BDO Zone Rating: **'BBB'**

Biofuel Development Opportunity Zone Risk Rating

'BBB'

The Emporia, KS BDO Zone for corn stover is rated 'BBB.' This rating denotes good prospective viability of Feedstock Supply and Infrastructure (FS&I), and expectations of FS&I risk are currently low in the Zone. Capacity to support new biobased plant operations is considered adequate, but adverse weather, supply chain, economic, or infrastructure conditions may impair this capacity over time.

Rating Parameters:

Category	Rated Quantity	Delivered Price	BDO Zone Size
Corn Stover	100,000 bdt/yr	$97 - $106 (bdt)	75-mi drive distance from Emporia, KS

BDO Zone Assets

- **Harvesting corn stover is a relatively common practice in the region, offering the supply zone a starting point in equipment availability and operational experience.**
- **Industrial site has access to the east-west highway corridor, taking advantage of the state's great road infrastructure.**
- **Established educational institutions with history of working with industry to attract & develop skilled labor.**

BDO Zone Liabilities

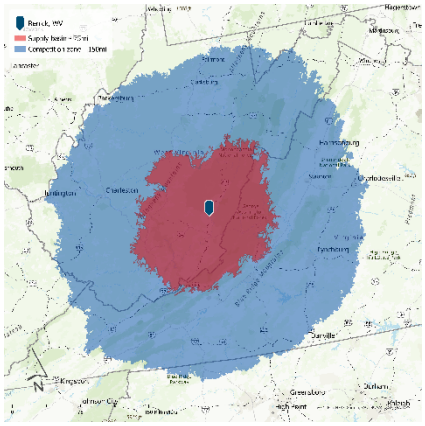
- **Yield variability could present sustainability challenges regarding corn stover removal rate in certain regions of the supply zone.**
- **Cattle farming utilizes corn silage and corn stover, creating competition and impacting the security of the supply chain.**
- **Despite competitively priced industrial land, no industrial activities currently happening on the site, which adds uncertainty to permitting and utilities installation.**
- **Infrastructure for transporting commercial quantities of corn stover bales is not fully established.**

BDO Zone Risk Rating

The Emporia, KS, Biofuel Development Opportunity Zone is rated 'BBB,' or 'low-moderate' risk.

Risk Rating Grades are defined as follows: AAA (*extremely low*), AA (*very low*), A (*low*), and BBB (*low-moderate*), BB (*moderate*), B (*moderate-high*), C (*high*).

Emporia, KS BDO Zone



Scoring & Rating Methodology

In assessing the biomass supply chain risk for the Biofuel Development Opportunity (BDO) Zone, 88 Risk Indicators from the US Standards for Biomass Supply Chain Risk (BSCR) were applied. These BDO Zone Risk Indicators are the subset of BSCR Risk Indicators applicable to evaluating feedstock risk within a BDO Zone.

Feedstock quantities are expressed in bone dry tons per year (bdt/yr), while feedstock costs are expressed in United States dollars (USD). Maximum transport distance is based on a 75-mile driving distance from the center point (Emporia, KS).

The 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 Risk Likelihood (RRL)** score which denotes the likelihood of a risk to future BDO Zone projects due to the Risk Indicator. RRL Scores are scaled as either *very low* (2), *low* (4), *medium* (6), *high* (8), or *very high* (10).

Next, each BDO Zone Risk Indicator is given a **Raw Risk Impact (RRI)** score which denotes the impact on a future BDO Zone project due to the Risk Indicator. RRI scores are scaled as either *very low* (2), *low* (4), *medium* (6), *high* (8), or *very high* (10). Impact level scores are based on the impact level of a risk on the successful development and deployment of a BDO Zone project with no mitigation measures.

Then, the **Gross Risk Indicator (GRI)** score is calculated as the product of the RRL and the RRI

scores. For example, if the 'Competitor Price and Price Sensitivity' is scored at a RRL of 2 and a RRI of 8, then the GRI for this risk indicator is $2 \times 8 = 16$.

If the analyst deems that a typical bio-based project could put in place economically reasonable measures or best practices that mitigate either the likelihood (RRL) or the impact (RRI), or both, then the GRI will be notched accordingly.

Finally, the **Loaded RI** score for each Risk Indicator is calculated as the product of the Total Notch and the GRI score, which is the final score for that indicator.

Loaded RI scores of 4 or less are deemed *very low risk*; scores between 5 and 16 are deemed *low risk*; scores between 17 and 36 are deemed *medium risk*; scores between 37 and 64 are deemed *high risk*; and scores of 65 and greater are deemed *very high risk*.

The total risk rating for the BDO Zone is the average of all Loaded RI scores. The BDO Zone score for Location is ***24.60 out of 100, resulting in a 'BBB' designation***.

All scoring and rationale for each Risk Indicator are provided in Appendix B.

Analyst Notes

The agricultural profile of this BDO Zone is a mix of row crops, cattle, and forages. The soil is shallow and susceptible to wind erosion, leading many growers to adopt no-till practices. The region is part of the Great Plains, where native grasslands serve as grazing pastures for cattle producers. The livestock nutrition is supplemented with hay (grown and baled in about 20% of the land), silage, and also by corn stover, although in lower quantities.

Over the last decade, the supply zone has harvested, on average, 93% of the corn planted area, around 450,000 acres/year, with an average yield of 122 bu/acre. The weather patterns and soil type in the supply zone lead to yield variability in the drylands, with averages ranging from as low as around 90 bu/acre to as high as 150 bu/acre in the different counties. The corn yield variability in the past 10 years warrants additional discussions about soil sustainability and the optimal corn stover left on the ground for each micro-region.

Of the corn produced in the BDO zone, a portion is sold as grain, and the other is used as animal feed by the cattle industry. The region has never had large-scale industrial demand for corn stover; it has utilized it as a nutritional supplement for livestock. Due to the lower average yields compared to other corn-growing regions in the Midwest and competition from livestock, there are few ethanol plants in the area.

BDO Zone Assets

Our findings showed that many farmers in the supply zone already own harvest equipment and are somewhat experienced with field operations, presenting a springboard for scaling up in the event of a bio-based project coming to the region. Because hay baling happens towards the end of summer, there would likely be no competing interests for baling corn stover in late Fall.

An eventual bio-based project would benefit from the State's sound infrastructure, rated #6 in the country, and an industrial parcel that presents all utilities running adjacent to the lots with competitive land prices in the region. Additionally, the City of Emporia is home to educational institutions with a history of working with industry to attract and develop skilled labor.

BDO Zone Liabilities

Academic literature suggests a minimum yield of 150 bu/per acre before considering biomass removal from the soil while maintaining its health. The 10-year average in this BDO Zone is lower than that at 122 bu/acre. In addition, there is great yield variability in the micro-regions, increasing the already fragmented nature of this supply chain. Farmers are already conscious of their soil health challenges, especially because of the soil type in this region, as mentioned above, and would necessitate support from the extension programs to potentially adapt practices.

The current transportation infrastructure is not prepared to move large quantities of corn stover bales in a short window and would require extensive capital investments to scale up. Likewise, even though a number of farmers are used to baling hay, the most

common type of equipment is a round baler. The quality requirements of a commercial facility would likely demand high-density square bales, which again would mean a substantive capital investment in specialized field equipment.

Infrastructure Profile

The industrial park assessed in this report can be considered a greenfield, with utilities (gas, water, sewage, communications) running adjacent to the lots but requiring connections to the future facility.

The land is competitively priced compared to other sites in the region; however, there are no industrial activities currently happening there, which adds uncertainty to the permitting and utilities installation.

The site sits at Route 50, a transcontinental highway that stretches from Ocean City, Maryland (on the east coast), to Sacramento, California (on the west coast), providing ample market access; however, road transport is the only readily available freight, as access to waterways and rail are 90 and 60-miles away respectively and the rail yard has not operated in over a decade.

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Figure 1: Risk Indicators (Sorted by Risk Level)

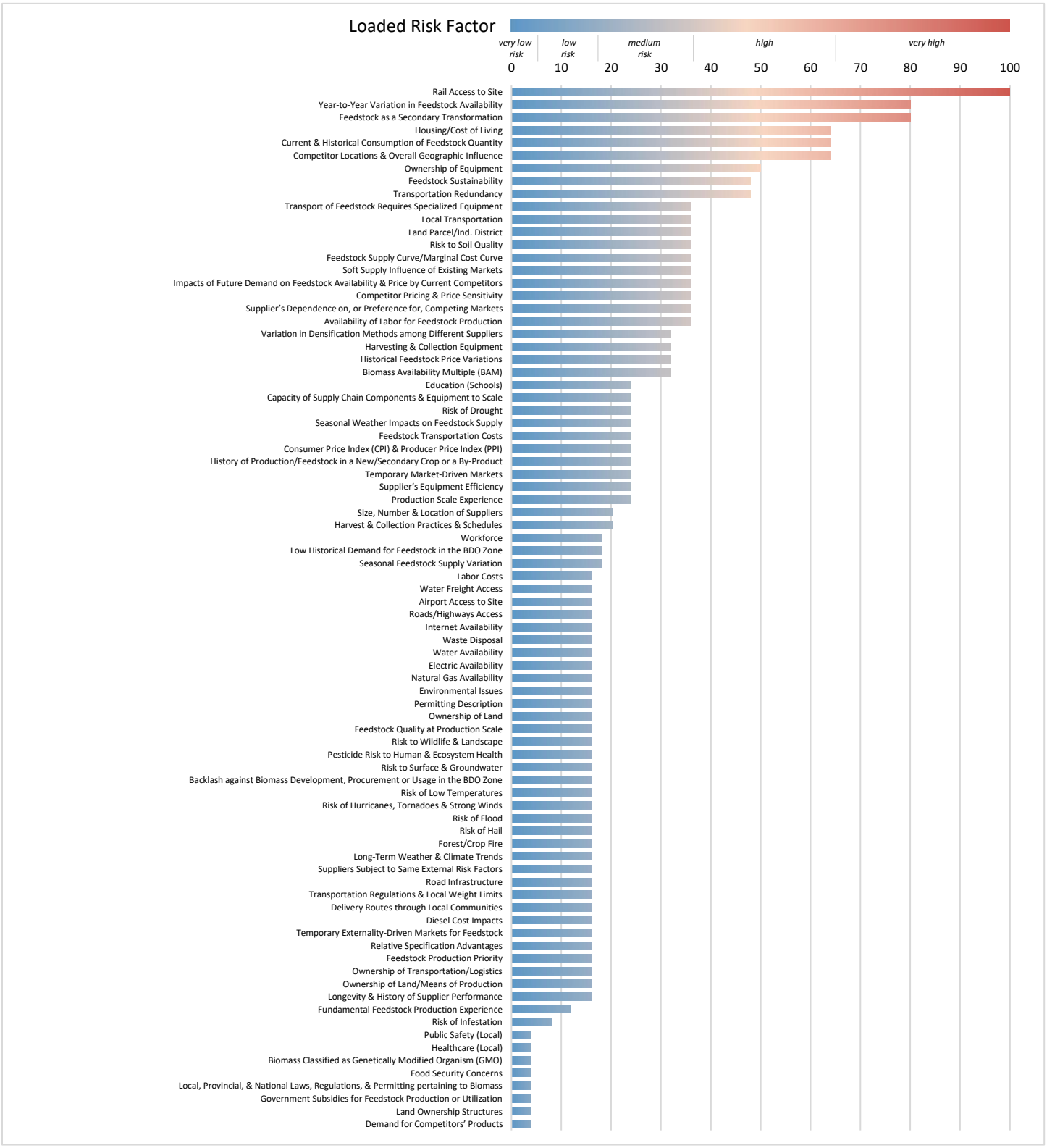


Table 1: Risk Indicators and Associated Scores

	Feedstock Supply Chain Risk Indicators	Raw Risk Likelihood	Raw Risk Impact	Gross Risk Indicator	Mitigation /Notching	Loaded RI Score
	Category 1.0: Supplier Risk					
1.1.1	Longevity & History of Supplier Performance	4	4	16	NN	16
1.2.1	Supplier's Dependence on, or Preference for, Competing Markets	6	6	36	NN	36
1.3.1	Ownership of Land / Means of Production	4	4	16	NN	16
1.3.2	Ownership of Equipment	10	10	100	50%	50
1.3.3	Ownership of Transportation/Logistics	4	4	16	NN	16
1.3.4	Feedstock as a Secondary Transformation	8	10	80	NN	80
1.4.1	Fundamental Feedstock Production Experience	4	6	24	50%	12
1.4.2	Production Scale Experience	8	8	64	63%	24
1.5.1	Supplier's Equipment Efficiency	8	8	64	63%	24
1.6.1	Feedstock Production Priority	8	8	64	75%	16
	Category 2.0: Competitor Risk					
2.1.1	Competitor Locations and Overall Geographic Influence	8	8	64	NN	64
2.1.2	Current and Historical Consumption of Feedstock Quantity	8	8	64	NN	64
2.1.3	Competitor Pricing and Price Sensitivity	6	6	36	NN	36
2.1.4	Impacts of Future Demand on Feedstock Availability and Price by Current Competitors	6	6	36	NN	36
2.1.5	Soft Supply Influence of Existing Markets	6	6	36	NN	36
2.1.6	Temporary Market-Driven Markets	4	6	24	NN	24
2.2.1	Relative Inventory Capacity	NR	NR	NR	NR	NR
2.2.2	Relative Accessibility / Delivery Hours and Wait Times	NR	NR	NR	NR	NR
2.2.3	Relative Specification Advantages	4	4	16	NN	16
2.2.4	Demand for Competitors' Products	2	2	4	NN	4
	Category 3.0: Supply Chain Risk					
3.1.1	Biomass Availability Multiple (BAM)	4	8	32	NN	32
3.1.2	Feedstock Supply Curve / Marginal Cost Curve	6	6	36	NN	36
3.1.3	Seasonal Feedstock Supply Variation	6	6	36	50%	18
3.1.4	Year-to-Year Variation in Feedstock Availability	8	8	64	50%	32
3.2.1	Historical Feedstock Price Variations	8	8	64	50%	32
3.2.2	Low Historical Demand for Feedstock in the BDO Zone	6	6	36	50%	18
3.2.3	History of Production/Feedstock in a New/Secondary Crop or a By-Product	4	6	24	NN	24
3.3.1	Consumer Price Index (CPI) and Producer Price Index (PPI)	6	4	24	NN	24
3.3.2	Currency Risk	NR	NR	NR	NR	NR
3.3.3	Border Risk	NR	NR	NR	NR	NR
3.3.4	Temporary Externality-Driven Markets for Feedstock	4	4	16	NN	16
3.4.1	Harvest and Collection Practices and Schedules	6	6	36	44%	20.25
3.4.2	Harvesting and Collection Equipment	8	8	64	50%	32
3.4.3	Variation in Densification Methods among Different Suppliers	8	8	64	50%	32
3.4.4	Availability of Labor for Feedstock Production	8	8	64	44%	36
3.5.1	Feedstock Transportation Costs	4	8	32	25%	24
3.5.2	Diesel Cost Impacts	4	4	16	NN	16
3.5.3	Transport of Feedstock Requires Specialized Equipment	8	8	64	NN	36
3.5.4	Delivery Routes through Local Communities	4	4	16	NN	16
3.5.5	Transportation Regulations and Local Weight Limits	4	4	16	NN	16
3.5.6	Road Infrastructure	4	4	16	NN	16
3.5.7	Transportation Redundancy	8	8	64	25%	48
3.6.1	Size, Number and Location of Suppliers	6	6	36	44%	20.25
3.6.2	Suppliers Subject to Same External Risk Factors	4	4	16	NN	16
3.6.3	Land Ownership Structures	2	2	4	NN	4
3.7.1	Seasonal Weather Impacts on Feedstock Supply	4	6	24	NN	24
3.7.2	Long-Term Weather and Climate Trends	4	4	16	NN	16
3.7.3	Forest / Crop Fire	4	4	16	NN	16
3.7.4	Risk of Infestation	2	4	8	NN	8
3.7.5	Risk of Hail	4	4	16	NN	16
3.7.6	Risk of Flood	4	4	16	NN	16
3.7.7	Risk of Drought	4	6	24	NN	24
3.7.8	Risk of Hurricanes, Tornadoes and Strong Winds	4	4	16	NN	16
3.7.9	Risk of Low Temperatures	4	4	16	NN	16
3.8.1	Government Subsidies for Feedstock Production or Utilization	2	2	4	NN	4
3.8.2	Local, Provincial, and National Laws, Regulations, and Permitting pertaining to Biomass	2	2	4	NN	4
3.8.3	Backlash against Biomass Development, Procurement or Usage in the BDO Zone	4	4	16	NN	16
3.8.4	Consent of, and Co-operation with, Indigenous Communities and First Nations	NR	NR	NR	NR	NR

3.8.5	Food Security Concerns	2	2	4	NN	4
3.9.1	Feedstock Sustainability	8	8	64	NN	48
3.9.2	Risk to Soil Quality	6	6	36	NN	36
3.9.3	Risk to Surface and Groundwater	4	4	16	NN	16
3.9.4	Water Use	NR	NR	NR	NR	NR
3.9.5	Pesticide Risk to Human and Ecosystem Health	4	4	16	NN	16
3.9.6	Risk to Wildlife and Landscape	4	4	16	NN	16
3.9.7	Biomass Classified as Genetically Modified Organism (GMO)	2	2	4	NN	4
	Category 4.0: Feedstock Scale-up Risk					
4.1.1	Feedstock Quality at Production Scale	8	8	64	75%	16
4.1.2	Capacity of Supply Chain Components and Equipment to Scale	8	8	64	63%	24
	Category 5.0: Infrastructure					
5.1.1	Land Parcel/Ind. District	6	6	36	NN	36
5.1.2	Ownership of Land	4	4	16	NN	16
5.1.3	Permitting Description	4	4	16	NN	16
5.1.4	Environmental Issues	4	4	16	NN	16
5.2.1	Natural Gas Availability	4	4	16	NN	16
5.2.2	Electric Availability	4	4	16	NN	16
5.2.3	Water Availability	4	4	16	NN	16
5.2.4	Waste Disposal	4	4	16	NN	16
5.2.5	Internet Availability	4	4	16	NN	16
5.3.1	Roads/Highways Access	4	4	16	NN	16
5.3.2	Rail Access to Site	10	10	100	NN	100
5.3.3	Airport Access to Site	4	4	16	NN	16
5.3.4	Water Freight Access	4	4	16	NN	16
5.4.1	Healthcare (Local)	2	2	4	NN	4
5.4.2	Education (Schools)	6	4	24	NN	24
5.4.3	Local Transportation	6	6	36	NN	36
5.4.4	Public Safety (Local)	2	2	4	NN	4
5.4.5	Housing/Cost of Living	8	8	64	NN	64
5.5.1	Workforce	6	6	36	50%	18
5.5.2	Labor Costs	4	4	16	NN	16
					Average	**24.60**



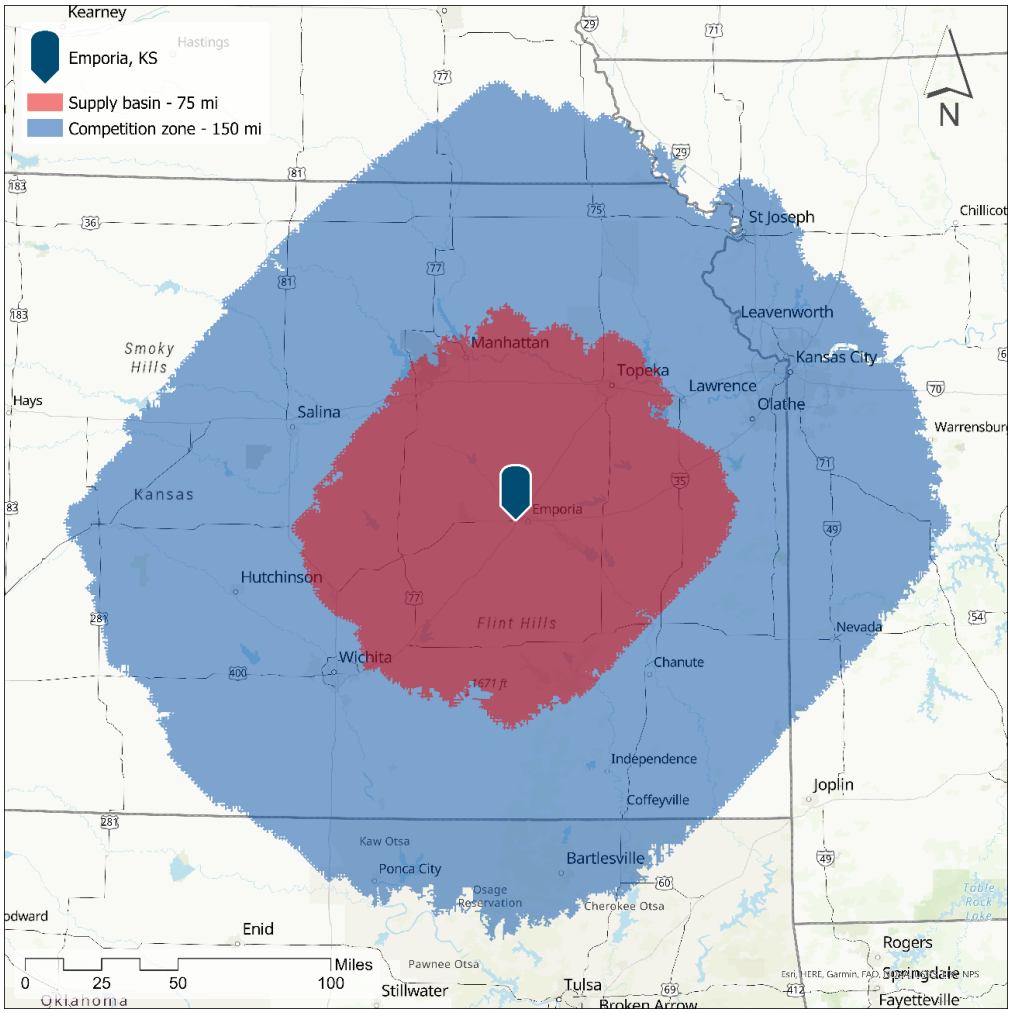
Emporia, KS BDO Zone Independent Review Committee (IRC)

Chuck Scott – Emporia RDA
Corey Spikes – Countryside Feeds
Katie Sawyer – Office of Senator Roger Marshall
Brian Rees – K-State Research and Extension
Connie Fischer – Kansas Corn Growers Association
Trace Mulligan – Kansas Dept. of Agriculture
Rick Pemberton – Kansas Corporation Commission
Dr. DeAnn Presley, Ph.D. – Kansas State University

APPENDIX A: BIOMASS AVAILABILITY AND PRICING

This section assesses the availability and pricing of corn stover as feedstock for biofuels, bioenergy, and other bio-based products within a 75-mile drive distance from Emporia, Kansas (KS), which is the center point of the supply zone, as shown in Map A-1.

Map A-1. Emporia BDO Zone Area Map



Study Region

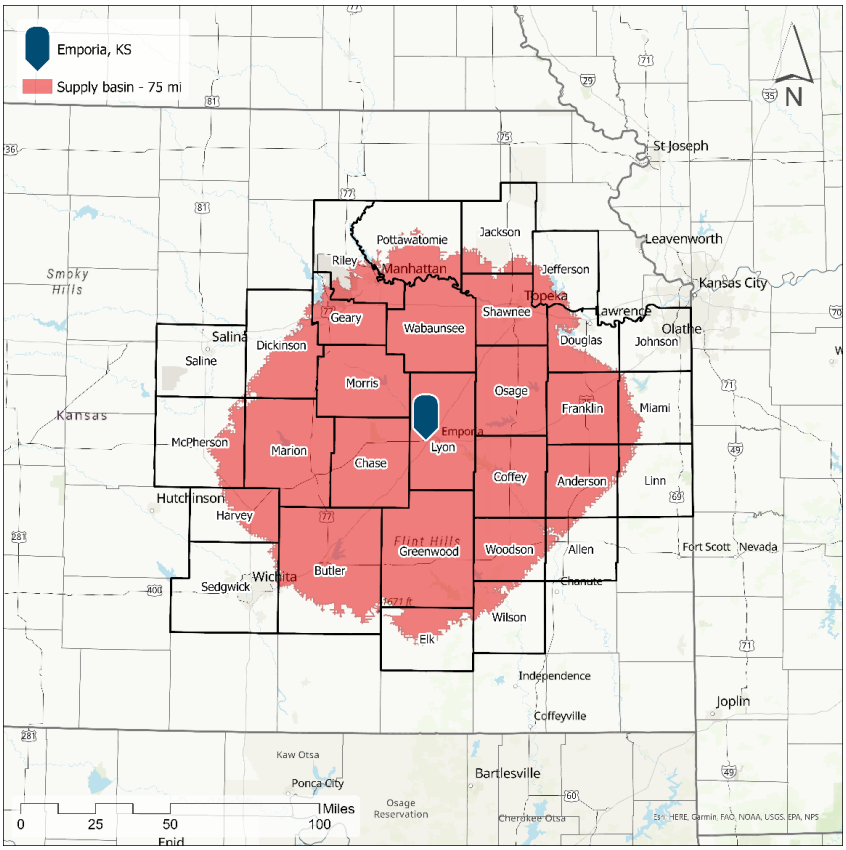
The BDO Zone Region is defined by a 75-mile drive distance from Emporia, KS (Map A-1), and encompasses corn stover availability within that distance (referred to as the supply zone) within 30 counties, as shown in Map A-2 while also investigating current and emerging competing markets within the broader 150-mile drive distance (referred to as the competition zone).

The BDO Zone region's primary agricultural activities are corn and soybeans on rotation and cattle farming. Winter wheat and other cover crops such as barley, oats, and rye are common. Around 20% of the land is used for growing hay for animal feed. Based on the outreach to the Kansas State Extension Program, the agricultural land is split somewhat evenly between these three activities (food crops, livestock, and animal feed).

According to USDA historical corn production data, the 10-year average harvested area for corn is 424,378 acres, with an average yield of 122 bu/acre. Recent droughts in Kansas caused a break in hay production, forcing several farmers to grow and harvest corn for silage and bale corn stover to serve as cattle feed, even though the nutritional aspect of corn stover is not ideal. Normally, out of the total corn planted area, around 10% would be allocated to silage production, which is considered the only current competition for corn stover in the supply zone.

Drought negatively impacted grain productivity in the 2022 harvest, leading to unusually low corn yields (97 bu/acre) and harvested area (5% lower than the 10-year average). However, as seen in Map A-2, the region has consistently harvested an average of around 93% of the total corn planted area.

Map A-2. Counties with the supply zone



Methodology for estimating the rated quantity of corn stover in the supply zone

The BDO Zone Risk Indicators are scored with reference to specific feedstock quantity and price, referred to in this report as the rated quantity and price. Rated quantity is the low-risk biomass a future bio-based project would likely be able to secure after considering factors such as current and future competition, logistics, sustainability, and operational constraints. In other words, the rated quantity is the conservative estimate of biomass availability for future bio-based projects.

In this report, five parameters are used to estimate the rated quantity of corn stover in the supply zone, including

(1) Average production of corn stover in the supply zone using historical production of corn grains in the last 10 years

The corn stover generation within the supply zone is estimated using data from the USDA's online database. This data includes information on cropland area and yields, which are processed using Ecostrat's methodology. A corn stover generation ratio of 1:1 between grain and corn stover is applied to estimate the total corn stover generation. The resulting quantity is then converted to a bone-dry-ton (bdt) measure by removing 22% moisture content.[1] This quantity is referred to as the average annual corn stover generation.

(2) Current demand for corn stover in the supply zone

The main demands for corn stover are animal feed or bedding. In regions with livestock operations, corn crops may be harvested for silage, rendering those areas unable to generate corn stover. The current consumption data are collected and validated via outreach to the farmers and local experts and deducted from the total corn stover generation quantities estimates from parameter (1). This calculation results in the potential availability of corn stover.

