Bioeconomy Development Opportunity Zone Risk Rating

'A'

The Tazewell, VA Bioeconomy Development Opportunity Zone is rated 'A.' Small-diameter roundwood and forest residues are available in sufficient quantities and prices to support large biomass-based projects.

Rating Parameters:

Category	Rated Quantity	Delivered Cost	BDO Zone Size
Pulpwood	**500,000 gt/yr**	**$40-$50/gt**	**75-mile maximum road distance from Tazewell, VA**
Sawmill Residuals	**25,000 gt/yr**	**$30-$60/gt**	
Forest Residues	**100,000 gt/yr**	**$40-$60/gt**	

BDO Zone Assets

- **625,000 gt/yr of woody biomass potentially available at low risk**
- **Competition for biomass in the region is currently limited**
- **Existing terminal chipping infrastructure and workforce experience could be leveraged for a new bio-project**
- **A 180-acre development site with flexible zoning, access to natural gas, and in close proximity to the interstate highway system**

BDO Zone Liabilities

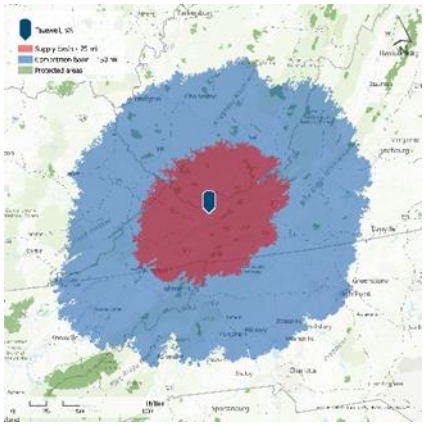
- **Three coal generating stations within 150 miles of Tazewell are eligible to co-fire biomass indefinitely**
- **Logging and milling capacity is relatively low and has recently weakened further as a result of paper mill closures**
- **Only seven sawmills operate in the supply basin, significantly limiting availability of sawmill residuals**
- **Supply chain scale-up is necessary to meet a portion of the rated quantity of roundwood**

BDO Zone Risk Rating

The Tazewell, VA, Bioeconomy Development Opportunity Zone is rated 'A,' or 'high quality.'

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

Tazewell, VA BDO Zone



Scoring and Rating Methodology

In assessing the biomass supply chain risk for the Bioeconomy Development Opportunity (BDO) Zone, 52 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 green tons per year (gt/yr). While feedstock costs are expressed in United States (USD) dollars. Maximum transport distance is based on a 75-mile driving distance from the center point (Tazewell, VA).

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 RI** score based on the research and analysis conducted on the feedstock supply chain in the region. Raw RI Scores are scaled between 1 (*low risk*) and 10 (*high risk*).

Next, each Risk Indicator is discounted, or "notched," based on the degree to which the uncertainty drivers are deemed addressable and whether there are reasonable expectations that mitigation measures could be put into place within the price parameters for this rating.

The **Notched Salience score** corresponds to the likelihood of each Risk Indicator's described risk

materializing given the implementation of reasonable mitigation measures. To arrive at the Notched Salience score, Raw RI scores are reduced based on the efficacy of the likely mitigation measures. If applicable, notching occurs at one of 3 levels: 25%, 50%, or 75%.

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

The **Loaded RI** score for each Risk Indicator is calculated as the product of Notched Salience and Impact Level scores. For example, if the Risk Indicator 'Competitor Price and Price Sensitivity' is scored at a Raw Score of 4, a Notched Salience of 2, and the Impact Level is high (i.e., 9.99). The final Loaded RI score for this risk indicator is 2 × 9.99 = 19.98 (out of 100).

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

The total risk rating for the BDO Zone is the average of all Loaded RI scores. The BDO Zone score for Tazewell, VA is ***15.06 out of 100, resulting in an 'A' designation***.

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

Analyst Notes

The Tazewell BDO Zone encompasses an 8,730 square mile area (75-mile maximum road distance from Tazewell) from which woody biomass availability was quantified. Pricing and supply chain risks were assessed over a broader 40,186 square mile competition basin (150-mile maximum road distance from Tazewell). The supply basin encompasses 16 Virginian counties, 10 West Virginian counties, and 7 counties in North Carolina, Tennessee, and Kentucky. Approx. 40% of the supply basin covers the Appalachian coalfields (west and north of Tazewell). The competition basin extends to Corbin, KY in the west, Charleston, WV in the north, Lexington, VA in the east, and Greensboro, NC in the south.

