.97
1.7	Production Scale Experience	9	4.5	6.66	29.97
1.8	Feedstock Production Priority				39.96
	Category 2: Competitor Risk				
2.1	Competitor Locations and Geographical Influence on the Market	1	1.0	9.99	9.99
2.2	Historical Fluctuation on Quantity Used	1	1.0	9.99	9.99
2.3	Competitor Pricing and Price Sensitivity	1	1.0	9.99	9.99
2.4	Impacts of Future Demand on Feedstock Availability and Price	8	4.0	6.66	26.64
2.5	Supply Influence of Competitor	1	1.0	9.99	9.99
2.6	Temporary Market-Driven Markets	1	1.0	9.99	9.99
2.7	Relative Inventory Capacity	1	1.0	6.66	6.66
2.8	Relative Accessibility/Delivery Hours and Wait Times	1	1.0	6.66	6.66
2.9	Relative Specification Advantages	1	1.0	6.66	6.66
2.10	Demand for Competitors' Products	1	1.0	6.66	6.66
	Category 3: Supply Chain Risk				
3.1	Feedstock Availability	1	1.0	9.99	9.99
3.2	Impact of Increased Utilization of Feedstock	7	3.5	6.66	23.31
3.3	Feedstock Supply Curve/Marginal Cost Curve	1	1.0	3.33	3.33
3.4	Seasonal Feedstock Supply Variation	8	4.0	9.99	39.96
3.5	Year-to-Year Variation in Feedstock Availability	5	2.5	6.66	16.65
3.6	Double-Counting Feedstock	1	1.0	9.99	9.99
3.7	Front-End Validation of Data used in Feedstock Availability Models	1	1.0	9.99	9.99
3.8	History of Production/Feedstock in a New/Secondary Crop or a By-Product	6	1.5	9.99	14.98
3.9	Diesel, Oil, and Producer Price Index (PPI)	5	5.0	6.66	33.30
3.10	Currency Risk	1	3.33	3.33	3.33
3.11	Border Risk	1	1.0	3.33	3.33
3.12	Temporary Externality-Driven Markets for Feedstock	1	1.0	6.66	6.66
3.13	Harvest and Collection Practices and Schedules	9	4.5	9.99	44.96
3.14	Harvesting and Collection Equipment	8	4.0	9.99	39.96
3.15	Variation in Densification among Different Suppliers	9	4.5	6.66	29.97
3.16	Availability of Labour for Feedstock Production	5	2.5	6.66	16.65
3.17	Feedstock Transportation Costs	3	3.0	9.99	29.97
3.18	Number, Size, Mix, and Locations of Suppliers	5	3.75	6.66	24.98
3.19	Suppliers Subject to Same External Risk Factors	6	3.0	6.66	19.98
3.20	Seasonal Weather Impacts on Feedstock Supply	5	2.5	9.99	24.98
3.21	Long-Term Weather and Climate Trends	5	2.5	9.99	24.98
3.22	Risk of Infestation	4	1.0	9.99	9.99
3.23	Risk of hail, flood, drought, hurricanes, tornadoes, strong winds, and low temperatures	3	3.0	9.99	29.97
3.24	Government Subsidies for Feedstock Production or Utilization	1	3.33	3.33	3.33
3.25	Local, Provincial, and National Laws, Regulations, and Permitting pertaining to Biomass	1	1.0	3.33	3.33
3.26	Backlash against Biomass Development, Procurement or Usage in the Region	1	1.0	3.33	3.33
3.27	Consent of, and Co-Operation With, Indigenous Communities and First Nations	1	1.0	3.33	3.33
3.28	Feedstock Sustainability, including risks to soil quality and surface and groundwaters.	9	4.5	9.99	44.96
3.29	Geographic Location Influence on Feedstock Variability	1	1.0	9.99	9.99
3.30	Capacity of Supply Chain Components and Equipment to Scale	8	4.0	9.99	39.96
	Category 4: Infrastructure				
4.1	Physical Infrastructure				6.33
4.2	Logistics				6.66
4.3	Social Infrastructure				7.14
4.4	Workforce and Permitting				8.33
				Average	**17.36**

BDO Zone Rating Independent Review Committee – Sarnia-Lambton County, ON

Shauna Carr, Sarnia Lambton Economic Partnership

Dave Park, Parkland Farms

Hank Trim, Agriculture and Agri Food Canada

Sandy Marshall, Bioindustrial Innovation Canada

Murray McLaughlin, Biomass Quality Network Canada

APPENDIX A: SCORING PROTOCOLS, RATIONALE, AND RATINGS

The objective of this Bioeconomy Development Opportunity (BDO) Zone assessment is to assess corn stover biomass supply chain risks for Sarnia-Lambton County, ON. **The BDO Zone rating for corn stover in Sarnia-Lambton County, ON, is 'A.'**

Category 1: Supplier Risk

1.1. Supplier's Dependence On, or Preference For, Competing Markets

Rationale: Suppliers may have a vested interest or preference to supply to specific competitors for biomass feedstock. Preferences may be due to historical, long-term, or personal relationships, less stringent feedstock quality requirements, more flexible operating hours by competing markets, or suppliers' dependence on competing markets to accept or purchase other products/by-products. During periods of feedstock shortage suppliers may be more likely to allocate scarce supplies to a competitor, resulting in supply disruptions for the Proponent.	**Score**
Raw RI Score: In the region, the demand for corn stover is limited as no significant end-users exist for this product. The Competition Zone has a relatively low concentration of livestock farming, primarily limited to feedlots that do not utilize corn stover as bedding or feed. There is a small number of farmers who aggregate corn stover for personal use, representing a minor local market for animal bedding. This limited usage is estimated to consume less than 2% of corn stover generated regionally. Raw RI Score is *1 out of 10*.	**1**
Notched Salience: No adjustments. De-risking measures are not necessary for risk indicators with Raw RI Scores of 1, as they are already at the lowest risk.	**Score Unnotched 1.0**
Impact Level: RI Impact Level is deemed *low*.	**Score 3.33**
Loaded RI Score: Loaded RI Score (Notched Score × Impact Level) is 3.33 out of 100.	**Score 3.33**

1.2. Ownership of Equipment

Rationale: In most cases, suppliers that own or lease equipment for the harvest, collection, and processing of feedstock are at a lower risk than those that do not. For example, third-party harvesting equipment may not be available when required, meaning that short harvest windows may be missed if a farmer and contractor cannot schedule convenient harvest times, resulting in quantity shortages. In some circumstances, relying on third-party equipment to harvest or produce feedstock can decrease supply chain risk. For instance, when harvesting agricultural residues such as corn stover, the use of third-party companies with standard equipment specializing in harvesting, collection, and transportation may decrease quality variations (e.g., ash content) of final feedstock.	**Score**
Raw RI Score: In Ontario, approximately 50% of hay and wheat straw is harvested by custom service providers. Square balers are the preferred equipment for baling corn stover and represent around 30% of the total available baling capacity. Based on current supply basin conditions, the insufficient availability of farmer-owned baling equipment would necessitate the engagement of third-party harvesters to achieve large-scale corn stover aggregation. To increase the utilization of their baling equipment, third-party balers can take advantage of the fall and spring seasons to harvest corn stover.	**8**

However, this strategy presents two notable risks. Firstly, the abrasive nature of corn stover can cause excessive wear and tear on the baling equipment, which may discourage third parties from participating. Secondly, the harvesting window for corn stover in the fall and spring is short and weather-dependent, meaning that farmers are likely to restrict access to their fields if they are wet due to soil compaction concerns. These factors increase the operational risk associated with corn stover aggregation in the region.

Raw RI Score is 8 out of 10.

Notched Salience: RI 1.2 could be significantly mitigated by involving an experienced third-party baling company or vertical integration within the project. A new corn stover processing plant may mitigate risks associated with baling equipment ownership by purchasing its own equipment, or financing growers to do so. As a result, Raw RI Score is notched by 50%: Notched Salience is 4.0.	**Score Notched 4.0**
Impact Level: A third-party baling company may not be available during the harvesting season, or its cost may be prohibitive. If so, the local supply chain would need to scale up and acquire the necessary baling equipment. It remains unclear whether local growers would have an appetite to invest in such equipment. RI Impact Level is deemed *moderate*.	**Score 6.66**
Loaded RI Score: Loaded RI Score (Notched Score × Impact Level) is 26.64 out of 100.	**Score 26.64**

1.3. Ownership of Transportation/Logistics

Rationale: In most cases, suppliers that own or lease equipment necessary to transport biomass from forests or fields are at lower risk than those that do not. However, in some circumstances, reliance on third parties to transport biomass is considered common practice and does not contribute to risk.	**Score**
Raw RI Score: The annual biomass harvest of hay and straw in the four counties of Chatham-Kent, Middlesex, Lambton, and Huron in Ontario, totals 1.25 million tons, which is primarily transported to feedlots for end use. The biomass transport infrastructure in the region has the capacity to support the additional transportation of 190,000 ODMT/yr of corn stover. During the harvest season in the fall and spring, equipment availability is adequate. Relying on third parties to transport bales is common in the region and does not pose any additional risk to the supply chain.	**2**

Raw RI Score is 2 out of 10.

Notched Salience: No adjustments. De-risking measures are not necessary for risk indicators with Raw RI Scores of 2, as they are already low risk.	**Score Unnotched 2.0**
Impact Level: RI Impact Level is deemed *low*.	**Score 3.33**
Loaded RI Score: Loaded RI Score (Notched Score × Impact Level) is 6.66 out of 100.	**Score 6.66**

1.4. Supplier as an Aggregator or Broker

Rationale: Aggregators may effectively provide supply chain redundancy and eliminate the risk and complexity of dealing with multiple supply sources by combining them into a single master contract. Aggregators can add much-needed stability to biomass supply basins by increasing the offtake stability for both suppliers and markets. An aggregator can be a more reliable long-term offtake solution for suppliers by having access to multiple markets. **Parallelly they** are also more reliable long-term suppliers for markets by having multiple suppliers – i.e., when a single supplier breaches, the aggregator can source from another.	**Score** **1**

Both aggregators and brokers are intermediaries. Aggregators consolidate and manage feedstock procurement from a number of smaller suppliers. While brokers often act as intermediaries between a single source of supply. However, brokers of multiple sources of feedstock are also common. Aggregators act as principles in the supply of feedstock and assume the contractual obligations of a direct supplier, whereas brokers do not.

Definitional confusion between aggregators and brokers is common. If an aggregator does not assume the supply risk of sub-contractors, then they are more accurately deemed either a "procurement manager" or "broker". Aggregators add more value in terms of risk mitigation than other intermediaries. Thus, an aggregator premium should relate to the degree to which they are able to mitigate feedstock supply risks.

Raw RI Score: There are no aggregators in the area. However, the presence of several growers allow for the spread of supply sources and reduces the risk of shortages.

Raw RI Score is 1 out of 10.

Notched Salience: No adjustments. De-risking measures are not necessary for risk indicators with Raw RI Scores of 1, as they are already the lowest risk.	**Score Unnotched 1.0**
Impact Level: Corn grower participation is low and potential failure by the growers to aggregate corn stover poses a significant risk. RI Impact Level is deemed *high*.	**Score 9.99**
Loaded RI Score: Loaded RI Score (Notched Score × Impact Level) is 9.99 out of 100.	**Score 9.99**

1.5. Feedstock as a Secondary Transformation

Rationale: A secondary transformation is dependent upon the production of primary products, e.g. corn stover resulting from the production of corn. Risks are higher if the feedstock is a secondary transformation of a primary, more valuable product, as it may not be economical for suppliers to produce biomass on their own in the absence of markets for the primary product. In the case of agricultural feedstocks such as Flax Straw, the feedstock is a by-product of a primary crop. Since the primary crop is significantly more lucrative than the residue, it is the producers' priority. If the production of a primary crop requires resources to be taken away from the production of a secondary crop (e.g., in case of shorter harvesting windows due to weather), the secondary feedstock supply will suffer. In times of stretched resources, suppliers may perceive harvesting and collecting the feedstock (secondary product) as a nuisance, potentially decreasing production levels.	**Score**
Raw RI Score: Removal of corn stalks presents several benefits, including improved seed-to-soil contact, enhanced germination rates, faster soil warming in the spring, the potential to reduce disease incidence in corn-on-corn crop rotations, and serves as an additional income source for farmers. As a secondary by-product of primary corn production, corn stover is often a lower priority for producers who prioritize the production of corn. Historically, corn has been the favored crop in the Sarnia-Lambton County BDO Zone, and has consistently been prioritized by growers during the planting season. However, factors such as short	**8**

planting seasons, drought, or poor market conditions can significantly reduce the planted corn acreage year-over-year, thereby impacting the availability of corn stover. Due to the potential for significant fluctuations in corn acreage, the risk is deemed high. Raw RI Score is 8 out of 10.	
Notched Salience: The long term outlook of corn production in the Sarnia-Lambton County BDO zone is positive and risks can be mitigated by establishing an adequate supply inventory. As a result, Raw RI Score is notched by 50%: Notched Salience is 4.	**Score Notched 4.0**
Impact Level: RI Impact Level is deemed *high*.	**Score 9.99**
Loaded RI Score: Loaded RI Score (Notched Score × Impact Level) is 39.96 out of 100.	**Score 39.96**

1.6. Fundamental Feedstock Production Experience

Rationale: Risk is higher when a supplier has limited experience with planting, growing, harvesting, processing, and/or collecting biomass. Limited experience may be common for agricultural residue supply chains where farmers may have no previous experience. In cases where experience is lacking, the Proponent should show that steps have been taken to ensure proper training, knowledge dissemination, and monitoring.	**Score**
Raw RI Score: The supply chain has little experience producing, storing, and handling commercial quantities of corn stover as the only consumers to date are local spot markets such as animal bedding. Many individual growers have never baled corn stover, though most growers have baled straw from other crops. Raw RI Score is 7 out of 10.	**7**
Notched Salience: RI 1.6 could be significantly reduced by enlisting the services of an experienced third-party baling company (or companies) or by providing similar services though the establishment of a vertically integrated bio-project or Co-op. As a result, Raw RI Score is notched by 50%: Notched Salience is 3.5.	**Score Notched 3.5**
Impact Level: The RI impact of not being able to enlist third-party baling or that the cost would be prohibitive is deemed ***low.***	**Score 9.99**
Loaded RI Score: Loaded RI Score (Notched Score × Impact Level) is 34.97 out of 100.	**Score 34.97**

1.7. Production Scale Experience

Rationale: Scale-up entails risk. The risk is higher when suppliers have limited experience with production at the quantity of feedstock required.	**Score**
Raw RI Score: Production-scale experience with corn stover is lacking in the region. The transition from current corn stover production levels to those required for a large-scale facility would be significant.	**9**

Raw RI Score is 9 out of 10.	
Notched Salience: RI 1.7 could be reduced by outsourcing harvest and collection to credible third-party baling companies or by providing similar services through a vertically integrated bio-project. As a result, Raw RI Score is notched by 50%: Notched Salience is 4.5.	**Score 4.5**
Impact Level: There is a risk that a third-party baling company could not be enlisted, or its cost would be prohibitive. RI Impact Level is deemed *moderate*.	**Score 6.66**
Loaded RI Score: Loaded RI Score (Notched Score × Impact Level) is 29.97 out of 100.	**Score 29.97**