Potential availability = average annual corn stover generation (parameter 1) – current demand in the competition zone (parameter 2)

(3) Sustainable removal quantity

This report utilizes the best practice estimates from agronomic research,[2] which recommends leaving 60% of produced biomass in the field while harvesting only 40%. While acknowledging regional variations in field and soil conditions, as well as agricultural practices, this sustainable removal rate serves as a conservative estimate of potential biomass quantities for the BDO Zone project. Due to the lack of local data on sustainable removal rates specific to this region, a conservative assumption of 40% was utilized, recognizing that research from other states may not fully capture the conditions present in the BDO Zone.

Sustainable removal quantity = Potential availability of crop residues (parameter 2) – the sustainable amount left in the field (60% of potential availability estimated in step 2)

(4) Field equipment efficiency to remove corn stover from the field

Not all the corn stover can be collected by harvesting operators; therefore, we apply an 82% field equipment efficiency to the sustainable removal quantity (parameter 3). This equipment efficiency was provided by one of the largest harvest groups in the country.

Field removal quantity = Sustainable removal quantity * Equipment efficiency (82%)

[1] Industrial Corn Stover Harvest, Iowa State University Extension and Outreach, PM 3050 page 6, March 2024

[2] Science-based maize stover removal can be sustainable, Maecio R. Nunes et.al. Agronomy Journal, 2021; Vol. 113 page 3178-3192 (https://acsess.onlinelibrary.wiley.com/doi/10.1002/agj2.20724)

The summary of assumptions applied to calculate the amounts of corn stover available to be removed sustainably in the supply zone can be found in Table A-1 below:

Table A-1. Assumptions to estimate sustainable quantity of corn stover available for removal in the supply zone

Harvested corn stover to grain ratio	1:1	Total corn stover produced given the production of corn grain
Sustainable Removal Rate	40%	Biomass sustainably harvested from field
Equipment Efficiency	82%	Efficiency of field equipment to harvest and collect corn stover from the field
Moisture Content[3]	22%	Average moisture content of corn stover at the harvest time

(5) Biomass Availability Multiple (BAM)[4] and Farmer Participation Rate

There are risk factors involved in the corn stover supply chain that cannot be fully captured, and in reality, not all the produced corn stover will be available for biomass projects. Since large-scale markets for corn stover do not presently exist, farmers are likely to underestimate potential challenges of harvesting in a short period of time and the effort it takes to collect and bale corn stover at an acceptable quality (low soil contaminations). To account for these risks, a Biomass Availability Multiple (BAM) is applied to the field removal quantity, resulting in the low-risk rated quantity. BAM also provides redundancy in the corn stover supply because only a portion of available corn stover will be available for future biomass projects since only a portion of crop growers will be interested in supplying their biomass.

The resulting rated quantity is a conservative estimate of biomass availability, considering factors like competition, farmer participation rate, logistics, sustainability, and operational constraints.

In summary, the rated quantity is calculated by removing from the total corn stover generation: current competition (2), the sustainable amount that needs to be left behind in the field (3), inefficiencies of field operations (4), and BAM factor (5), as shown in Table A-2.

[3] Industrial Corn Stover Harvest, Iowa State University Extension and Outreach, PM 3050 page 6, March 2024

[4] Biomass Availability Multiple (BAM) indicates the degree of redundancy in the biomass supply in the BDO Zone. BAM is the mean ratio of biomass feedstock available to a project, in relation to delivered cost, divided by the biomass project's mean rated quantity. BAM is a strong indicator of supply chain resilience when stressed by supply shortage and/or supplier breach.

Table A-2. Summary of parameters and their description to estimate the rated quantity

Parameter Name	Description
Total corn stover generation	Based on USDA data and a 1:1 ratio between grain and corn stover (Step 1)
Potential availability	Total corn stover generation – current demand (Step 2)
Sustainable removal quantity	Potential availability after sustainability factor to maintain the soil organic matter (step 3)
Field removal quantity	Sustainable removal quantity after the consideration of field equipment efficiency (step 4)
Rated quantity	Field removal quantity / BAM (step 5)

Historical Corn and Corn Stover Generation

As mentioned above, this report utilizes USDA's National Agricultural Statistics Service[5] data, which provides 10-year grain yields, production, and area harvested at the county level, with the latest data being 2022. Based on USDA harvest data, the average yield of corn grain is estimated to be around 122 bushels/acre. This report assumes corn stover to be at 22% moisture, and using this basis, given corn yields for the supply zone, the average yield of corn stover is estimated to be 2.66 bdt/acre.

Figure A-3 shows the total planted and harvested corn in the supply zone. On average, 93% of the planted acreage has been harvested in the supply zone for the past 10 years. The 10-year average corn harvested area in the supply zone is 424,378 acres. Data for the 2022 harvest season shows 402,213 acres of corn were harvested, about 5% below the ten-year average. The calculations use 10-year averages to account for yearly acreage fluctuation dedicated to a crop, depending on market signals and yields that vary according to weather conditions.

[5] https://quickstats.nass.usda.gov/

Figure A-1. 10-year corn grain planted and harvested areas within the supply zone

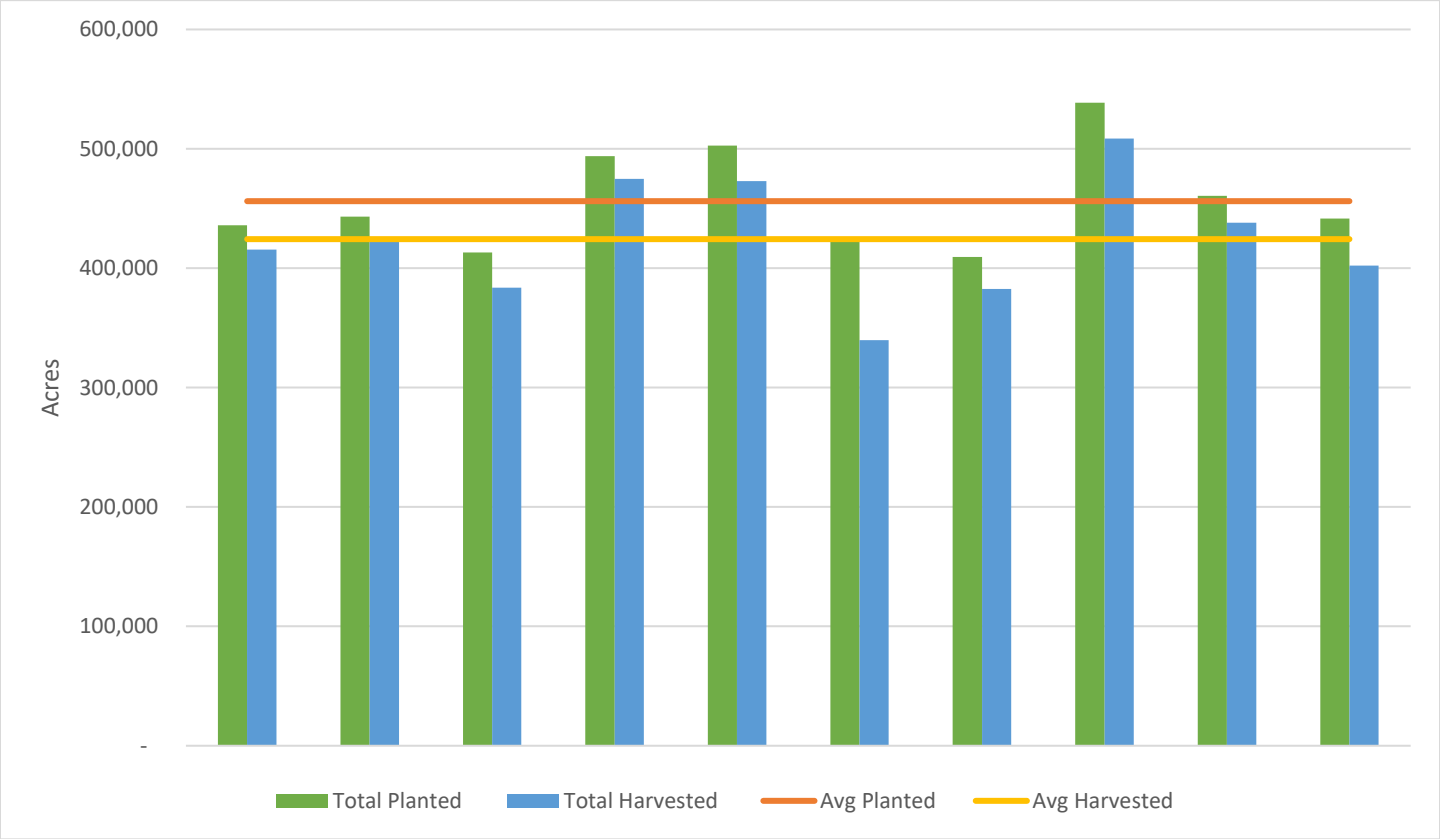


Table A-3 summarizes the average 10-year low and 10-year high for Corn grain planted area, harvested area, and yield.

Table A-3. Corn grain planted and harvested area and yield comparison over the period of 2012-2022

	2022 harvest season	10-year Average (2013-2022)	10-year low (2013-2022)	10-year high (2013-2022)
Planted Area	441,551	456,187	409,439	538,564
Harvested Area	402,213	424,378	339,761	508,663
Avg Grain Yield (tons/acre)	97	122	97	137

The total corn stover generation is determined by multiplying the 10-yr average harvested area (424,378 acres) by grain yield in bdt/acre (2.66), totaling 1,130,747 bdt of corn stover per year. Table A-4 shows the detailed calculations[6] below.

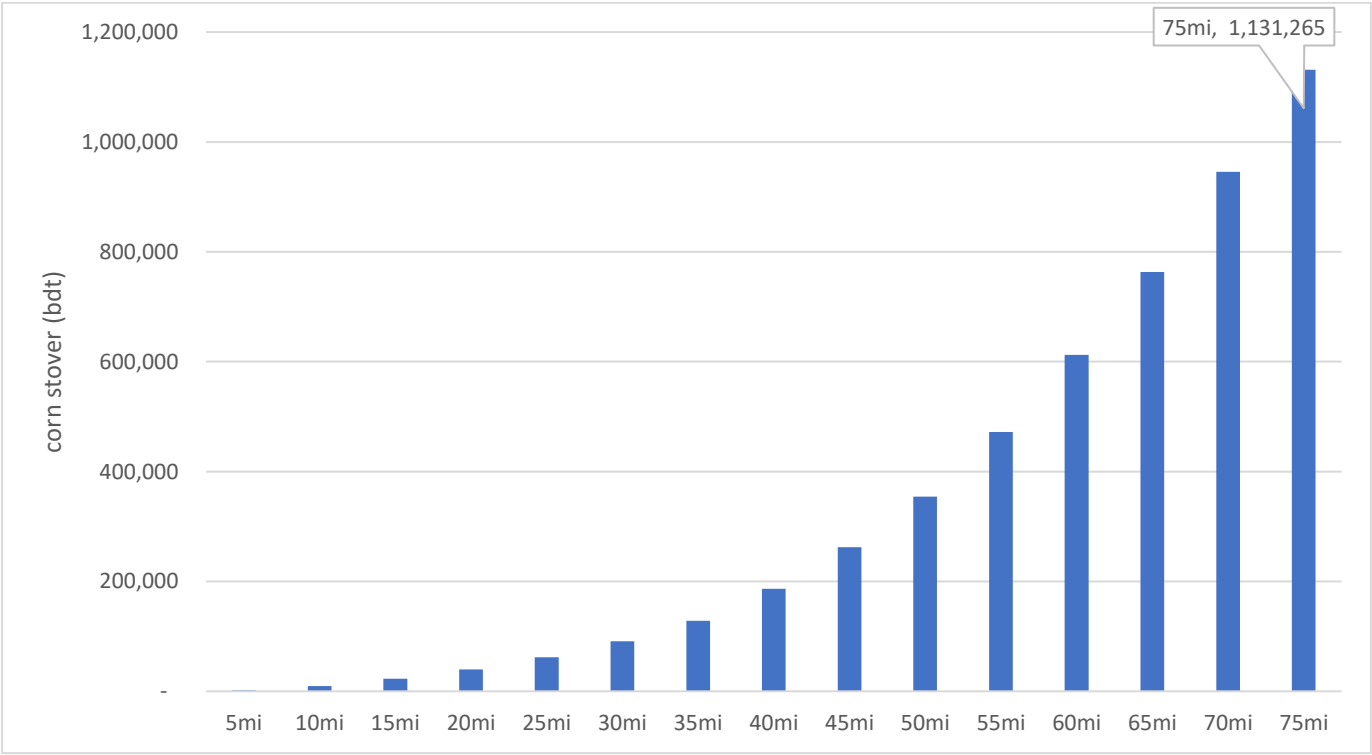
[6] A detailed table with assumptions can be found in Appendix C – Table C-4.

Table A-4. Detailed corn stover generation calculation

Average area harvested in the last 10 years (acre)	424,378
Average corn yield in the last 10 years (bu/acre)	122
Corn lbs. (wet)/acre	6,832
Tons (wet)/acre	3.42
Corn stover yield at the field (bdt/acre)	2.66
Average annual corn stover generation (bdt/yr)	**1,130,747**

The corn stover generation supply curve is mapped in Figure A-2 below in 5-mile increments from the center point (Emporia, KS). About half of the corn stover supply is available within a 60-mile radius.

Figure A-2. Corn stover generation and distribution in the supply zone in 5-mi distance increments from the center point



Current Competition

Research conducted for the BDO Zone found no large-scale facilities currently consuming corn stover within the 150-mile Competition Zone; however, around 10% of the corn grown within the supply zone is harvested for silage, to be supplied to the cattle producers. The estimated quantity generated in this area is then removed from the total corn stover generation (1,130,747 bdt/yr * 90% = 1,017,672 bdt/yr), resulting in the potential corn stover availability for future biomass projects.

Cattle growers also use corn stover for animal bedding and feeding sporadically when they do not have alternative products to apply but we expect this will be an insignificant volume. The agricultural practices in the region suggest that the current usage of corn stover bales for animal feed and bedding in the region is unlikely to change significantly. Table A-5 details this calculation step.

Table A-5. Potential availability of corn stover with the consideration of current competition

Percentage of crop land/corn stover used for animal bedding/feed	10%
Potential availability of corn stover for future biomass projects (bdt/yr)	**1,017,672**

Sustainable Removal & Field Equipment efficiency quantity

When left in the field, crop residues perform several vital functions, such as maintaining soil moisture, accommodating beneficial microbes, increasing soil organic matter, and recycling plant nutrients. Therefore, certain crop residues are required to be left in the field to maintain soil quality. On the other hand, excessive residues, which could occur with high crop yields, would lead to slower soil warming in the planting season, slower evaporation, and difficulties operating planting machinery. The optimum removal of crop residues is site-specific, depending on crop rotation and the soil management practices of individual farmers. Therefore, this report utilizes the research published in the Agronomy Journal,[7] which recommends a sustainable removal rate of 40%.

Additionally, the machinery, transportation and general field operations present inefficiencies and are not able to fully harvest and turn the estimated quantities into usable feedstock. Operating in a large area with thousands of tons per year can present significant quantity differences. Therefore, an 82% efficiency factor is applied to the sustainable quantities to estimate the field availability amount.

From the potential availability of 1,017,672 bdt/y, sustainability, and equipment efficiency constraints[8] are deducted, arriving at a sustainable availability figure of 333,796 bdt/yr, as detailed in Table A-6:

[7] Science-based maize stover removal can be sustainable, Maecio R. Nunes et.al. Agronomy Journal, 2021; Vol. 113 page 3178-3192 (https://acsess.onlinelibrary.wiley.com/doi/10.1002/agj2.20724)
[8] INCUDE IOWA STATES REFERENCE

Table A-6. Sustainable removal quantity of corn stover

Soil Sustainability Factor (percent left in the field)	60%
Harvest Equipment Efficiency to remove stover	82%
Sustainable removal rate (bdt/yr)	**333,796**

Low-Risk Corn Stover Availability

The calculation of the low-risk quantity considers that not all farmers may be willing to participate in the supply chain for different reasons, such as pricing or soil health concerns. In high-yielding areas (>3 bdt/ac) with favorable planting and harvest season and high soil quality, the farmer participation rate is expected to be higher than in regions with low yield, dry land area, and frequent drought, where farm participation rate is expected to be low. Given the low average yields of the supply zone and the historical concerns with wind erosion in the drylands, the farmer participation rate of 35% is applied to the field availability (a calculated quantity which already accounts for the sustainability factor), resulting in a farmer participation rate of 116,829 bdt/yr.

Finally, to account for unknown risks associated with the supply chain and possible errors in our assumptions, a Biomass Availability Multiple (BAM) is applied to the farmer's participation quantity. Given that the previous calculation steps address several risks and constraints, such as competition, sustainability, and equipment efficiency, this report utilizes a BAM factor of 1.20, resulting in a low-risk rated quantity of about 100,000 bdt/yr.[9] The calculation steps can be found in Table A-7 as follows:

Table A-7. Detailed low-risk quantity calculation

Farmer Participation Rate	35%
Potential availability of corn stover with farmer participation rate (bdt/yr)	**116,829**
BAM Factor	1.20
Rated Quantity of corn stover for the BDO Zone (bdt/yr)	**97,357**
Rated quantity to total production ratio	9%

The low-risk quantity is the low-risk annual quantity that a potential project developer could expect to source, given that the region's risk profile is acceptable.

[9] The low-risk rated quantity is rounded up to 100,000 bdt/yr for presentation purposes.

Rated pricing of corn stover

There are three distinct periods in the corn stover logistic operations:

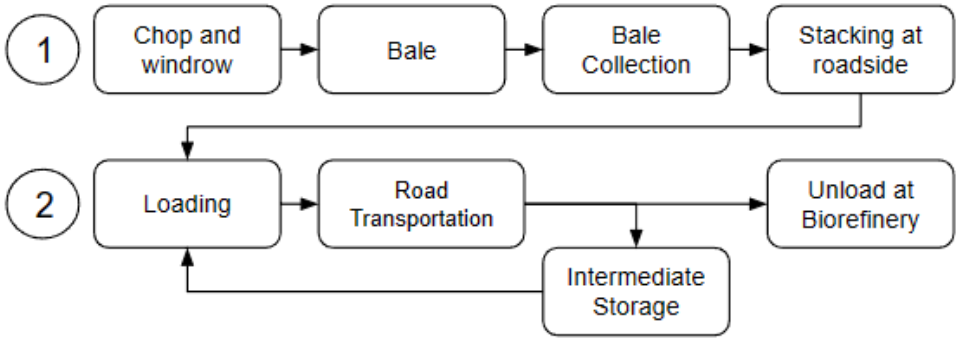
Harvest Season: The period immediately after grain harvest, when corn stover is chopped, baled, moved, and stacked on the side of the field.

Roadside bale pickup and transportation: The window of time between grain harvest and corn planting season, when the bales on the side of the field are loaded, transported, and unloaded either directly to the biorefinery or at an intermediate storage site for later delivery to the biorefinery.

Post-harvest after planting: Bales have been removed from corn fields and may be at an intermediate storage facility for several months before being finally transported to the biorefinery. Well-drained ground and tarps are recommended to protect the ground from the elements and minimize dry matter loss.

Figure A-3 below illustrates the different phases of the logistics of harvesting and transporting corn stover bales:

Figure A-3. Corn stover logistics operations[10]



The farm-gate cost estimation is based on the recently published literature review and Outreach modeling[11] and takes into account nutrient deficiency, chopping, bailing, and edge-of-field stacking costs. The model does not account for the cost of covering the bale pile or a harvest coordination cost, which will be incurred when the project developer takes over the inventory.

There is minimal trade of corn stover bales within the supply zone; therefore, there is no pricing benchmark, either as biomass or bale and an understanding of pricing for a potential bio-based project is limited. The estimated price for corn stover bales is derived from a combination of modeling, soil nutritional replacement, and direct outreach to farmers.

Although not used as animal bedding due to the cattle being raised on grazing pasture, corn stover may have demand spikes in years when hay production has low yields and corn stover is used to supplement livestock nutrition. However, many of the cattle farms are also corn growers and may bale their own corn stover or even for neighbors' use, and therefore, there is no established market price for this product.

When interpreting prices verbally indicated by farmers, two limitations should be considered. The cost of replacing fertilizer due to the removal of biomass from the soil is a critical consideration for crop growers. Regarding pricing, ask prices for bales tend to be high; however, in markets where very few farmers are participating as biomass suppliers, pricing

[10] https://www.sciencedirect.com/science/article/abs/pii/S0306261917302878?via%3Dihub
[11] https://www.extension.iastate.edu/agdm/crops/html/a1-70.html

is unknown to many and, therefore, tends to be unrealistic. The pricing calculations draw from a database of machinery costs, fertilizer market prices, and verbal indications from farmers during outreach to try and create as realistic a price as possible.

Pricing calculations to estimate the cost of a bale at the roadside of a field follow the Iowa State University's Extension and Outreach modeling[12] and takes into account the nutrient deficiency from removing the biomass from the field. Due to the relatively established corn stover market in Iowa, pricing data from that region is used, however, our outreach to the local experts confirmed that these prices are also applicable to the BDO Zone region once corn stover market starts establishing in the region due to the demand from future biomass projects.

The latest fertilizer prices[13] are used to calculate nutrient replacement values paid to the crop growers to remove a portion of their corn stover as follows:

Table A-8. Nutrition calculation assumptions

Nutrient Removal Rate (lbs./bdt of biomass)		DTN Fertilizer Price (Dec 2023)		Cost of Nutrient Removal ($/bdt)
N	0	DAP	721	
P2O5	3.5	P/lbs.	0.73	3.00
P	1.5	Potash	514	
K2O	19.2	K/lbs.	0.32	6.50
K	15.9			

The calculated dollar value associated with the nutrient deficit from the biomass removal in this study is estimated to be $9.46/ bdt, referred to as the "material cost". The material cost is the price paid to the crop growers intended to replace nutrient deficiency from the removal of biomass from the soil. Due to the significant variation in soil type and yields and lower yields of corn in the BDO Zone region, this report assumes a range for nutrient replacement, applying a 15-25% premium to the estimated nutrient removal for a final material cost compensation of $11-12/ bdt, to encourage farmers to supply their corn stover.

Other assumptions considered in the methodology include:

1) Given fair corn stover prices, growers will likely be willing to supply;
2) The biomass project developer will successfully invest in creating relationships with growers to establish supply;
3) Once the biomass facility is commissioned, the price of the corn stover becomes attractive, and the supply chain develops, participation levels will likely increase.

Material Cost: $11-12/bdt

Flail Chopper Cost: $9-10/bdt

Baling & Collection Cost: $30-35/bdt

Edge of field stacking Cost: $ 3-5/bdt

The field operations cost is estimated to be in the range of $53-62/bdt, which is the sum of material cost, chopping, baling, collection, and stacking at the edge of the field. However, that is not the full price estimated to be paid to the farmer for

[12] Estimating a Value for Corn Stover | Ag Decision Maker (iastate.edu)
[13] https://www.dtnpf.com/agriculture/web/ag/crops/article/2023/08/30/major-retail-fertilizer-prices-lower

the bale, as outreach indicated that in order to compensate for the cost of opportunity, they would require a profit of at least $18/acre, or $16/bdt (sustainable removal yield of around 1.1 dry tone/acre). On this basis, the estimated corn stover price at the farm-gate is $69-78/bdt.

Transport Cost

The bale weight (wet basis) range is assumed[14] to be 1,100 and 1,300 lbs. for large 5'x6' round bales and 4'x4'x8' square bales, respectively. The average bale weight used in this report is assumed to be 1,200 lbs. (wet basis), which is 0.60 tons or 0.47 bdt/bale.

The transport cost is calculated for an average drive distance of 50 miles for a supply radius of 75 miles at an average cost of $4.00/mile[15] (one way). The cost of loading and unloading (bale handling) is approximately $5.80/bdt. However, from the outreach to transportation companies in the region, it is possible that there would be a charge per diem; in this case, the figure provided was around $720 per half day, which is the minimum charge.

Table A-9. Bale load capacity configuration table[16]

Truck Configurations[a]	Load Limits		Payload		Maximum Load Bulk Density (DM lb/ft³)
	Length (ft)	GVW (lb)	Max (lb)	Square Bale Count	
(1) 48-ft flatbed trailer	48[b]	80,000[b]	51,100	24 – 4×4×8-ft 36 – 3×4×8-ft	16.6 – 4×4×8-ft 14.8 – 3×4×8-ft
(2) 53-ft flatbed trailer	53[c]	80,000[b]	50,800	26 – 4×4×8-ft 39 – 3×4×8-ft	15.3 – 4×4×8-ft 13.6 – 3×4×8-ft
(3) 24-ft flatbed tractor pulling two 30-ft flatbed trailers	105[d,e]	105,500[d]	59,500	44 – 4×4×8-ft 66 – 3×4×8-ft	10.6 – 4×4×8-ft 9.4 – 3×4×8-ft

As shown in Table A-9, a standard 53' flatbed trailer can carry between 26 and 39 bales per load (depending on the bale size). For commercial-scale biomass projects, it is common that the project developer will require large square bales to minimize transportation risks and storage costs. Assuming 39 bales with an average weight of 1,200 lbs., the payload is estimated to be 23.4 tons (wet) or 21.91 bdt. Given this average payload, the transportation cost is $21.91/bdt. While the report expresses quantities in bone dry tons, a table detailing the actual transportation cost of bales at 22% moisture content can be found in Appendix C.

In summary, the estimated delivery cost is $97-106/bdt, including farm-gate price ($69-78/bdt), transportation cost ($21.91/bdt), and loading/unloading ($5.80/bdt).

[14] Bale weight varies based on the type of equipment and the operator experience. Each manufacturer will publish numbers. For example, AGCO high density balers will compact to 13 lbs/cubic feet. Publications refer to "assumptions". The provided bales densities are the average reported values
[15] Cost estimates acquired through direct outreach to transportation companies, but are subject to change.
[16] a. Impacts on transportation costs for these configurations are discussed in greater detail in Section 2.3.2.2. b. Federal limits. c. Common state maximum on National Network (NN) highways. d. Allowable common limits in CO, ID, KS, ND, NE, OK, and SD for two trailing units on non-NN highways. e. Overall truck length limit. Actual load length is 95 ft

Table A-10. Rated price range calculation breakdown in $/bdt and $/bale.

Cost Component	$/bdt	$/bale
Material cost/Fertilizer replacement cost	11-12	5.17 - 5.64
Crop growers' compensation for removal of corn stover	16	7.52
Chopping	9-10	4.23 - 4.70
Baling and collection	30-35	14.1 - 16.45
Stacking at the field side	3-5	1.41 - 2.35
Handling (loading and unloading)	5.80	2.73
Transportation	21.91	9.96
Delivered price	**97 - 106**	**45 – 50**

APPENDIX B: RISK INDICATOR SCORING METRICS

CATEGORY 1.0: SUPPLIER RISK

1.1 Risk Factor: Credit-Worthiness/Future Solvency of Suppliers

1.1.1 Longevity & History of Supplier Performance

Rationale: Number of years in business is a positive indicator of future solvency. Historical performance is an indicator of future performance.
Risk Information: The supply zone has historically been a crop-growing region, with beef cattle on a smaller scale. Corn production has averaged around 1,000,000 tons per year in the last decade. The expertise and experience of growers are well established in the supply zone where, on average, 97% of the planted area has been harvested.