Timberlands in the Zone are comprised almost exclusively of hardwoods (~97%). Dominant tree species include yellow-poplar, chestnut oak, red oak, white oak, and soft maple. The majority of timberlands are privately owned (77%) and average 30-40 acres per property. Larger privately-owned tracts exist along the VA-WV border and in the coalfields in the northwestern portion of the supply basin. Many of the State and federal lands (23%) are accessible for sustainable logging, including the 720,000-acre Jefferson National Forest and 250,000 acres owned by The Nature Conservancy (Clinch River Valley project).

Logging and milling capacity in the BDO Zone is relatively limited. This is due in part to the history of coal mining in the Tazewell area, which has taken precedence over forestry until recently. Capacities have been declining since the economic downturn in the late-2000s. Demand has further weakened following the closure of two major paper mills in 2020 (Domtar – Kingsport, TN) and 2023 (Pactiv Evergreen – Canton, NC). As of 2019, the growth-to-removal ratio (GRR), which indicates the extent to which annual growth of timber exceeds annual timber losses from logging and natural mortality, was as high as 10:1 for pulpwood (small-diameter trees between 5- and 11-inches diameter at breast height). The current GRR for the supply basin likely exceeds 10:1 given recent paper mill closures.

Although labor and capital capacities have declined, a significant base of logging and trucking professionals, foresters, and brokers continues to operate in the region. Forestry capacities stand to be strengthened as a

result of government policies, which are curtailing the use of coal and actively seeking to transfer coal industry expertise and equipment to alternative industries (e.g., Virginia Clean Economy Act (2020) and Reclamation Program of the Virginia Department of Energy).

US Department of Energy data (Billion-Ton Report) indicates that the total quantity of standing pulpwood (i.e., small-diameter trees of between 5 and 11 inches at breast height) available for a new entrant in the region is approx. 725,000 gt/yr (Appendix C). We estimate that approx. 70% of this amount (500,000 gt/yr) could be felled, extracted, and delivered to a new project within the supply basin at low risk for the rated price of $40/gt to $50/gt. An additional 100,000 gt/yr of forest residues (tree branches, bottoms, and tops normally discarded during conventional logging operations) could also be made available at the rated price of $40/gt to $60/gt (Appendix C).

Harvesting levels will likely have to increase to procure the rated quantity of forest biomass (pulpwood and forest residue). Logging operations in the area tend to have low levels of mechanization, with the majority involving chainsaw felling/ delimbing and cable skidder extraction. This limits average productivity to ~10 truckloads per week. At a price of $40/gt to $50/gt, we expect that the productivity of existing logging contractors would improve and that new logging personnel would enter the market. Long-term supply contracts were regarded as particularly important, as this would provide the revenue guarantee required for purchases of new equipment and associated productivity gains. All foresters and logging contractors contacted agreed that the network of stationary chippers in the Zone that remains following the closure of the Domtar paper mill in Tennessee could be leveraged for a new project. Despite these advantages, concerns regarding the time required to achieve full scale-up and the lack of equipment financing remain.

Only seven hardwood sawmills operate in the supply basin. Three of the sawmills have annual lumber production capacities larger than 10 million board feet (MMBF) per year; the remaining four have capacities <2 MMBF/yr. For a market capture rate of 20%, approx. 25,000 gt/yr of sawmill residuals could be made available for a new project at a price $25/gt – $40/gt (Appendix C). This constitutes a mere 4% of the total rated quantity of woody biomass.

At present, competition for biomass in the region is limited. There is currently one large paper mill located >120 miles from Tazewell (WestRock – Covington, VA) that procures pulp-quality chips, bark, and to a lesser extent pulpwood from the Tazewell area. Other users of biomass in the competition basin include five pellet mills (all of which are restricted to sawdust), a single OSB plant in Heaters, WV with a modest annual pulpwood demand, and three coal generating stations that co-fire sawmill residuals sporadically.

Key Risk Indicators

The main strengths of the Tazewell BDO Zone relate to the region's underutilized, fast-growing hardwood forests and latent workforce capacity. Given the recent closure of a paper mill in Tennessee that used to draw pulpwood from the area, the growth-to-removal ratio for trees between the diameters of 5 and 11 inches is likely greater than 10-to-1. Consequently, a new bio-project is likely to have access to at least 500,000 gt/yr of oak, maple, and poplar pulpwood. With regards to the regional workforce, a large proportion of the working age population has experience in natural resource extraction (coal). Workforce development programs are already in place and forestry professionals in the area are capable of re-training with sufficient resources.