1.8. Feedstock Production Priority

Rationale: When biomass feedstock is a secondary or non-core line of business, or when it is a by-product /residual from a more valuable primary product, suppliers may not put sufficient effort into consistently producing it. The risk of breach increases when production and/or delivery of feedstock compromises the supplier's ability to make a primary product. When biomass feedstock is a by-product of another main higher margin or main product (e.g. corn stover), supply may not be a top priority for a supplier.	**Score**
Raw RI Score: During the fall harvest window for corn stover, on-farm labor and equipment are prioritized towards the management of primary crops, resulting in a lack of resources and interest in corn stover harvest. The fall season presents a short harvesting window for corn stover, and soil compaction concerns lead farmers to restrict equipment access to wet fields, further limiting the available harvest time. These factors contribute to low farmer participation rates despite the potential benefits and revenue from corn stover removal. Moreover, unfavorable fall weather conditions can lead to lower corn stover production from suppliers, further increasing the supply chain's operational risk. Raw Risk Score is *8 out of 10*.	**8**
Notched Salience: Baling corn stover in the spring season, when there are fewer competing land management activities, can significantly extend harvesting windows and mitigate risks associated with the fall harvest window. Additionally, outsourcing corn stover harvest and collection to credible third-party baling companies or providing similar services through a vertically integrated bio-project can further reduce operational risks to farmers associated with corn stover aggregation. As a result, Raw RI Score is notched by 50%: Notched Salience is 4.	**Score Notched 4.0**
Impact Level: RI Impact Level is deemed *high*.	**Score 9.99**
Loaded RI Score: Loaded RI Score (Notched Score × Impact Level) is 39.96 out of 100.	**Score 39.96**

Category 2: Competitor Risk

2.1. Competitor Locations and Geographical Influence on the Market

Rationale: Competitors' locations relative to a Proponent can affect the viability of procuring feedstock and feedstock cost. Accurate and detailed competitor mapping provides an understanding	**Score**

of the geographical influence a competitor may have, including competitive advantages such as short hauling. **Raw RI Score:** There are no large-scale competitors for corn stover in the region. Raw RI Score is 1 out of 10.	**1**
Notched Salience: No adjustments. De-risking measures are not necessary for risk indicators with Raw RI Scores of 1, as they are already the lowest risk.	**Score Unnotched 1.0**
Impact Level: If a large-scale competitor enters the market, the impact would be significant. RI Impact Level is deemed *high*.	**Score 9.99**
Loaded RI Score: Loaded RI Score (Notched Score × Impact Level) is 9.99 out of 100.	**Score 9.99**

2.2. Historical Fluctuation of Quantity Used

Rationale: A clear understanding of key competitors' consumption of each feedstock type is essential to quantifying the risks associated with each competitor. Understanding historical trends of feedstock utilization can provide valuable information about feedstock price elasticity during shortages and insight into events that may impact future supply conditions. This allows for more accurate estimates of the sensitivity of feedstock availability to potential future consumption levels or due to the impact of external events (e.g., weather events, structural economic changes, seasonality, or policy change).	**Score**
Raw RI Score: There are no major historical competitors for corn stover. Regional markets such as the cattle bedding market are the only current local consumers of corn stover, consuming less than 2% of all feedstock generated. Raw RI Score is *1 out of 10*.	**1**
Notched Salience: No adjustments. De-risking measures are not necessary for risk indicators with Raw RI Scores of 1, as they are already the lowest risk.	**Score Unnotched 1.0**
Impact Level: RI Impact Level is deemed *high*.	**Score 9.99**
Loaded RI Score: Loaded RI Score (Notched Score × Impact Level) is 9.99 out of 100.	**Score 9.99**

2.3. Competitor Pricing and Price Sensitivity

Rationale: Understanding how much competitors pay for different feedstock types is essential to determine the competitiveness of the Proponent. Historical prices paid by competitors provide insight into their procurement behaviors and willingness to pay premiums for feedstock which would exert pressure on the Proponent's suppliers during times of feedstock shortage. Competitors that can offer higher prices for feedstock during shortages can pose significant risks to the Proponent.	**Score**

Knowledge of competitor pricing and price sensitivity is an essential prerequisite to formulating a feedstock cost curve which can enable predictions of feedstock redundancy; i.e., how much feedstock could become available at different pricing levels (see Category 3–Supply Chain Risk 3.1.3).

Raw RI Score: There are no significant competitors for corn stover in the region. **1**

Raw RI Score is 1 out of 10.

Notched Salience: No adjustments. De-risking measures are not necessary for risk indicators with Raw RI Scores of 1, as they are already the lowest risk.	**Score Unnotched 1.0**
Impact Level: RI Impact Level is deemed *high*.	**Score 9.99**
Loaded RI Score: Loaded RI Score (Notched Score × Impact Level) is 9.99 out of 100.	**Score 9.99**

2.4. Impacts of Future Demand on Feedstock Availability and Price

Rationale: Future competitors for feedstock or an expansion of feedstock demand by current competitors can cause feedstock market disruption. **Score**

Even before new competitors become operational, high interest in a supply basin can make suppliers overconfident, leading to a supplier-controlled market where short-term contracting becomes the norm and compromising supply chain reliability for the Proponent. Once operational, new competitors increase demands for feedstock, potentially lowering its availability and increasing costs.

Existing competitors may seek to expand operations, increasing consumption of feedstock.

Raw RI Score: Project Radius, located in Southern Ontario, is a late-development-stage portfolio of three high-quality, on-farm renewable natural gas (RNG) projects, collectively capable of producing ~1.7 million GJ/year of RNG[1]. Project Radius has announced three biogas digesters in Southern Ontario with one digester located in Huron County and two digesters located in Norfolk County[2]. The announcements indicate that the digesters will be constructed throughout 2023 and 2024. The digesters will take in local agricultural feedstocks like corn stover, liquid dairy, and swine manure. Assuming a co-digestion feedstock ratio of 1:3 for cattle manure to corn stover which has been shown in literature to produce optimal biogas production,[3] then collectively the plant will consume approximately 75,000 ODMT/yr of corn stover and be a significant competitor in the Competition Zone. **8**

[1] Northeast Renewables. (2023, 02 15). What is Project Radius? Retrieved from Project Radius: https://www.radiusrng.com/
[2] EverGen Infrastructure Corp. (2023, 03 13). EverGen Acquires 50% Interest in Project Radius, Development Portfolio of 3 RNG projects in Ontario. Retrieved from EverGen: https://www.evergeninfra.com/post/evergen-acquires-50-interest-in-project-radius-development-portfolio-of-3-rng-projects-in-ontario
[3] Xiujin Li, L. L. (2009). Anaerobic Co-Digestion of Cattle Manure with Corn stover Pretreated by Sodium Hydroxide for Efficient Biogas Production. Energy & Fuels, 4635–4639.

Project Radius plans to locate on the edge of the BDO supply zone and will compete for biomass within the BDO Zone. There is a high degree of uncertainty regarding the feedstock type and quantity that will be consumed by Project Radius. This uncertainty presents a significant risk to the supply chain, as it could lead to increased competition for biomass, which may result in higher prices and reduced availability for other end-users. Raw RI Score is 8 out of 10.	
Notched Salience: Mitigating risks associated with Project Radius's uncertainty regarding feedstock type and quantity consumption can be achieved by understanding their requirements and securing long-term contracts with growers closer to Sarnia-Lambton County. By doing so, the Proponent can reduce competition for biomass in the BDO Zone and ensure a consistent and reliable supply of feedstock. As a result, Raw RI Score is notched by 50%: Notched Salience is 4.	**Score Notched 4.0**
Impact Level: Given Project Radius's proximity to Sarnia-Lambton County the RI Impact is deemed ***moderate***.	**Score 6.66**
Loaded RI Score: Loaded RI Score (Notched Score × Impact Level) is 26.64 out of 100.	**Score 26.64**

2.5. Supply Influence of Competitor

Rationale: In some cases, competitors may exert high degrees of pressure over local suppliers, effectively enabling them to control feedstock, especially during shortages. This control can stem from previous relationships between suppliers and competitors, often in the form of verbal or "understood" agreements, or from a competitor being able to assist suppliers in times of surplus by maintaining large inventories enabling suppliers to continue supplying when other markets impose quotas. Understanding and planning around such soft risk factors is important. If such relationships exist in the Proponent's procurement area, they may indicate an increased risk of feedstock shortage or pricing changes.	**Score**
Raw RI Score: Corn stover has no large-scale competitors and is widely available throughout the province, so competitors are unlikely to be located in the same BDO Zone. Raw RI Score is 1 out of 10.	**1**
Notched Salience: No adjustments. De-risking measures are not necessary for risk indicators with Raw RI Scores of 1, as they are already the lowest risk.	**Score Unnotched 1.0**
Impact Level: RI Impact Level is deemed *high*.	**Score 9.99**
Loaded RI Score: Loaded RI Score (Notched Score × Impact Level) is 9.99 out of 100.	**Score 9.99**

2.6. Temporary Market-Driven Markets

Rationale: Alternative, non-traditional, market-driven competitors for feedstock can drive feedstock demand in unusual circumstances. A Proponent using corn stover as a feedstock, for example, would not typically compete with higher-end animal feed markets due to quality issues. However, in times of significant hay shortage (e.g., during drought), farmers may use corn stover in place of hay, driving up the price of feedstock and decreasing availability for bio-projects (Bergtold 2018).	**Score**
	1

Raw RI Score: Historically, there have been no non-traditional or market-driven markets for corn stover, even during regional hay shortages corn stover has not been utilized for animal feed. As a result, the Raw Risk Score for this risk factor is deemed low. Raw RI Score is 1 out of 10.	
Notched Salience: No adjustments. De-risking measures are not necessary for risk indicators with Raw RI Scores of 1, as they are already the lowest risk.	**Score Unnotched 1.0**
Impact Level: Medium or large-scale temporary markets would pose a significant impact to the supply chain. RI Impact Level is deemed *high*.	**Score 9.99**
Loaded RI Score: Loaded RI Score (Notched Score × Impact Level) is 9.99 out of 100.	**Score 9.99**

2.7. Relative Inventory Capacity

Rationale: Storing inventory enhances one's competitiveness. The ability to store large biomass inventories allows Proponents to purchase inventory when prices are low, yielding economic advantages. Additionally, the ability to store inventory during feedstock supply surpluses enables competitors to continue to intake feedstock when the Proponent (with lesser inventory capacity) may be forced to put suppliers on quota. Larger inventory capacity thereby creates supplier loyalty, increasing reliability while decreasing risk.	**Score**
Raw RI Score: Corn stover presently has no large-scale competitors and there is little demand for corn stover. Therefore, there is no current need for large-scale inventory. Cattle feedlots typically stockpile up to a year's worth of feedstock. However as they consume less than 1% of all locally generated corn stover the market for feedstock remains small. Raw RI Score is 1 out of 10.	**1**
Notched Salience: No adjustments. De-risking measures are not necessary for risk indicators with Raw RI Scores of 1, as they are already the lowest risk.	**Score Unnotched 1.0**
Impact Level: RI Impact Level is deemed *moderate*.	**Score 6.66**
Loaded RI Score: Loaded RI Score (Notched Score × Impact Level) is 6.66 out of 100.	**Score 6.66**

2.8. Relative Accessibility/Delivery Hours and Wait Times

Rationale: The value attributed by suppliers to local markets is often directly related to the degree of flexibility the market provides in terms of delivery hours and the efficiency of discharge.	**Score**
Raw RI Score: There are no large-scale competitors for feedstock in the region. Raw RI Score is 1 out of 10.	**1**
Notched Salience: No adjustments. De-risking measures are not necessary for risk indicators with Raw RI Scores of 1, as they are already the lowest risk.	**Score Unnotched 1.0**
Impact Level: RI Impact Level is deemed *moderate*.	**Score 6.66**

Loaded RI Score: Loaded RI Score (Notched Score × Impact Level) is 6.66 out of 100.	**Score 6.66**

2.9. Relative Specification Advantages

Rationale: When choosing a market, suppliers look at price as well as relative quality requirements or specifications. It is important to understand a competitor's feedstock quality specifications to accurately quantify the risk that a competitor can exert on the Proponent's supply chain.	**Score**
Raw RI Score: There are no large-scale competitors for feedstock in the region. The cattle bedding market is tolerant of poor feedstock quality and accounts for less than 2% of total corn stover generated locally. Raw RI Score is 1 out of 10.	**1**
Notched Salience: No adjustments. De-risking measures are not necessary for risk indicators with Raw RI Scores of 1, as they are already the lowest risk.	**Score Unnotched 1.0**
Impact Level: RI Impact Level is deemed *moderate*.	**Score 6.66**
Loaded RI Score: Loaded RI Score (Notched Score × Impact Level) is 6.66 out of 100.	**Score 6.66**

2.10. Demand for Competitors' Products

Rationale: Increased demand for competitors' products can cause an increased demand for feedstock from the competitor, given the competitor can increase its production capacity easily. For example, increased demand for biofuels due to a clean fuels policy can cause increased biofuel production by the competitor, thereby increasing demand for feedstock.	**Score**
Raw RI Score: There are no large-scale competitors for corn stover in the region. Raw RI Score is 1 out of 10.	**1**
Notched Salience: No adjustments. De-risking measures are not necessary for risk indicators with Raw RI Scores of 1, as they are already the lowest risk.	**Score Unnotched 1.0**
Impact Level: RI Impact Level is deemed *moderate*.	**Score 6.66**
Loaded RI Score: Loaded RI Score (Notched Score × Impact Level) is 6.66 out of 100.	**Score 6.66**

Category 3: Supply Chain Risk

3.1. Feedstock Availability

Rationale: Feedstock availability is scored through three lenses: i) feedstock generation in addition to current markets ii) Biomass Availability Multiple (BAM) over the rated quantity and iii) estimated supplier participation rate. A BAM is the ratio of feedstock available in a Zone over the amount needed by a potential project; the larger the BAM, the greater the degree of redundancy in a feedstock supply chain.	**Score**
	1

Raw RI Score: There is no large-scale competition for corn stover within the BDO Zone. We estimate that less than 2% of generated corn stover is used as animal bedding. Given the lack of current markets for corn stover, and significant first mover advantages for a new plant in the BDO Zone, a BAM of 1.2 is considered adequate to provide adequate feedstock redundancy, even at full utilization of the rated quantity. Based on grower feedback, we estimate grower participation rate at 20% (assumptions discussed further in Appendix B).

We estimate that 190,000 ODMT/yr of corn stover is available within a 140-km drive distance from a rough center point of Sarnia-Lambton County. (See Appendix B for calculations).

Raw Risk Score is 1 out of 10.

Notched Salience: No adjustments. De-risking measures are not necessary for risk indicators with Raw RI Scores of 1, as they are already the lowest risk.	**Score Unnotched 1.0**
Impact Level: Our estimates are based on key assumptions regarding generation and farmer participation rate which if incorrect, could result is a significant impact on feedstock availability. RI Impact Level is deemed *high*.	**Score 9.99**
Loaded RI Score: Loaded RI Score (Notched Score × Impact Level) is 9.99 out of 100.	**Score 9.99**

3.2. Impact of Increased Utilization of Feedstock

Rationale: Feedstock utilization in a supply basin can change over time. Existing consumers of feedstock can expand operations or new facilities may enter the market. Increased utilization puts additional pressure on feedstock and can lead to higher prices, feedstock disruptions, shortages, or supplier breach.	**Score 7**

Raw RI Score: Currently, there is no substantive corn stover market in the Sarnia-Lambton County BDO Zone, and significant feedstock supplies are available. However, Project Radius announced to be a late-stage RNG project consisting of three high-quality, on-farm projects, can potentially become a competitor for corn stover within the region. The project mentions the potential use of corn stover as a feedstock to co-digest with animal manure. Still there is a high degree of uncertainty regarding the quantity of corn stover that Project Radius will consume once operational. Based on its generation capacity, it is estimated that Project Radius could consume up to 75,000 ODMT of corn stover.