Raw Risk Likelihood (RRL) The risk likelihood is deemed *low*, therefore the RRL is 4 out of 10.	**Score** **4**
Raw Risk Impact (RRI) The risk impact is deemed *low*, therefore the RRI is 4 out of 10.	**Score** **4**
Gross Risk Indicator (GRI) The Gross Risk Indicator (RRL × RRI) is 16 out of 100.	**Score** **16**
Mitigation/Notching *RRL Mitigation (Notch)* No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).	**Notch** **NN**
Loaded RI Score The Loaded RI Score ((1-Total Notch) × GRI Score) is 16 out of 100.	**Score** **16**

1.2 Risk Factor: Conflicts of Interest/Vested Interest with Competing Market(s)

1.2.1 Suppliers' 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 supplier's dependences on competing markets to accept or purchase other products/by-products. During periods of feedstock shortage such suppliers may be more likely to allocate the scarce supply to a competitor resulting in supply disruptions for the Issuer.
Risk Information: There is no industrial demand for corn stover bales in the supply zone. The livestock is raised mostly on pasture lands supplemented with hay, but the erratic weather patterns may occasionally cause a shortage of forage and hay bales for feed. In this situation, farmers use corn stover bales to supplement their livestock feed, even though this biomass has a low nutritional value. In a year such as 2022, where draught affected all forages and crops and yields were 5% lower than the 10-year average, the corn stover baled was used for livestock nutrition.

Raw Risk Likelihood (RRL) The risk likelihood is deemed *medium*, therefore the RRL is 6 out of 10.	**Score** **6**
Raw Risk Impact (RRI) The risk impact is deemed *medium*, therefore the RRI is 6 out of 10.	**Score** **6**

Gross Risk Indicator (GRI)	**Score**
The Gross Risk Indicator (RRL × RRI) is 36 out of 100.	**36**
Mitigation/Notching *RRL Mitigation (Notch)* No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).	**Notch** **NN**
Loaded RI Score	**Score**
The Loaded RI Score ((1-Total Notch) × GRI Score) is 36 out of 100.	**36**

1.3 Risk Factor: Supplier Control Over Production and Transportation

1.3.1 Ownership of Land/Means of Production

Rationale: Suppliers that own land where feedstock is produced, or a production facility, tend to have better control of supply chains and present lower degrees of supply risk.

Risk Information: Crop growers are owners of the land where feedstock is produced. Overall, these lands have been used for crop production, and the ownership will not impact the corn stover supply.

Raw Risk Likelihood (RRL)	**Score**
The risk likelihood is deemed *low*, therefore the RRL is 4 out of 10.	**4**
Raw Risk Impact (RRI)	**Score**
The risk impact is deemed *low*, therefore the RRI is 4 out of 10.	**4**
Gross Risk Indicator (GRI)	**Score**
The Gross Risk Indicator (RRL × RRI) is 16 out of 100.	**16**
Mitigation/Notching *RRL Mitigation (Notch)* No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).	**Notch** **NN**
Loaded RI Score	**Score**
The Loaded RI Score ((1-Total Notch) × GRI Score) is 16 out of 100.	**16**

1.3.2 Ownership of Equipment

Rationale: In most cases, suppliers which own or lease equipment for harvest, collection and processing feedstock are lower risk than those who are not. For example, third-party harvesting equipment may not be available when required. Short harvest windows may be missed if a farmer and contractor cannot schedule harvest times that are convenient and quantity shortages can result. However, in some circumstances reliance on third-party equipment to harvest or produce feedstock can decrease supply chain risk. For example, when harvesting agricultural residues such as corn stover, the use of a third-party company with standard equipment specializing in harvesting, collection and transportation may decrease quality variations (e.g., ash content) of final feedstock.

Risk Information: Currently, there is a small-scale market for corn stover bales as a feed alternative to beef cattle. These bales are round and expected to be no more than 5% of total availability. However, farmers who raise cattle are more

likely to own silage implements. Equipment ownership for bailing corn stover is low, where usually one grower will invest and provide service or rent to neighbors.

A large-scale baling operation would require a significant increase in equipment availability.

Raw Risk Likelihood (RRL) The risk likelihood is deemed *very high*, therefore the RRL is 10 out of 10.	**Score** **10**
Raw Risk Impact (RRI) The risk impact is deemed *very high*, therefore the RRI is 10 out of 10.	**Score** **10**
Gross Risk Indicator (GRI) The Gross Risk Indicator (RRL × RRI) is 100 out of 100.	**Score** **100**
Mitigation/Notching *RRL Mitigation (Notch)* The likelihood of this risk can be reduced by providing incentives such as offtake agreements and financing for the purchase of equipment, which would create a stable investment opportunity for farmers. However, even then, the likelihood of growers to invest in highly specialized equipment is low. There is no notching in this category because there are no established incentives in place. *RRI Mitigation (Notch)* Certain biomass projects invest in the collection and bailing fleets, taking the responsibility of owning equipment away from the farmer. Other third-party operators can provide the collection and bailing service. Such arrangements would mitigate the feedstock quantity available for a project. Therefore, this risk impact is notched at 50%. The Total Notch (RRL Notch × RRI Notch) is 50%.	**Notch** **50%**
Loaded RI Score The Loaded RI Score ((1-Total Notch) × GRI Score) is 50 out of 100.	**Score** **50**

1.3.3 Ownership of Transportation/Logistics

Rationale: In most cases, suppliers that own or lease transportation equipment necessary to transport biomass from forest or field are lower risk than those who do not. However, in some circumstances, reliance on third parties to transport biomass is common practice and does not contribute to risk.

Risk Information: The region has a history of producing and transporting hay bales for livestock feed. Given that roughly 20% of the land in the supply zone is used for hay production, the transportation infrastructure in place could also be diverted for transporting corn stover bales. Furthermore, there would be no competition for trucks for transporting corn stover since the hay baling season is in the summer.

Raw Risk Likelihood (RRL) The risk likelihood is deemed *low*, therefore the RRL is 4 out of 10.	**Score** **4**
Raw Risk Impact (RRI) The risk impact is deemed *low*, therefore the RRI is 4 out of 10.	**Score** **4**
Gross Risk Indicator (GRI) The Gross Risk Indicator (RRL × RRI) is 16 out of 100.	**Score** **16**

Mitigation/Notching	**Notch**
RRL Mitigation (Notch) No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).	**NN**
Loaded RI Score	**Score**
The Loaded RI Score ((1-Total Notch) × GRI Score) is 16 out of 100.	**16**

1.3.4 Feedstock as a Secondary Transformation

Rationale: A secondary transformation dependent upon the production of primary products, e.g., forest residues, corn stover, bark, or sawmill chips (unless from a dedicated chip mill) are all secondary transformations of a primary product.

Risks are higher if feedstock is a secondary transformation of a primary, more valuable product. It may not be economical for suppliers to produce biomass on its own, in the absence of markets for the primary product. For example, a supplier may produce dimensional lumber as its primary product and wood chips as a by-product, therefore relying on the health of the housing market for production levels. If the demand for dimensional lumber drops, so can the availability of sawmill residues.

In case of agricultural feedstocks such as corn stover, the feedstock is a by-product of a primary crop. Since the primary crop is significantly more lucrative than the residue, it will be a priority for the producer. If production of the primary crop requires resources to be taken away from the production of 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 also perceive harvesting and collection of the feedstock as a nuisance, potentially decreasing production levels.

Understanding the economic drivers for suppliers' primary product can help gauge risk levels for secondary transformation biomass products.

Risk Information: The supply zone has a long history of grain production, and despite having consistent production figures with around 93% of the planted area harvested in the last 10 years, the average yield is relatively low, around 122 bu/acre, mainly due to shallow soil and erratic rain patterns. The University of Iowa's Extension Program recommends that corn stover should not be removed from croplands with grain yields lower than 150 bushels/acre for economic and soil health reasons. It's reasonable to expect that some crop growers in the supply zone will likely not be willing to remove corn stover from their fields.

Raw Risk Likelihood (RRL)	**Score**
The risk likelihood is deemed *high*, therefore the RRL is 8 out of 10.	**8**
Raw Risk Impact (RRI)	**Score**
The risk impact is deemed *very high*, therefore the RRI is 10 out of 10.	**10**
Gross Risk Indicator (GRI)	**Score**
The Gross Risk Indicator (RRL × RRI) is 80 out of 100.	**80**
Mitigation/Notching	**Notch**
RRL Mitigation (Notch) Increasing yield and improving farm practices would be the primary possible mitigating factors. However, there are limitations on their implementation, and therefore, this category cannot be notched. *RRI Mitigation (Notch)* No adjustment.	**NN**

The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).
Loaded RI Score **Score**
The Loaded RI Score ((1-Total Notch) × GRI Score) is 80 out of 100. **80**

1.4 Risk Factor: Supplier Experience

1.4.1 Fundamental Feedstock Production Experience

Rationale: Risk is higher when suppliers have limited experience with planting/growing/harvesting/processing and/or collecting biomass. Limited experience may be common for stover or forest residue supply chains where farmers or forestry producers may have no previous experience.

Risk Information: Farmers in the BDO Zone have a history of baling hay for livestock. In years when draught affects forage yields, corn stover is baled as a substitute for animal feed. Even though there has never been large-scale demand for corn stover bales, adapting baling practices for this biomass could be feasible, but one could expect a longer learning curve for quality and quantity optimization.

Raw Risk Likelihood (RRL)	**Score**
The risk likelihood is deemed *low*, therefore the RRL is 4 out of 10.	**4**
Raw Risk Impact (RRI)	**Score**
The risk impact is deemed *medium*, therefore the RRI is 6 out of 10.	**6**
Gross Risk Indicator (GRI)	**Score**
The Gross Risk Indicator (RRL × RRI) is 24 out of 100.	**24**
Mitigation/Notching	**Notch**
RRL Mitigation (Notch) No adjustment. *RRI Mitigation (Notch)* Introducing a third-party custom harvester can increase the quantity harvested and feedstock quality. Additionally, partnering with the University's extension programs and providing training can expedite the skills acquisition. Therefore, this category is notched at 50%. The Total Notch (RRL Notch × RRI Notch) is 50%.	**50%**
Loaded RI Score	**Score**
The Loaded RI Score ((1-Total Notch) × GRI Score) is 12 out of 100.	**12**

1.4.2 Production Scale Experience

Rationale: Scale-up entails risk. Risk is higher when suppliers have limited experience with the production of the quantity of feedstock required.

Risk Information: The region has a history of baling hay, however, the equipment and quality needs for this product are very different from a commercial scale bio-developer taking in large amounts of high-density corn stover bales. The current equipment and labor in use for forages are not specialized or optimized for high efficiency. Scaling up the harvesting, collection, and transportation of corn stover with proper quality controls is a major challenge in this supply zone.

Raw Risk Likelihood (RRL)	**Score**
The risk likelihood is deemed *high*, therefore the RRL is 8 out of 10.	**8**
Raw Risk Impact (RRI)	**Score**
The risk impact is deemed *high*, therefore the RRI is 8 out of 10.	**8**

Gross Risk Indicator (GRI)	**Score**
The Gross Risk Indicator (RRL × RRI) is 64 out of 100.	**64**
Mitigation/Notching *RRL Mitigation (Notch)* Previous baling experience can be leveraged through extension programs and other training resources. However, the likelihood of mitigating the scale-up risk of an entire supply zone in the short term is remote. Therefore, this category is notched at 25%. *RRI Mitigation (Notch)* Introducing a third-party custom harvester that has experience with this biomass can mitigate the scaling risk of a project. Skilled operators with experience bailing in other regions can positively impact the entire supply chain; therefore, this category is notched at 50%. The Total Notch (RRL Notch × RRI Notch) is 63%.	**Notch** **63%**
Loaded RI Score	**Score**
The Loaded RI Score ((1-Total Notch) × GRI Score) is 24 out of 100.	**24**

1.5 Risk Factor: Supplier Harvesting/Collection/Processing Capacity

1.5.1 Supplier's Equipment Efficiency

Rationale: Equipment efficiency significantly influences supplier's feedstock production capacity. Understanding supplier's equipment capability enables understanding of their ability to produce feedstock of suitable quality.

Risk Information: The region's most common type of baling equipment is round balers for hay. A bio-based operator is likely to demand high-density square bales as a standard feedstock, rendering the current infrastructure unsuitable for the required efficiency. The need to upgrade equipment increases risk.

Raw Risk Likelihood (RRL)	**Score**
The risk likelihood is deemed *high*, therefore the RRL is 8 out of 10.	**8**
Raw Risk Impact (RRI)	**Score**
The risk impact is deemed *high*, therefore the RRI is 8 out of 10.	**8**
Gross Risk Indicator (GRI)	**Score**
The Gross Risk Indicator (RRL × RRI) is 64 out of 100.	**64**
Mitigation/Notching *RRL Mitigation (Notch)* Establishing commercial demand in the supply zone could incentivize farmers to purchase or upgrade their equipment to improve efficiency. Therefore, this category is notched at 25%. *RRI Mitigation (Notch)* Introducing a third-party service provider such as Pacific Ag that will bring their own equipment for the bailing operation can significantly reduce the supply risk. Therefore, this category is notched at 50%. The Total Notch (RRL Notch × RRI Notch) is 63%.	**Notch** **63%**
Loaded RI Score	**Score**
The Loaded RI Score ((1-Total Notch) × GRI Score) is 24 out of 100.	**24**

1.6 Risk Factor: Supplier Motivation

1.6.1 Feedstock Production Priority

Rationale: When biomass feedstock is a secondary or non-core line of business, or when it is a by-product or a residual from a more valuable primary product, then suppliers may not put in sufficient effort for consistent production. Risk of breach increases when production and/or delivery of feedstock compromises a 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 (e.g., corn) or forest residues (e.g., pulpwood)) supply may not be a top priority for a supplier.

Risk Information: Collecting and baling corn stover after grain harvesting happens only when livestock nutrition must be supplemented due to a shortage of forage; however, a considerable part of cattle farmers are also corn producers and use their crops for silage, in which case there will be no biomass left in the field. Given that it is very common that cattle growers are also grain producers, one could expect the priority of the biomass to be directed to silage, potentially disrupting supply quantities of corn stover for a bio-based project.

Raw Risk Likelihood (RRL) The risk likelihood is deemed *high*, therefore the RRL is 8 out of 10.	**Score** **8**
Raw Risk Impact (RRI) The risk impact is deemed *high*, therefore the RRI is 8 out of 10.	**Score** **8**
Gross Risk Indicator (GRI) The Gross Risk Indicator (RRL × RRI) is 64 out of 100.	**Score** **64**
Mitigation/Notching *RRL Mitigation (Notch)* Applying BAM to the potential biomass availability should cover the risk associated with competing industries. Therefore, this category is notched at 75%. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is 75%.	**Notch** **75%**
Loaded RI Score The Loaded RI Score ((1-Total Notch) × GRI Score) is 16 out of 100.	**Score** **16**

CATEGORY 2.0: COMPETITOR RISK

2.1 Risk Factor: Influence on Feedstock Supply of Existing Markets

2.1.1 Competitor Locations and Overall Geographical Influence

Rationale: Competitors' locations relative to siting locations within a BDO Zone can affect the viability of procuring feedstock and the cost of that feedstock. Accurate and detailed competitor mapping provides an understanding of the geographical influence a competitor may have on new plants within a BDO Zone, including competitive advantages such as short hauling.

Risk Information: There is no established demand for a large supply of corn stover bales in the supply zone. However, there is competition for the corn plant for silage, which would leave no biomass in the field. In drought years, additional corn stover may be baled to serve as feed in addition to the silage. The demand for planted corn by the cattle industry significantly increases risk in this category.

Raw Risk Likelihood (RRL) The risk likelihood is deemed *medium*, therefore the RRL is 8 out of 10.	**Score** **8**

Raw Risk Impact (RRI) The risk impact is deemed *medium*, therefore the RRI is 8 out of 10.	**Score** **8**
Gross Risk Indicator (GRI) The Gross Risk Indicator (RRL × RRI) is 64 out of 100.	**Score** **64**
Mitigation/Notching *RRL Mitigation (Notch)* No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).	**Notch** **NN**
Loaded RI Score The Loaded RI Score ((1-Total Notch) × GRI Score) is 64 out of 100.	**Score** **64**

2.1.2 Current and Historical Consumption of Feedstock Quantity

Rationale: Clear understanding of feedstock consumption by key competitors for each rated type of feedstock in the BDO Zone is essential to quantifying competitor risk.

Understanding current consumption and 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. It can enable more accurate estimates of the sensitivity of feedstock availability to potential future consumption levels or to the impact of external events (e.g., weather events, structural economic changes, seasonality, or policy change).

Risk Information: Corn stover bales have been used as animal feed with relative frequency and demand increases in years of drought. Of the corn harvested for grain, 20-40% is baled. The combination of low corn grain yields at 122 bu/acre and the demand for corn stover bales driven by the livestock farmers increases risk.

Raw Risk Likelihood (RRL) The risk likelihood is deemed *high*, therefore the RRL is 8 out of 10.	**Score** **8**
Raw Risk Impact (RRI) The risk impact is deemed *high*, therefore the RRI is 8 out of 10.	**Score** **8**
Gross Risk Indicator (GRI) The Gross Risk Indicator (RRL × RRI) is 64 out of 100.	**Score** **64**
Mitigation/Notching *RRL Mitigation (Notch)* No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).	**Notch** **NN**
Loaded RI Score The Loaded RI Score ((1-Total Notch) × GRI Score) is 64 out of 100.	**Score** **64**

2.1.3 Competitor Pricing and Price Sensitivity

Rationale: Understanding how much competitors pay (or receive) for different feedstock types is an essential step to determining competitiveness of Issuer and to accurate assessment of the delivered cost range in the BDO Zone rating.

Current and historical prices paid/received by competitors provide insight into their procurement behaviors and exert pressure on suppliers in the BDO Zone. Such as ability/willingness to pay premiums for feedstock during times of feedstock shortage or reduce prices (or cut off deliveries) during gluts. Competitors that have an ability to offer higher prices for feedstock during feedstock shortages can pose significant risk to Issuer.

Knowledge of competitor pricing and price sensitivity is also 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).

Risk Information: There has never been large-scale demand for corn stover bales in this supply zone; therefore, no market price is available. From outreach, farmers indicated that they often use corn stover bales as animal feed in their operations, as many grow grain and raise cattle. Due to the uncertainty of the price range and the internal use of biomass, this category has increased risk.

Raw Risk Likelihood (RRL)	**Score**
The risk likelihood is deemed *medium*, therefore the RRL is 6 out of 10.	**6**
Raw Risk Impact (RRI)	**Score**
The risk impact is deemed *medium*, therefore the RRI is 6 out of 10.	**6**
Gross Risk Indicator (GRI)	**Score**
The Gross Risk Indicator (RRL × RRI) is 36 out of 100.	**36**
Mitigation/Notching	**Notch**
RRL Mitigation (Notch) No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).	**NN**
Loaded RI Score	**Score**
The Loaded RI Score ((1-Total Notch) × GRI Score) is 36 out of 100.	**36**

2.1.4 Impacts of Future Demand on Feedstock Availability and Price by Current Competitors

Rationale: Feedstock utilization in a BDO Zone can change over time. Expansion of feedstock demand by current competitors can put additional pressure on feedstock and can lead to higher prices, feedstock disruptions, shortages or supplier breach or other types of supply chain disruption.

If current markets for feedstock have been publicly signaling the potential for increased demand for feedstock (in the case of a sawmill adding a shift, or pulp mill potentially expanding into production of renewable chemicals, for example), high interest in a supply basin can make suppliers overconfident, leading to a supplier-controlled market where short-term contracting becomes the norm and supply chain reliability is compromised for the Issuer. If and when it occurs, increased demand on feedstock may decrease availability and increase cost for new plants within the BDO Zone.

Risk Information: Currently, there is no established demand for corn stover. Although the use of corn stover for livestock nutrition is quite common, it does not present quantities that would significantly affect availability and price. Farmers also harvest corn for silage, which renders those acres unsuitable for corn stover removal. In years of drought, which are not very often, farmers rely even more on this biomass, pressuring availability and increasing risk.

Raw Risk Likelihood (RRL)	**Score**
The risk likelihood is deemed *medium*, therefore the RRL is 6 out of 10.	**6**

Raw Risk Impact (RRI)	**Score**
The risk impact is deemed *medium*, therefore the RRI is 6 out of 10.	**6**
Gross Risk Indicator (GRI)	**Score**
The Gross Risk Indicator (RRL × RRI) is 36 out of 100.	**36**
Mitigation/Notching *RRL Mitigation (Notch)* No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).	**Notch** **NN**
Loaded RI Score	**Score**
The Loaded RI Score ((1-Total Notch) × GRI Score) is 36 out of 100.	**36**

2.1.5 Soft Supply Influence of Existing Markets

Rationale: In some cases, existing markets for feedstock may be able to exert high degrees of pressure over local suppliers, effectively enabling control feedstock, especially during times of shortage. This control can derive from qualitative or "soft" factors such as long previous relationships between local suppliers and existing markets for feedstock.

Risk Information: Historically, there has never been a commercial market for corn stover bales in the supply zone; however, this biomass is commonly used as bedding and feed for livestock in the region. Many farms grow both cattle and grain and may harvest some of the fields for silage. In these instances, there would be no biomass available for baling. However, this practice occurs in around 5-10% of the panted area and, therefore, doesn't present a high risk. The existing livestock may exert more influence in availability when drought affects not only silage acres through reduced yield potential (tons of usable silage for feed) but also the planted acres intended for grain production (poor pollination, low yield potential, poor plant growth, etc.). Farmers will harvest additional acres intended for grain as silage to salvage some income, reducing the corn stover potential.

Raw Risk Likelihood (RRL)	**Score**
The risk likelihood is deemed *medium*, therefore the RRL is 6 out of 10.	**6**
Raw Risk Impact (RRI)	**Score**
The risk impact is deemed *medium*, therefore the RRI is 6 out of 10.	**6**
Gross Risk Indicator (GRI)	**Score**
The Gross Risk Indicator (RRL × RRI) is 36 out of 100.	**36**
Mitigation/Notching *RRL Mitigation (Notch)* No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).	**Notch** **NN**
Loaded RI Score	**Score**
The Loaded RI Score ((1-Total Notch) × GRI Score) is 36 out of 100.	**36**

2.1.6 Temporary Market-Driven Markets

Rationale: Alternative, non-traditional, market-driven competitors for feedstock can drive feedstock demand in unusual circumstances. A BDO Zone Rating Issuer based on 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 use corn stover in place of hay, driving the price of feedstock and decreasing availability for bio-projects.[17]

Risk Information: The land in the BDO Zone is roughly split between grain crops and pasture for grazing, with the last 20% being used to grow forages. Many farmers grow both grain and cattle. Since livestock is a relevant operation in the region, corn stover bales are often used to supplement animal nutrition; however, the main activity impacting feedstock availability is harvesting corn for silage, which removes all biomass from the soil. Apart from the normal nutrition routine, a drought or break in hay baling would force farmers to harvest more acres for silage or direct more corn stover to compensate for the lack of other forages. However, the likelihood of this happening continuously and negatively impacting the supply chain is low.

Raw Risk Likelihood (RRL)	**Score**
The risk likelihood is deemed *low*, therefore the RRL is 4 out of 10.	**4**
Raw Risk Impact (RRI)	**Score**
The risk impact is deemed *medium*, therefore the RRI is 6 out of 10.	**6**
Gross Risk Indicator (GRI)	**Score**
The Gross Risk Indicator (RRL × RRI) is 24 out of 100.	**24**
Mitigation/Notching	**Notch**
RRL Mitigation (Notch) No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).	**NN**
Loaded RI Score	**Score**
The Loaded RI Score ((1-Total Notch) × GRI Score) is 24 out of 100.	**24**

2.2 Risk Factor: Specific Competitors' Competitive Advantage

2.2.1 Relative Inventory Capacity

Rationale: The more inventory a competing biomass facility is able to store, the more competitively pressure it can exert on supply. Ability to store large inventories allows competitors to purchase inventory when the prices are low, potentially giving it an economic advantage. Additionally, the ability to store inventory during feedstock supply surpluses can enable competitors to continue to intake feedstock when the Issuers plant (with lesser inventory capacity) may be forced to put suppliers on quota. Larger inventory capacity on the part of competing markets thereby creates supplier loyalty and can make it more difficult for new projects to secure supply without paying a significant premium.

Risk Information: No large-scale facilities operate; therefore, no inventory is established in the BDO Zone region.

Raw Risk Likelihood (RRL)	**Score**
The risk likelihood is deemed *not relevant*, therefore the RRL is not rated.	**NR**
Raw Risk Impact (RRI)	**Score**
The risk impact is deemed *not relevant*, therefore the RRI is not rated.	**NR**

[17] Bergtold, 2018.

Gross Risk Indicator (GRI)	**Score**
The Gross Risk Indicator (RRL × RRI) is not rated.	**NR**
Mitigation/Notching	**Notch**
The Total Notch (RRL Notch × RRI Notch) is not rated.	**NR**
Loaded RI Score	**Score**
The Loaded RI Score (Total Notch × GRI Score) is not rated.	**NR**

2.2.2 Relative Accessibility/Delivery Hours and Wait Times

Rationale: The value attributed by suppliers to local competing markets for biomass is often directly related to the degree of flexibility the market provides in terms of delivery hours, and the more efficiently discharge can occur.

Risk Information: There is no established commercial market, and therefore, this risk indicator is not relevant.

Raw Risk Likelihood (RRL)	**Score**
The risk likelihood is deemed *not relevant*, therefore the RRL is not rated.	**NR**
Raw Risk Impact (RRI)	**Score**
The risk impact is deemed *not relevant*, therefore the RRI is not rated.	**NR**
Gross Risk Indicator (GRI)	**Score**
The Gross Risk Indicator (RRL × RRI) is not rated.	**NR**
Mitigation/Notching	**Notch**
The Total Notch (RRL Notch × RRI Notch) is not rated.	**NR**
Loaded RI Score	**Score**
The Loaded RI Score (Total Notch × GRI Score) is not rated.	**NR**

2.2.3 Relative Specification Advantages

Rationale: When choosing a market for biomass feedstock, suppliers not only look at price, but also at relative quality requirements or specifications. It is important to understand feedstock quality specifications for competing markets within the BDO Zone in order to accurately quantify the risk that competitors can exert on the Issuer's supply chain.

Risk Information: There is no commercial-scale demand for feedstock in the region; therefore, quality and specifications cannot be used as a tool to pressure competitors.

Raw Risk Likelihood (RRL)	**Score**
The risk likelihood is deemed *low*, therefore the RRL is 4 out of 10.	**4**
Raw Risk Impact (RRI)	**Score**
The risk impact is deemed *low*, therefore the RRI is 4 out of 10.	**4**
Gross Risk Indicator (GRI)	**Score**
The Gross Risk Indicator (RRL × RRI) is 16 out of 100.	**16**
Mitigation/Notching	**Notch**
RRL Mitigation (Notch) No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).	**NN**
Loaded RI Score	**Score**
The Loaded RI Score ((1-Total Notch) × GRI Score) is 16 out of 100.	**16**

2.2.4 Demand for Competitors' Products

Rationale: Increased demand for competitor's final product can cause an increased demand for feedstock by the competitor. For example, an increased demand for wood pellets due to high energy prices in Europe or for biofuels due to a favorable clean fuels policy can cause increased pellet/biofuel production by competing markets. Thereby driving demand for feedstock within a BDO Zone.
Risk Information: There is no large-scale commercial demand for corn stover that would create competition for the final product.