The most significant risks to the establishment and operation of a new biomass-based project in the Tazewell, VA BDO Zone relate to Virginia's coal generating fleet. Legislation relevant to the state's renewable energy portfolio standards was recently revised in favor of biomass co-firing. The three coal generating stations located within the competition basin are now incentivized to combust biomass. There is therefore a risk that the rated biomass quantities will not be consistently available to a new project. There is also risk that biomass prices will increase beyond the rated price ranges owing to increasing competition.

Risks associated with biomass co-firing are moderated to some degree by uncertainty related to negative public opinion of large-scale bioenergy and, by association, to whether the current rules around biomass co-firing are durable. Current competition by coal generating stations is limited to the Hybrid Energy Center in St. Paul, VA. Since its establishment in 2012, the facility's demand for sawmill residuals and to a lesser extent forest residue has been inconsistent.

Other significant risks to a new project in the Tazewell BDO Zone relate to the capacities of businesses that stand to be involved in the supply of the rated quantities of pulpwood and forest residue. The existing population of logging contractors in the supply basin numbers approx. 50. These businesses are characterized by single crews with fewer than four employees. Many crews are unmechanized, felling and delimbing manually with chainsaws and extracting tree-lengths with cable skidders. Although skilled and experienced, the low number of contractors and low mechanization of many harvesting operations present supply risks.

Current logging operations in the supply basin generally do not involve the recovery of pulpwood due to the absence of markets. Bringing this pulpwood to market would not require additional workers. However, there is uncertainty as to whether the quantities recovered in the course of conventional logging operations would amount to 500,000 gt/yr. It is possible that additional logging crews will need to be recruited to procure the rated quantity of pulpwood.

Labor availability is not anticipated to impact procurement of the rated quantity of forest residue. With slight modifications to harvesting practices, tree branches and tops could be recovered at a rate of approx. 10 gt/acre. Contractors with experience in full-tree harvesting and roadside chipping of forest residue are present in the area. Recent examples include residue production for the Hybrid Energy Center in St. Paul, VA and for the now closed Domtar paper mill in Kingsport, TN. To procure the rated quantity of forest residues (100,000 gt/yr), integrated harvesting and roadside chipping would need to be implemented on approximately half of the area that is harvested annually under current market conditions (~20,000 acres/yr).

The availability of equipment, chip vans, and logistics coordination are the main bottlenecks for forest residue supply. Additional mobile chippers will need to be purchased and new logistics networks established. Procuring the rated quantity of pulpwood may also require investment in additional feller bunchers and grapple skidders.

There is at least 1 million green tons per year of woody biomass (pulpwood, residue, and residuals) available in the BDO Zone. Given the large supply potential in the area, there is also positive upside risk in terms of the aggregate impacts that an increased throughput of biomass for co-firing will have on a new bio-project. The rated quantities only represent approximately two-thirds of the biomass available within the BDO Zone, as estimated using the more

conservative Billion-Ton Report dataset. The three coal generating stations will inevitably source woody biomass from forest resources not assessed here given their location near the periphery of the BDO Zone. Increased aggregate demand for biomass in the region could have positive impacts on the supply of labor and capital in the Tazewell area.

Other significant risks relate to diesel prices, and transport costs and distances. Diesel prices in the Lower Atlantic Region have experienced a significant increase of over 100% in the past three years. Considering current trucking rates in the region, which encompass diesel, capital, and labor expenses, the transportation costs for feedstock can constitute more than 50% of the total delivered costs at transport distances greater than 100 miles. Efforts to optimize transportation routes, enhance operational efficiencies, and negotiate favorable contracts will necessarily have limited effects.

Infrastructure Asset Profile

Tazewell County and surrounding counties in Virginia possess attributes favorable to biomass-based project development. The region is crisscrossed by well-maintained primary and secondary road networks. Secondary and tertiary roads in the forested areas northwest of Tazewell are particularly well-developed owing to the history of coal production in the region. The rail network is also reliable and well-connected, linking the region to inland and coastal hubs relevant to bio-product export, including the Port of Virginia. The working-age population in the region is significant: in Tazewell County alone, there are over 20,000 individuals between 18 and 64 years of age, with a median age of 45. The Bluestone Business Park in Tazewell County, which was analyzed in more detail, is positioned on a four-way divided highway with easy access to the Interstate highway system. The Park's large acreage, flexible zoning, and natural gas access are all conducive to biomass-based manufacturing.