Suppose Project Radius creates a market for corn stover in the Sarnia-Lambton County BDO Zone. In that case it may generate interest from growers and increase participation rates, potentially offsetting the competition for feedstock. However, this also creates uncertainty and risk, as the demand from Project Radius could drive-up prices and create supply shortages.

Raw RI is 7 out of 10.

Notched Salience: Mitigating the risk associated with Project Radius's uncertainty regarding feedstock type and quantity consumption can be achieved by understanding their requirements and securing long-term contracts with growers closer to Sarnia-Lambton County. By securing long-term contracts with growers closer to Sarnia-Lambton County, the Proponent can reduce competition for biomass in the BDO Zone and ensure a consistent and reliable supply of feedstock. As a result, Raw RI Score is notched by 50%: Notched Salience is 3.5.	**Score Notched 3.5**
Impact Level: Given Project Radius's proximity to Sarnia-Lambton County the RI Impact is deemed moderate.	**Score 6.66**

Loaded RI Score: Loaded RI Score (Notched Score × Impact Level) is 23.31out of 100.	**Score 23.31**

3.3. Feedstock Supply Curve / Marginal Cost Curve

Rationale: The greater the feasible transport distance, the greater the amounts of feedstock accessible to the Proponent, but at a higher delivered cost. The feedstock supply curve, also referred to as the marginal cost curve, is a function of feedstock availability over its cost, which is primarily, but not exclusively, a function of distance. The feedstock supply curve is used to determine the availability of redundant feedstock at various price points and the cost of replacing feedstock with substitutes located at different distances. Feedstock cost curves are useful in determining supply chain resilience. They provide information about feedstock cost and availability in times of supply disturbance. Biomass supply chains are prone to supply disturbances over time. For instance, suppliers can become insolvent, or weather events can temporarily disrupt feedstock availability. When a disturbance occurs, the Proponent may need to source replacement feedstock from different suppliers at different locations and costs. A biomass supply curve indicates quantities of feedstock available at various price levels from suppliers located farther away than core suppliers.	**Score**
Raw RI Score: We estimate that the cost to transport corn stover an additional kilometre is $0.03/ODMT or 30 cents per 10 km per ODMT. Therefore, the cost to access additional corn stover outside of the BDO Zone is relatively low. Raw RI Score is 1 out of 10.	**1**
Notched Salience: No adjustments. De-risking measures are not necessary for risk indicators with Raw RI Scores of 1, as they are already the lowest risk.	**Score Unnotched 1.0**
Impact Level: Given that Southern Ontario is a strong corn-growing region, there is confidence that an ample supply of feedstock is available outside the Sarnia-Lambton County BDO Zone. Therefore, the impact level of feedstock availability on the Sarnia-Lambton County BDO Zone's Raw RI is deemed *low*.	**Score 3.33**
Loaded RI Score: Loaded RI Score (Notched Score × Impact Level) is 3.33 out of 100.	**Score 3.33**

3.4. Seasonal Feedstock Supply Variation

Rationale: Biomass supply can present significant seasonal supply variations. When combined with limitations associated with longer-distance transportation and storage, this can result in regional biomass supply imbalances (Golecha & Gan 2016) and can manifest as supply shortages and higher costs for Proponents.	**Score**
Raw RI Score: Corn stover harvesting occurs for approximately six weeks in the fall and spring. The fall season is highly dependent on rainfall, and fields need to be dry to prevent soil compaction from harvesting equipment. Baling corn stover in the fall at high moisture content increases the risk of poor bale quality and spoiling during storage. Snow is prohibitive to baling, but once it has cleared, there is a second opportunity for baling in the spring when the corn stover has a lower moisture content, resulting in better quality bales. These factors contribute to a high level of uncertainty and risk associated with corn stover harvesting, increasing risk.	**8**

Raw RI Score is 8 out of 10.

Note: The risk of a short harvest window has been factored into the RI 1.8 reported above.

Notched Salience: The Raw RI Score for the risk of seasonal supply variation in corn stover can be reduced by implementing adequate feedstock inventory and optimizing the number of harvest days through a network of suppliers and third-party harvesters spread across different rainfall regions in the BDO Zone. Additionally, substituting wheat straw during supply shortages of corn stover is an excellent mitigation strategy if the proponent's biomass conversion technology allows for feedstock substitution. Raw RI Score is notched by 50%: Notched Salience is 4.0.	**Score 4.0**
Impact Level: Weather can have significant impact on corn stover production and not all conversion technology allows for feedstock substitution. The RI Impact Level is deemed *high*.	**Score 9.99**
Loaded RI Score: Loaded RI Score (Notched Score × Impact Level) is 39.96 out of 100.	**Score 39.96**

3.5. Year-to-Year Variation in Feedstock Availability

Rationale: Biomass can have significant year-to-year supply variations due to variability in yield from biomass harvesting operations, particularly with agricultural biomass.	**Score**
Raw RI Score: The variation in feedstock supply from year to year is determined by the number of corn acres planted, which can be affected by market prices for corn and weather during the planting season, as well as the corn yield. Annual variations in seeded and harvested corn acres have been significant in the past, as shown in Figure 4 (Appendix B). Between 2011 and 2012 there was an increase in seeded corn by 19%, while between 2012 and 2014 there was a subsequent drop of 20%, resulting in a 10-year low. Seeded acres have been steadily rising since this low in 2014. Wet weather during the spring planting season will reduce the acres of corn seeded, while dry weather can reduce the availability of corn stover because it reduces corn yields. Rainfall patterns are influenced by Lake Huron, and seasonal droughts can impact isolated regions within the Sarnia-Lambton County BDO zone. However, there have been no historically documented failed corn crops due to drought in the region. Raw RI score is 5 out of 10.	**5**
Notched Salience: Changes in seasonal feedstock supply variation can be mitigated by sourcing corn stover from outside the BDO Zone. Due to the low marginal cost to transport corn stover additional distances, we consider this as a feasible mitigator. As a result, Raw RI Score is notched by 50%: Notched Salience is 2.5.	**Score Notched 2.5**
Impact Level: Low-seed and low-yield year can have significant impacts on the availability of corn stover. However, the impact is moderated by variable rainfall patterns throughout the region. RI Impact Level is deemed *moderate*.	**Score 6.66**
Loaded RI Score: Loaded RI Score (Notched Score × Impact Level) is 16.65 out of 100.	**Score 16.65**

3.6. Double-Counting Feedstock

Rationale: Aggregators, intermediaries, or brokers, organize and distribute feedstock produced by suppliers. If such sources of supply are used in assessing feedstock availability for BAMs or supply curves, the Proponent should be sure not to double count feedstock produced by one supplier and traded/supplied by an intermediary.	**Score**
Raw RI Score: Feedstock availability estimates are based on estimates of what is directly available from growers and results from adjacent regions. There is no risk of double counting in our method. Raw RI Score is 1 out of 10.	**1**

Notched Salience: No adjustments. De-risking measures are not necessary for risk indicators with Raw RI Scores of 1, as they are already the lowest risk.	**Score Unnotched 1.0**
Impact Level: RI Impact Level is deemed *high*.	**Score 9.99**
Loaded RI Score: Loaded RI Score (Notched Score × Impact Level) is 9.99 out of 100.	**Score 9.99**

3.7. Front-End Validation of Data Used in Feedstock Availability Models

Rationale: Feedstock supply models can be complex. A lack of clarity about model assumptions and baseline data can result in confusion on the part of the capital markets and drive financing costs for biomass projects. The adequacy and credibility of assumptions and baseline data are paramount to credible model outputs.	**Score**
Raw RI Score: The county-level acres by yield grouping data used to model feedstock availability is provided by Agricorp crop insurance, which is the highest quality industry data available. The assumptions used in the development of feedstock supply curves, which are listed in Appendix B of this rating, are based on verbal feedback from a number of local growers and experts in the BDO Zone as well as previous feasibility reports on corn stover for the region. Given the high quality of the industry data used and the input from local growers and experts, the Raw RI Score for this risk indicator is deemed low. Raw RI Score is 1 out of 10.	**1**

Notched Salience: No adjustments. De-risking measures are not necessary for risk indicators with Raw 1, as they are already the lowest risk.	**Score Unnotched 1.0**
Impact Level: Uncertainty in assumptions pertains to increased risk. RI Impact Level is deemed *high*.	**Score 9.99**
Loaded RI Score: Loaded RI Score (Notched Score × Impact Level) is 9.99 out of 100.	**Score 9.99**

3.8. History of Production / Feedstock Is a Secondary Crop or a By-Product

Rationale: If the feedstock is a new secondary crop or a by-product, suppliers may either lack sufficient experience to mitigate risk or be unable to react to it. Producers are also unlikely to prioritize the production of these crops, at the expense of higher-value commodities. For new crop types, inexperience in planting, harvesting, collection, and yield data may pose higher levels of risk. If the feedstock is a secondary crop, then production can be subject to variables beyond suppliers' control (e.g., changing primary crop prices).	**Score**
Raw RI Score: Corn stover availability in the BDO Zone is determined by the number of corn acres planted and the corn yield. Production of corn stover is proportional to corn production, which has increased significantly in recent years. Figure 5 in Appendix B shows the average yield per acre in Southern Ontario has increased from below 140 bushels/ac in 2004 to over 185 bushels/ac in 2021. However, the number of corn acres planted each year is influenced by market forces, such as crop prices and rainfall patterns during the fall planting season. Growers in the region tend to favor corn planting over soybeans and canola when prices are positive, but decisions are often made a few months before seeding. Imperfect crop rotation and corn yield also affect corn stover availability. Raw RI Score is 6 out of 10.	**6**
Notched Salience: RI 3.8 can be mitigated by sourcing corn stover from outside the BDO Zone. Due to the low marginal cost to transport corn stover additional distance, we consider this as a feasible mitigator. As a result, Raw RI Score is notched by 75%: Notched Salience is 1.5.	**Score Notched 1.5**
Impact Level: The short and unpredictable baling season for corn stover makes it difficult for growers without historical production (baling) experience to prioritize corn stover baling. We deem RI Impact Level *high*.	**Score 9.99**
Loaded RI Score: Loaded RI Score (Notched Score × Impact Level) is 14.98 out of 100.	**Score 14.98**

3.9. Diesel, Oil and Producer Price Index (PPI)

Rationale: Diesel, oil, and Producer Price Index (PPI) can impact costs affiliated with harvesting feedstock and its collection over time. Sensitivities to worst-case scenarios should be run.	**Score**
Raw RI Score: The delivered cost of corn stover is affected by the price of diesel and oil as well as the PPI. The cost of baling and transportation is directly affected by the price of diesel. The PPI has an indirect impact on baling and transportation costs via labour costs. The price of diesel is volatile (Figure 6 in Appendix B). Moreover, the federal carbon tax is expected to decrease the use of fossil fuels or increase costs annually. The industrial product price index (IPPI), on the other hand, shows little year-to-year volatility and continues to rise (Figure 7 in Appendix B). Note: we consider data for the past two years an anomaly due to variabilities introduced by the pandemic. Raw RI Score is 5 out of 10.	**5**

Notched Salience: No adjustments. The prices of fuels are dictated by regional and international supply and demand.	**Score Unnotched 5.0**
Impact Level: Even with high diesel prices, the cost to travel an additional 10 km to acquire larger quantities of corn stover is $0.3/km. On the other hand, the past two years of increased PPI may not have been an anomaly and the trend may continue (projections are uncertain). RI Impact Level is deemed *medium*.	**Score 6.66**
Loaded RI Score: Loaded RI Score (Notched Score × Impact Level) is 33.30 out of 100.	**Score 33.30**

3.10. Currency Risk

Rationale: If the Proponent's supply basin does not have a history of developing, large-scale feedstock procurement, suppliers may not have sufficient expertise in feedstock production to ensure reliable supply, especially early on. Where supply chains are not well-established, risk can be mitigated when a Proponent controls a higher degree of feedstock processing.	**Score**
Raw RI Score: The availability of corn stover estimated in this assessment does not include corn produced in the United States. Raw RI Score is 1 out of 10.	**1**
Notched Salience: No adjustments. De-risking measures are not necessary for risk indicators with Raw RI Scores of 1, as they are already the lowest risk.	**Score Unnotched 1**
Impact Level: RI Impact Level is deemed *low*.	**Score 3.33**
Loaded RI Score: Loaded RI Score (Notched Score × Impact Level) is 3.33 of of 100.	**Score 3.33**

3.11. Border Risk

Rationale: Where feedstock is transported to another country, there is a risk of exposure to border closures and crossing delays. The availability of trucks willing to do cross-border runs is limited, often decreasing supply chain flexibility and resilience. Plants near the US-Canada border which intake feedstock from both countries are exposed to these risks.	**Score**
Raw RI Score: Sarnia-Lambton County is located on the Ontario-Michigan border, but the BDO rating for this area does not consider biomass equirement across the US border. However, as there is a relative abundance of corn stover available on the Canadian side of the border, and the phytosanitary equirement to return any soil that crosses the border back to the United States make it reasonable to limit the biomass availability to Canada, the risk profile of the BDO Zone is significantly reduced. Raw Risk Score is 1 out of 10.	**1**
Notched Salience: Border risk can be mitigated by acquiring corn stover from larger distances on the Canadian side of the border.	**Score Notched 1.0**

Thus, Raw RI is unnotched: Notched Salience is 1.0.	
Impact Level: We are confident with our assessment that the US part of the BDO Zone has limited impact on the entire supply basin. RI Impact Level is deemed *low*.	**Score 3.33**
Loaded RI Score: Loaded RI Score (Notched Score × Impact Level) is 3.33 out of 100.	**Score 3.33**

3.12. Temporary Externality-Driven Markets for Feedstock

Rationale: Alternative, non-traditional, externality-driven competitors for feedstock can drive feedstock demand (and cost) in unusual circumstances. For example, a Proponent using corn stover as a feedstock would not typically compete with the higher-end animal feed market. However, in times of significant hay shortage (e.g., during drought), farmers may use corn stover as hay replacement, driving the price of corn stover feedstock and decreasing its availability for bio-projects (Bergtold 2018). **Raw RI Score:** No non-traditional and externality-driven markets for feedstock were identified. Raw RI Score is 1 out of 10.	**Score** **1**
Notched Salience: No adjustments. De-risking measures are not necessary for risk indicators with Raw RI Scores of 1, as they are already the lowest risk.	**Score Unnotched 1.0**
Impact Level: Although we did not identify non-traditional and externality-driven markets for feedstock, the existence of such markets would be significant. RI Impact Level is deemed *moderate*.	**Score 6.66**
Loaded RI Score: Loaded RI Score (Notched Score × Impact Level) is 6.66 out of 100.	**Score 6.66**

3.13. Harvest and Collection Practices and Schedules

Rationale: Differences in harvest timing and practices can create a risk to both the quantity and quality of feedstock. For example, feedstock harvested by different suppliers in different windows can undergo different levels of exposure to sun, wind, and moisture, leading to variations in delivered feedstock quality. For example, agricultural feedstocks and energy crops have optimal harvesting windows to ensure minimal moisture content. In certain regions, these harvesting windows may coincide with heightened weather risks, such as frost or rain.	**Score**
Raw RI Score: Corn stover harvesting occurs for approximately six weeks in the fall and spring. The fall season is highly dependent on rainfall, and fields need to be dry to prevent soil compaction from harvesting equipment. Baling corn stover in the fall at high moisture content increases the risk of poor bale quality and spoiling during storage. Snow is prohibitive to baling, but once the snow has cleared, there is a second opportunity for baling in the spring when the corn stover has a lower moisture content, resulting in better quality bales. However, corn stover harvesting is highly weather dependent, with short and unpredictable harvesting windows in both described seasons. These factors increase the operational risk associated with corn stover aggregation in the region. Raw RI score is 9 out of 10.	**9**