Raw Risk Likelihood (RRL) The risk likelihood is deemed *very low*, therefore the RRL is 2 out of 10.	**Score** **2**
Raw Risk Impact (RRI) The risk impact is deemed *very low*, therefore the RRI is 2 out of 10.	**Score** **2**
Gross Risk Indicator (GRI) The Gross Risk Indicator (RRL × RRI) is 4 out of 100.	**Score** **4**
Mitigation/Notching *RRL Mitigation (Notch)* No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).	**Notch** **NN**
Loaded RI Score The Loaded RI Score ((1-Total Notch) × GRI Score) is 4 out of 100.	**Score** **4**

CATEGORY 3.0: SUPPLY CHAIN RISK

3.1 Risk Factor: Feedstock Availability

3.1.1 Biomass Availability Multiple (BAM)

Rationale: Biomass Availability Multiple (BAM) indicates the degree of redundancy in an Issuer's supply chain in relation to the rated quantity in the BDO Zone. BAM is the mean ratio of biomass feedstock available to a project, in relation to delivered cost, divided by the Issuer's mean rated quantity. BAM is a strong indicator of supply chain resilience when stressed by supply shortage and/or supplier breach. BAMs of 1.5 or higher are generally signals of lower feedstock risk for new projects in BDO Zones.
Risk Information: Not all of the produced corn stover will be available for future biomass projects for reasons such as the unwillingness of crop growers to participate as a supplier, uncertainty in the length of harvest season, future competing demands, and labor/machine availability. The potential availability of corn stover with a farmer participation rate of 35% is estimated at 116,829 bdt/ yr. To account for unknown risks associated with the supply chain and possible errors in our assumptions, a Biomass Availability Multiple (BAM) 0f 1.2 is applied to the potential availability quantity **t**o achieve a low-risk rated quantity of 100,000 bdt/year of corn stover.

Raw Risk Likelihood (RRL) The risk likelihood is deemed *low*, therefore the RRL is 4 out of 10.	**Score** **4**
Raw Risk Impact (RRI) The risk impact is deemed *high*, therefore the RRI is 8 out of 10.	**Score** **8**
Gross Risk Indicator (GRI) The Gross Risk Indicator (RRL × RRI) is 32 out of 100.	**Score** **32**

Mitigation/Notching	**Notch**
RRL Mitigation (Notch) No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).	**NN**
Loaded RI Score	**Score**
The Loaded RI Score ((1-Total Notch) × GRI Score) is 32 out of 100.	**32**

3.1.2 Feedstock Supply Curve/Marginal Cost Curve

Rationale: The greater the feasible transport distance, the more feedstock is accessible to the Issuer, but at a higher delivered cost. The feedstock supply curve, sometimes 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 the cost of feedstock availability in times of supply disturbance. Biomass supply chains are prone to supply disturbances over time; suppliers can become insolvent, or weather events can temporarily disrupt feedstock availability. When a disturbance occurs, the Issuer 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 generally located further away than core supplier.

Risk Information: A supply curve illustrating the availability of corn stover based on distance can be found in Figure A-4. The supply curve does not represent actual corn stover biomass availability; rather, it illustrates an estimation of potential within the supply zone. The supply curve assesses the economic impact of sourcing biomass at longer distances; therefore, this report found that the rated quantity could theoretically be sourced within 35 miles. However, the limited information from farmer outreach and the difficulty in pinpointing where the actual supply would come from creates a challenge for calculating the cost impact of increased supply distances, and thus, increases risk.

Raw Risk Likelihood (RRL)	**Score**
The risk likelihood is deemed *medium*, therefore the RRL is 6 out of 10.	**6**
Raw Risk Impact (RRI)	**Score**
The risk impact is deemed *medium*, therefore the RRI is 6 out of 10.	**6**
Gross Risk Indicator (GRI)	**Score**
The Gross Risk Indicator (RRL × RRI) is 36 out of 100.	**36**
Mitigation/Notching	**Notch**
RRL Mitigation (Notch) No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).	**NN**
Loaded RI Score	**Score**
The Loaded RI Score ((1-Total Notch) × GRI Score) is 36 out of 100.	**36**

3.1.3 Seasonal Feedstock Supply Variation

Rationale: Biomass supply can present significant seasonal supply variations. Seasonal supply variations combined with limitations associated with longer-distance transportation and storage can lead to BDO Zone biomass supply imbalances[18] and can manifest in shortages and higher costs for Issuers.

Risk Information: Corn stover is only available after corn harvest, which occurs in late September through November; consequently, all corn stover must be harvested and stored within a few weeks and before farmers decide to till or the weather disrupts operations. Additionally, erratic weather patterns can impact yields, render fields unsustainable for biomass removal, and potentially affect the quantity and quality of feedstock.

Raw Risk Likelihood (RRL)	**Score**
The risk likelihood is deemed *medium*, therefore the RRL is 6 out of 10.	**6**
Raw Risk Impact (RRI)	**Score**
The risk impact is deemed *medium*, therefore the RRI is 6 out of 10.	**6**
Gross Risk Indicator (GRI)	**Score**
The Gross Risk Indicator (RRL × RRI) is 36 out of 100.	**36**
Mitigation/Notching	**Notch**
RRL Mitigation (Notch) The introduction of irrigation could mitigate the yield risk; however, it is unrealistic to expect that growers in the supply zone would invest in the infrastructure and change their farming practices to this end. Therefore, this category has no notching. *RRI Mitigation (Notch)* Inventory management can greatly lower the supply risk to a biorefinery. Therefore, this category is notched at 50%. The Total Notch (RRL Notch × RRI Notch) is 50%.	**50%**
Loaded RI Score	**Score**
The Loaded RI Score ((1-Total Notch) × GRI Score) is 18 out of 100.	**18**

3.1.4 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.

Risk Information: Figure A-3 shows the total planted and harvested corn in the supply zone with a 10-year average harvested area of around 424,378 acres. Over the same period, this supply zone has harvested about 97% of the planted area. The lowest average yields have been 122 bu/acre. The highest yield during the period was 137 bu/acre, and the largest harvested area was around 508,000 acres. The lowest yield has been 97 bu/acre, and the smallest harvested area is 340,000 acres. In addition to the significant variability in corn production, weather patterns can influence harvesting operations and even force farmers to till the fields early, rendering biomass collection unfeasible. The potential disruption in availability increases risk.

Raw Risk Likelihood (RRL)	**Score**
The risk likelihood is deemed *high*, therefore the RRL is 8 out of 10.	**8**
Raw Risk Impact (RRI)	**Score**
The risk impact is deemed *high*, therefore the RRI is 8 out of 10.	**8**

[18] Golecha & Gan 2016.

Gross Risk Indicator (GRI)	**Score**
The Gross Risk Indicator (RRL × RRI) is 64 out of 100.	**64**
Mitigation/Notching *RRL Mitigation (Notch)* Sourcing corn stover from the micro-regions that present higher average yields can mitigate the variability. Therefore, this category is notched at 50%. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is 50%.	**Notch** **50%**
Loaded RI Score	**Score**
The Loaded RI Score ((1-Total Notch) × GRI Score) is 32 out of 100.	**32**

3.2 Risk Factor: Historical Issues

3.2.1 Historical Feedstock Price Variations

Rationale: If volatility is shown in the historical feedstock price, then the risk of future price fluctuation is elevated. If feedstock prices have historically exceeded the price at which the Issuer would have to cease operations or breach a financial covenant (i.e., the "red line" feedstock cost), then mitigation measures should be put in place.

Risk Information: There is no historical price data for corn stover in the supply zone. Growers have no benchmark to create asking prices in a commercial supply operation and are required to be educated on the revenue potential for their biomass/corn stover bales when supplied to a bio-based project. The uncertainty about bale pricing increases the risk for a developer.

Raw Risk Likelihood (RRL)	**Score**
The risk likelihood is deemed *high*, therefore the RRL is 8 out of 10.	**8**
Raw Risk Impact (RRI)	**Score**
The risk impact is deemed *high*, therefore the RRI is 8 out of 10.	**8**
Gross Risk Indicator (GRI)	**Score**
The Gross Risk Indicator (RRL × RRI) is 64 out of 100.	**64**
Mitigation/Notching *RRL Mitigation (Notch)* With the establishment of solid demand for corn stover from a commercial biomass project and the increased knowledge of crop growers on corn stover field operations, the benchmark price is expected to emerge in the region. Therefore, 50% notching is considered for this risk indicator. No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is 50%.	**Notch** **50%**
Loaded RI Score	**Score**
The Loaded RI Score ((1-Total Notch) × GRI Score) is 32 out of 100.	**32**

3.2.2 Low Historical Demand for Feedstock in the BDO Zone

Rationale: If Issuer BDO Zone does not have history of developed, large-scale feedstock procurement, suppliers may not have sufficient expertise in feedstock production to ensure reliable supply, especially in early years. This can be particularly true for forest residues where typically the infrastructure for collection, processing and delivery is immature.

Where supply chains are not well-established, risk can be mitigated when new bio-based plants control a higher degree of feedstock processing. For example, if a BDO Zone rating is issued for clean wood chips and the historical demand in the Zone has been exclusively for pulpwood, then supply chain risk will be decreased for new bio-based plants that intake of pulpwood and manage log debarking and chipping internally. Rather than requiring inexperienced suppliers to deliver debarked wood chips.

Risk Information: The supply zone has no history of commercial-scale corn stover demand; however, farmers bale some for animal feed. The region has a longer history of baling hay. In drought years, quantities of corn stover baled increase to supplement animal feed potentially disrupted by lower quantities of forages. This baling experience could be leveraged to expedite scaling up corn stover collection at a larger scale.

Raw Risk Likelihood (RRL) The risk likelihood is deemed *medium*, therefore the RRL is 6 out of 10.	**Score** **6**
Raw Risk Impact (RRI) The risk impact is deemed *medium*, therefore the RRI is 6 out of 10.	**Score** **6**
Gross Risk Indicator (GRI) The Gross Risk Indicator (RRL × RRI) is 36 out of 100.	**Score** **36**
Mitigation/Notching *RRL Mitigation (Notch)* Demand for commercial-scale corn stover bales in the supply zone will only be achieved once a credible project is established with stable biomass demand. Due to the externality of this category, there is no notching. *RRI Mitigation (Notch)* Introducing a third-party service provider with expertise in bale collection can mitigate the historically low demand for corn stover. Therefore, this category is notched at 50%. The Total Notch (RRL Notch × RRI Notch) is 50%.	**Notch** **50%**
Loaded RI Score The Loaded RI Score ((1-Total Notch) × GRI Score) is 18 out of 100.	**Score** **18**

3.2.3 History of Production/Feedstock is a New/Secondary Crop or a Byproduct

Rationale: If 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 such risk. Secondary crop or by-product producers may be less likely to prioritize production.

For new crop types, inexperience in planting, harvest, collection, and yield data may pose higher levels of risk.

If feedstock is a secondary transformation (i.e., wheat straw, corn stover, or forest residue), then production can be subject to variables beyond suppliers' control (e.g., changing demand for sawtimber, or primary crop prices).

Risk Information: Although there is no large-scale demand for corn stover bales, farmers in this BDO zone have experience baling this biomass for animal feed, as well as hay. In normal years where drought does not affect yields, up to 10% of the corn grown can be harvested as silage, which is more commonly used for animal feed. This unique situation presents corn stover as a byproduct of corn production but also partially competing with corn acres intended for silage.

Raw Risk Likelihood (RRL) The risk likelihood is deemed *low*, therefore the RRL is 4 out of 10.	**Score** **4**
Raw Risk Impact (RRI) The risk impact is deemed *medium*, therefore the RRI is 6 out of 10.	**Score** **6**
Gross Risk Indicator (GRI) The Gross Risk Indicator (RRL × RRI) is 24 out of 100.	**Score** **24**
Mitigation/Notching *RRL Mitigation (Notch)* No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).	**Notch** **NN**
Loaded RI Score The Loaded RI Score ((1-Total Notch) × GRI Score) is 24 out of 100.	**Score** **24**

3.3 Risk Factor: Non-Weather Based Externalities

3.3.1 Consumer Price Index (CPI) and Producer Price Index (PPI)

Rationale: CPI and PPI can impact feedstock cost of harvest and collection over time. Sensitivities to worst case scenarios should be run.

Risk Information: Producer Price Index (PPI) affects the biomass price and the delivery cost of corn stover. Diesel price affects planting, harvesting, baling, and transportation costs directly. The PPI index indirectly affects baling and transportation costs through labor and admin/overhead costs. The historical diesel and PPI data in the last 10 years or so shows significant variability in recent years due to the pandemic and global supply chain disruptions. However, diesel price and PPI have been experiencing a downward trend in the last few months (see Figures C-4 and C-6 in Appendix C). Overall, the impact on the ability of a project to receive feedstock reliably at market prices over a long period of time is not significant because the entire supply chain will adapt to the changes in inflation and energy prices.

Raw Risk Likelihood (RRL) The risk likelihood is deemed *medium*, therefore the RRL is 6 out of 10.	**Score** **6**
Raw Risk Impact (RRI) The risk impact is deemed *low*, therefore the RRI is 4 out of 10.	**Score** **4**
Gross Risk Indicator (GRI) The Gross Risk Indicator (RRL × RRI) is 24 out of 100.	**Score** **24**
Mitigation/Notching *RRL Mitigation (Notch)* No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).	**Notch** **NN**
Loaded RI Score The Loaded RI Score ((1-Total Notch) × GRI Score) is 24 out of 100.	**Score** **24**

3.3.2 Currency Risk

Rationale: Where feedstock is purchased in a currency different than that which a new bio-based plant with locate in a BDO Zone, currency exchange rates and volatility can constitute risk exposure. BDO Zones that cross the US-Canada border, for example, which intake feedstock from both countries are exposed to such currency risk.

Risk Information: None of the feedstock would be sourced from or sold outside the region. Therefore, there is no currency risk.

Raw Risk Likelihood (RRL) The risk likelihood is deemed *not relevant*, therefore the RRL is not rated.	**Score** **NR**
Raw Risk Impact (RRI) The risk impact is deemed *not relevant*, therefore the RRI is not rated.	**Score** **NR**
Gross Risk Indicator (GRI) The Gross Risk Indicator (RRL × RRI) is not rated.	**Score** **NR**
Mitigation/Notching The Total Notch (RRL Notch × RRI Notch) is not rated.	**Notch** **NR**
Loaded RI Score The Loaded RI Score (Total Notch × GRI Score) is not rated.	**Score** **NR**

3.3.3 Border Risk

Rationale: Where feedstock is transported cross-border to another country, risk exposure to border closures and crossing delays becomes present. The availability of trucks willing to do cross-border runs is limited, which can decrease supply chain flexibility and resilience. Plants near the US-Canada border which intake feedstock from both countries are exposed to these risks.

Risk Information: None of the feedstock would be sourced from outside of the region, therefore there is no border risk.

Raw Risk Likelihood (RRL) The risk likelihood is deemed *not relevant*, therefore the RRL is not rated.	**Score** **NR**
Raw Risk Impact (RRI) The risk impact is deemed *not relevant*, therefore the RRI is not rated.	**Score** **NR**
Gross Risk Indicator (GRI) The Gross Risk Indicator (RRL × RRI) is not rated.	**Score** **NR**
Mitigation/Notching The Total Notch (RRL Notch × RRI Notch) is not rated.	**Notch** **NR**
Loaded RI Score The Loaded RI Score (Total Notch × GRI Score) is not rated.	**Score** **NR**

3.3.4 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, an Issuer 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 stover feedstock and decreasing its availability for bio-projects.[19]

Risk Information: Corn stover and silage are commonly used as animal feed in the BDO Zone. In years of drought, apart from the negative yield impact in corn and other forages, farmers will harvest larger areas for silage to guarantee animal

[19] Bergtold, 2018.

feed and salvage income from those fields. In these instances, no biomass would be left in the fields for corn stover. That is on top of the fact that lower corn yields would restrict biomass availability anyway. BAM already accounts for part of the mitigating factor for this category, and the likelihood of severe drought affecting supply is low.
Raw Risk Likelihood (RRL) **Score** The risk likelihood is deemed *low*, therefore the RRL is 4 out of 10. **4**
Raw Risk Impact (RRI) **Score** The risk impact is deemed *low*, therefore the RRI is 4 out of 10. **4**
Gross Risk Indicator (GRI) **Score** The Gross Risk Indicator (RRL × RRI) is 16 out of 100. **16**
Mitigation/Notching **Notch** *RRL Mitigation (Notch)* **NN** No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).
Loaded RI Score **Score** The Loaded RI Score ((1-Total Notch) × GRI Score) is 16 out of 100. **16**

3.4 Risk Factor: Risks Related to Feedstock Production, Harvest and Collection

3.4.1 Harvest & Collection Practices & Schedules

Rationale: Differences in harvest timing and practices used can create risk to both the quantity and quality of feedstock. For example, feedstock harvested by different suppliers in different windows can undergo varying 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 BDO Zones these harvesting windows may coincide with heightened weather risk such as frost or rain.

For forestry biomass, unsightly clear cuts, and slash piles (even on plantation forests and especially when located near communities) can provoke unwanted public backlash even when suitable and sustainable replanting regimes are followed.

Risk Information: Corn stover supply is fragmented by nature, as collection and bailing are done by multiple operators, leading to quality variability. Bales are commonly stacked by the side of the field and will remain there until the buyer is ready to move it, usually no later than April, either to the biorefinery or a secondary storage location. This leads to an increased quality risk as wet weather can negatively affect the integrity of the biomass.

Raw Risk Likelihood (RRL) The risk likelihood is deemed *medium*, therefore the RRL is 6 out of 10.	**Score** **6**
Raw Risk Impact (RRI) The risk impact is deemed *medium*, therefore the RRI is 6 out of 10.	**Score** **6**
Gross Risk Indicator (GRI) The Gross Risk Indicator (RRL × RRI) is 36 out of 100.	**Score** **36**

Mitigation/Notching	**Notch**
RRL Mitigation (Notch) Careful planning and mobilization of equipment to optimize the short harvest window operation can somewhat mitigate this risk; therefore, this category is notched at 25%. *RRI Mitigation (Notch)* An experienced custom harvest group can reduce the feedstock supply risk to a bioprocessing facility by baling and moving inventory to an appropriate storage facility, lowering the quality risk; therefore, this category is notched at 25%. The Total Notch (RRL Notch × RRI Notch) is 44%.	**44%**
Loaded RI Score	**Score**
The Loaded RI Score ((1-Total Notch) × GRI Score) is 20.25 out of 100.	**20.25**

3.4.2 Harvesting & Collection Equipment

Rationale: Different types of harvesting and collection equipment used by suppliers in a BDO Zone can have a significant impact on the quality and availability of feedstock. 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.

Risk Information: Baling operations in the BDO zone are conducted for hay using round balers, which are cheaper to acquire and require less maintenance than high-density square balers. The supply zone does not presently have sufficient quantities of specialized equipment necessary to supply large volumes of corn stover bales.

Raw Risk Likelihood (RRL)	**Score**
The risk likelihood is deemed *high*, therefore the RRL is 8 out of 10.	**8**
Raw Risk Impact (RRI)	**Score**
The risk impact is deemed *high*, therefore the RRI is 8 out of 10.	**8**
Gross Risk Indicator (GRI)	**Score**
The Gross Risk Indicator (RRL × RRI) is 64 out of 100.	**64**
Mitigation/Notching	**Notch**
RRL Mitigation (Notch) No adjustment. *RRI Mitigation (Notch)* An experienced third-party baling company or a vertically integrated bio-project that uses its own equipment will significantly reduce the risk of feedstock supply. Therefore, this category is notched at 50%. The Total Notch (RRL Notch × RRI Notch) is 50%.	**50%**
Loaded RI Score	**Score**
The Loaded RI Score ((1-Total Notch) × GRI Score) is 32 out of 100.	**32**

3.4.3 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. The size of wood fiber processed in a grinder is less homogenous than if a chipper is used.

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.[20]
Risk Information: Biorefineries prefer operating with square bales, both for logistics and handling efficiency but also due to safety (compared to round bales that can move and are hard to stack). The optimal standard for a biorefinery to receive corn stover is high-density square bales with weights ranging between 1,100 lbs. and 1,500 lbs. To achieve this quality, suppliers must operate high density square balers, however, this equipment requires a substantial financial investment. Current baling operations in the BDO zone focus on hay and use round balers, which are not optimized for efficiency or density and, therefore, would not be optimal for a commercial operation.

Raw Risk Likelihood (RRL)	**Score**
The risk likelihood is deemed *high*, therefore the RRL is 8 out of 10.	**8**
Raw Risk Impact (RRI)	**Score**
The risk impact is deemed *high*, therefore the RRI is 8 out of 10.	**8**
Gross Risk Indicator (GRI)	**Score**
The Gross Risk Indicator (RRL × RRI) is 64 out of 100.	**64**
Mitigation/Notching	**Notch**
RRL Mitigation (Notch) Growers could get financial and contractual incentives from an anchor bio-processing facility to buy or finance new equipment. The developer could also put in place training programs in partnership with extension programs, for example, to teach and train baling crews and improve the quality and standards of their product. However, none of these initiatives are in place. Therefore, this category cannot be notched. *RRI Mitigation (Notch)* A third-party baler can decrease the variability in the quality of the feedstock. Therefore, this category is notched at 50%. The Total Notch (RRL Notch × RRI Notch) is 50%.	**50%**
Loaded RI Score	**Score**
The Loaded RI Score ((1-Total Notch) × GRI Score) is 32 out of 100.	**32**

3.4.4 Availability of Labor for Feedstock Production

Rationale: Skilled labor shortages can be difficult to remedy in the short-term. Availability of suitable labor in an area can impact the ability to procure sufficient feedstock quantities on required schedules. Labor risks are higher where supply chains are not yet active; or for Issuer's for whom large feedstock requirements, or development of new (or expanded) supply chains, demand significant additions to the local labor force.
Risk Information: Farming has grappled with increasing challenges of labor cost, hiring and retention, and corn stover baling operations requiring specialized labor for several weeks of the year, often necessitating crews beyond the farm's normal operations. The lack of trained baler operators and the widespread challenge of recruiting for short-term jobs at this time of the year poses an immediate risk.

Raw Risk Likelihood (RRL)	**Score**
The risk likelihood is deemed *high*, therefore the RRL is 8 out of 10.	**8**
Raw Risk Impact (RRI)	**Score**
The risk impact is deemed *high*, therefore the RRI is 8 out of 10.	**8**

[20] Huhnke, 2018.

Gross Risk Indicator (GRI)	**Score**
The Gross Risk Indicator (RRL × RRI) is 64 out of 100.	**64**
Mitigation/Notching *RRL Mitigation (Notch)* Having a project developer or partnering with university extension programs to offer training programs can partially mitigate this risk. Thus, it is notched down by 25%. *RRI Mitigation (Notch)* Importing temporary labor from other regions, as well as contracting a third party for harvest and collection or by the provision of similar services through a vertically integrated bio-project, can significantly lower the labor risk. However, it is a complex plan to execute; therefore, this category is notched at 25%. The Total Notch (RRL Notch × RRI Notch) is 44%.	**Notch** **44%**
Loaded RI Score	**Score**
The Loaded RI Score ((1-Total Notch) × GRI Score) is 36 out of 100.	**36**

3.5 Risk Factor: Transportation

3.5.1 Feedstock Transportation Costs

Rationale: Transportation can be 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.

Transport distances of 80-120 km for biomass feedstocks are typical but larger distances can be common. Where average transport distance from suppliers to Issuer is high, the supply chain is subject to greater sensitivities to risks, such as increases in diesel cost, weather impacts, mechanical breakdown, and by the demand for scarce feedstock from competitors closer to the source.

Understanding average transport distance can help flag higher-risk BDO Zones where transport distance materially exceeds the average.

Risk Information: This study estimates that transportation costs make up approximately 20-22% of the total feedstock delivered cost. It is observed that even a relatively slight increase in the average transport distance can result in a substantial expansion of the feedstock supply basin, as demonstrated in the supply curves. However, there is no substantial impact on the delivered price of feedstock due to marginal increases in transportation costs. Outreach has shown that once collected and stacked on the edge of the field, the supplier is no longer invested in the transportation of this material because it would require a dedicated transportation operation, likely demanding equipment that the crop grower does not own, and because of the quality issue that may arise depending on how long that biomass has been sitting in the elements. Therefore, although distances may be manageable, there is a potential increased risk in pricing and availability from the new demand for transportation within the BDO Zone.

Raw Risk Likelihood (RRL)	**Score**
The risk likelihood is deemed *low*, therefore the RRL is 4 out of 10.	**4**
Raw Risk Impact (RRI)	**Score**
The risk impact is deemed *high*, therefore the RRI is 8 out of 10.	**8**
Gross Risk Indicator (GRI)	**Score**
The Gross Risk Indicator (RRL × RRI) is 32 out of 100.	**32**

Mitigation/Notching	**Notch**
RRL Mitigation (Notch) No adjustment. *RRI Mitigation (Notch)* Preemptively working with multiple transportation companies to increase their capacity to transport bales by potentially providing seasonal contracts could be a mitigating factor. However, there is uncertainty if this type of arrangement would be sufficient to convince a service provider to invest in new equipment; therefore, this category is notched at 25%. The Total Notch (RRL Notch × RRI Notch) is 25%.	**25%**
Loaded RI Score	**Score**
The Loaded RI Score ((1-Total Notch) × GRI Score) is 24 out of 100.	**24**

3.5.2 Diesel Cost Impacts

Rationale: Changes in diesel cost impact transport cost over time. Sensitivities to worst case scenarios should be run.

Risk Information: According to the IEA, Midwest No.2 diesel prices fluctuated from U$ 3.86/gallon in September 2013 to U$ 4.44/gallon in September 2023, a 15% increase in nominal terms. In real terms (adjusted for inflation using CPI), the diesel cost fell around 13% in this period. Diesel prices can fluctuate in the short term, which affects the entire supply chain. However, according to the IEA data, diesel prices have been on a slight downward trend. Short-term changes in diesel prices can exert pressure on operational margins; however, the likelihood of the price change being significant enough to pose a substantial risk that can affect operations is low.

Raw Risk Likelihood (RRL)	**Score**
The risk likelihood is deemed *low*, therefore the RRL is 4 out of 10.	**4**
Raw Risk Impact (RRI)	**Score**
The risk impact is deemed *low*, therefore the RRI is 4 out of 10.	**4**
Gross Risk Indicator (GRI)	**Score**
The Gross Risk Indicator (RRL × RRI) is 16 out of 100.	**16**
Mitigation/Notching	**Notch**
RRL Mitigation (Notch) No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).	**NN**
Loaded RI Score	**Score**
The Loaded RI Score ((1-Total Notch) × GRI Score) is 16 out of 100.	**16**

3.5.3 Transportation of Feedstock Requires Specialized Equipment

Rationale: Requirements for specialized transport equipment (e.g., walking-floor trailers) can increase supply chain risk. Where there is low availability in required transportation equipment, equipment owners have increased leverage over transportation prices and supply chain resiliency can be lower.

Risk Information: Handling of the bales for loading and unloading can be done using various implements on the tractor, such as wheel loaders or skid steer loaders. However, road transportation of corn stover bales is done by flatbed trailers, which, although quite common in farm operations, are not available in sufficient numbers to transport commercial

quantities in the BDO Zone. A surge in demand for this type of transport would create competition and increase prices, increasing risk in the supply chain.
Raw Risk Likelihood (RRL) — **Score**
The risk likelihood is deemed *high*, therefore the RRL is 8 out of 10. — **8**
Raw Risk Impact (RRI) — **Score**
The risk impact is deemed *high*, therefore the RRI is 8 out of 10. — **8**
Gross Risk Indicator (GRI) — **Score**
The Gross Risk Indicator (RRL × RRI) is 64 out of 100. — **64**
Mitigation/Notching — **Notch**
RRL Mitigation (Notch) — **44%** It is expected that with the establishment of long-term demand for corn stover by future biomass projects, the local transportation capacity will increase as flatbed trucks are common and used across the country. Fleet owners are used to providing services outside their service areas. However, since the demand for a future biomass project is unknown, the transportation capacity scale-up may take years. So, this category is notched at 25%. *RRI Mitigation (Notch)* The impact of successfully mitigating the transportation scale-up, as outlined above, could be significant. However, the transportation cost could be higher if the capacity is met by the logistics companies outside the region; therefore, this category is notched at 25%. The Total Notch (RRL Notch × RRI Notch) is 44%.
Loaded RI Score — **Score**
The Loaded RI Score ((1-Total Notch) × GRI Score) is 36 out of 100. — **36**

3.5.4 Delivery Routes through Local Communities

Rationale: Transportation of biomass can become a nuisance to local communities, especially if a large number of trucks pass through residential and school areas. Local communities often have power to force regulations regarding truck transport, impeding the ability BDO Zone suppliers to transport feedstock.
Risk Information: Corn stover bales will be sourced at the farms and transported either directly to a biorefinery or an intermediary storage facility. The land parcel assessed for this report sits at the outside edge of the western part of Emporia, KS, and could be accessed exclusively by using highways, lowering the risk of disrupting local communities.
Raw Risk Likelihood (RRL) — **Score**
The risk likelihood is deemed *low*, therefore the RRL is 4 out of 10. — **4**
Raw Risk Impact (RRI) — **Score**
The risk impact is deemed *low*, therefore the RRI is 4 out of 10. — **4**
Gross Risk Indicator (GRI) — **Score**
The Gross Risk Indicator (RRL × RRI) is 16 out of 100. — **16**
Mitigation/Notching — **Notch**
RRL Mitigation (Notch) — **NN** No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).