Notched Salience: The involvement of an experienced third-party baling company who uses square balers or vertical integration within the bio project could significantly reduce RI 3.13. As a result, Raw RI Score is notched by 50%: Notched Salience is 4.5.	**Score Notched 4.5**
Impact Level: RI Impact Level is deemed *high*.	**Score 9.99**
Loaded RI Score: Loaded RI Score (Notched Score × Impact Level) is 44.96 out of 100.	**Score 44.96**

3.14. Harvesting and Collection Equipment

Rationale: Different types of harvesting and collection equipment used by suppliers can have a significant impact on the quality and availability of feedstock. The use of different types and combinations of harvesting, collection, and processing equipment among suppliers can lead to non-homogeneous feedstock. Equipment that is not designed specifically for biomass cultivation, harvesting, and collection can increase feedstock quality risks. Relevant equipment should be specified for the sake of product consistency and risk reduction.	**Score**
Raw RI Score: Square balers are prevalent in the region and becoming more prevalent as round balers are being replaced with square balers as old equipment is being decommissioned. As harvesting infrastructure is used for baling wheat straw and hay, it is often available during fall and spring harvesting windows, but tractor and labor availability may compete with other land management operations. Not all third-party harvesters and growers will be interested in baling corn stover as it is high wearing on the equipment. Investment in high-efficiency balers designed for baling biomass is necessary for the supply basin. Raw RI score is 8 out of 10.	**8**
Notched Salience: The high capital investment required for high-efficiency square balers makes it unlikely for local growers to invest in them for supplying a bio-plant in the BDO Zone. RI 3.14. can be significantly mitigated by involving an experienced third-party baling company or through vertical integration within the project. Additionally, a new corn stover processing plant could mitigate the risk associated with baling equipment ownership by purchasing its own equipment or financing growers to do so. As a result, Raw RI Score is notched by 50%: Notched Salience is 4.0.	**Score Notched 4.0**
Impact Level: RI Impact Level is deemed *high*.	**Score 9.99**
Loaded RI Score: Loaded RI Score (Notched Score × Impact Level) is 39.96 out of 100.	**Score 39.96**

3.15. Variation in Densification Methods among Different Suppliers

Rationale: The shape and density of the unit in which feedstock is supplied can impact feedstock cost and quality. Standard feedstock densification modes for biomass consist of round or square bales, pellets, cubes, chips, or grindings. Also, bales of different densities can absorb moisture at different rates. In certain cases, round bales have been viewed as problematic due to their uneven moisture content distribution (Huhnke 2018).	**Score**
Raw RI Score: The majority of the baling infrastructure in the supply basin are square balers as older round balers are replaced by square balers. The greatest variation in corn stover bale quality comes from moisture differences between fall and spring baling. Spring bales have lower moisture content and higher quality. Experienced third-party balers in the region indicated that fall baling resulted in poor-quality bales prone to falling apart. If growers invest in high-efficiency square balers (unlikely due to capital costs), it will improve the bale quality and reduce the variation in bale density between fall and spring baling. Raw RI Score is 9 out of 10.	**9**
Notched Salience: RI 3.15. can be significantly mitigated by involving an experienced third-party baling company or through vertical integration within the project. Additionally, a new corn stover processing plant could mitigate the risk associated with baling equipment ownership by purchasing its own equipment or financing growers to do so. As a result, Raw RI Score is notched by 50%: Notched Salience is 4.5	**Score Notched 4.5**
Impact Level: RI Impact Level is deemed *moderate*.	**Score 6.66**
Loaded RI Score: Loaded RI Score (Notched Score × Impact Level) is 29.97 out of 100.	**Score 29.97**

3.16. Availability of Labor for Feedstock Production

Rationale: Skilled labour shortages can be difficult to remedy in the short term. The availability of suitable labor regionally can impact the ability to procure sufficient feedstock quantities on schedule. Labour risks are higher for greenfield facilities where supply chains are not yet active; or for Proponents for whom large feedstock requirements or the development of new (or expanded) supply chains demand significant additions to the local labour force.	**Score**
Raw RI Score: Labor for corn stover collection and transportation is only required for a short period during the fall and spring harvest seasons. However, on-farm labor may be limited due to competing agricultural activities. The increase in demand for labor during the harvest season can be handled by transport and baling companies as this is a common dynamic in agricultural markets. Although a lack of market and an underdeveloped supply chain exists for corn stover, there is access to seasonal labour in Sarnia-Lambton County to overcome short-term labor demands. Locally new baler operators will need to be trained, fortunately, the Sarnia-Lambton County region has a strong college network that works closely with industry to train skilled labour. Raw RI score is 5 out of 10.	**5**

Notched Salience: All sub-risks in RI 3.16 could be significantly mitigated by outsourcing harvest and collection to a credible third-party baling company or by provision of similar services through a vertically integrated bio-project. As a result, Raw RI Score is notched by 50%: Notched Salience is 2.5.	**Score Notched 2.5**
Impact Level: RI Impact Level is deemed *moderate*.	**Score 6.66**
Loaded RI Score: Loaded RI Score (Notched Score × Impact Level) is 16.65 out of 100.	**Score 16.65**

3.17. Feedstock Transportation Costs

Rationale: Transportation is often one of the most significant cost components of biomass supply chains. The average transport cost and percentage of total feedstock cost attributable to transport should be known.	**Score**
Raw RI Score: We estimate that transportation costs will account for about 22-38% of total feedstock delivered costs. Given that a minor increase in average transport distance results in a significant expansion of the feedstock supply basin (see supply curves in Appendix B). Thus, the risk of rising transportation costs significantly impacting the delivered price of feedstock to be low. The raw RI Score is 3 out of 10.	**3**
Notched Salience: No adjustments. De-risking measures are not necessary for risk indicators with Raw RI Scores of 3, as they are already low risk.	**Score Unnotched 3.0**
Impact Level: RI Impact Level is deemed *high*.	**Score 9.99**
Loaded RI Score: Loaded RI Score (Notched Score × Impact Level) is 29.97 out of 100.	**Score 29.97**

3.18. Number, Size, Mix and Locations of Suppliers

Rationale: Generally, a supply portfolio involving multiple suppliers of various sizes (and from multiple regions) is important for ensuring steady and uninterrupted feedstock supplies with minimal price fluctuations. If a small number of large suppliers provides a high proportion of total feedstock, a disruption or supplier breach will have a greater impact on the supply chain. In such cases, the risk of disruption is lower, but the impact of those disruptions is higher. Conversely, a large number of small suppliers are less likely to have the capacity to withstand internal disruptions and thus may be more likely to breach. Here, the risk of disruption is higher, but its impact is lower. The number of suppliers, as well as the ratio of small to large suppliers, should be optimized. There is no pre-determined number or optimal ratio of suppliers, although having too many or too few can both pose higher degrees of risk.	**Score** **5**
Raw RI Score: Numerous potential feedstock suppliers are in the Sarnia-Lambton County BDO Zone, with the majority of field crop growers cultivating 500-1,000 acres and the largest growers cultivating 10,000-12,000 acres. This diversity in suppliers can help reduce feedstock risk, as isolated failures would not have a significant impact on the entire supply chain. However, coordinating feedstock	

supply chains of this size can be challenging, which contributes to a *moderate* level of risk for this raw risk indicator.

Raw RI Score is 5 out of 10.

Notched Salience: The large number of potential suppliers can make coordinating the supply chain potentially more complicated and costly. Because the number of suppliers could impact the interest and effectiveness of a third-party baling company as a mitigant to other RIs, Raw RI Score notched by 25%: Notched Salience is 3.75.	**Score Notched 3.75**
Impact Level: RI Impact Level is deemed *moderate*.	**Score 6.66**
Loaded RI Score: Loaded RI Score (Notched Score × Impact Level) is 24.98 out of 100.	**Score 24.98**

3.19. Suppliers Subject to Same External Risk Factors (Non-Weather and Equipment Based)

Rationale: When a single risk event can impact the feedstock production ability of all (or most) suppliers, then feedstock risk is higher and supply chain resiliency lower. Resilience is maximized when biomass supply chains exhibit diversity in spatial location (i.e., geography), production practices, and other elements of supply chain structure such that the impact of single high-risk events has varying impacts on suppliers.	**Score**
Raw RI Score: Corn stover suppliers face risks related to falling corn prices and increasing price of other oilseed crops such as soybean and canola, which may force growers to switch to other crops. Historically corn prices have been favorable. The raw RI Score is 6 out of 10.	**6**
Notched Salience: On-site bale inventories of more than 12 months can help to smooth out typical moderate fluctuations in corn stover supply. Farmers who enter supply contracts with a bio-project would consider their profit from corn stover in addition to primary corn generation. This additional income may keep corn planting competitive (in terms of farmer profit), even if other crops become marginally more valuable in certain years. As a result, Raw RI Score is notched by 50%: Notched Salience is 3.0	**Score Notched 3.0**
Impact Level: RI Impact Level is deemed *moderate*.	**Score 6.66**
Loaded RI Score: Loaded RI Score (Notched Score × Impact Level) is 19.98 out of 100.	**Score 19.98**

3.20. Seasonal Weather Impacts on Feedstock Supply

Rationale: Seasonal weather impacts are defined as deriving from natural weather variations (i.e., spring thaws, rainy seasons, or dry seasons) as opposed to singular weather events (like fires, droughts, or hurricanes). Seasonal weather changes can be a significant risk factor affecting feedstock availability, quality, and price. Given the major influence weather has on multiple aspects of growing, harvesting, and transporting biomass, it is difficult to predict the availability of biomass at a given location with a high degree of certainty. However, it is possible to generate reasonable upper/lower bound estimates of biomass	**Score**

production in any given year in a wider supply basin, using past data and statistical models. Such estimates are important in assessing feedstock risk and enable accurate assessment of the efficacy of Proponent's mitigation methods.	
Raw RI Score: Weather significantly impacts feedstock supply. Corn production, and thus corn stover availability, varies from yearly. Weather events may cause significant variations in yield, but the range of variance has been well-tracked and is represented by the 1-in-10-year low statistic. The statistic indicates that the Sarnia-Lambton County BDO Zone can expect a low of 131,1000 ODMT/yr of corn stover every ten years under the BDO feedstock availability assumptions. Fall rainfall and early winter snows can shorten the harvesting season, leaving less time for corn stover collection (growers prioritize grain collection over corn stover). Dry weather reduces the potential availability of corn stover because it reduces corn yields and because drier straw is more difficult to bale. Raw RI Score is 5 out of 10.	**5**
Notched Salience: Marginal cost increases due to longer transport distances; on-site bale inventories of more than 12 months; option agreements with redundant growers; and engagement of a credible third-party (or equivalent vertical integration of such service within a bio-project) to harvest/bale corn stover from redundant growers could help mitigate RI 3.20. As a result, Raw RI Score is notched by 50%: Notched Salience is 2.5.	**Score Notched 2.5**
Impact Level: In case where seasonal weather impacts cannot be effectively mitigated, the RI Impact Level is deemed *high*.	**Score 9.99**
Loaded RI Score: Loaded RI Score (Notched Score × Impact Level) is 24.98 out of 100.	**Score 24.98**

3.21. Long-Term Weather and Climate Trends

Rationale: In certain regions, climatic trends and significant potential changes to future weather patterns can create feedstock risk.	**Score**
Raw RI Score: Although precise forecasting is impossible, it is expected that regional temperatures will rise as a result of climate change. However, the proximity to Lake Huron is expected to result in only moderate warming. The same risks would exist in drier weather as in 3.20. Raw RI Score is 5 out of 10.	**5**
Notched Salience: Access to the corn stover outside the supply area in case of drought years could mitigate the risk. As a result, Raw RI Score is notched by 50%: Notched Salience is 2.50	**Score Notched 2.5**
Impact Level: In case where long-term weather and climate trends cannot be effectively mitigated, RI Impact Level is deemed *high*.	**Score 9.99**
Loaded RI Score: Loaded RI Score (Notched Score × Impact Level) is 24.98 out of 100.	**Score 24.98**

3.22. Risk of Infestation

Rationale: Risk of future infestation, including its estimated consequences on feedstock supply, should be calculated into the overall risk profile. Since insect populations are influenced by environmental conditions, future changes in climate can be expected to significantly alter the outbreak dynamics of certain insect species. In some cases, larger and more frequent insect outbreaks may occur, but in other cases recurring outbreaks may be disrupted or diminished.	**Score**
Raw RI Score: Ontario has a tremendous scouting and reporting system for pests and diseases. Being located north of the US is a tremendous advantage as infestations show up there first and local scouts can become vigilant. Early detection is a key measure for disease and pest prevention. In recent years Tar spot and corn Rootworm have been observed in Ontario. Risks can be higher with higher temperatures, potentially driven by changing climates. Raw RI Score is 4 out of 10.	**4**

Notched Salience: Early detection by the Ontario scouting system allows growers to respond and effectively reduce the risk of infestation. On-site bale inventories of more than 12 months can help to smooth out typical moderate fluctuations in straw supply. As a result, Raw RI Score is notched by 75%: Notched Salience is 1.0.	**Score Notched 1.0**
Impact Level: Disease outbreak can have a significant impact on the availability of corn stover due to corn crop failure. RI Impact Level is deemed *high*.	**Score 9.99**
Loaded RI Score: Loaded RI Score (Notched Score × Impact Level) is 9.99 out of 100.	**Score 9.99**

3.23. Risk of Extreme Weather Events—Hail, Flood, Drought, Hurricanes, Tornadoes, Strong Winds, and Extreme Low Temperature

Rationale: See BSCRS Standards RI 3.7.5 Risk of Hail; 3.7.6 Risk of Flood; 3.7.7 Risk of Drought; 3.7.8 Risk of Hurricanes, Tornadoes, Strong Winds; 3.9.7 Risk of Low Temperatures.	**Score**
Raw RI Score: Extreme weather events such has hail, flooding, and strong winds pose a limited. risk to corn stover availability in the Sarnia-Lambton County BDO Zone. Raw RI Score is 3 out of 10.	**3**

Notched Salience: No adjustments. De-risking measures are not necessary for risk indicators with Raw RI Scores of 3 or less, as they are already the lowest risk.	**Score Unnotched 3.0**
Impact Level: An extreme weather event can cause corn crop to fail. RI Impact Level is deemed *high*.	**Score 9.99**
Loaded RI Score: Loaded RI Score (Notched Score × Impact Level) is 29.97 out of 100.	**Score 29.97**

3.24. Government Subsidies for Feedstock Production or Utilization

Rationale: Feedstock directly subsidized though government programs can pose greater long-term risk than feedstock that is not. Subsidies may be subject to amendment or repeal, sometimes with minimal notice. NOTE: This risk indicator refers to direct feedstock subsidies only; it does not apply to government subsidies that pertain indirectly to the operations of the Proponent, such as Loan Guarantees, or to the markets for products produced by the Proponent.	**Score**
Raw RI Score: No government subsidies for feedstock exist currently, including corn. The raw RI Score is 1 out of 10.	**1**

Notched Salience: No adjustments. De-risking measures are not necessary for risk indicators with Raw RI Scores of 1, as they are already the lowest risk.	**Score Unnotched 1.0**
Impact Level: RI Impact Level is deemed *low*.	**Score 3.33**
Loaded RI Score: Loaded RI Score (Notched Score × Impact Level) is 3.33 out of 100.	**Score 3.33**

3.25. Local, Provincial, and National Laws, Regulations and Permitting Pertaining to Biomass

Rationale: Feedstock whose production is directly dependent on local, provincial/state, or national laws and government regulations can pose greater long-term risk than feedstock that is not, since laws and regulations may be subject to amendment or repeal. If biomass utilization requires specific permits (i.e., percentage removal of forest residues or corn stover, allowable cut limits, air emission, storage permits, rights-of-way, overweight permits for trucks, cross-border permitting for shipment of biomass, chain of custody, or certification of sustainability) then likelihood of obtaining such permits and/or complying with permitting requirements should be examined.	**Score** **1**
Raw RI Score: Corn stover supply is not governed by any laws, regulations, or permits issued by the government. Raw RI Score is 1 out of 10.	

Notched Salience: No adjustments. De-risking measures are not necessary for risk indicators with Raw RI Scores of 1, as they are already the lowest risk.	**Score Unnotched 1.0**
Impact Level: RI Impact Level is deemed *low*.	**Score 3.33**
Loaded RI Score: Loaded RI Score (Notched Score × Impact Level) is 3.33 out of 100.	**Score 3.33**

3.26. Backlash Against Biomass Development, Procurement or Usage in the Region

Rationale: Public backlash against biomass development in the Proponent region can directly impact Proponent's ability to procure, transport, trans-load, store, or utilize feedstock by affecting local policies, regulations, and the Proponent's ability to obtain necessary permitting.	**Score**
Raw RI Score: No backlash against biomass development is expected.	**1**
Raw RI Score is 1 out of 10.	
Notched Salience: No adjustments. De-risking measures are not necessary for risk indicators with Raw RI Scores of 1, as they are already the lowest risk.	**Score Unnotched 1.0**
Impact Level: RI Impact Level is deemed *low.*	**Score 3.33**
Loaded RI Score: Loaded RI Score (Notched Score × Impact Level) is 3.33 out of 100.	**Score 3.33**

3.27. Consent of, and Co-Operation With, Indigenous Communities and First Nations

Rationale: Where new project development is on or near Indigenous or First Nation land, or when Indigenous or First Nations exert influence over feedstock producing areas, consent of, and co-operation with, Indigenous communities and First Nations decreases the Proponent's risk.	**Score**
Raw RI Score: No Indigenous communities that would be impacted by corn stover production or procurement were identified in the supply basin.	**1**
Raw RI Score is 1 out of 10.	
Notched Salience: No adjustments. De-risking measures are not necessary for risk indicators with Raw RI Scores of 1, as they are already the lowest risk.	**Score Unnotched 1.0**
Impact Level: RI Impact Level is deemed *low*	**Score 3.33**
Loaded RI Score: Loaded RI Score (Notched Score × Impact Level) is 3.33 out of 100.	**Score 3.33**

3.28. Feedstock Sustainability, Including Risks to Soil Quality and Surface and Ground Waters

Rationale: Understanding a project's overall emissions and carbon intensity throughout the feedstock supply chain is essential to reducing risks related to carbon pricing mechanisms and related regulations.	**Score**
GHG emissions from production, harvest, and transportation can pose significant challenges to Proponent claims of carbon neutrality for biomass projects. Carbon emissions from harvested soils, as well as emissions from harvesting machinery or delivery trucks, can make the achievement of net-zero difficult. If a Proponent's financial model relies on carbon neutrality/GHG regulatory pricing frameworks, then an investigation into the feedstock's carbon emission status is essential.	

Raw RI Score:

The removal of corn stover for bioprocessing has the potential to reduce the GHG emissions of corn production in Ontario by lowering the nitrogen application rate needed to produce corn. A regional study of the GHG intensity of corn production in Ontario found that emissions of 79 kg of CO2/ton dry matter were associated with corn stover production[4].

The timing of corn stover harvest in the fall creates a high risk of soil compaction, which can lead to a yield loss of 3 bushels per acre on the following soybean crop. Farmer participation rate is estimated to be 20%.

Growers can rely on tillage reduction practices, crop rotation involving at least three cultivars over a 4-to-5-year period, the use of ground cover through the overwintering period, soil testing for nutrients and organic matter, use of 4R-certified crop consultants for fertilization advice, and the actual stover removal rate to ensure both soil health and sustainability parameters are achieved. In practice, several BMPs are used simultaneously to produce a crop.

The certification schemes (SAI, ISCC and Field to Market) rely on overall scores based on multiple criteria from field agronomics, fertilization, labor, health & safety etc. For example, plowing a field to address a specific field issue would not be penalized; changing practices to more environmentally friendly ones would add to the score. Each criterion is scored separately, and a sample of farms are subject to audit each year where farm records are verified. There is no pass/fail for any criteria, simply a lower score that affects the final carbon calculation for the farm. Each end-user client can specify the criteria for their use.

Indirect Land Use Change (iLUC) is a standardized criterion across schemes. In practice, auditors use a one-acre threshold to determine if a change has occurred. In some circumstances, a land conversion greater than one acre can be acceptable if the farmer has proof that it was previously in agriculture and that the conversion would not have biodiversity issues. Proof that the land was in agriculture before 2008 is done using Agricorp records.

AGRIS has been providing advice and collecting data from growers for several years. Their experience has been most positive. Farmers appreciate being able to tell their story through a certification program, as most have done sustainable practices. The need to subscribe to the sustainability program is growing and requires a one-on-one farm visit to explain how it works. Once farmers realize it is not a pass/fail system, they are agreeable to participate.

Extending the use of these certification systems to a corn stover harvest would not limit participation for a stover harvest as many of the criteria will be similar.

Raw RI Score is 1 out of 10.

Notched Salience: Optimizing harvesting logistics to reduce soil compaction and paying farmers adequate margins on corn stover to cover potential yield losses should reduce risk. As a result, Raw RI Score is notched by 50%: Notched Salience is 4.5.	**Score Notched 4.5**
Impact Level: Despite mitigation farmers may still not be willing to take the risk to participate in corn stover removal. RI Impact Level is deemed *high*	**Score 9.99**

[4] Jayasundara, S., Wagner-Riddle, C., Dias, G., & Kariyapperuma, K. A. (2012). Energy and greenhouse gas intensity of corn (Zea mays L.) production in Ontario: A regional assessment. Journal of Sustainable Agriculture, 36(6), 641-659.

Loaded RI Score: Loaded RI Score (Notched Score × Impact Level) is 44.96 out of 100.	**Score 44.96**

3.29. Geographic Location Influence on Feedstock Variability

Rationale Feedstock from different regions may differ in quality due to variations in soil quality, topography, harvest practices, weather, fertilizer applied, etc.	**Score**
Raw RI Score: There should be no significant variation in feedstock quality from feedstock harvested within the BDO Zone. Raw RI Score is 1 out of 10.	**1**
Notched Salience: No adjustments. De-risking measures are not necessary for risk indicators with Raw RI Scores of 1, as they are already the lowest risk.	**Score Unnotched 1.0**
Impact Level: Feedstock quality will likely be important to a new corn stover processing project. RI Impact Level is deemed *high*.	**Score 9.99**
Loaded RI Score: Loaded RI Score (Notched Score × Impact Level) is 9.99 out of 100.	**Score 9.99**

3.30. Capacity of Supply Chain Components and Equipment to Scale

Rationale: Scale-up risk increases if supply chain components or underlying feedstock infrastructure necessary for these components cannot scale to handle Proponent feedstock requirements and throughput capacity. Capacity to scale should be demonstrated**.**	**Score**
Raw RI Score: The supply basin has the adequate baling capacity, but to ensure adequate bale quality and supply, large-scale investment in high-efficiency square balers is required to bale corn stover. However, it is unlikely that growers will make such investments due to the high capital costs involved. There is a high risk that baling equipment would not scale, especially in the short term. Labour availability may be an issue as well, as discussed above. Raw RI Score is 8 out of 10.	**8**
Notched Salience: RI 3.30 could be moderately mitigated by outsourcing harvest and collection to a credible third-party baling company or by vertically integrating in the bio-project. As a result, Raw RI Score is notched by 50%: Notched Salience is 4.0.	**Score Notched 4.0**
Impact Level: Baling is necessary to collect and transport corn stover. RI Impact Level is deemed *high*.	**Score 9.99**
Loaded RI Score: Loaded RI Score (Notched Score × Impact Level) is 39.96 out of 100.	**Score 39.96**

Category 4.0: Infrastructure Risks

4.1 Risk Factor: Physical Infrastructure

4.1.1 Land Parcel

Raw RI Score: There is suitable land available in varying parcel sizes within existing industrial parks that include brownfield and greenfield development opportunities. Target area existing industrial parks include Bio-Industrial Park Sarnia-Lambton County, Bluewater Energy Park, and St. Clair Industrial Park. Raw RI Score is 1 out of 10.	**Score 1**
Notched Salience: No adjustment.	**Score Unnotched**
Impact Level: RI Impact level is deemed *low*.	**Score 3.33**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 3.33.	**Score 3.33**

4.1.2 City Ownership

Raw RI Score: The city owns the three sites referenced above and has a history of supporting new development. Raw RI Score is 1 out of 10.	**Score 1**
Notched Salience: No adjustment.	**Score Unnotched**
Impact Level: RI Impact level is deemed *low.*	**Score 3.33**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 3.33.	**Score 3.33**

4.1.3 Industrial Land Use Zone

Raw RI Score: Approved land use and zoning within existing industrial parks is in place for medium and heavy industrial development. Raw RI Score is 2 out of 10.	**Score 2**
Notched Salience: No adjustment.	**Score Unnotched**
Impact Level: RI Impact level is deemed *low.*	**Score 3.33**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 6.66.	**Score 6.66**

4.1.4 Natural Gas Line

Raw RI Score: Lambton County has an extensive network of natural gas storage facilities and distribution network sufficient to supply new industrial development. Raw RI Score is 2 out of 10.	**Score 2**
Notched Salience: No adjustment.	**Score Unnotched**
Impact Level: RI Impact level is deemed *low.*	**Score 3.33**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 6.66.	**Score 6.66**

4.1.5 Electrical

Raw RI Score: Lambton County has an extensive network of electrical distribution systems sufficient to supply new industrial development. Raw RI Score is 2 out of 10.	**Score 2**
Notched Salience: No adjustment.	**Score Unnotched**
Impact Level: RI Impact level is deemed *low.*	**Score 3.33**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 6.66.	**Score 6.66**

4.1.6 Fresh Water Supply

Raw RI Score: Potable and raw water is available and specifically where there are brownfield sites, existing water permits are in place. Raw RI Score is 2 out of 10.	**Score 2**
Notched Salience: No adjustment.	**Score Unnotched**
Impact Level: RI Impact level is deemed *low.*	**Score 3.33**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 6.66.	**Score 6.66**

4.1.7 Sewage Disposal Trunk Line

Raw RI Score: Sanitary sewage treatment facilities are located throughout Sarnia-Lambton County 11 municipalities. Industrial operations that generate unacceptable contaminants are required to pretreat such waste before putting the effluent into the municipal sewer system. Raw RI Score is 2 out of 10.	**Score 2**
Notched Salience: No adjustment.	**Score Unnotched**
Impact Level: RI Impact level is deemed low.	**Score**

	3.33
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 6.66.	**Score 6.66**

4.1.8 Drainage and Stormwater Management

Raw RI Score: Land and subdivision drainage systems are built into existing brownfield developments. Greenfield developments will require stormwater drainage infrastructure to be developed in accordance with master drainage plans in place. Raw RI Score is 3 out of 10.	**Score 3**
Notched Salience: No adjustment.	**Score Unnotched**
Impact Level: RI Impact level is deemed *low.*	**Score 3.33**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 9.99.	**Score 9.99**

4.1.9 Available ICT (Information & Communication Technology) Services

Raw RI Score: Full ICT services are available in the target areas for industrial development, which can be tailored to the needs of individual industries. Raw RI Score is 2 out of 10.	**Score 2**
Notched Salience: No adjustment.	**Score Unnotched**
Impact Level: RI Impact level is deemed *low.*	**Score 3.33**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 6.66.	**Score 6.66**

4.1.10 Infrastructure – Landfill/Alternative Markets for Waste Disposal

Raw RI Score: Solid waste disposal facilities are located within the region, including a toxic/hazardous waste facility. Industry is responsible for their solid waste management including hauling to waste disposal facilities. Raw RI Score is 2 out of 10.	**Score 2**
Notched Salience: No adjustment.	**Score Unnotched**
Impact Level: RI Impact level is deemed *low.*	**Score 3.33**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 6.66.	**Score 6.66**

4.2 Risk Factor: Logistics

4.2.1 Road and Highway Access and Intersection

Raw RI Score: Sarnia-Lambton County is served by a network of highways that connects the region to the Great Lakes industrial corridor, the southern United States, and Mexico. Raw RI Score is 2 out of 10.	**Score 2**
Notched Salience: No adjustment.	**Score Unnotched**
Impact Level: RI Impact level is deemed *low.*	**Score 3.33**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 6.66.	**Score 6.66**

4.2.2 Ocean/River Access

Raw RI Score: The Sarnia Harbour is owned by the City of Sarnia, and the Port of Sarnia encompasses a large geographical area, which includes various communities and private facilities as well as the Public Port Facility. Raw RI Score is 2 out of 10.	**Score 2**
Notched Salience: No adjustment.	**Score Unnotched**
Impact Level: RI Impact level is deemed *low.*	**Score 3.33**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 6.66.	**Score 6.66**

4.2.3 Railway Service

Raw RI Score: Rail service is available by both Canadian National (CN) North America and CSX Transportation. Raw RI Score is 1 out of 10.	**Score 1**
Notched Salience: No adjustment.	**Score Unnotched**
Impact Level: RI Impact level is deemed *low.*	**Score 3.33**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 3.33.	**Score 3.33**

4.2.4 Accessibility to Airport

Raw RI Score: Sarnia Chris Hadfield Airport is a certified facility that is roughly five kilometres (three miles) east of Sarnia's city core. It offers direct access to Highway 402 and provides commuter links to Pearson International Airport in Toronto. Raw RI Score is 3 out of 10.	**Score 3**
Notched Salience: No adjustment.	**Score**

	Unnotched
Impact Level: RI Impact level is deemed *low.*	**Score 3.33**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 9.99.	**Score 9.99**

4.3 Risk Factor: Social Infrastructure

4.3.1 Healthcare Facilities

Raw RI Score: Bluewater Health provides a full range of healthcare services, and the region has an active physician recruitment program in place. Bluewater Health, with locations in Sarnia and Petrolia, cares for the approximately 131 000 residents of Sarnia-Lambton. With close to 2500, Professional Staff and volunteers, Bluewater Health provides an array of specialized acute care, complex continuing care, and allied health and ambulatory care services. Raw RI Score is 2 out of 10.	**Score 2**
Notched Salience: No adjustment.	**Score Unnotched**
Impact Level: RI Impact level is deemed *low.*	**Score 3.33**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 6.66.	**Score 6.66**

4.3.2 Educational Facilities

Raw RI Score: There is a full range of education institutions and programs available in the region. Lambton College specifically has been instrumental in supporting industry through tailored programs as needed. Raw RI Score is 2 out of 10.	**Score 2**
Notched Salience: No adjustment.	**Score Unnotched**
Impact Level: RI Impact level is deemed *low.*	**Score 3.33**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 6.66.	**Score 6.66**