Loaded RI Score	**Score**
The Loaded RI Score ((1-Total Notch) × GRI Score) is 16 out of 100.	**16**

3.5.5 Transportation Regulations & Local Weight Limits

Rationale: In many BDO Zones, transportation is regulated based on seasonal road conditions. These regulations (e.g., "frost laws") often take the form of weight restrictions or limits on the number of trucks allowed on roads. Such regulations can impede the project's ability to source sufficient feedstock or increase the cost of doing so at certain times of the year.

Risk Information: In Kansas, freeze laws apply to vehicles transporting agricultural products, such as grain, hay, or livestock, exceeding legal weight limits. These vehicles are allowed to operate on frozen roads but must reduce their weight by 10% when the roads are thawing, but this is not a significant risk for transporting corn stover bales.

Raw Risk Likelihood (RRL)	**Score**
The risk likelihood is deemed *low*, therefore the RRL is 4 out of 10.	**4**
Raw Risk Impact (RRI)	**Score**
The risk impact is deemed *low*, therefore the RRI is 4 out of 10.	**4**
Gross Risk Indicator (GRI)	**Score**
The Gross Risk Indicator (RRL × RRI) is 16 out of 100.	**16**
Mitigation/Notching	**Notch**
RRL Mitigation (Notch) No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).	**NN**
Loaded RI Score	**Score**
The Loaded RI Score ((1-Total Notch) × GRI Score) is 16 out of 100.	**16**

3.5.6 Road Infrastructure

Rationale: Feedstock cost and availability can be a function of road infrastructure, in particular the accessibility the infrastructure provides to feedstock. Issues with road networks will translate directly to risks to feedstock supply.

Risk Information: According to a U.S. News & World Report study, among all states, Kansas was ranked #7 overall for infrastructure and #10 for roads. Kansas roads are in better condition than the national average, with only 11.4% classified as poor, compared to 19.0% nationwide.

Raw Risk Likelihood (RRL)	**Score**
The risk likelihood is deemed *low*, therefore the RRL is 4 out of 10.	**4**
Raw Risk Impact (RRI)	**Score**
The risk impact is deemed *low*, therefore the RRI is 4 out of 10.	**4**
Gross Risk Indicator (GRI)	**Score**
The Gross Risk Indicator (RRL × RRI) is 16 out of 100.	**16**

Mitigation/Notching	**Notch**
RRL Mitigation (Notch) No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).	**NN**
Loaded RI Score	**Score**
The Loaded RI Score ((1-Total Notch) × GRI Score) is 16 out of 100.	**16**

3.5.7 Transportation Redundancy

Rationale: Transport equipment redundancy is important for dealing with seasonally variable feedstock supplies as well as the risk of equipment breakdowns.

Risk Information: Flatbed trailers are the most widely used method of transporting bales. This equipment is inexpensive and very common both in farming operations and transportation companies. Based on the rated quantity of 100,000 bdt/year. Assuming 39 bales with an average weight of 1,200 lbs., the payload is estimated at about 21 bdt. Therefore, 4,760 loads would be necessary to move all feedstock or 15 loads per day on a 330-day/year operation. Although flatbeds are widely used by farming and transportation companies alike, the region does not currently present an established infrastructure to transport large quantities of bales, including corn stover.

Raw Risk Likelihood (RRL)	**Score**
The risk likelihood is deemed *high*, therefore the RRL is 8 out of 10.	**8**
Raw Risk Impact (RRI)	**Score**
The risk impact is deemed *high*, therefore the RRI is 8 out of 10.	**8**
Gross Risk Indicator (GRI)	**Score**
The Gross Risk Indicator (RRL × RRI) is 64 out of 100.	**64**
Mitigation/Notching	**Notch**
RRL Mitigation (Notch) A reputable biorefinery operator can influence suppliers and transportation companies to invest in additional transportation equipment and, over time, create redundancy. However, that is a medium-term solution; therefore, notched at 25%. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is 25%.	**25%**
Loaded RI Score	**Score**
The Loaded RI Score ((1-Total Notch) × GRI Score) is 48 out of 100.	**48**

3.6 Risk Factor: Supply Chain Resiliency

3.6.1 Size, Number and Location of Suppliers

Rationale: In general, a supply portfolio involving multiple suppliers of various sizes (and from multiple BDO Zones) is important for ensuring steady and uninterrupted feedstock supply 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 greater impact on the supply chain. In such cases the risk of disruption is lower, but the impact of those disruptions is higher. Conversely, many small suppliers are less likely to have the capacity to withstand internal disruptions and thus may be

more likely to breach. Here, risk of disruption is higher, but their likely 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.

Risk Information: The supply of corn stover is inherently fragmented, as it depends on the participation of various farms in each season. The supply availability and reliability can only be determined after a credible operator sets up a plant in the area and manages the coordination of the diverse supply chain.

Raw Risk Likelihood (RRL)	**Score**
The risk likelihood is deemed *medium*, therefore the RRL is 6 out of 10.	**6**
Raw Risk Impact (RRI)	**Score**
The risk impact is deemed *medium*, therefore the RRI is 6 out of 10.	**6**
Gross Risk Indicator (GRI)	**Score**
The Gross Risk Indicator (RRL × RRI) is 36 out of 100.	**36**
Mitigation/Notching *RRL Mitigation (Notch)* Although the number of potential suppliers may seem high, currently, there is no indication of how many would supply feedstock to the project or their location. Only the operator's outreach could mitigate this category. Therefore, this category is notched at 25%. *RRI Mitigation (Notch)* Identifying the optimal mix of size and location of suppliers and planning the coordination of multiple sources will create redundancy in the supply chain. However, this is a complex endeavor; therefore, this category is notched at 25%. The Total Notch (RRL Notch × RRI Notch) is 44%.	**Notch** **44%**
Loaded RI Score	**Score**
The Loaded RI Score ((1-Total Notch) × GRI Score) is 20.25 out of 100.	**20.25**

3.6.2 Suppliers Subject to Same External Risk Factors

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 is lower. Resilience is maximized when biomass supply chains exhibit diversity in spatial location (i.e., geography), production practices, and other elements of supply chain structures such that the impact of single high-risk events have varying impacts on suppliers.

Risk Information: The supply zone's corn production has seen a 10-year average harvested area of about 424,378 acres. Over the same period, corn prices fluctuated, hitting a high of $7.63/bu in 2012 and a low of $3.12/bu in 2020, with an average of $4.68/bu. The demand for corn for various uses like energy and food production remains strong. Considering corn stover as a by-product and the historical trends, it seems the availability of corn is resilient to market disruptions.

Raw Risk Likelihood (RRL)	**Score**
The risk likelihood is deemed *low*, therefore the RRL is 4 out of 10.	**4**
Raw Risk Impact (RRI)	**Score**
The risk impact is deemed *low*, therefore the RRI is 4 out of 10.	**4**
Gross Risk Indicator (GRI)	**Score**
The Gross Risk Indicator (RRL × RRI) is 16 out of 100.	**16**

Mitigation/Notching	**Notch**
RRL Mitigation (Notch) No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).	**NN**
Loaded RI Score	**Score**
The Loaded RI Score ((1-Total Notch) × GRI Score) is 16 out of 100.	**16**

3.6.3 Land Ownership Structures

Rationale: The ownership (or control) of the land base on which feedstock is produced can have significant impact on Issuer's feedstock risks. Risk of long-term variation in stumpage cost for wood fiber (i.e., the cost that one pays to a landowner for the right to cut and purchase their wood fiber) for example are much higher in the US where >90% of the land is private, and thus stumpage cost is determined on a competitive auction basis. Conversely, in Canada >90% of the land is owned by the Crown and stumpage is allocated by the government.

Risk Information: Regardless of land ownership structure, the croplands are expected to be used for cash crop production, such as corn and soybeans.

Raw Risk Likelihood (RRL)	**Score**
The risk likelihood is deemed *very low*, therefore the RRL is 2 out of 10.	**2**
Raw Risk Impact (RRI)	**Score**
The risk impact is deemed *very low*, therefore the RRI is 2 out of 10.	**2**
Gross Risk Indicator (GRI)	**Score**
The Gross Risk Indicator (RRL × RRI) is 4 out of 100.	**4**
Mitigation/Notching	**Notch**
RRL Mitigation (Notch) No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).	**NN**
Loaded RI Score	**Score**
The Loaded RI Score ((1-Total Notch) × GRI Score) is 4 out of 100.	**4**

3.7 Risk Factor: Climate and Natural Risks

3.7.1 Seasonal Weather Impacts on Feedstock Supply

Rationale: Seasonal weather impacts are defined as those deriving from natural weather variations (i.e., spring thaws, rainy seasons, or dry seasons – as opposed to from 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 that weather has on multiple aspects of growing, harvesting, and transporting biomass, it is difficult to predict the availability of biomass at a specific location at different points in the future with a high degree of certainty. However, it is still possible, using past data and statistical models, to generate reasonable upper/lower bound

estimates of biomass production in any given year in a wider supply basin. Such estimates are important in assessing feedstock risk and enable accurate assessment of the efficacy of Issuer's mitigation methods.

Risk Information: Weather can negatively influence corn production and, thus, the availability of corn stover year-to-year. In the past 10 years, the supply zone has harvested an average of 93% of the planted area, with an average yield of 122 bu/acre. Despite new corn varieties that have proven even more resilient to drought, the 2023 harvest season was disappointing as the region had a severe to extreme drought throughout the growing season.

The short collection window for corn stover can present a more immediate risk if the weather conditions deteriorate. However, the precipitation for October in the supply zone has been shown to be very dry, as illustrated in Chart C-4, from less than one inch in October to almost four inches in November. If the soil is too wet**,** it affects the ability of equipment to bale and the quality of the bale itself due to moisture in a season where it does not dry. Most of the stover harvest is expected to take place in October.

Like in Iowa, the baling season can be extended into December if weather becomes an issue. However, depending on the timing of the rain after harvest, crop growers may choose to till the fields before baling can take place, impacting the corn stover availability.

Raw Risk Likelihood (RRL)	**Score**
The risk likelihood is deemed *low*, therefore the RRL is 4 out of 10.	**4**
Raw Risk Impact (RRI)	**Score**
The risk impact is deemed *medium*, therefore the RRI is 6 out of 10.	**6**
Gross Risk Indicator (GRI)	**Score**
The Gross Risk Indicator (RRL × RRI) is 24 out of 100.	**24**
Mitigation/Notching	**Notch**
RRL Mitigation (Notch) No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).	**NN**
Loaded RI Score	**Score**
The Loaded RI Score ((1-Total Notch) × GRI Score) is 24 out of 100.	**24**

3.7.2 Long-Term Weather and Climate Trends

Rationale: In certain BDO Zones, climatic trends and significant potential changes to future weather patterns can create feedstock risk.

Risk Information: Historical data suggests that the Midwest has been experiencing more rainfall and fewer droughts over the past century. However, in Kansas, recent continuous droughts indicate that despite the overall increase in rainfall, drought periods can still occur**.** This underscores the need for continued monitoring and adaptive strategies to mitigate potential risks associated with these changes.[21]

Raw Risk Likelihood (RRL)	**Score**
The risk likelihood is deemed *low*, therefore the RRL is 4 out of 10.	**4**

Raw Risk Impact (RRI)	**Score**
The risk impact is deemed *low*, therefore the RRI is 4 out of 10.	**4**
Gross Risk Indicator (GRI)	**Score**
The Gross Risk Indicator (RRL × RRI) is 16 out of 100.	**16**
Mitigation/Notching *RRL Mitigation (Notch)* No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).	**Notch** **NN**
Loaded RI Score	**Score**
The Loaded RI Score ((1-Total Notch) × GRI Score) is 16 out of 100.	**16**

3.7.3 Forest/Crop Fire

Rationale: Forest/crop fires, especially when occurring at large-scale, destroy feedstock and create shortages.

Fire-prone conditions are predicted to increase across Canada. This could potentially result in a doubling of the amount of area burned by the end of this century compared with amounts burned in recent decades. Boreal forests, which have been historically greatly influenced by fire, will likely be especially affected by this change.

Other climate change impacts that could add damaged or dead-wood to the forest fuel load (e.g., as a result of insect outbreaks, ice storms, or high winds) may increase the risk of fire activity. New research is aimed at refining these climate change estimates of fire activity, and at investigating adaptation strategies and options to deal with future fire occurrence. There is growing consensus that as wildfire activity increases, fire agency suppression efforts will be increasingly strained. However, analyses of fire history suggest that it is the effect of climate variability on precipitation regimes that is the primary reason for the decreasing fire activity in the southern BDO Zone of Canada.

Risk Information: According to the National Interagency Fire Center, information about fires, including wildfires and controlled burns shows that the peak risk for fire period is in February – March ahead of the growing season. During crop growth, the state reports very few wildfires; acreage lost ranges between 500 to 1,000 acres. Crop fires are not an issue as the material is green. Field stacks of bales could catch fire because of a lightning strike. The bigger risk is with the project storage yards that hold as much as 20% of their annual inventory. Spontaneous combustion due to wet material can occur if the yard stacks do not allow for proper ventilation and the material is baled under wet conditions.[22]

Raw Risk Likelihood (RRL)	**Score**
The risk likelihood is deemed *low*, therefore the RRL is 4 out of 10.	**4**
Raw Risk Impact (RRI)	**Score**
The risk impact is deemed *low*, therefore the RRI is 4 out of 10.	**4**
Gross Risk Indicator (GRI)	**Score**
The Gross Risk Indicator (RRL × RRI) is 16 out of 100.	**16**

[22] https://www.nifc.gov/fire-information/maps

Mitigation/Notching	**Notch**
RRL Mitigation (Notch) No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).	**NN**
Loaded RI Score	**Score**
The Loaded RI Score ((1-Total Notch) × GRI Score) is 16 out of 100.	**16**

3.7.4 Risk of Infestation

Rationale: Risk of future infestation, including its estimated consequences on feedstock supply, should be calculated into the overall risk profile.

Since forest insect populations are influenced by environmental conditions, future changes in climate can be expected to significantly alter the outbreak dynamics of certain forest insect species. In some cases, larger and more frequent insect outbreaks may occur, but in other cases recurring outbreaks may be disrupted or diminished. As climate continues to change, we can expect more situations, particularly at the margins of tree ranges, where sub-optimal conditions for tree growth and reduced tree vigor can lead to outbreaks of forest insects.

Risk Information: Corn diseases are airborne and can spread via farm equipment. To mitigate this, equipment is cleaned before moving between farms. Farmers monitor their crops for pests and use treatments as needed. They also use interstate intelligence on crop threats. A slight risk exists with third-party balers due to potential inadequate cleaning, but proper management practices effectively control most diseases.

Raw Risk Likelihood (RRL)	**Score**
The risk likelihood is deemed *very low*, therefore the RRL is 2 out of 10.	**2**
Raw Risk Impact (RRI)	**Score**
The risk impact is deemed *low*, therefore the RRI is 4 out of 10.	**4**
Gross Risk Indicator (GRI)	**Score**
The Gross Risk Indicator (RRL × RRI) is 8 out of 100.	**8**
Mitigation/Notching	**Notch**
RRL Mitigation (Notch) No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).	**NN**
Loaded RI Score	**Score**
The Loaded RI Score ((1-Total Notch) × GRI Score) is 8 out of 100.	**8**

3.7.5 Risk of Hail

Rationale: Hail has negligible impact of forestry biomass but is one of the principal destroyers of agricultural crops in North America.

There is much uncertainty about the effects of anthropogenic climate change on the frequency and severity of extreme weather events like hailstorms and their subsequent economic losses. Some studies indicate a strong positive

relationship between hailstorm activity and hailstorm damage, as predicted by minimum temperatures using simple correlations. This relationship suggests that hailstorm damage may increase in the future if global warming leads to further temperature increase.
Risk Information: Kansas is one of four states that receives the most hail in the US and can damage a young corn crop especially when plant roots are not firmly established early in the growing season. In many cases, the hail damage is limited to planting leaves, and the crop recovers. However**,** once corn enters the dough stage, it becomes more resilient, and kernel loss due to stressors is no longer a concern. Damage from hail in the supply zone is covered by crop insurance as the corn grain yield is affected. It is unlikely that a field hit by hail would be selected for stover harvest. This is part of the project logistics info prior to mapping the fields where the harvest will occur. The damaged areas are likely a very small portion of the total BDO zone.

Raw Risk Likelihood (RRL) The risk likelihood is deemed *low*, therefore the RRL is 4 out of 10.	**Score** **4**
Raw Risk Impact (RRI) The risk impact is deemed *low*, therefore the RRI is 4 out of 10.	**Score** **4**
Gross Risk Indicator (GRI) The Gross Risk Indicator (RRL × RRI) is 16 out of 100.	**Score** **16**
Mitigation/Notching *RRL Mitigation (Notch)* No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).	**Notch** **NN**
Loaded RI Score The Loaded RI Score ((1-Total Notch) × GRI Score) is 16 out of 100.	**Score** **16**

3.7.6 Risk of Flood

Rationale: Floods can cause catastrophic disruption and delay in feedstock supply. Where there is high risk of flood and thus negative impact to feedstock supply, the BDO Zone rating should account for this risk.
Risk Information: Whether a seed or seedling survives flooding is based on the length of time that flooding lasts and the soil temperature. Corn can usually survive two to four days, sometimes more than a week, if temperatures are cool and leaves are exposed. Croplands are well-drained with surface ditches and field tiles. In July 2023, the region received over two months of rainfall in a few days, which damaged some of the crops in low-lying areas. As stated before, the harvested acres represent 93% of planted acres.

Raw Risk Likelihood (RRL) The risk likelihood is deemed *low*, therefore the RRL is 4 out of 10.	**Score** **4**
Raw Risk Impact (RRI) The risk impact is deemed *low*, therefore the RRI is 4 out of 10.	**Score** **4**
Gross Risk Indicator (GRI) The Gross Risk Indicator (RRL × RRI) is 16 out of 100.	**Score** **16**

Mitigation/Notching	**Notch**
RRL Mitigation (Notch) No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).	**NN**
Loaded RI Score	**Score**
The Loaded RI Score ((1-Total Notch) × GRI Score) is 16 out of 100.	**16**

3.7.7 Risk of Drought

Rationale: Droughts can cause significant disruptions to feedstock supplies across entire BDO Zones for extended periods of time, especially in case of agricultural residues and energy crops. Parts of Western Canada are experiencing more frequent and severe droughts, and scientists expect drought to affect new areas across Canada going forward.

Tree species are adapted to specific moisture conditions. Having less water available through drought has a range of negative impacts on the health of forest ecosystems. Direct impacts include reduced growth, increased tree mortality and failure to regenerate. Indirect impacts include reduced ability to defend against insects and disease, and increased fire risk. These impacts can affect the availability of wood fiber for an Issuer.

Risk Information: According to the USDA Drought Monitor, some degree of drought occurs nearly every year. The drought of 2022-23 was the most severe in Kansas, negatively impacting corn yields to the lowest in the last 10 years. The average planted-to-harvest area in the supply zone in the past 10 years has been 96%.

As evidenced by the data above, droughts are common but apart from this past season, do not pose a regular and significant risk to supply of feedstock.

Raw Risk Likelihood (RRL)	**Score**
The risk likelihood is deemed *low*, therefore the RRL is 4 out of 10.	**4**
Raw Risk Impact (RRI)	**Score**
The risk impact is deemed *medium*, therefore the RRI is 6 out of 10.	**6**
Gross Risk Indicator (GRI)	**Score**
The Gross Risk Indicator (RRL × RRI) is 24 out of 100.	**24**
Mitigation/Notching	**Notch**
RRL Mitigation (Notch) No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).	**NN**
Loaded RI Score	**Score**
The Loaded RI Score ((1-Total Notch) × GRI Score) is 24 out of 100.	**24**

3.7.8 Risk of Hurricanes, Tornadoes and Strong Winds

Rationale: Hurricanes, tornadoes, and strong winds can destroy timber stands, crops, and feedstock piles. They can also delay forestry and agricultural operations. Hurricanes and tornadoes can indirectly cause temporary shortages of available transportation as available trucking moves to handle higher value disaster related contracts. For example,

Katrina cleanup limited availability of live-bottom trailers in the North and South-East of the US for several months as truckers shifted operations to handle more lucrative government contracts.

Although scientists are uncertain whether climate change will lead to an increase in the number of hurricanes, warmer ocean temperatures and higher sea levels are expected to intensify their impacts.

Recent analyses conclude that the strongest hurricanes occurring in some BDO Zones including the North Atlantic have increased in intensity over the past two to three decades.

Risk Information: Although Kansas is part of the US tornado alley, outreach has found that it is not a risk to corn production as the impact is localized.

Raw Risk Likelihood (RRL) The risk likelihood is deemed *low*, therefore the RRL is 4 out of 10.	**Score** **4**
Raw Risk Impact (RRI) The risk impact is deemed *low*, therefore the RRI is 4 out of 10.	**Score** **4**
Gross Risk Indicator (GRI) The Gross Risk Indicator (RRL × RRI) is 16 out of 100.	**Score** **16**
Mitigation/Notching *RRL Mitigation (Notch)* No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).	**Notch** **NN**
Loaded RI Score The Loaded RI Score ((1-Total Notch) × GRI Score) is 16 out of 100.	**Score** **16**

3.7.9 Risk of Low Temperatures

Rationale: Low temperatures can cause crop failure, leading to shortages of biomass. Additionally, low temperatures can have adverse impacts on the operations of feedstock processing equipment in Northern BDO Zones.

Risk Information: The region is far enough south to have limited exposure to freezing during the growing season from May to September. The corn plant reaches physiological maturity in September. Therefore, the risk of crop failure is low.

Raw Risk Likelihood (RRL) The risk likelihood is deemed *low*, therefore the RRL is 4 out of 10.	**Score** **4**
Raw Risk Impact (RRI) The risk impact is deemed *low*, therefore the RRI is 4 out of 10.	**Score** **4**
Gross Risk Indicator (GRI) The Gross Risk Indicator (RRL × RRI) is 16 out of 100.	**Score** **16**
Mitigation/Notching *RRL Mitigation (Notch)* No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).	**Notch** **NN**

Loaded RI Score	**Score**
The Loaded RI Score ((1-Total Notch) × GRI Score) is 16 out of 100.	**16**

3.8 Risk Factor: Political and Social

3.8.1 Government Subsidies for Feedstock Production or Utilization

Rationale: Feedstock that is 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 subsides only; it does not apply to government subsidies that pertain indirectly to the operations of the Issuer such as Loan Guarantees or to the markets for products produced by the Issuer.

Risk Information: At this point, there are no direct government subsidies for corn stover. However, corn is one of the biggest recipients of government subsidies in the US, and its production directly affects the availability of corn stover. The Agriculture Risk (ARC) and Price Loss Coverage (PLC) programs provide financial protections to farmers from substantial drops in crop prices or revenues based on a benchmark pricing of $3.70/bu. Although corn is directly subsidized, these programs have been in place for several decades and are not at risk of being repealed.

Raw Risk Likelihood (RRL)	**Score**
The risk likelihood is deemed *very low*, therefore the RRL is 2 out of 10.	**2**
Raw Risk Impact (RRI)	**Score**
The risk impact is deemed *very low*, therefore the RRI is 2 out of 10.	**2**
Gross Risk Indicator (GRI)	**Score**
The Gross Risk Indicator (RRL × RRI) is 4 out of 100.	**4**
Mitigation/Notching	**Notch**
RRL Mitigation (Notch) No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).	**NN**
Loaded RI Score	**Score**
The Loaded RI Score ((1-Total Notch) × GRI Score) is 4 out of 100.	**4**

3.8.2 Local, Provincial, & National Laws, Regulations, & Permitting Pertaining to Biomass

Rationale: Feedstock whose production is directly dependent on local, provincial, or national laws or 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 utilization of biomass 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.

Risk Information: Currently, there are no regulations regarding corn stover production, removal, and utilization.

Raw Risk Likelihood (RRL)	**Score**
The risk likelihood is deemed *very low*, therefore the RRL is 2 out of 10.	**2**
Raw Risk Impact (RRI)	**Score**
The risk impact is deemed *very low*, therefore the RRI is 2 out of 10.	**2**

Gross Risk Indicator (GRI)	**Score**
The Gross Risk Indicator (RRL × RRI) is 4 out of 100.	**4**
Mitigation/Notching *RRL Mitigation (Notch)* No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).	**Notch** **NN**
Loaded RI Score	**Score**
The Loaded RI Score ((1-Total Notch) × GRI Score) is 4 out of 100.	**4**

3.8.3 Backlash Against Biomass Development, Procurement or Usage in the Region

Rationale: Public backlash against biomass development in the Issuer BDO Zone can directly impact Issuer's ability to procure, transport, trans-load, store, or utilize feedstock by affecting local policies, regulations, and Issuer's ability to obtain necessary permitting.

Risk Information: Currently, there is no distinguishable public sentiment for or against developing a biomass supply chain in the BDO Zone region.

Raw Risk Likelihood (RRL)	**Score**
The risk likelihood is deemed *low*, therefore the RRL is 4 out of 10.	**4**
Raw Risk Impact (RRI)	**Score**
The risk impact is deemed *low*, therefore the RRI is 4 out of 10.	**4**
Gross Risk Indicator (GRI)	**Score**
The Gross Risk Indicator (RRL × RRI) is 16 out of 100.	**16**
Mitigation/Notching *RRL Mitigation (Notch)* No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).	**Notch** **NN**
Loaded RI Score	**Score**
The Loaded RI Score ((1-Total Notch) × GRI Score) is 16 out of 100.	**16**

3.8.4 Consent of, and Co-operation with, Indigenous Communities and First Nations

Rationale: Where new project development on or near Indigenous or First Nation land, or where near Indigenous or First Nations exert influence over feedstock producing areas, consent of, and co-operation with, Indigenous communities and First Nations decreases Issuer risk.

Risk Information: There is no risk associated with Indigenous or First Nation land for this BDO Zone.

Raw Risk Likelihood (RRL)	**Score**
The risk likelihood is deemed *not relevant*, therefore the RRL is not rated.	**NR**
Raw Risk Impact (RRI)	**Score**
The risk impact is deemed *not relevant*, therefore the RRI is not rated.	**NR**

Gross Risk Indicator (GRI)	**Score**
The Gross Risk Indicator (RRL × RRI) is not rated.	**NR**
Mitigation/Notching	**Notch**
The Total Notch (RRL Notch × RRI Notch) is not rated.	**NR**
Loaded RI Score	**Score**
The Loaded RI Score (Total Notch × GRI Score) is not rated.	**NR**

3.8.5 Food Security Concerns

Rationale: Despite the fact that any significant correlation between food prices and biofuel production is unclear, claims that biofuel production has driven up food prices, taken food from communities or had a negative impact on land use can fuel public backlash. For example, removal of biomass may raise public concerns relating to food security if Issuer feedstock requires the use of land that would otherwise be used for growing food.