4.3.3 Transportation Facilities

Raw RI Score: Sarnia-Lambton is served by a network of highways that connects the region to the Great Lakes industrial corridor, the southern United States, and Mexico. The Sarnia Harbour is owned by the City of Sarnia, and the Port of Sarnia encompasses a large geographical area, including various communities and private facilities as well as the Public Port Facility. Sarnia Chris Hadfield Airport is a certified facility that is roughly five kilometres (three miles) east of Sarnia's city core, offers direct access to Highway 402 and provides commuter links to Pearson International Airport in Toronto. Rail service is available by both Canadian National (CN) North America and CSX Transportation. Raw RI Score is 2 out of 10.	**Score** **2**
Notched Salience: No adjustment.	**Score** **Unnotched**
Impact Level: RI Impact level is deemed *low.*	**Score** **3.33**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 6.66.	**Score** **6.66**

4.3.4 Recreational Facilities

Raw RI Score: There is a wide variety of recreational and cultural amenities throughout the County of Lambton and in the City of Sarnia, including art galleries and museums, theatre and film, music and festivals, parks and recreation and tourism. Raw RI Score is 2 out of 10.	**Score** **2**
Notched Salience: No adjustment.	**Score** **Unnotched**
Impact Level: RI Impact level is deemed *low.*	**Score** **3.33**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 6.66.	**Score** **6.66**

4.3.5 Cultural Facilities

Raw RI Score: There is a wide variety of recreational and cultural amenities throughout the County of Lambton and in the City of Sarnia, including art galleries and museums, theatre and film, music and festivals, parks and recreation and tourism. Raw RI Score is 2 out of 10.	**Score** **2**
Notched Salience: No adjustment.	**Score** **Unnotched**
Impact Level: RI Impact level is deemed *low.*	**Score** **3.33**

Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 6.66.	**Score 6.66**

4.3.6. Public Safety Facilities

Raw RI Score: According to the Canada Crime Index, the overall Crime Severity Index for Sarnia is 90.1, which is consistent with the national average. Raw RI Score is 3 out of 10.	**Score 3**
Notched Salience: No adjustment.	**Score Unnotched**
Impact Level: RI Impact level is deemed *low.*	**Score 3.33**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 9.99.	**Score 9.99**

4.3.7 Housing

Raw RI Score: A wide variety of housing (rental and ownership) is available within Sarnia-Lambton. According to the Sarnia-Lambton Real Estate Board, the average price of homes sold in February 2023 was $487,089, a decrease of 17.3% from February 2022. Active residential listings numbered 290 units on the market at the end of February, more than double the levels from a year earlier, increasing 326.5% from the end of February 2022. Active listings were 64.6% above the five-year average and 9.6% above the 10-year average for the month of February. Raw RI Score is 2 out of 10.	**Score 2**
Notched Salience: No adjustment.	**Score Unnotched**
Impact Level: RI Impact level is deemed *low.*	**Score 3.33**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 6.66.	**Score 6.66**

4.4 Risk Factor: Workforce and Permitting

4.4.1 Labour Availability

Raw RI Score: There is a strong labor market for new industrial development. A growing challenge is the aging trades workforce with less people entering skilled trades training. Unskilled labor is available in retail trade and construction. Sarnia-Lambton County demonstrates a labour force of 63,049 with 59,228 total employees. In 2022, leading industries were health care, retail trade, manufacturing, and construction. 19.45% of the labor force is employed in trades, transport, equipment operators and related occupations. 5,352 jobs in construction alone existed in 2022. Raw RI Score is 3 out of 10.	**Score 3**
Notched Salience: No adjustment.	**Score Unnotched**
Impact Level: RI Impact level is deemed *low.*	**Score**

	3.33
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 9.99.	**Score 9.99**

4.4.2 Labour Cost

Raw RI Score: The federal minimum wage rate in Ontario is $14.50 per hour. According to Statistics Canada, the average employment income in 2020 for full-year full-time workers was $82,300 and median employment income was $68,000. Raw RI Score is 3 out of 10.	**Score 3**
Notched Salience: No adjustment.	**Score Unnotched**
Impact Level: RI Impact level is deemed *low.*	**Score 3.33**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 9.99.	**Score 9.99**

4.4.3 Training Programs / Community College

Raw RI Score: There is a full range of education institutions and programs available in the region. Lambton College specifically has been instrumental in supporting the industry through tailored programs as needed. Raw RI Score is 2 out of 10.	**Score 2**
Notched Salience: No adjustment.	**Score Unnotched**
Impact Level: RI Impact level is deemed *low.*	**Score 3.33**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 6.66.	**Score 6.66**

4.4.4 Permit Process

Raw RI Score: Permitting process is well described on the Sarnia Lambton Municipal Website. The city has a history of welcoming economic development and supporting timely processing. Raw RI Score is 2 out of 10.	**Score 2**
Notched Salience: No adjustment.	**Score Unnotched**
Impact Level: RI Impact level is deemed *low.*	**Score 3.33**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 6.66.	**Score 6.66**

APPENDIX B: BACKGROUND RESEARCH

This appendix serves as a corn stover availability background study to the BDO Zone Risk Rating for Sarnia-Lambton County, ON.

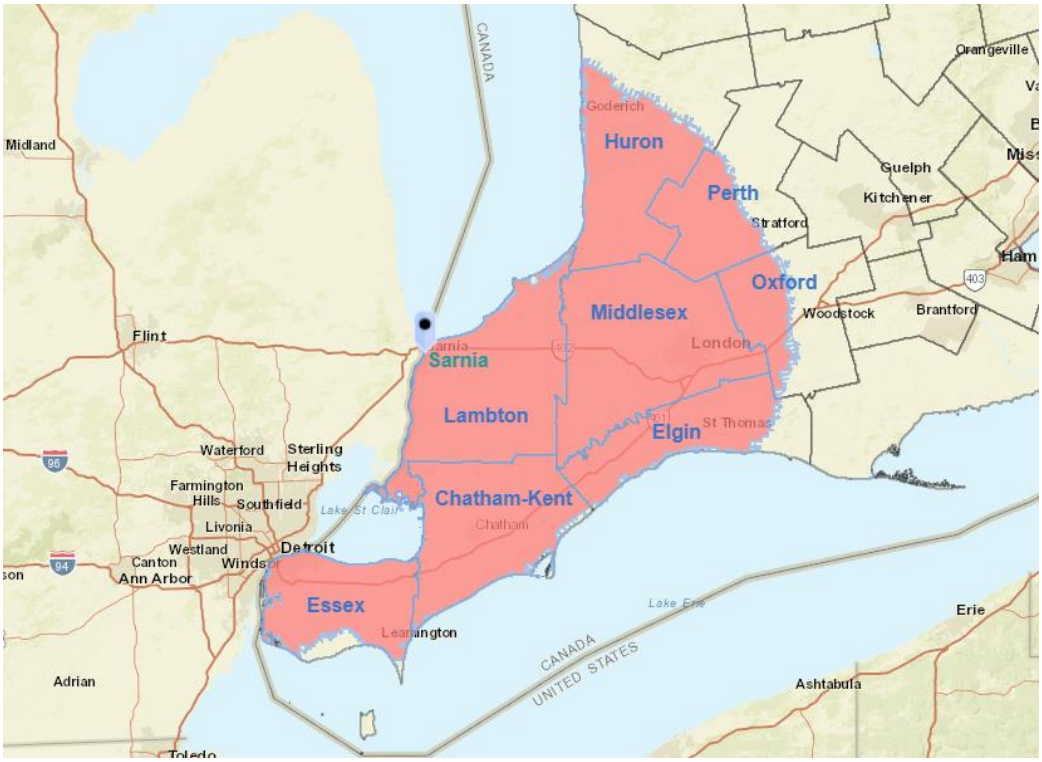
BACKGROUND RESEARCH AND ASSUMPTIONS

Study Region

The BDO Zone is defined as a 140 km drive distance from Sarnia, ON (Map 1). We have considered corn stover availability from Canadian soil only in our estimates. Currently, the phytosanitary requirement for corn stover sourced and transported to Canada from the United States is that any soil contamination be returned after processing. The costs and logistics of this may be prohibitive and given the abundance of corn stover in Southern Ontario and minimal feedstock competition, the risk profile of the BDO Zone is significantly improved by limiting availability to Canadian soil.

To investigate competing markets, we researched an area equal to 280 km drive distance from Sarnia (double the BDO Zone). We did not identify any large-scale users of corn stover within that area. There is little livestock farming in the region other than cattle feedlots that do not consume Corn stover. It is estimated that less than 1% of corn stover generated in the supply basin is consumed by animal bedding.

Map 1: Feedstock supply basin



Current Demand

Presently no large-scale facilities consuming corn stover exist within the 280 km Competition Zone. There is little livestock farming in the region other than cattle feedlots that do not consume corn stover. It is estimated that less than 1% of corn stover generated in the supply basin is consumed by animal bedding. Therefore, based on our assumptions, 99% of generated corn stover is currently unused and potentially available to new buyers.

Assumptions

Potential Corn stover Availability

We utilized two approaches to determine the potential availability of corn stover in the region. Potential (as opposed to actual) corn stover availability is the amount of corn stover that could be acquired from the supply basin. It does not consider the availability of equipment or other variables related to infrastructure that could affect actual availability. These variables are discussed later.

Approach 1: Theoretical Model

To estimate the theoretical potential availability of corn stover, we used 5-year corn acreage by yield grouping data from Agricorp. Yield determines the sustainable removal rate of corn stover and therefore is a key variable used to determine its availability. Yields below 150bu/acre are not feasible for corn stover removal. Sustainable removal by yield grouping is derived from commercial experience with corn stover baling.

Yield Grouping (bu/acre)		150-160	160-170	170-180	180-190	190-200	200+
Stover	Removal (15.5% MC)	1	1.2	1.4	1.6	1.8	2

Assumptions:

- Corn stover removal is not feasible for yields lower than 150 bushels/ac.
- The total corn stover that could be potentially acquired makes up between 30% and 46% of corn yield by weight.
- A moisture content of 15.5%

Approach 2: Outreach to Growers and Transport Companies in Adjacent Areas

To determine growers' willingness to supply corn stover and to confirm corn stover potential availability, assumptions based on previous studies in the Supply Zone have been considered.

Growers tend to provide estimates based on the bale and acre unit. For example, the price of corn stover paid for by cattle feedlots is calculated per bale.

Limitations to our methodology:

There are two main assumptions exist within the methodology:

1) Given fair corn stover prices, growers will be willing to supply;
2) Once the biomass facility is commissioned and the price of the corn stover becomes attractive, and the supply chain develops, participation levels will increase.

Since large-scale markets for corn stover do not presently exist, farmers may be underestimating potential problems (such as twine left in the fields) and the effort it takes to collect and bale corn stover. Faced with the realities of actual corn stover supply, some growers may decline to participate.

Alternatively, growers who indicated that they are currently not interested in supplying may change their minds and supply once the Project demonstrates that it is a serious buyer and that corn stover can be a significant source of income. Additionally, growers with negative experience in supplying straw for the cattle bedding market (for example, uneven demand or problems with twine left in the fields) might be initially reluctant to supply. However, this could change once a project demonstrates it is a reliable and profitable corn stover buyer.

1-in-10-Year Low

Corn production, and therefore corn stover potential availability, varies from year to year. 1-in-10-year low corn yield statistics are available from BIMAT.

Corn Stover & Transportation Cost

As there is no established market for corn stover, it is difficult to determine market prices. However, there is a small animal bedding market for corn stover estimated to be less than 1% of all potential corn stover production. The bedding market is primarily made up of growers baling corn stover for their own animal bedding needs, which makes it difficult to establish an accurate market price.

No index that tracks the price of corn stover in the region exists, and for these reasons, we estimate price based on regional costing studies and grower feedback.

Limitations: When interpreting prices verbally indicated by farmers, two limitations should be considered:

- Farmers provide 'ask' prices. In regular markets, ask prices tend to be higher than the market price as sellers attempt to raise prices. Therefore, reported 'ask' prices tend to overestimate the actual price.

- With high demand for feedstock, price can increase significantly. Farmers base their price indications on variables such as the cost of replacing fertilizer, the cost of baling, and the current market price for bedding straw. Once a large-scale facility significantly increases demand for straw, farmers may increase prices[5].

Tables 3 and 4 show cost calculations developed by the University of Guelph for corn growers in the region. Originally prices were calculated at 15.5% moisture content. We converted these prices to ODMT for consistency.

Material cost: The material cost of corn stover paid to farmers is impacted by the risk of soil compaction, which can result in a yield loss of up to 3 bushels per acre on the following soybean rotation. Therefore, the material cost range for corn stover in the BDO Zone is estimated to be $15-25/ODMT.

Farm-gate cost: The farm gate cost for corn stover includes expenses such as material baling, collection, and stacking. Based on a cost calculation template developed by the University of Guelph for corn stover in Southern Ontario and augmented by grower feedback, the farm-gate cost is estimated to range between $60-80 per ODMT.

Transport Cost: The transport cost is calculated for an average travel distance of 100km and includes the cost of loading and unloading. Based on a cost calculation template developed by the University of Guelph for corn stover in Southern

[5] One way to mitigate price increases due to increased demand is through fixed-price contracts. At this point, however, we do not know whether farmers would be open to such agreements.

Ontario and supplemented feedback from transportation companies, transportation cost is estimated to range between $25-35 per ODMT. The marginal cost to travel an extra km is $0.03/ODMT.

Table 3: Calculated costs. Prices per ODMT

	Low	High	Average
Material Cost ($/ODMT)	$15	$25	$20
Farm-gate Cost ($/ODMT)	$60	$80	$70
Transport Cost ($/ODMT)	$25	$35	$30
Total Cost ($/ODMT)	$100	$140	$120

Wheat Straw as a Mitigation Strategy to Increase Farmer Participation Rate

Corn, soybeans, and winter wheat are all grown in the BDO supply zone. It has been difficult to obtain high corn stover participation rates in previously proposed projects due to factors such as a short planting season, drought, poor market conditions that can significantly reduce the planted corn acreage, and the potential for compaction of the soil. In addition to other mitigation strategies outlined in the report, low confirmed participation rates for proposed corn stover projects could be mitigated by encouraging a mix of soybean and winter wheat production. Wheat uses the same types of balers for gathering wheat straw as used for corn stover, using even less equipment.

Note: Bioproducts facilities would not be able to utilize both wheat straw and corn stover at the same time, requiring the wheat straw to go to existing markets (animal bedding) and/or other types of bioproducts facilities that use wheat straw.

Charts and Tables

The following are charts and tables with results from research conducted for the purposes of this BDO Zone development.

Figure 1. Theoretical availability of corn stover at 20% participation rate and 1.2x redundancy

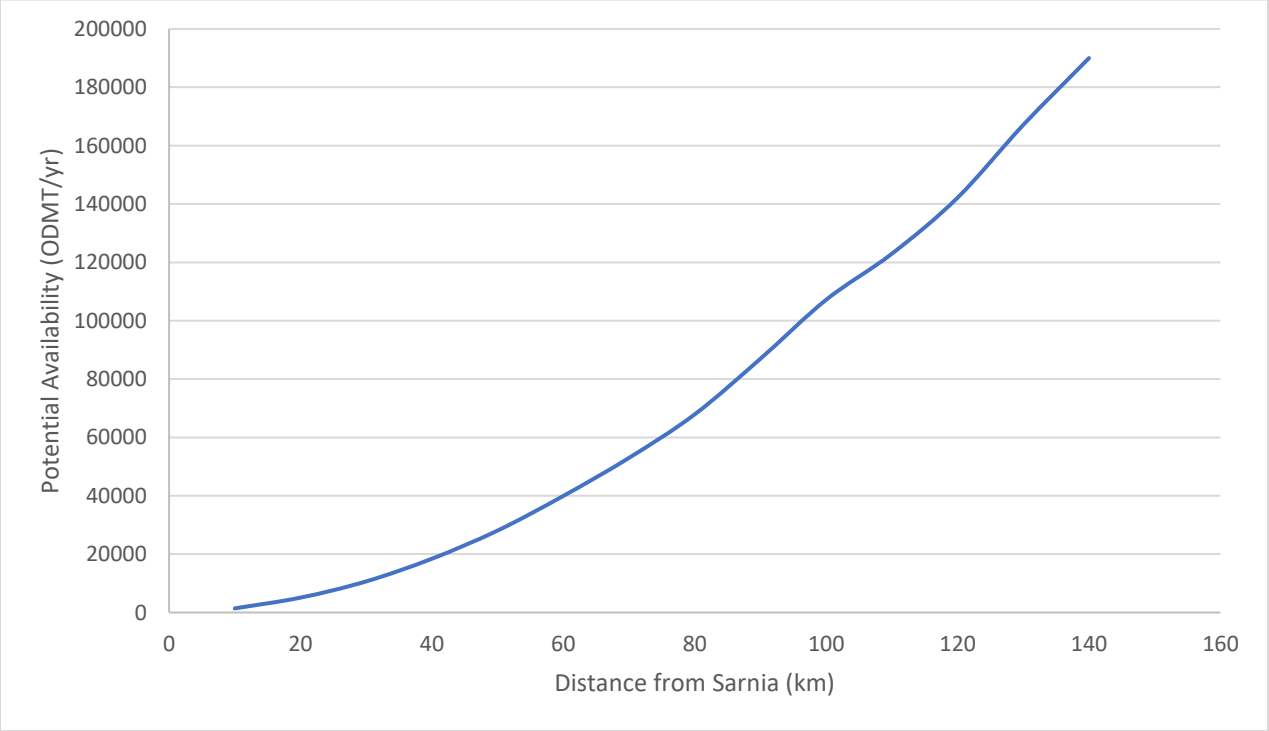


Figure 2. Historical corn production in Southern Ontario, 2004 – 2021

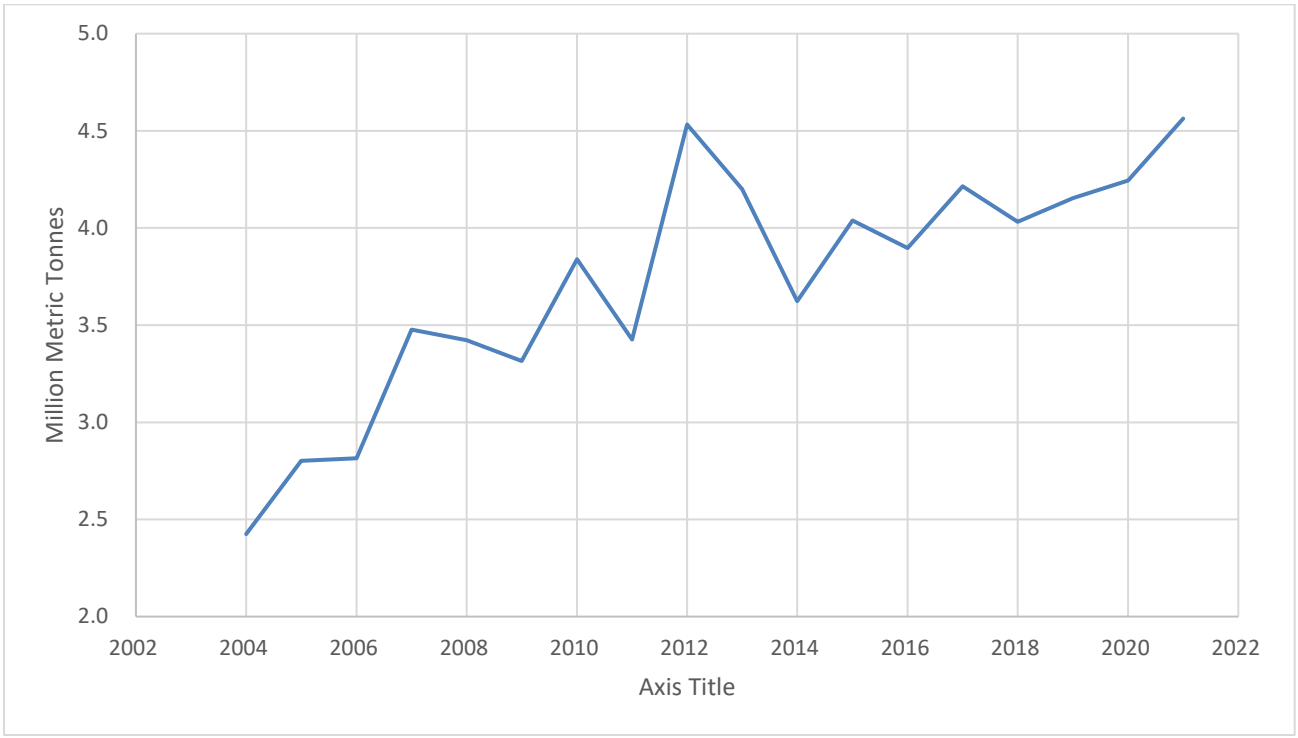


Figure 3. Historical area of corn seeded and harvested in Southern Ontario, 2004-2021

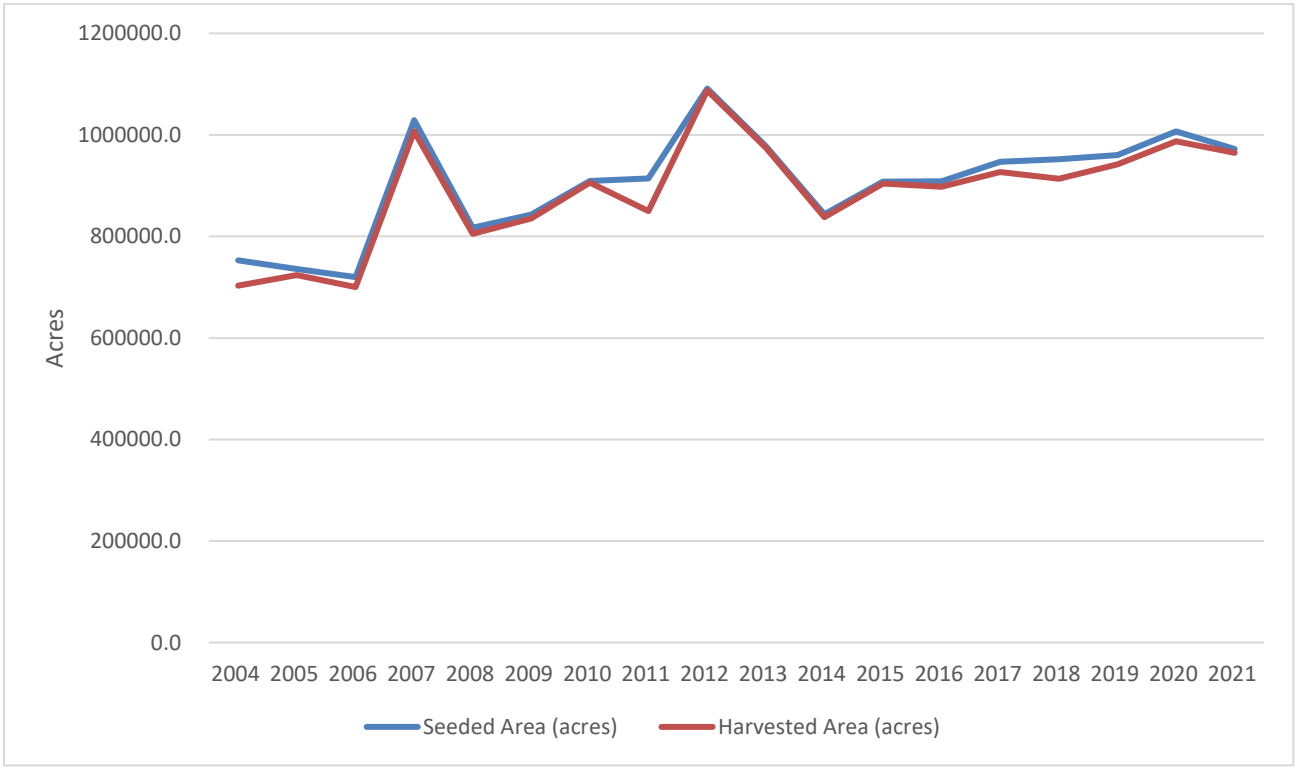


Figure 4. Historical corn yield in Southern Ontario, 2004-2021

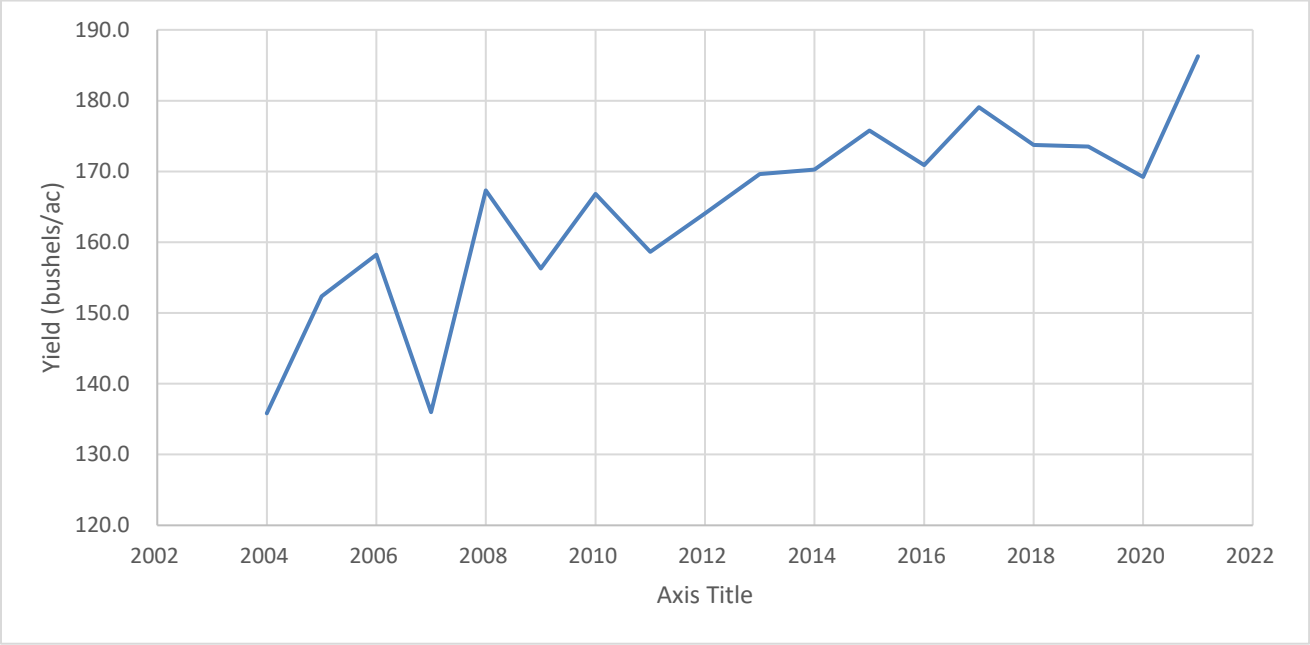


Figure 5. Historical Diesel Price for Southern Ontario

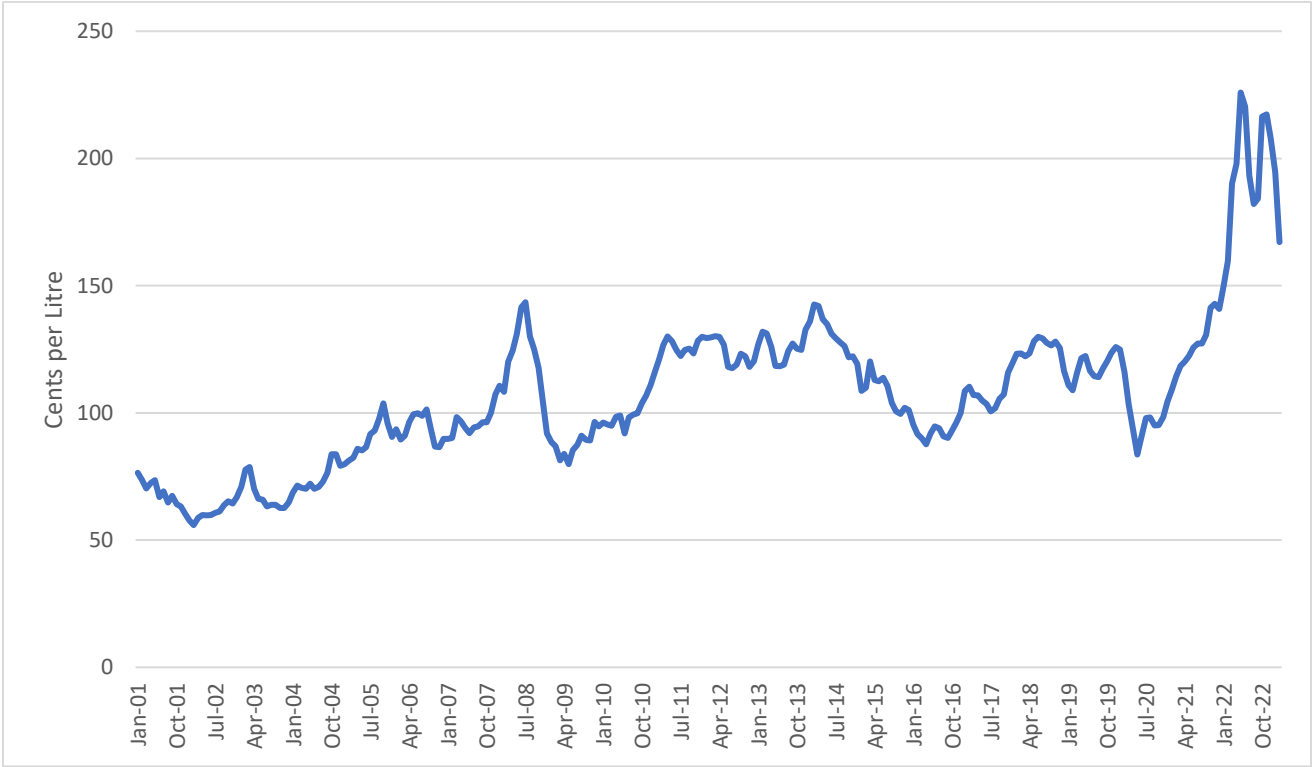
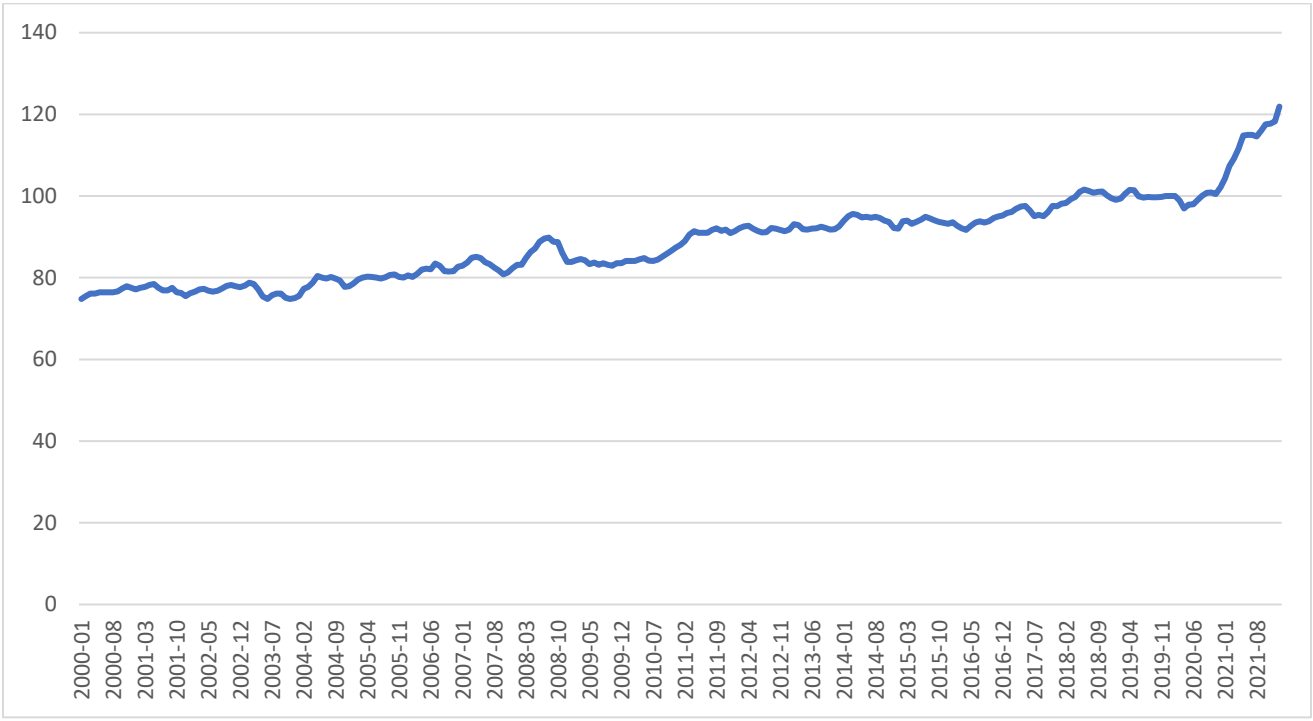