Risk Information: Since corn stover is a by-product of corn grain production, there is no competition between renewable fuels and food. Additionally, corn stover is not a suitable animal feed alternative, seldom used as a last resort in the absence of any other alternative.

Raw Risk Likelihood (RRL)	**Score**
The risk likelihood is deemed *very low*, therefore the RRL is 2 out of 10.	**2**
Raw Risk Impact (RRI)	**Score**
The risk impact is deemed *very low*, therefore the RRI is 2 out of 10.	**2**
Gross Risk Indicator (GRI)	**Score**
The Gross Risk Indicator (RRL × RRI) is 4 out of 100.	**4**
Mitigation/Notching	**Notch**
RRL Mitigation (Notch) No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).	**NN**
Loaded RI Score	**Score**
The Loaded RI Score ((1-Total Notch) × GRI Score) is 4 out of 100.	**4**

3.9 Risk Factor: Sustainability and Environmental Concern

3.9.1 Feedstock Sustainability

Rationale: Public concerns about sustainability of feedstock production can jeopardize biomass feedstock operations. Sustainability certification schemes should be utilized where applicable to ensure that feedstock comes from sustainable sources.

Canada leads all countries with 166 million hectares of certified forests, a figure that is nearly four times more than second place United States at 47 million hectares.

Risk Information: Academic literature suggests a minimum yield of 150 bu/acre to remove corn stover sustainably to maintain soil organic matter. However, in practice, crop rotation, farm practices (e.g., tilling/no tilling, irrigation), and weather conditions in planting and harvest season can allow the sustainable removal of corn stover in fields with yields lower than 150 bu/acre, where outreach has found in some regions of the country. Despite USDA's recommendation, it is our estimation based on research done in Kansas that adoption of Best Management Practices (BMP) for soil

preservation is below 10%, with over 50% of soil fertility lost due to cropping.[23] Growers in Kansas are also concerned about soil fertility loss, which significantly increases this risk category.
Raw Risk Likelihood (RRL) **Score** The risk likelihood is deemed *high*, therefore the RRL is 8 out of 10. **8**
Raw Risk Impact (RRI) **Score** The risk impact is deemed *high*, therefore the RRI is 8 out of 10. **8**
Gross Risk Indicator (GRI) **Score** The Gross Risk Indicator (RRL × RRI) is 64 out of 100. **64**
Mitigation/Notching **Notch** *RRL Mitigation (Notch)* **25%** Sourcing corn stover from micro-regions/counties with higher average yields within the supply zone can mitigate soil health concerns. Therefore, this category is mitigated at 25%. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is 25%.
Loaded RI Score **Score** The Loaded RI Score ((1-Total Notch) × GRI Score) is 48 out of 100. **48**

3.9.2 Risk to Soil Quality

Rationale: Soil sustainability can be defined as management of soil in a way that does not exert any negative or irreparable effects either on the soil itself or any other systems. There is a diversity of approaches to soil sustainability in jurisdictional guidelines for forest biomass harvesting and production. For different feedstock types, there are also different thresholds at which feedstock removal causes significant negative consequences on soil.

Poor soil quality that negatively impacts the long-term sustainability of the feedstock can entail long-term feedstock risk. Sub-optimal soil management can leave exposed soil post residue-harvest which can lead to soil wash-off and soil carbon loss from precipitation and wind. Over-harvesting of biomass also depletes the carbon stock in the soil and creates a negative feedback loop which can degrade the soil and its nutrients.

Risk Information: In the central east region, two soil types influence agriculture. West of Lyon County has shallow soils suitable for cattle grasslands. East of Lyon County, with its deep, poorly drained soils, is ideal for crops. The sustainability of crop residue removal hinges on retaining sufficient nutrients and preventing erosion. Agronomic research advises leaving at least 60% of the biomass in the field for yields above 150 bu/acre to maintain soil organic matter.

However, soil compaction during fall harvest and depletion of soil potash levels due to increased soybean cultivation pose significant risks. Despite equipment improvements to mitigate compaction, the clayey soil in the region could still compact under wet conditions. These factors indicate a high risk to feedstock sustainability in the BDO Zone region, necessitating careful management and possible compensation for farmers.

Raw Risk Likelihood (RRL) **Score** The risk likelihood is deemed *medium*, therefore the RRL is 6 out of 10. **6**
Raw Risk Impact (RRI) **Score** The risk impact is deemed *medium*, therefore the RRI is 6 out of 10. **6**

[23] https://www.sciencedirect.com/science/article/abs/pii/S0264837723004222

Gross Risk Indicator (GRI)	**Score**
The Gross Risk Indicator (RRL × RRI) is 36 out of 100.	**36**
Mitigation/Notching *RRL Mitigation (Notch)* No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).	**Notch** **NN**
Loaded RI Score	**Score**
The Loaded RI Score ((1-Total Notch) × GRI Score) is 36 out of 100.	**36**

3.9.3 Risk to Surface and Groundwater

Rationale: Excessive nutrient runoff from biomass feedstock production can accumulate in surface waters and result in algal blooms and hypoxia which can lead to habitat loss for aquatic species higher up the food chain and alter aquatic ecosystem food webs. Damage to aquatic ecosystems can cause social and regulatory backlash. Water intake issues can also increase risk.

Risk Information: Less than one percent of Kansas' land base is used for corn production in the BDO zone. As the zone drains into the Mississippi, there are concerns that any form of agriculture contributes to the nitrogen issues in ground and surface water, although the area does not have intensive agricultural production. Many rural wells are poorly constructed and are at shallow depths. Well water quality is regulated and monitored by the Kansas Department of Health and Environment, which reports traces of nitrogen and chemicals but does not exceed safe limits.[24]

Raw Risk Likelihood (RRL)	**Score**
The risk likelihood is deemed *low*, therefore the RRL is 4 out of 10.	**4**
Raw Risk Impact (RRI)	**Score**
The risk impact is deemed *low*, therefore the RRI is 4 out of 10.	**4**
Gross Risk Indicator (GRI)	**Score**
The Gross Risk Indicator (RRL × RRI) is 16 out of 100.	**16**
Mitigation/Notching *RRL Mitigation (Notch)* No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).	**Notch** **NN**
Loaded RI Score	**Score**
The Loaded RI Score ((1-Total Notch) × GRI Score) is 16 out of 100.	**16**

[24] www.kdhe.ks.gov/DocumentCenter/View/8963/Private-Wells-Safe-Location-and-Construction-PDF

3.9.4 Water Use

Rationale: Biomass feedstock operations can have significant impacts on the hydrological flux (infiltration, groundwater recharge, interception, and transpiration) of ecosystems. This can lead to water shortages, lower yields, and backlash from regulatory bodies if management plans are not properly instituted.

Risk Information: The stover harvest does not require water, and the harvest season occurs in late fall when all crops have stopped growing, a time of year when evapotranspiration is not a factor.

Raw Risk Likelihood (RRL) The risk likelihood is deemed *not relevant*, therefore the RRL is not rated.	**Score** **NR**
Raw Risk Impact (RRI) The risk impact is deemed *not relevant*, therefore the RRI is not rated.	**Score** **NR**
Gross Risk Indicator (GRI) The Gross Risk Indicator (RRL × RRI) is not rated.	**Score** **NR**
Mitigation/Notching The Total Notch (RRL Notch × RRI Notch) is not rated.	**Notch** **NR**
Loaded RI Score The Loaded RI Score (Total Notch × GRI Score) is not rated.	**Score** **NR**

3.9.5 Pesticide Risk to Human and Ecosystem Health

Rationale: Application of pesticides (i.e., herbicides, fungicides, and insecticides) on agricultural and forest landscapes can result in adverse health effects for humans and ecosystems. If pesticide application is required in feedstock production, the impact must be considered in the BDO Zone rating.

Risk Information: The BDO zone is not an intensive agricultural productive area. As stated before, corn production accounts for less than 1% of the land use. On a county basis, 74 to 95% of the land is used for either beef cattle production or cropland. Ecosystem concerns are balanced through the provision of ecological programs to support balance. Farmers avail themselves of financing to set aside land through the Conservation Reserve Program.[25] Through partnerships with the Department of Natural Resources, it addresses the preservation and restoration of grasslands to protect corridors for migratory birds using the Kansas River corridor. Overall, the assessment of the risk is low due to the nature of its production.

Raw Risk Likelihood (RRL) The risk likelihood is deemed *low*, therefore the RRL is 4 out of 10.	**Score** **4**
Raw Risk Impact (RRI) The risk impact is deemed *low*, therefore the RRI is 4 out of 10.	**Score** **4**
Gross Risk Indicator (GRI) The Gross Risk Indicator (RRL × RRI) is 16 out of 100.	**Score** **16**
Mitigation/Notching *RRL Mitigation (Notch)* No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).	**Notch** **NN**

[25] (https://www.fsa.usda.gov/programs-and-services/conservation-programs/conservation-reserve-program/index).

Loaded RI Score	**Score**
The Loaded RI Score ((1-Total Notch) × GRI Score) is 16 out of 100.	**16**

3.9.6 Risk to Wildlife and Landscape

Rationale: Biomass production and supply chain operations with negative impacts on wildlife and landscape are at a greater long-term risk of encountering project setbacks and disruptions.

Risk Information: Through the USDA Conservation Services, farmers "set aside" least productive acres suitable for wildlife. Also, the corn acreage is generally less than 1% of the total land available in Kansas.

Raw Risk Likelihood (RRL)	**Score**
The risk likelihood is deemed *low*, therefore the RRL is 4 out of 10.	**4**
Raw Risk Impact (RRI)	**Score**
The risk impact is deemed *low*, therefore the RRI is 4 out of 10.	**4**
Gross Risk Indicator (GRI)	**Score**
The Gross Risk Indicator (RRL × RRI) is 16 out of 100.	**16**
Mitigation/Notching	**Notch**
RRL Mitigation (Notch) No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).	**NN**
Loaded RI Score	**Score**
The Loaded RI Score ((1-Total Notch) × GRI Score) is 16 out of 100.	**16**

3.9.7 Biomass Classified as Genetically Modified Organism (GMO)

Rationale: There are various risks associated with GMOs such as migration or dispersion across the landscape, which can generate community backlash and create supply chain risk. GMOs can also be heavily regulated. If planning to grow or procure GMO feedstocks, especially purpose-grown energy crops, it is important to understand the risks.

Risk Information: This is not relevant to corn stover. When it comes to stover, there is no quality designation enabling differentiation of feedstock sources.

Raw Risk Likelihood (RRL)	**Score**
The risk likelihood is deemed *very low*, therefore the RRL is 2 out of 10.	**2**
Raw Risk Impact (RRI)	**Score**
The risk impact is deemed *very low*, therefore the RRI is 2 out of 10.	**2**
Gross Risk Indicator (GRI)	**Score**
The Gross Risk Indicator (RRL × RRI) is 4 out of 100.	**4**
Mitigation/Notching	**Notch**
RRL Mitigation (Notch) No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).	**NN**

Loaded RI Score	**Score**
The Loaded RI Score ((1-Total Notch) × GRI Score) is 4 out of 100.	**4**

CATEGORY 4.0 FEEDSTOCK SCALE-UP RISK

4.1 Risk Factor: Feedstock Scale-Up

4.1.1 Feedstock Quality at Production Scale

Rationale: The physical and chemical properties of feedstock used in lab, pilot and field testing can fail to be representative of feedstock generated by large-scale operations.

It is important to conduct tests on feedstock representative of that which will be produced by large-scale operations. Failure to adequately test the full range of parameter values can result in severe problems during scale-up.

Risk Information: Corn stover is an inherent by-product of corn cultivation, and its quality as a feedstock is dependent mostly on collection and baling practices and storage. Although the region has a history of baling hay, the collection and quality control of corn stover may present a challenge due to the lack of large-scale demand for this feedstock. Therefore, the impact of the low quality of corn stover on biomass projects could be significant.

Raw Risk Likelihood (RRL)	**Score**
The risk likelihood is deemed *high*, therefore the RRL is 8 out of 10.	**8**
Raw Risk Impact (RRI)	**Score**
The risk impact is deemed *high*, therefore the RRI is 8 out of 10.	**8**
Gross Risk Indicator (GRI)	**Score**
The Gross Risk Indicator (RRL × RRI) is 64 out of 100.	**64**
Mitigation/Notching	**Notch**
RRL Mitigation (Notch) With the establishment of markets for corn stover, it is expected that some of the hay baling knowledge will be transferred to this operation, in addition to developing training protocols that minimize soil contamination and moisture content. Thus, the likelihood is notched to 50%. *RRI Mitigation (Notch)* An experienced third-party bailing company can significantly offset the quality issues of feedstock; therefore, this category is notched at 50%. The Total Notch (RRL Notch × RRI Notch) is 75%.	**75%**
Loaded RI Score	**Score**
The Loaded RI Score ((1-Total Notch) × GRI Score) is 16 out of 100.	**16**

4.1.2 Capacity of Supply Chain Components & Equipment to Scale

Rationale: Scale-up risk increases if supply chain components, or underlying feedstock infrastructure necessary for these components, cannot scale to handle Issuer feedstock requirements and throughput capacity. Capacity to scale should be demonstrated.

Risk Information: The existing infrastructure for corn production is extensive and optimized for consistent high efficiency. However, the absence of infrastructure for large-scale collection, baling, and transportation of corn stover is attributed to the lack of commercial demand. Although efficient equipment for corn stover collection and baling is available, distributors in the supply zone would need to invest in and maintain this equipment. While scaling up is feasible, it necessitates a compelling project to motivate distributors to engage in such expansion. Farmers with hay baling equipment lack an efficient corn stover baling operation and may struggle to meet quality requirements, including

density and transportation quantities, mandated by bio-based projects. Farmers interested in participating in this supply chain would likely need to acquire or upgrade equipment to be able to fulfill quality specifications, necessitating financing and the guarantee of a strong project to take on this kind of debt.

Raw Risk Likelihood (RRL)	**Score**
The risk likelihood is deemed *high*, therefore the RRL is 8 out of 10.	**8**
Raw Risk Impact (RRI)	**Score**
The risk impact is deemed *high*, therefore the RRI is 8 out of 10.	**8**
Gross Risk Indicator (GRI)	**Score**
The Gross Risk Indicator (RRL × RRI) is 64 out of 100.	**64**
Mitigation/Notching *RRL Mitigation (Notch)* Establishing a reputable developer in the supply zone can influence the expansion of the equipment supply and accelerate scale-up. Therefore, this category is notched at 25%. *RRI Mitigation (Notch)* Introducing a third party that owns equipment can significantly reduce the scaling-up risk. Therefore, this category is notched at 50%. The Total Notch (RRL Notch × RRI Notch) is 63%.	**Notch** **63%**
Loaded RI Score	**Score**
The Loaded RI Score ((1-Total Notch) × GRI Score) is 24 out of 100.	**24**

CATEGORY 5.0: INFRASTRUCTURE RISKS

5.1 Risk Factor: Physical Infrastructure

5.1.1 Land Parcel/Ind. District

Risk Information: Industrial Park 4 is the industrial site assessed in the relevant indicators. It is located on the west side of Emporia, KS (pop. 25,000), Lyon County, on the north side of Interstate 50, and 1⁄2 mile west of Road G (Americus Road). Please refer to Appendix D for a map of the location. Industrial Park 4 is a 151-acre greenfield with main utility lines running along the road, water, natural gas, and electrical. The park is undergoing an annexation and rezoning from light to heavy industry to gain access to city water and sewer services. The rezoning is in compliance with the Comp Plan; therefore, no issues are expected. Timeline for completion of the process is expected by the end of 2023.

The park is currently undergoing rezoning to light and heavy industrial and is expected to be approved by the end of 2023**.** Most of the City of Emporia is designated as a severe distress and non-metropolitan New Market Tax Credit area. This means that most of the city of Emporia is considered to be a low-income community that qualifies for the New Markets Tax Credit (NMTC) program, which is a federal program that encourages private investment in economically distressed areas. The NMTC program provides a 39% tax credit for investors who qualify.

As a greenfield with utilities close by, Industrial Park IV offers excellent road access and is competitively priced compared to other parks in the region. However, no light or heavy industries are currently operating, which adds uncertainty to the permitting installation and utilities.

Raw Risk Likelihood (RRL)	**Score**
The risk likelihood is deemed *medium*, therefore the RRL is 6 out of 10.	**6**

Raw Risk Impact (RRI) The risk impact is deemed *medium*, therefore the RRI is 6 out of 10.	**Score** **6**
Gross Risk Indicator (GRI) The Gross Risk Indicator (RRL × RRI) is 36 out of 100.	**Score** **36**
Mitigation/Notching *RRL Mitigation (Notch)* No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).	**Notch** **NN**
Loaded RI Score The Loaded RI Score ((1-Total Notch) × GRI Score) is 36 out of 100.	**Score** **36**

5.1.2 Ownership of Land

Risk Information: Privately owned by Emporia Enterprises, parcels in this location have been sold rather than leased, and both the landowner and the city are motivated to develop the region. The latest commercial market rate was $22,500/acre.

As a means of comparison, Ottawa, KS, 55 miles East of Emporia, has an industrial park on the South side of that city, where, based on a listing in the Franklyn County Development Commission website, the price per acre of a parcel in the "Industrial-Heavy, Industrial-Light" zoning is $25,000, slightly higher cost than the Emporia Industrial Park IV.

Raw Risk Likelihood (RRL) The risk likelihood is deemed *low*, therefore the RRL is 4 out of 10.	**Score** **4**
Raw Risk Impact (RRI) The risk impact is deemed *low*, therefore the RRI is 4 out of 10.	**Score** **4**
Gross Risk Indicator (GRI) The Gross Risk Indicator (RRL × RRI) is 16 out of 100.	**Score** **16**
Mitigation/Notching *RRL Mitigation (Notch)* No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).	**Notch** **NN**
Loaded RI Score The Loaded RI Score ((1-Total Notch) × GRI Score) is 16 out of 100.	**Score** **16**

5.1.3 Permitting Description

Risk Information: The Building and Neighborhood Development Department of the City of Emporia[26] regulates and controls the design, construction, location, quality of materials, use, and occupancy of all buildings and structures within

[26] https://emporiaks.gov/183/Building-Department

the city. It also issues various types of permits, such as building permits, electrical permits, plumbing permits, gas permits, and private sewage disposal permits.

The average processing time for development permits in Emporia depends on the type and complexity of the project, as well as the completeness and accuracy of the application. Some general guidelines for processing time are as follows:

- Building permits: 5 to 10 business days
- Electrical permits: Same day or next day
- Plumbing permits: Same day or next day
- Gas permits: Same day or next day
- Private sewage disposal permits: 5 to 10 business days
- Development permits: 30 to 60 days

Raw Risk Likelihood (RRL)	**Score**
The risk likelihood is deemed *low*, therefore the RRL is 4 out of 10.	**4**
Raw Risk Impact (RRI)	**Score**
The risk impact is deemed *low*, therefore the RRI is 4 out of 10.	**4**
Gross Risk Indicator (GRI)	**Score**
The Gross Risk Indicator (RRL × RRI) is 16 out of 100.	**16**
Mitigation/Notching	**Notch**
RRL Mitigation (Notch) No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).	**NN**
Loaded RI Score	**Score**
The Loaded RI Score ((1-Total Notch) × GRI Score) is 16 out of 100.	**16**

5.1.4 Environmental Issues

Risk Information: The industrial site is not in a flood hazard area. There are no air quality concerns.	
Raw Risk Likelihood (RRL)	**Score**
The risk likelihood is deemed *low*, therefore the RRL is 4 out of 10.	**4**
Raw Risk Impact (RRI)	**Score**
The risk impact is deemed *low*, therefore the RRI is 4 out of 10.	**4**
Gross Risk Indicator (GRI)	**Score**
The Gross Risk Indicator (RRL × RRI) is 16 out of 100.	**16**
Mitigation/Notching	**Notch**
RRL Mitigation (Notch) No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).	**NN**
Loaded RI Score	**Score**
The Loaded RI Score ((1-Total Notch) × GRI Score) is 16 out of 100.	**16**

5.2 Risk Factor: Utilities

5.2.1 Natural Gas Availability

Risk Information: Kansas Gas Service is responsible for the transportation of natural gas in the industrial park. The main line runs adjacent to the south side of the park on a 4"–6" pipe operating at a pressure of 50 psi. Price composition is as follows: Commodity Price ($4.32/MCF)[27] + $0.90/MCF delivered + $300 customer charge. The gas company is expected to take around 60 days to extend from the main to the bio-based project. Depending on gas usage, the company will do a 10-year study and potentially waive any costs associated with this installation. Additionally, the developer would have to invest in the 2" service line from the main into the plant. The gas company assured there is sufficient supply for an industrial operation.

Raw Risk Likelihood (RRL) The risk likelihood is deemed *low*, therefore the RRL is 4 out of 10.	**Score** **4**
Raw Risk Impact (RRI) The risk impact is deemed *low*, therefore the RRI is 4 out of 10.	**Score** **4**
Gross Risk Indicator (GRI) The Gross Risk Indicator (RRL × RRI) is 16 out of 100.	**Score** **16**
Mitigation/Notching *RRL Mitigation (Notch)* No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).	**Notch** **NN**
Loaded RI Score The Loaded RI Score ((1-Total Notch) × GRI Score) is 16 out of 100.	**Score** **16**

5.2.2 Electric Availability

Risk Information: The electrical utility provider is Evergy Inc. The main line runs adjacent to the park's south side at 12,470v. The company will take around 60 days after projects are approved to bring an access point to the plant. Users with demand above 200kW will pay a net monthly bill consisting of a basic service fee ($118.42), an energy charge (depends on kWh and season), and a demand charge (depends on kW and $16.15 rate). The energy charge rate is 1.0987¢ per kWh in winter (October to May) and 1.4471¢ per kWh in summer (June to September).

Raw Risk Likelihood (RRL) The risk likelihood is deemed *low*, therefore the RRL is 4 out of 10.	**Score** **4**
Raw Risk Impact (RRI) The risk impact is deemed *low*, therefore the RRI is 4 out of 10.	**Score** **4**
Gross Risk Indicator (GRI) The Gross Risk Indicator (RRL × RRI) is 16 out of 100.	**Score** **16**

[27] https://www.eia.gov/dnav/ng/hist/n3035ks3m.htm

Mitigation/Notching	**Notch**
RRL Mitigation (Notch) No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).	**NN**
Loaded RI Score	**Score**
The Loaded RI Score ((1-Total Notch) × GRI Score) is 16 out of 100.	**16**

5.2.3 Water Availability

Risk Information: The City of Emporia's primary water source is the Neosho River, managed through the Council Grove Reservoir. The city has a 12" water main on the north, west, and south sides of Industrial Park IV with an available flow of 20 cubic ft/second. The City of Emporia charges a monthly service fee for water based on the size of the meter and the type of customer (residential, commercial, industrial, etc.). The monthly service fee ranges up to $1,000/month for a 10-inch meter (industrial). The water usage charge for industrial customers in winter ranges from $1.50 per 100 cubic feet (for the first 2,000 cubic feet) to $2.50 per 100 cubic feet (for over 100,000 cubic feet).[28] There is an 18" sanitary sewer line along a part of the southeast portion of the south property line. The City of Emporia charges a monthly wastewater fee for industrial customers based on the volume of water used and the strength of the wastewater discharged. The sewage fees in Emporia are around $4.14/1,000 gallons inside the city limits and $8.29 outside.[29] For comparison, a similar town within the supply zone charges $7.54/1,000gal. The sewage treatment plant in Emporia operates using an Integrated Fixed-Film Activated Sludge (IFAS) system, which has received approval from the State Department of Health.

The industrial park is subject to the Kansas Department of Health and Environment (KDHE), which issues permits for stormwater discharges associated with industrial activities, as well as the Stormwater Management Ordinance of the City of Emporia, which requires any person, firm, corporation or business proposing to construct buildings or develop land within the city to submit a stormwater management plan that controls and/or detains stormwater. However, there are no stormwater lines near the park. Therefore, there is uncertainty about the cost and ability to have a management plan approved.

Raw Risk Likelihood (RRL)	**Score**
The risk likelihood is deemed *low*, therefore the RRL is 4 out of 10.	**4**
Raw Risk Impact (RRI)	**Score**
The risk impact is deemed *low*, therefore the RRI is 4 out of 10.	**4**
Gross Risk Indicator (GRI)	**Score**
The Gross Risk Indicator (RRL × RRI) is 16 out of 100.	**16**
Mitigation/Notching	**Notch**
RRL Mitigation (Notch) No adjustment. *RRI Mitigation (Notch)* No adjustment.	**NN**

[28] https://emporiaks.gov/1265/Water-Rates
[29] https://www.emporiaks.gov/1264/Sewer-Rates

The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).
Loaded RI Score — **Score**
The Loaded RI Score ((1-Total Notch) × GRI Score) is 16 out of 100. — **16**

5.2.4 Waste Disposal

Risk Information: The Emporia/Lyon County Landfill, 3.4 miles from the industrial park at 3100 W South Avenue, Emporia, KS, also functions as a transfer station. Regulated by the Kansas Department of Health and Environment (KDHE), it handles varied waste types, including construction debris and municipal waste. A nearby recycling center processes standard recyclables. The adjacent Lyon County Hazardous Waste facility primarily serves residential waste needs. Specific waste categories include 'Industrial Waste' from manufacturing processes and a tire facility dedicated to split tires. Different rates apply if a compactor or open-top roll-off are utilized. For MSW, it's $96.01 per ton, and for CD waste, it's $63.27 per ton. Open tops rented from the city also have a weekly rental fee.

Liquid and Hazardous Waste: The city does not accept liquid waste. Solid waste would be handled as trash via the transfer station. True industrial waste could be processed via the transfer station but requires landfill owner and KDHE approval, potentially necessitating a permit. The rate for industrial waste is $68.47 per ton, with a KDHE Permit required. The city does not process liquid waste, and certain hazardous categories require specialized handling.

Raw Risk Likelihood (RRL)	**Score**
The risk likelihood is deemed *low*, therefore the RRL is 4 out of 10.	**4**
Raw Risk Impact (RRI)	**Score**
The risk impact is deemed *low*, therefore the RRI is 4 out of 10.	**4**
Gross Risk Indicator (GRI)	**Score**
The Gross Risk Indicator (RRL × RRI) is 16 out of 100.	**16**
Mitigation/Notching	**Notch**
RRL Mitigation (Notch) No adjustment.	**NN**
RRI Mitigation (Notch) No adjustment.	
The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).	
Loaded RI Score	**Score**
The Loaded RI Score ((1-Total Notch) × GRI Score) is 16 out of 100.	**16**

5.2.5 Internet Availability

Risk Information: The industrial park is served by fiber-optic and cable networks. ValueNET fiber offers 50MB to 10GB fiber connections at the park, with pricing starting at $100/month. Another cable company called Sparklight and AT&T all provide internet, phone, and TV services. Additionally, HughesNet and ViaSat are two providers of satellite internet services. The options of technologies and competitive pricing make this category low risk.

Raw Risk Likelihood (RRL)	**Score**
The risk likelihood is deemed *low*, therefore the RRL is 4 out of 10.	**4**
Raw Risk Impact (RRI)	**Score**
The risk impact is deemed *low*, therefore the RRI is 4 out of 10.	**4**
Gross Risk Indicator (GRI)	**Score**
The Gross Risk Indicator (RRL × RRI) is 16 out of 100.	**16**

Mitigation/Notching	**Notch**
RRL Mitigation (Notch) No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).	**NN**
Loaded RI Score	**Score**
The Loaded RI Score ((1-Total Notch) × GRI Score) is 16 out of 100.	**16**

5.3 Risk Factor: Transportation/Logistics

5.3.1 Road/Highway Access

Risk Information: The selected site for the study is situated in Industrial Park IV at the west end of Emporia. Sitting North of Highway 50, East of Road F, and West of Rd G, U.S. Route 50 is a transcontinental highway that stretches from Ocean City, Maryland, on the east coast to Sacramento, California, on the west coast. In Emporia, U.S. 50 provides a critical east-west transportation corridor, linking the city to other major Kansas cities like Wichita and Topeka. Road accessibility is a low risk.

Raw Risk Likelihood (RRL)	**Score**
The risk likelihood is deemed *low*, therefore the RRL is 4 out of 10.	**4**
Raw Risk Impact (RRI)	**Score**
The risk impact is deemed *low*, therefore the RRI is 4 out of 10.	**4**
Gross Risk Indicator (GRI)	**Score**
The Gross Risk Indicator (RRL × RRI) is 16 out of 100.	**16**
Mitigation/Notching	**Notch**
RRL Mitigation (Notch) No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).	**NN**
Loaded RI Score	**Score**
The Loaded RI Score ((1-Total Notch) × GRI Score) is 16 out of 100.	**16**

5.3.2 Rail Access

Risk Information: BNSF Railway Company (Burlington Northern Santa Fe Railway) yard in Emporia has not operated in decades, and currently, there is no option to transload from the industrial park to anywhere in Emporia, even though this route is a major east-west freight corridor that connects the West Coast, particularly ports in California, with the Midwest and eastern regions of the United States. The closest option for transloading from truck to rail would be to use a transloading service company in El Dorado, some 60-mile drive distance SW. If rail is paramount to the viability of a project, the developer would have to work with the City of Emporia to find a suitable parcel, invest in the construction of a spur, and pursue the appropriate licensing to create the capability to use rail from this park. Additionally, from outreach to BNSF, any project would require, among other things, to arrive/depart a full train (approximately 8,000 feet). Therefore, this risk category is deemed very high.

Raw Risk Likelihood (RRL) The risk likelihood is deemed *very high*, therefore the RRL is 10 out of 10.	**Score** **10**
Raw Risk Impact (RRI) The risk impact is deemed *very high*, therefore the RRI is 10 out of 10.	**Score** **10**
Gross Risk Indicator (GRI) The Gross Risk Indicator (RRL × RRI) is 100 out of 100.	**Score** **100**
Mitigation/Notching *RRL Mitigation (Notch)* No adjustment. *RRI Mitigation (Notch)* The closest access to intermodal from the industrial park is 60 miles away in El Dorado, KS. However, this category is not mitigated due to the uncertainty of the operational and cost constraints. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).	**Notch** **NN**
Loaded RI Score The Loaded RI Score ((1-Total Notch) × GRI Score) is 100 out of 100.	**Score** **100**

5.3.3 Airport Access

Risk Information: Emporia Municipal Airport is a small public airport that provides regular business and general aviation aircraft. It offers radar service and is equipped with two runways. The runways have lighting for operations in low visibility or nighttime. The nearest national airport to Emporia is the Wichita Dwight D. Eisenhower National Airport, located approximately 96 miles away. It is served by several carriers, offering a total of 49 daily flights. The airport also accommodates air cargo carriers such as Amazon Air, DHL, Federal Express, UPS, and Southwest Airlines Cargo. The nearest major international airport is Kansas City International, 125 miles away.

Raw Risk Likelihood (RRL) The risk likelihood is deemed *low*, therefore the RRL is 4 out of 10.	**Score** **4**
Raw Risk Impact (RRI) The risk impact is deemed *low*, therefore the RRI is 4 out of 10.	**Score** **4**
Gross Risk Indicator (GRI) The Gross Risk Indicator (RRL × RRI) is 16 out of 100.	**Score** **16**
Mitigation/Notching *RRL Mitigation (Notch)* No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).	**Notch** **NN**
Loaded RI Score The Loaded RI Score ((1-Total Notch) × GRI Score) is 16 out of 100.	**Score** **16**

5.3.4 Water Freight Access

Risk Information: The nearest intermodal terminal to Emporia that is capable of transferring cargo to river or ocean ports is the Kansas City Intermodal Facility. This facility is managed by BNSF Railway and is situated at 32880 W 191st Street, Edgerton, KS 66021, approximately 90 miles from Emporia. It provides connections to river ports along the

Missouri River, including destinations like Kansas City, MO, and St. Joseph, MO. The Missouri River ultimately feeds into the Mississippi River, which in turn flows to the Gulf of Mexico. Additionally, the Kansas City Intermodal Facility facilitates connections to ocean ports on the Pacific Ocean, such as Seattle, WA; Portland, OR; Oakland, CA; and Los Angeles, CA. The intermodal can also connect freight to ocean ports on the Atlantic Ocean, such as New York, NY; Baltimore, MD; Norfolk, VA; and Savannah, GA. If the operation requires water transportation, the drive distance to an intermodal is reasonable for a value-added product. However, it may impact profitability due to extra loading and unloading operations. Therefore, this risk is deemed medium.
Raw Risk Likelihood (RRL) **Score** The risk likelihood is deemed *low*, therefore the RRL is 4 out of 10. **4**
Raw Risk Impact (RRI) **Score** The risk impact is deemed *low*, therefore the RRI is 4 out of 10. **4**
Gross Risk Indicator (GRI) **Score** The Gross Risk Indicator (RRL × RRI) is 16 out of 100. **16**
Mitigation/Notching **Notch** *RRL Mitigation (Notch)* **NN** No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).
Loaded RI Score **Score** The Loaded RI Score ((1-Total Notch) × GRI Score) is 16 out of 100. **16**

5.4 Risk Factor: Social Infrastructure

5.4.1 Healthcare (Local)

Risk Information: There are a number of healthcare providers varying in size and services within Emporia's city limits. The main hospital is Newman Regional Health, the largest and most clinically capable Critical Access Hospital in Kansas, with state-of-the-art healthcare 24 hours a day, 160 beds, and a staff of over 650. The Emporia Surgical Hospital offers surgical services such as orthopedics, podiatry, urology, and ophthalmology and has around 100 beds and the Flint Hills Community Health Center offers primary care, dental care, behavioral health, and insurance enrollment assistance with some 10 physicians. According to the 2021 County Health Rankings,[30] Emporia ranked 46th out of 104 counties in Kansas for health outcomes and 51st for health factors. Health outcomes measure how long people live and how healthy they feel, while health factors measure the drivers of health, such as behaviors, clinical care, social and economic factors, and physical environment.
Raw Risk Likelihood (RRL) **Score** The risk likelihood is deemed *low*, therefore the RRL is 2 out of 10. **2**
Raw Risk Impact (RRI) **Score** The risk impact is deemed *low*, therefore the RRI is 2 out of 10. **2**
Gross Risk Indicator (GRI) **Score** The Gross Risk Indicator (RRL × RRI) is 4 out of 100. **4**

[30] https://www.khi.org/articles/2023-county-health-rankings-county-profiles/

Mitigation/Notching	**Notch**
RRL Mitigation (Notch) No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).	**NN**
Loaded RI Score	**Score**
The Loaded RI Score ((1-Total Notch) × GRI Score) is 4 out of 100.	**4**

5.4.2 Education (Schools)

Risk Information: Emporia State University, the city's largest institution with around 5,000 students, offers a diverse range of academic programs and a budget of around $100 million. The U.S. News & World Report[31] ranks Emporia State University as #83 in Regional Universities Midwest and #25 in Top Public Schools. The University promotes various events, services, and training in partnership with the private sector, such as posting jobs and internships and conducting on-campus interviews and career fairs. Flint Hills Technical College focuses on technical and vocational education, with an enrollment of about 1,500. The College offers customized training solutions uniquely tailored to the needs of private sector companies and delivered on campus or on-site. Additionally, the Emporia Unified School District provides K-12 education to the local community with an enrollment of around 4,000 pupils and an annual budget of $45 million spread across 14 schools. The district is ranked #134 out of 275 in the State.[32]

Raw Risk Likelihood (RRL)	**Score**
The risk likelihood is deemed *medium*, therefore the RRL is 6 out of 10.	**6**
Raw Risk Impact (RRI)	**Score**
The risk impact is deemed *low*, therefore the RRI is 4 out of 10.	**4**
Gross Risk Indicator (GRI)	**Score**
The Gross Risk Indicator (RRL × RRI) is 24 out of 100.	**24**
Mitigation/Notching	**Notch**
RRL Mitigation (Notch) No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).	**NN**
Loaded RI Score	**Score**
The Loaded RI Score ((1-Total Notch) × GRI Score) is ___ out of 100.	**24**

5.4.3 Local Transportation

Risk Information: Emporia has a public transportation system called L-CAT,[33] or Lyon County Area Transportation, that offers bus service within the city and to the rest of the county. The average commute time for workers in Emporia is 12.6 minutes, much lower than the national average of 26.9 minutes, meaning a drive distance between 6 and 10 miles.[34] To

[31] https://www.usnews.com/best-colleges/emporia-state-university-1927
[32] https://www.niche.com/k12/d/emporia-unified-school-district-ks/
[33] Transportation - Visit Emporia, Kansas
[34] U.S. Census Bureau QuickFacts: Emporia city, Kansas

reach the park's location on the outskirts of the city, L-CAT can be called to make this route. However, the lack of options makes this category risk medium.	
Raw Risk Likelihood (RRL) The risk likelihood is deemed *medium*, therefore the RRL is 6 out of 10.	**Score** **6**
Raw Risk Impact (RRI) The risk impact is deemed *medium*, therefore the RRI is 6 out of 10.	**Score** **6**
Gross Risk Indicator (GRI) The Gross Risk Indicator (RRL × RRI) is 36 out of 100.	**Score** **36**
Mitigation/Notching *RRL Mitigation (Notch)* No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).	**Notch** **NN**
Loaded RI Score The Loaded RI Score ((1-Total Notch) × GRI Score) is 36 out of 100.	**Score** **36**

5.4.4 Public Safety (Local)

Risk Information: Lyon County (pop. 33,302)[35] is served by 10 fire departments, catering to a population of 33,302 residents within an 848-square-mile area. This translates to an average of 1 fire department for every 3,330 residents, considerably above the US average[36] of 1 fire department per 11,147 residents. The Lyon County Sheriff's Department has one station located at 425 Mechanic Street. The City of Emporia has one police station located at 518 Mechanic Street. The police department has 45 officers and 24 civilian employees. The Emporia State University (ESU) police department has one location on the ESU. All fire departments, police, and medical units in Lyon County are dispatched through the Lyon County Emergency Communication Center (LCECC) located in Emporia. According to the FBI Crime Data Explorer,[37] in Kansas, the rate of violent crime by population has fluctuated considerably in the last 10 years, from 356/100,000 in 2012 to 414/100,000 in 2022. Violent crime in Lyon Country (where Emporia is located) is around 180/100,000 residents, considerably lower than the State averages. The current national average is 380/100,000. Having lower-than-average crime and above-average firefighting infrastructure is a very low risk.

Raw Risk Likelihood (RRL) The risk likelihood is deemed *very low*, therefore the RRL is 2 out of 10.	**Score** **2**
Raw Risk Impact (RRI) The risk impact is deemed *very low*, therefore the RRI is 2 out of 10.	**Score** **2**
Gross Risk Indicator (GRI) The Gross Risk Indicator (RRL × RRI) is 4 out of 100.	**Score** **4**

[35] https://www.census.gov/quickfacts/fact/table/lyoncountykansas/PST045222
[36] https://www.nfpa.org/-/media/Files/News-and-Research/Fire-statistics-and-reports/Emergency-responders/osFDProfileTables.pdf
[37] https://cde.ucr.cjis.gov/LATEST/webapp/#/pages/explorer/crime/crime-trend

Mitigation/Notching	**Notch**
RRL Mitigation (Notch) No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).	**NN**
Loaded RI Score	**Score**
The Loaded RI Score ((1-Total Notch) × GRI Score) is 4 out of 100.	**4**

5.4.5 Housing/Cost of Living

Risk Information: Over the last three years, housing prices in Emporia have surged 125%, from a median home value of $97,600 in 2020 to $219,900 in 2023. These prices are 15% lower than the State average of $259,000[38] and significantly lower than the U.S. median home price of $412,000. However, the sharp increase in prices in the city presents an affordability challenge for the locals, especially with the highest mortgage rates in the last 20 years, which reached 8%[39] in October 2023. Low affordability and increased interest rates are a deterrent for current homeowners to move or for the young to acquire a house.

Raw Risk Likelihood (RRL)	**Score**
The risk likelihood is deemed *high*, therefore the RRL is 8 out of 10.	**8**
Raw Risk Impact (RRI)	**Score**
The risk impact is deemed *high*, therefore the RRI is 8 out of 10.	**8**
Gross Risk Indicator (GRI)	**Score**
The Gross Risk Indicator (RRL × RRI) is 64 out of 100.	**64**
Mitigation/Notching	**Notch**
RRL Mitigation (Notch) No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).	**NN**
Loaded RI Score	**Score**
The Loaded RI Score ((1-Total Notch) × GRI Score) is 64 out of 100.	**64**

5.5 Risk Factor: Labor

5.5.1 Workforce

Risk Information: As of the 2020 U.S. Census Bureau data,[40] the labor force participation rate was recorded at 60.9%. The median age of the workforce in Emporia was reported as 33.6 years.

The dominant industries in Emporia were educational services (20.8%), manufacturing (16.9%), and health care and social assistance (15.1%). Commonly held occupations included office and administrative support (13.9%), production

[38] https://www.forbes.com/advisor/mortgages/real-estate/median-home-prices-by-state/
[39] https://www.bloomberg.com/news/articles/2023-10-28/mortgage-rates-for-us-homes-are-surging-toward-8-and-crushing-market
[40] https://www.census.gov/quickfacts/fact/table/emporiacitykansas/INC110221

(10.8%), and sales and related roles (10.1%). The average annual salary in Emporia was $37,000,[41] below the national average of $56,310.

Labor Force Availability and Changes: The unemployment rate[42] in Emporia as of September 2023 was 2.8%, lower than the national average of 3.8%. This represents a decrease from the 4.5% unemployment rate in July 2022, indicating an improving labor market. However, the labor force participation rate dropped from 62.8% in July 2022 to 60.9% in July 2023.[3] This decline suggests that some individuals may have left the workforce, possibly due to reasons like retirement, disability, or discouragement. Kansas has one of the lowest percent of people in poverty[43] in the country at 7.1%, compared to 12% nationally. Finding workers with professional or skilled abilities could be a challenge. This creates a moderate level of risk for the labor supply of new industries; however, training programs might mitigate this risk.

Training Programs: Flint Hills Technical College (FHTC) offers 2-year programs in the areas of arts, health, information technology, and industry technology. It also offers programs in automotive technology, computer program design, computerized machine tool engineering, graphic arts technology, industrial engineering technology, multimedia design, network technology, and welding technology, which could be relevant to the transportation, logistics, and biomass sectors. FHTC has a history of working with local employers to develop targeted programs that meet their needs, for example, partnering with Simmons Pet Food to create a customized training program for its employees that covers topics such as safety, quality, teamwork, and communication. Emporia also has access to other vocational education, such as the Kansas Office of Apprenticeship,[44] which supports apprenticeships across multiple industries and has an office in Emporia.

Raw Risk Likelihood (RRL)	**Score**
The risk likelihood is deemed *medium*, therefore the RRL is 6 out of 10.	**6**
Raw Risk Impact (RRI)	**Score**
The risk impact is deemed *medium*, therefore the RRI is 6 out of 10.	**6**
Gross Risk Indicator (GRI)	**Score**
The Gross Risk Indicator (RRL × RRI) is 36 out of 100.	**36**
Mitigation/Notching *RRL Mitigation (Notch)* Partnering with a local workforce program such as the Kansas Department of Commerce can mitigate the skilled labor risk by filtering specific skills that would be required for a bio-based project. Therefore, this category is notched at 50%. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is 50%.	**Notch** **50%**
Loaded RI Score	**Score**
The Loaded RI Score ((1-Total Notch) × GRI Score) is 18 out of 100.	**18**

[41] https://www.zippia.com/emporia-ks-jobs/salary/
42 https://www.bls.gov/web/laus/laumstrk.htm
[43] https://www.census.gov/data/tables/time-series/demo/income-poverty/historical-poverty-people.html
[44] https://ksapprenticeship.org/

5.5.2 Labor Costs

Risk Information: According to the Bureau of Labor Statistics,[45] the average hourly wage for skilled occupations, such as management, business and financial operations, computer and mathematical, architecture and engineering, and healthcare practitioners and technical occupations, ranged from $35.12 to $53.11 in Kansas in May of 2021. The average annual wage for these occupations ranged from $73,040 to $110,4801. Emporia's minimum wage rate aligns with the federal minimum wage at $7.25 per hour, which is lower than the minimum wage rates in neighboring states such as Colorado ($12.32), Missouri ($10.30), and Nebraska ($9.00). The average hourly pay in Emporia was reported at $17.0, which is below the national average of $27.1.

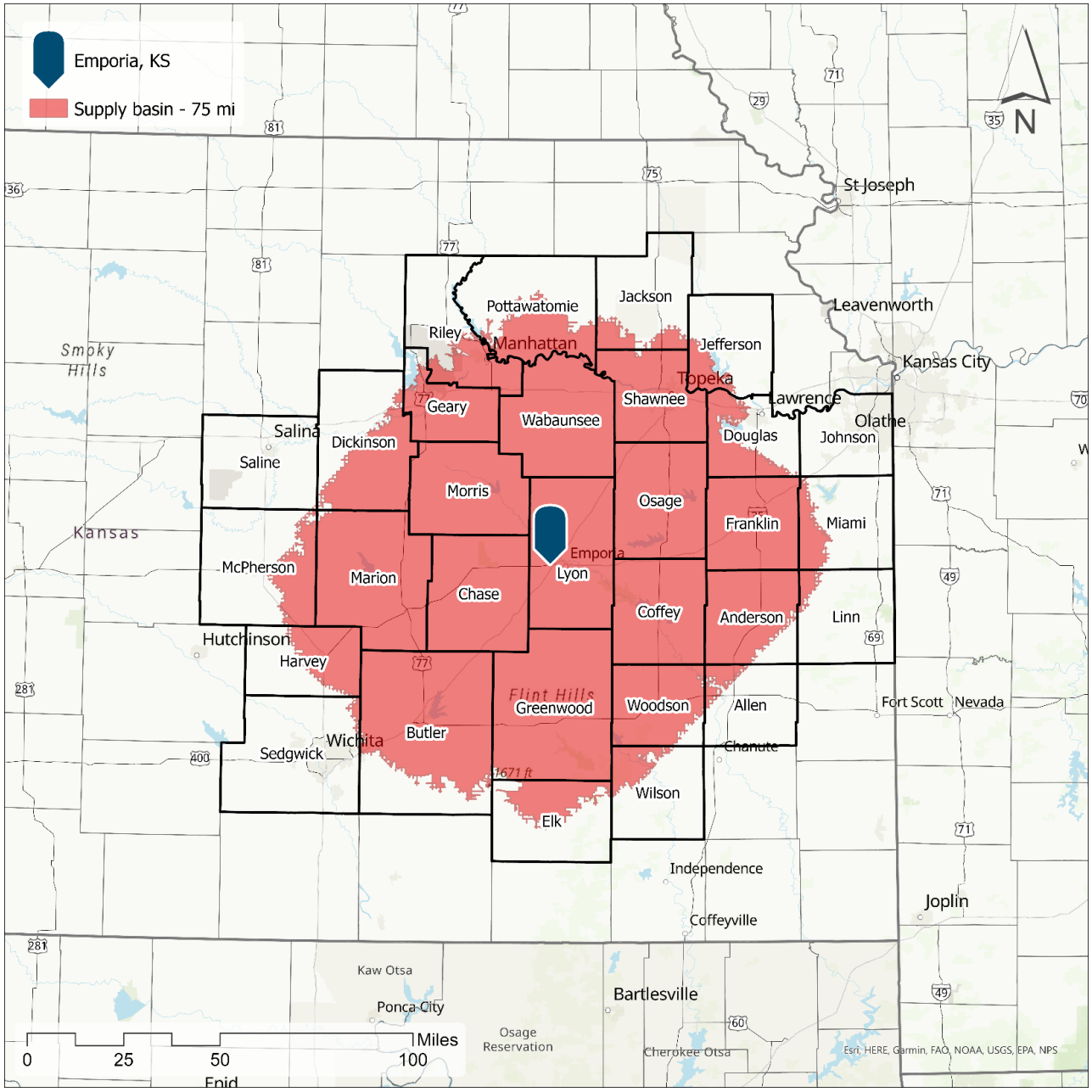
Wage rates in Emporia vary significantly by industry and occupation. According to 2021 Census Bureau data, Emporia's median annual household income is $36,111.

Raw Risk Likelihood (RRL) The risk likelihood is deemed *low*, therefore the RRL is 4 out of 10.	**Score** **4**
Raw Risk Impact (RRI) The risk impact is deemed ***low***, therefore the RRI is **4 out of 10.**	**Score** **4**
Gross Risk Indicator (GRI) The Gross Risk Indicator (RRL × RRI) is 16 out of 100.	**Score** **16**
Mitigation/Notching *RRL Mitigation (Notch)* No adjustment. *RRI Mitigation (Notch)* No adjustment. The Total Notch (RRL Notch × RRI Notch) is NN (No Notch).	**Notch** **NN**
Loaded RI Score The Loaded RI Score ((1-Total Notch) × GRI Score) is 16 out of 100.	**Score** **16**

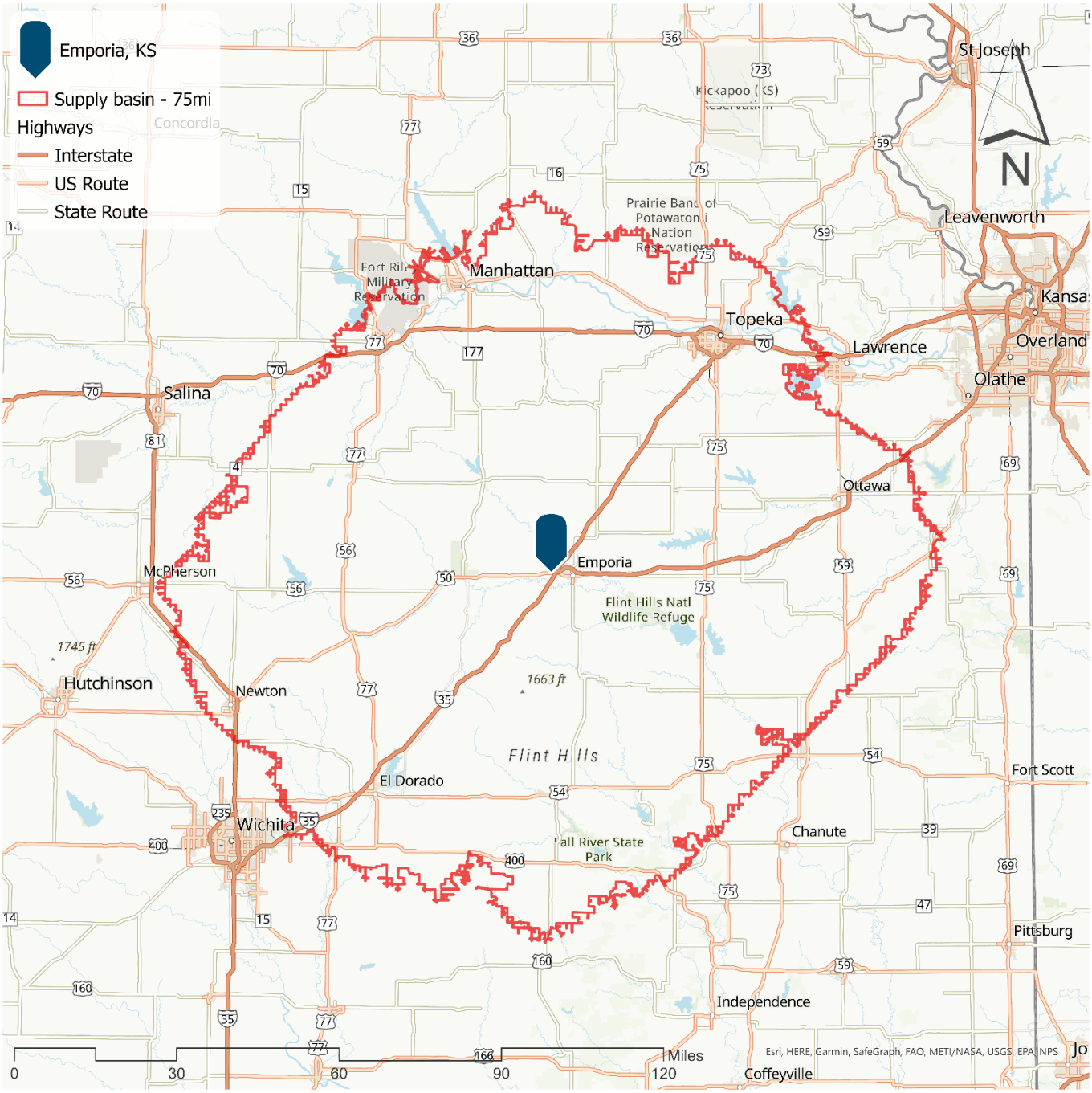
[45] https://www.bls.gov/oes/current/oes_ks.htm

APPENDIX C: TABLES AND FIGURES

Map C-1. Counties within the supply zone.