Figure 6. Historical Industrial Product Price Index (IPPI), 2000 - 2021



APPENDIX C: INFRASTRUCTURE

Location

The Sarnia Lambton Economic Partnership (SLEP) is a collaboration of 11 municipalities that are working together to attract industry, and the primary target for new industrial development is the City of Sarnia and St. Clair Township. Sarnia-Lambton is in the Canadian province of Ontario in the geographical region known as Southwestern Ontario. The community is located on the Canada / United States border within an approximately one-hour drive of major cities like Windsor and London, Ontario as well as Detroit, Michigan and approximately three hours from the Greater Toronto Area. The community is located on the shores of Lake Huron, one of the Great Lakes, a source of ample fresh water which helps moderate temperatures year-round. The largest of the 11 municipalities in Lambton County is the City of Sarnia. Sarnia-Lambton is directly connected to the State of Michigan via several border crossings, including the Blue Water Bridge. The area is also an official Foreign Trade Zone (FTZ) Point, which grows the area as a hub for international trade and investment and strengthens market access for existing businesses.

Most of the available information is accessible through the SLEP Sarnia-Lambton Economic Partnership (sarnialambton.on.ca)

Population

Sarnia Lambton demonstrates a total population of 131,583 with a strong educational attainment showing 85.94% of the population with Grade 12 education or higher.Municipal Data & Statistics - Sarnia-Lambton Economic Partnership (sarnialambton.on.ca)

Employment

Sarnia Lambton demonstrates a labour force of 63,049 with 59,228 total employees. In 2022, leading industries were health care, retail trade, manufacturing, and construction. Municipal Data & Statistics - Sarnia-Lambton Economic Partnership (sarnialambton.on.ca)

Land and Industrial Land Use

There is suitable land available in varying parcel sizes within existing industrial parks that include brownfield and greenfield development opportunities. Brownfield development opportunities include completed environmental assessments. The City of Sarnia has no development incentives, and St. Clair is open to discussion about development incentives. Existing industrial parks include Bio-Industrial Park Sarnia, Bluewater Energy Park, and St. Clair Industrial Park. Developed industrial lots are serviced with sufficient infrastructure servicing capacity identified.

Bio-Industrial Park Sarnia - Sarnia-Lambton Economic Partnership (sarnialambton.on.ca)

Bluewater Energy Park - Sarnia-Lambton Economic Partnership (sarnialambton.on.ca)

St. Clair Industrial Park - Sarnia-Lambton Economic Partnership (sarnialambton.on.ca)

Property Search & Analysis - Sarnia-Lambton Economic Partnership (sarnialambton.on.ca)

Water

The ***Lambton Area Water Supply System (LAWSS)*** provides approximately 90% of Sarnia-Lambton residents with drinking water. The plant draws water from the head of the St. Clair River in the Village of Point Edward. The Ontario Clean Water Agency provides, under contract to the Lambton Area Water Supply System, operational services to maintain the system infrastructure and regulatory compliance.

- Maximum rated capacity of 182,000 m^3/day
- Peak daily capacity in 2014 was less than 64,352 m^3/ day or 943.5 L/sec.
- 250 km of water main of various sizes and materials
- Three standpipes, one elevated tower
- Two booster stations with a combined storage capacity of 90,000 m3

The Town of Petrolia owns the Petrolia Bright's Grove Water Treatment Plant, which is operated by Ontario Clean Water Agency (OCWA). The system provides Petrolia as well as Enniskillen Township with water through a network of 40 km of pipeline, booster station and water tower.

The ***Lake Huron Primary Water Supply System*** services a portion of the municipality of Lambton Shores as well as other communities (London, North Middlesex, South Huron, Bluewater, Middlesex Centre, Lucan-Biddulph and Strathroy-Caradoc) from a water treatment plant located in South Huron, north of the village of Grand Bend. The plant has a current treatment capacity of 340 million litres per day (75 million Imperial gallons per day) and serves a population of approximately 350,000 people.

Natural Gas

Union Gas, a Spectra Energy Company, owns and operates the natural gas storage, transmission, and distribution systems in Sarnia-Lambton. A major Canadian utility, it delivers energy and related services to more than one million industrial, commercial, and residential customers in more than 400 Ontario communities.

Dawn Hub – **Union Gas** also provides natural gas storage and transportation services for other utilities and energy market participants in Ontario, Quebec, and the United States. The Dawn Hub is the largest integrated natural gas storage facility in Canada and one of the largest in North America. It offers customers such as power generators, distribution and pipeline companies and energy marketers an important link in the movement of natural gas from key supply basins to markets in central Canada and the northeast U.S.

- Working capacity of over **150 billion cubic feet (Bcf)**
- Takeaway capacity of 6.4 Bcf/d, growing to more than 8 Bcf/d by 2020
- Interconnects with several major pipelines, including Vector, Great Lakes, Panhandle, Bluewater, MichCon, Enbridge, and TransCanada at Kirkwall and Parkway.

Enbridge Gas Storage – In St. Clair Township, near the community of Corunna, **Enbridge Gas** maintains a large underground gas storage facility.

- Working capacity of over **112 billion cubic feet (Bcf)**
- Interconnects to four major pipelines including Vector, Niagara Gas Transmission – Link Pipeline, TransCanada, and Union.

Electrical

Ontario Power Generation Inc. purchases over 2,000 MW of natural gas-generated power (28% of the province's natural gas power capacity) through various privately owned and operated facilities in Lambton County. This locally generated power is used by area industries and transported through Ontario's electrical transmission system to other parts of the province and the U.S.

Infrastructure Highlights

- TransAlta Energy Corporation – 506 MW Co-generation (natural gas)
- Greenfield Energy – 1,005 MW (natural gas)
- St. Clair Energy Centre – 577 MW (natural gas)
- Green Electron Power Project – 289 MW (natural gas)
- Photo-voltaic Solar Farms – 120 MW
- Wind – over 165 MW with many more under construction and proposed.

TransAlta Corporation – Sarnia operates a 506-megawatt gas-fired facility at its Regional Cogeneration Plant in Sarnia. The facility currently supplies power and steam to local companies, including ARLANXEO Canada Inc., NOVA Chemicals Ltd. and Suncor Energy Products Inc. TransAlta also owns and operates the ***Bluewater Energy Park***, which is located adjacent to the cogeneration plant. Industries located in the Energy Park can access steam and **"behind the fence" electric power pricing.**

Solar – Enbridge operates the 80 MW Sarnia solar plant in Sarnia, and NextEra Energy Inc. operates two 20 MW solar plants in St. Clair Township.

Wind – Various wind projects have been built throughout Lambton County, and more projects are under development. These projects take advantage of the natural winds that come from Lake Huron to generate over 165 MW of wind energy.

Electrical Distribution Utilities
Two utilities provide power to Sarnia-Lambton: the *Bluewater Power Distribution Company* in Sarnia, Alvinston, Oil Springs, Petrolia, Point Edward and Warwick Township (part); and *Hydro One Networks Company* throughout the rest of Lambton County.

Transportation Infrastructure

Highways

- **Highway 402** – multiple lane freeway running from the Michigan/Ontario border in the west to London and Highway 401 in the east. The 402 is the main highway that connects Sarnia-Lambton with the United States and Interstate 75 and 69 Highways via the Blue Water Bridge, and the markets of London, Kitchener, Toronto, Montreal etc. via Highway 401 in the east as well as the Niagara – Buffalo, New York border crossing via highway 403.
- **Highway 40** – Runs south from Sarnia through St. Clair Township interconnecting our community with Chatham-Kent and Windsor.
- **Highway 21** – runs north from Highway 402 through the municipality of Lambton Shores, where it runs parallel to the Lake Huron shoreline into Huron County and the Grey-Bruce region of Ontario.

International Crossings

- **Blue Water Bridge** – The Blue Water Bridge international border crossing is a key link between Canada and the United States. The bridge is centrally located on the eastern border area between Point Edward/Sarnia, Ontario, and Port Huron, Michigan Strategically placed on the major trade and transportation corridors linking U.S. Interstates, I-69 and I-94, with Canadian 400 Series Highway, 402. The Blue Water Bridge currently ranks as the fourth busiest Ontario international crossing for total vehicles and is the second busiest for the number of commercial vehicle (truck) crossings.
- **Bluewater Ferry** – The Bluewater Ferry has been in operation since 1948. Located in Sombra and connecting to Marine City, Michigan, the ferry can handle commercial vehicles up to 13 feet high and 75 feet long.
- **Walpole – Algonac Ferry** – The Walpole-Algonac Ferry has been in operation for over 100 years. The ferry operates between Walpole Island and crosses the St. Clair River to Algonac, Michigan.
- **Free and Secure Trade (F.A.S.T.) Program**
  The Free and Secure Trade Program (F.A.S.T.) is a harmonized commercial program between the Canada Border Services Agency, Citizenship and Immigration Canada, and U.S. Customs and Border Protection. The F.A.S.T. program allows pre-approved low-risk importers, carriers, and drivers to be cleared into either country with greater speed and certainty and at a reduced cost of compliance.
- **Freight Carriers**
- Sarnia-Lambton's freight carriers can satisfy a variety of industrial shipping needs. Local freight carriers offer a wide range of services, including liquid bulk transport, dry bulk transport, flatbed, oversized loads, long haul

international, short-haul domestic, etc. Our business directory contains a complete listing of all local and international carriers located in our community.

- **Customs Brokers**
- Because of its border location, Sarnia-Lambton has an excellent complement of custom brokerages. Acting on behalf of their clients, the customs brokers will prepare the necessary import or export documents they receive from the freight forwarder, correctly classify the goods, pay the duty and forward the shipments as directed.

Rail

Canadian National – Canadian National (CN) is the principal rail carrier in the Greater Sarnia Area. Major customers include BP Energy Canada, NOVA Chemicals, Superior Propane, Provident Energy, CF Industries, Cabot Canada, ARLANXEO Canada Inc., Suncor Energy Products Inc., and Shell Canada. CN also operates the St. Clair Rail Tunnel under the St. Clair River between Sarnia and Port Huron, Michigan. This tunnel accommodates double-stacked containers and multi-level carriers with non-stop efficiency. CN maintains five rail yards in the region, including a public-transfer facility with a standing capacity for 1,000 cars, a working yard with a 600-car capacity, another with a 275-car capacity, an equipment repair yard, and one yard devoted to BP Energy.

CSX Transportation – In Sarnia-Lambton, CSX Transportation serves Imperial Oil, Suncor, Ethyl, Air Liquide, ARLANXEO Canada Inc., and Shell. Canadian National moves CSX rail cars in and out of the region.

Rail Car Maintenance – Given the considerable volume of rail traffic through Sarnia-Lambton, an extensive maintenance infrastructure exists, with services provided by Procor Limited, GATX Canada Inc., the Oil Well Supply Company Limited, and ARI Fleet Services of Canada Inc.

Ports

The **Sarnia Harbour** is owned by the City of Sarnia. The Port of Sarnia encompasses a large geographical area, which includes various communities and private facilities as well as the Public Port Facility. The port provides seagoing access for cargo in and out of the area, allowing expedient exporting of goods to national and international markets. It also provides a year-round berthing and repair facility for Great Lakes shipping.

- Located near the junction of the St. Clair River and Lake Huron.
- Navigation is seasonal from March to the end of December.
- Position Lat. 42º 58’0” N Long. 82º 25’0” W NOAA Chart: #14852
- Pilotage – Compulsory
- Approach Channel – Width 471.0 m (1545 feet)
- Storage – Available (Limited)

Services

- Harbour Master / Wharfinger
- Fresh Water*
- Supplies*
- Sewage Disposal* (by truck)
- Fuel* (by truck)
- Ship Repair*
- Winter Berthing

(* indicates by arrangement only)

Berthage

Government Dock – Length 320 m (1050 feet)
East Dock – Length 140 m (459 feet)
North Slip #1 – Length 220 m (722 feet)
North Slip #2 – Length 220 m (722 feet)

Depth of berths may vary. Mariners must consult nautical charts.

Air

Sarnia Chris Hadfield Airport – a certified facility that operates from 6:00 am to 12:00 midnight. It is roughly five kilometres (three miles) east of Sarnia's city core and offers direct access to Highway 402. The Sarnia airport provides commuter links to Pearson International in Toronto.
It can accommodate Dash 8 and slightly larger. Currently adding a new hanger and the city has longer term plans for the airport. https://www.sarniaairport.com/

Detroit Metropolitan International Airport – approximately an hour's drive from Sarnia-Lambton, Detroit Metropolitan offers service to major U.S. and international destinations and is a Delta hub.

Bishop International Airport – located in Flint, Michigan, just over an hour's drive west of Sarnia along Interstate-69. Daily air service is offered to many US destinations, including non-stop flights to Chicago, Minneapolis – St. Paul, Las Vegas, Atlanta, Baltimore – Washington, Orlando, Tampa Bay, and Fort Myers. Bishop is serviced by Delta, American, Southwest and United Airlines.

London International Airport is located just over an hour's drive east of Sarnia via Highway 402. Daily air service is offered to many Canadian, U.S. and international destinations, including non-stop flights to Toronto, Ottawa, Montreal, Chicago, Orlando, Cancun (Mexico), Punta Cana (Dominican Republic), Varadero (Cuba), and Santa Clara (Cuba).

APPENDIX D: LEGAL DISCLAIMER

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