Map C-2. Road network around Emporia, KS



Map C-3. Intermodal network around Emporia, KS

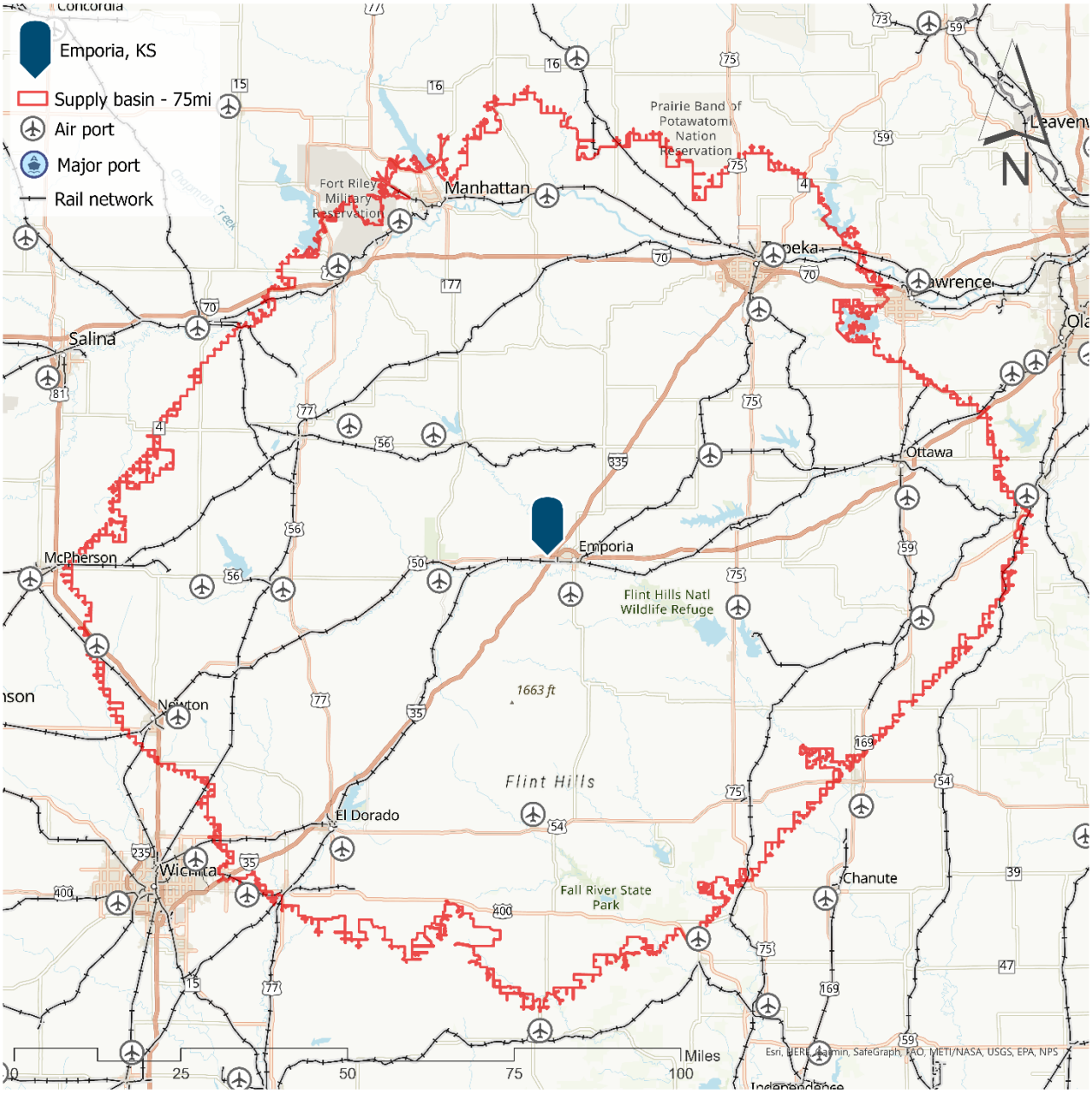
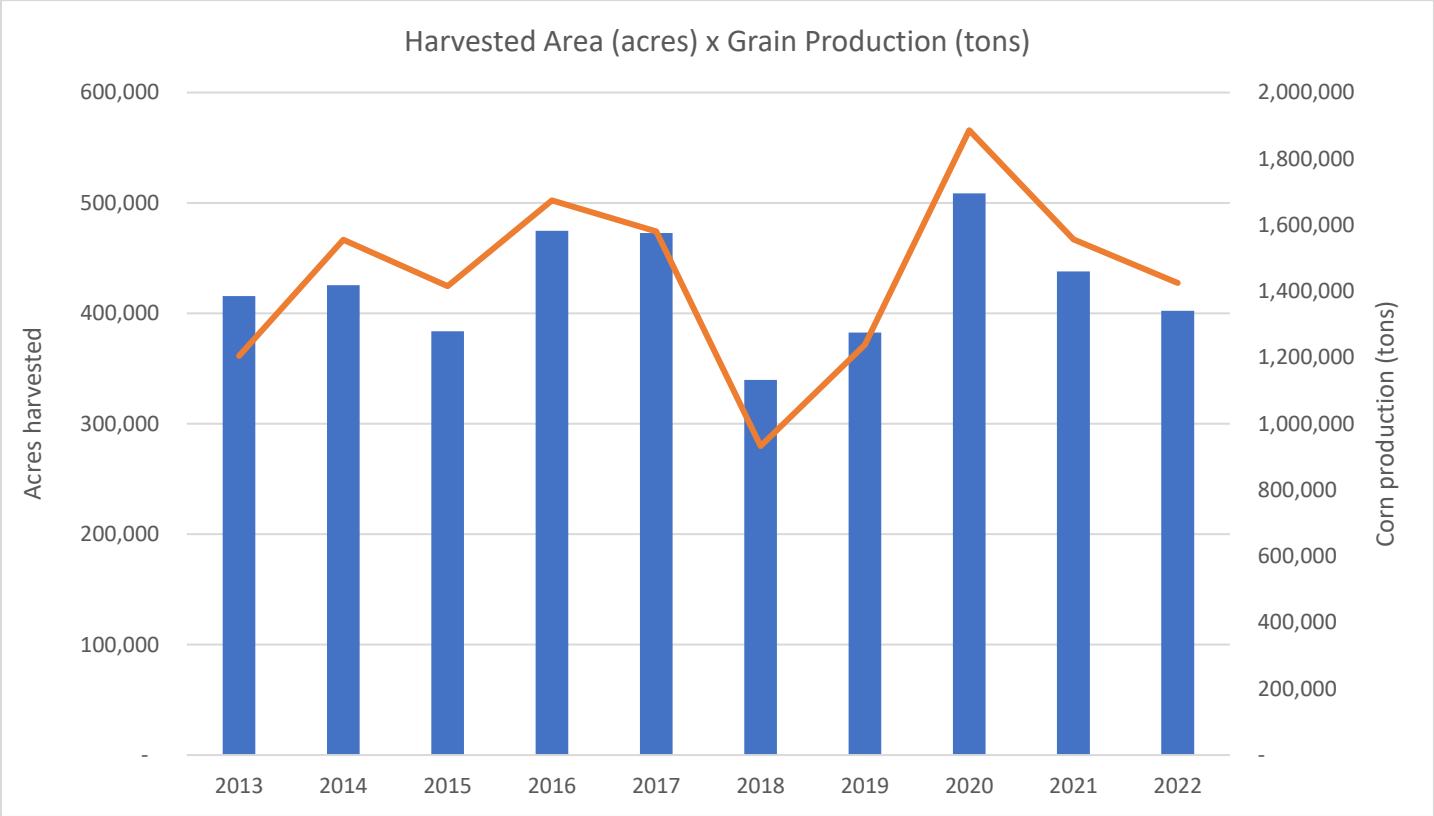


Table C-1. 10-year Corn harvested area in acres within the supply zone[46]

	Acres Harvested (acres within the supply zone)									
County	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
ALLEN	2,770	3,197	3,196	-	2,881	3,003	-	3,360	3,371	3,136
ANDERSON	33,343	36,888	35,318	41,691	35,276	39,817	37,141	39,251	36,635	33,258
BUTLER	49,162	47,148	45,491	52,810	50,616	-	-	49,908	47,446	43,567
CHASE	5,800	4,700	-	-	-	-	-	7,610	6,640	5,110
COFFEY	27,000	27,590	26,380	34,800	32,790	30,190	23,800	32,100	31,900	27,500
DICKINSON	-	-	4,830	-	11,115	-	-	11,295	10,808	7,692
DOUGLAS	12,321	11,193	11,500	13,166	12,170	11,023	11,094	11,991	12,746	10,952
ELK	-	1,106	-	-	1,098	1,305	1,361	-	-	1,247
FRANKLIN	27,600	28,800	29,670	35,700	32,210	31,760	25,000	30,500	-	-
GEARY	9,560	9,823	8,289	9,569	9,595	-	-	11,315	9,823	10,525
GREENWOOD	10,215	7,537	6,307	-	-	7,041	-	-	-	6,892
HARVEY	26,080	25,809	26,035	31,088	29,103	27,253	30,953	31,224	29,960	29,825
JACKSON	5,226	4,624	4,930	5,630	5,400	4,955	5,636	5,694	5,753	-
JEFFERSON	6,229	6,340	6,378	7,071	6,693	-	6,372	7,262	7,007	7,214
JOHNSON	-	-	-	-	-	0	-	-	-	0
LINN	-	924	-	-	-	-	-	1,152	-	764
LYON	26,500	25,600	23,300	28,200	25,700	19,390	24,100	27,300	29,500	20,000
MARION	46,005	44,217	42,975	57,551	54,302	44,435	64,984	62,400	65,182	61,406
MCPHERSON	9,237	8,254	8,620	9,992	10,358	8,871	11,844	10,449	10,220	-
MIAMI	3,515	3,315	3,225	4,113	3,877	3,821	3,297	4,094	3,152	2,681
MORRIS	18,400	19,500	17,200	21,480	20,700	6,300	22,500	21,200	20,500	16,400
OSAGE	34,100	36,400	35,800	37,700	32,900	30,990	29,900	29,900	-	26,200
POTTAWATOMIE	13,110	12,626	-	13,785	12,764	10,813	12,038	13,041	13,525	-
RILEY	5,305	-	3,460	-	-	-	6,761	8,009	7,975	8,391
SALINE	2	3	3	-	4	2	-	4	3	4
SEDGWICK	508	471	-	586	-	528	697	604	-	598
SHAWNEE	35,880	33,892	33,495	37,272	33,296	34,091	32,700	35,483	32,401	32,302
WABAUNSEE	-	-	-	24,670	25,230	16,690	25,400	24,400	25,600	21,300
WILSON	7,663	7,263	7,379	7,937	6,809	7,482	7,072	7,749	7,888	7,228
WOODSON	-	18,199	-	-	18,018	-	-	21,368	20,010	18,018
Total Harvested	**415,530**	**425,419**	**383,780**	**474,809**	**472,905**	**339,761**	**382,648**	**508,663**	**438,047**	**402,213**

[46] https://quickstats.nass.usda.gov/

Chart C-1. Harvested area in acres and grain production in tons in the supply zone[47]



[47] https://quickstats.nass.usda.gov/

Table C-2. 10-year historical corn grain production in tons[48]

	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Total	**1,205,256**	**1,556,013**	**1,415,897**	**1,674,340**	**1,580,498**	**932,826**	**1,238,933**	**1,886,126**	**1,556,331**	**1,425,468**
ALLEN	7,767	13,503	11,504	-	10,111	9,783	-	10,190	11,100	7,977
ANDERSON	82,440	154,031	128,049	142,031	118,455	135,524	115,836	120,681	119,594	118,686
BUTLER	107,971	164,787	167,924	179,690	165,420	-	-	173,706	170,050	121,542
CHASE	13,888	16,464	-	-	-	-	-	28,924	27,524	10,214
COFFEY	69,188	96,208	97,101	113,845	108,632	98,378	76,636	116,564	97,860	93,834
DICKINSON	-	-	20,026	-	34,176	-	-	44,905	40,133	16,398
DOUGLAS	43,950	47,624	44,452	48,880	50,665	22,537	38,570	49,819	44,677	42,525
ELK	-	4,825	-	-	4,074	4,205	4,128	-	-	2,009
FRANKLIN	78,372	117,712	109,284	137,956	126,924	67,452	82,656	118,804	-	93,240
GEARY	36,691	37,943	38,287	39,171	40,399	-	-	52,310	39,883	32,899
GREENWOOD	24,103	27,268	16,778	-	-	19,368	-	-	-	9,957
HARVEY	80,970	97,343	96,080	110,647	85,114	94,690	94,665	120,034	126,919	99,749
JACKSON	17,505	19,723	18,649	21,746	18,546	14,376	21,633	24,186	24,403	20,085
JEFFERSON	21,267	29,547	26,962	29,164	26,637	-	25,832	33,124	32,003	25,108
JOHNSON	-	-	-	-	-	1	-	-	-	0
LINN	-	4,076	-	-	-	-	-	4,138	-	1,006
LYON	77,980	89,544	77,868	89,558	78,719	46,544	64,876	88,984	90,524	74,117
MARION	121,275	124,808	145,452	200,372	131,875	112,892	182,121	214,199	201,846	155,951
MCPHERSON	29,917	33,918	35,544	39,763	33,656	32,138	39,693	43,739	35,000	35,930
MIAMI	9,851	14,691	12,344	16,656	16,843	11,786	12,048	15,685	10,856	12,775
MORRIS	57,092	57,960	62,283	65,500	62,518	8,949	63,616	85,064	69,468	57,831
OSAGE	103,600	130,340	132,140	123,505	125,328	57,313	96,768	110,768	-	93,971
POTTAWATOMIE	55,305	48,312	-	56,515	49,484	33,812	49,735	60,138	60,438	45,971
RILEY	18,873	-	15,621	-	-	-	27,999	36,037	35,173	16,866
SALINE	8.57	8.45	9.03	-	9.24	5.62	-	17.34	10.82	8.05
SEDGWICK	1,706	2,009	-	2,006	-	1,893	2,403	2,197	-	1,451
SHAWNEE	130,131	131,634	135,891	145,047	130,103	100,965	135,975	153,396	130,381	130,106
WABAUNSEE	-	-	-	81,564	93,408	35,224	79,856	101,808	98,336	56,165
WILSON	15,408	29,371	23,649	30,723	18,852	24,987	23,888	21,874	27,634	22,871
WOODSON	-	62,365	-	-	50,551	-	-	54,835	62,517	26,226

[48] https://quickstats.nass.usda.gov/

Chart C-2. Corn grain production supply curve in tons in the supply zone

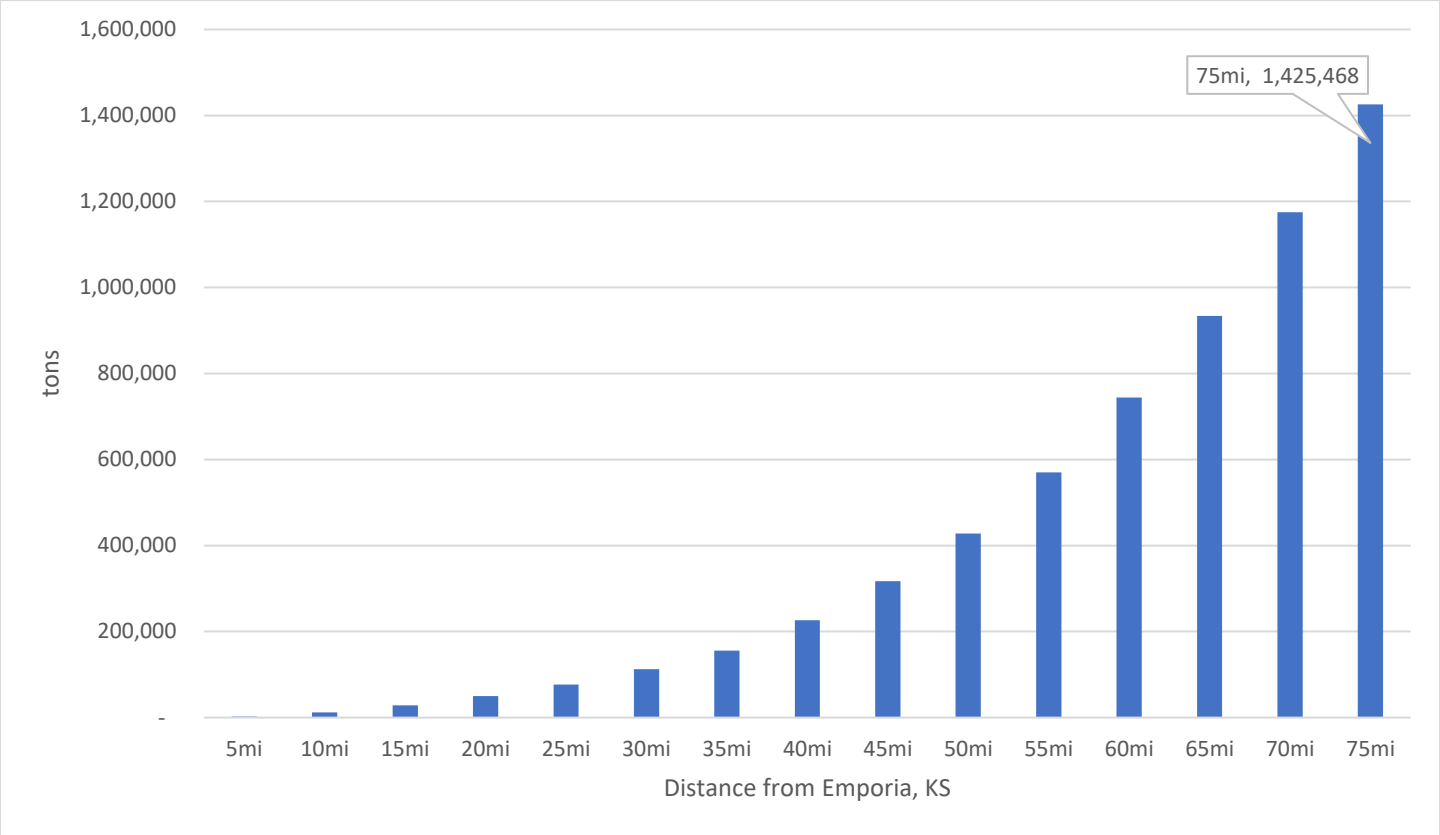


Table C-3. Transportation Cost details by bale

HDLSB per load	39	bales
Unit Transport Cost	4.00	$/mi
Avg Transportation Dist.	50	miles
Loading/ unloading cost	3.25	$/ton
Payload	21.83	tons
Cost per truckload	270.95	$/ truckload
Transportation Cost (bales)	**6.95**	**$/ bale transported**

Table C-4. Assumptions used to calculate corn stover rated quantity

Corn bushel (wet lbs)	56
Corn bushel (dry lbs)	47.32
Corn stover to corn grain ratio	1
Moisture content of corn stover at harvest time	22%
1 short ton in lbs	2,000
Large Square Bale Weight (lb)- wet basis	1,092
Large Round Bale Weight (lb)-wet basis	1,147
Avg Bale Weight (lb)- wet basis	**1,120**

Chart C-3. 10-year historic corn prices[49]

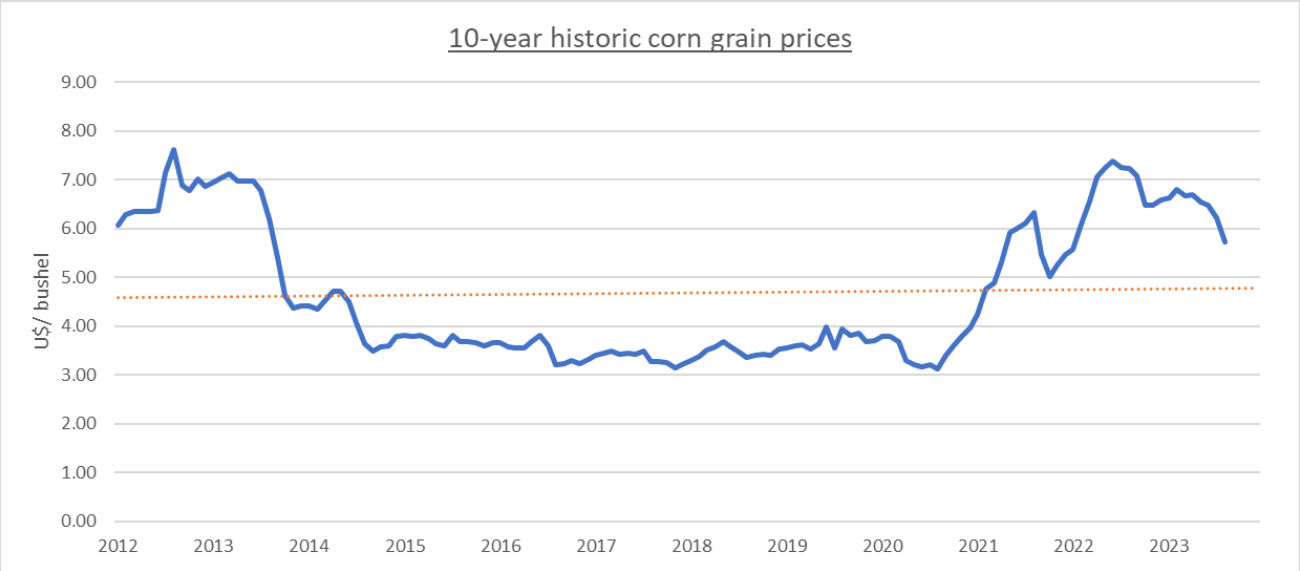
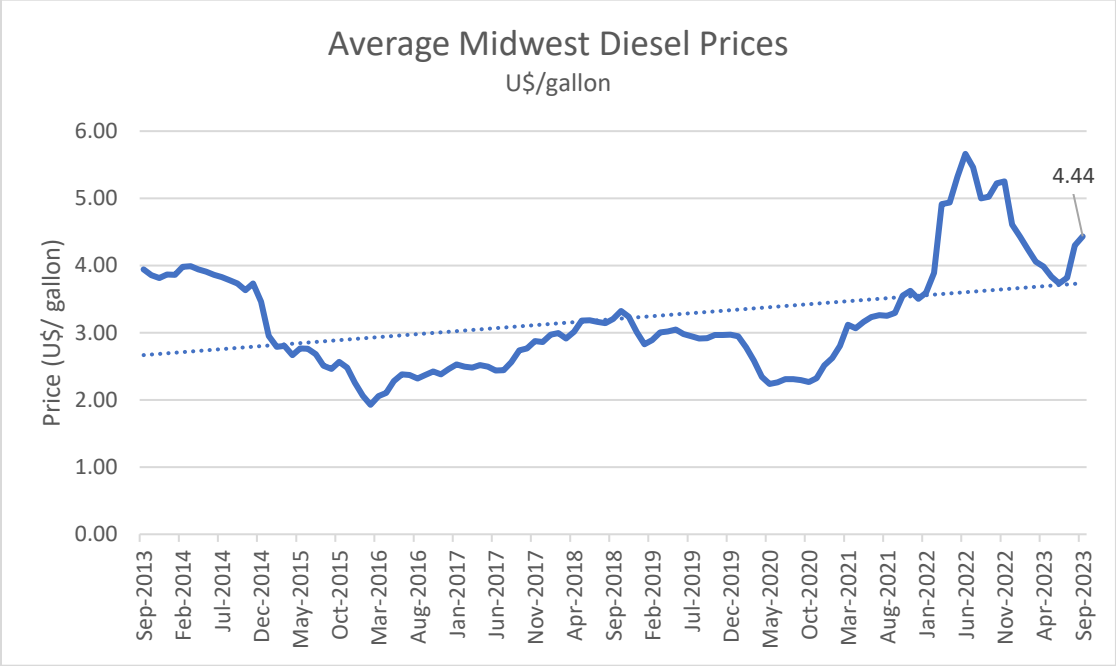


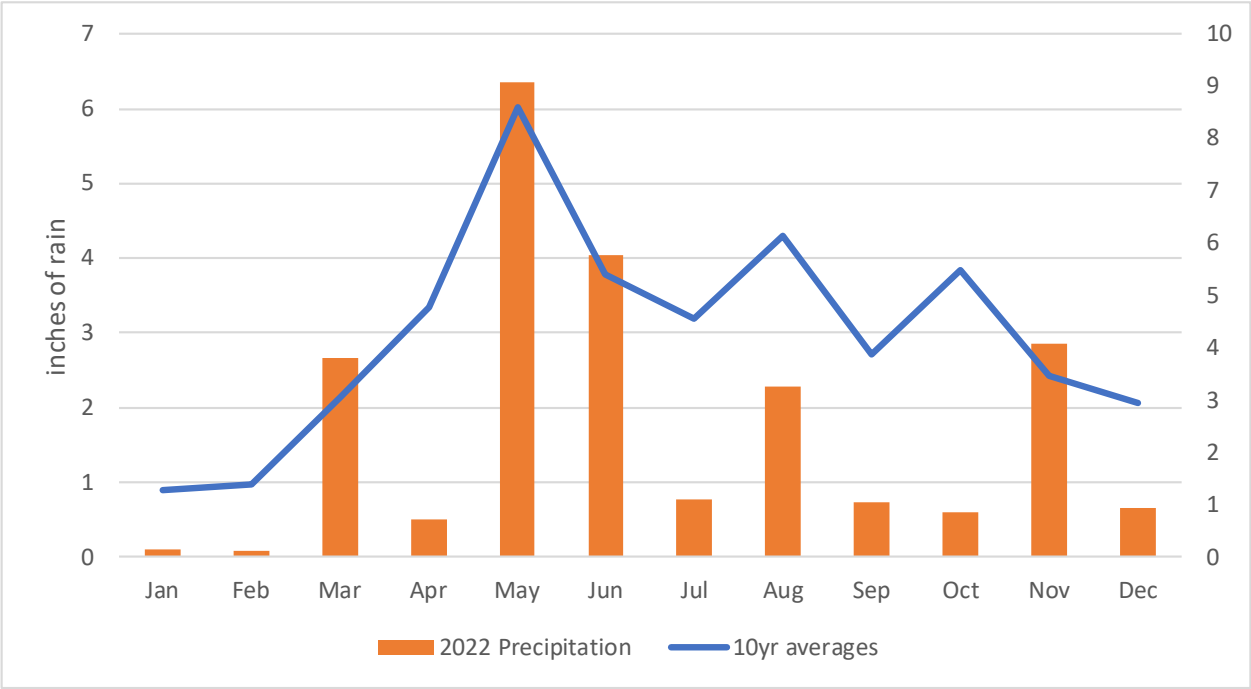
Chart C-4. 10-year average Midwest Diesel prices



Source: EIA

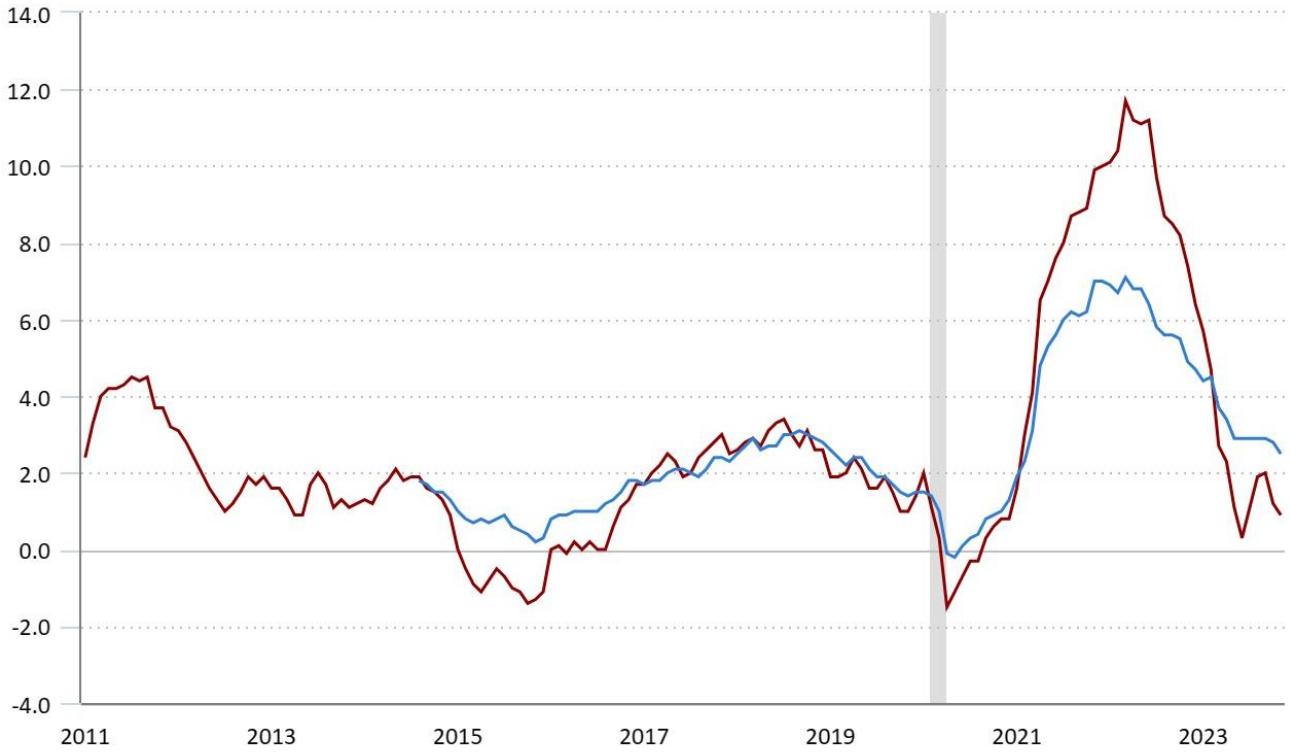
[49] https://quickstats.nass.usda.gov/

Chart C-5. 10-year precipitation comparison (in inches of rain) – Emporia, KS



Source: [Daily Summaries Station Details: EMPORIA ASOS, KS US, GHCND:USW00013989 | Climate Data Online (CDO) | National Climatic Data Center (NCDC) (noaa.gov)]

Chart C-6: 10-year Producer Price Index US



Source: U.S. BUREAU OF LABOR STATISTICS[50]

[50] https://www.bls.gov/charts/producer-price-index/final-demand-12-month-percent-change.htm

APPENDIX D: LEGAL DISCLAIMER

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