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Figure 1: Risk Indicators (Sorted by Risk Level)

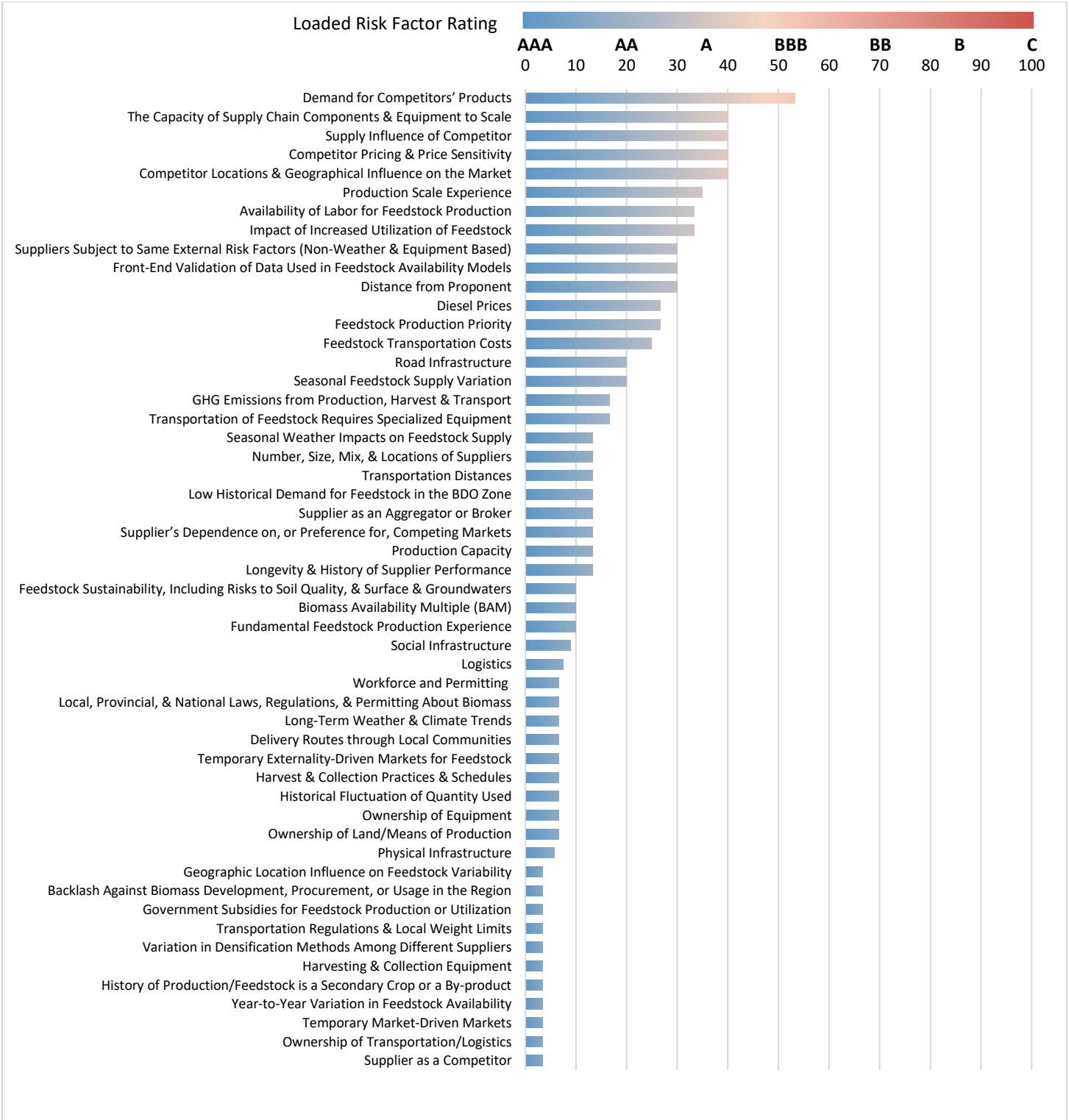


Table 1: Risk Indicators and Associated Scores

	Feedstock Supply Chain Risk Indicators	Raw RI Score	Notched Salience	Impact Level	Loaded RI Score
	Category 1: Supplier Risk				
1.1	Longevity & History of Supplier Performance	4	4.0	3.33	13.32
1.2	Production Capacity	4	4.0	3.33	13.32
1.3	Supplier's Dependence on, or Preference for, Competing Markets	2	2.0	6.66	13.32
1.4	Supplier as a Competitor	1	1.0	3.33	3.33
1.5	Ownership of Land / Means of Production	2	2.0	3.33	6.66
1.6	Ownership of Equipment	2	2.0	3.33	6.66
1.7	Ownership of Transportation/Logistics	1	1.0	3.33	3.33
1.8	Supplier as an Aggregator or Broker	2	2.0	6.66	13.32
1.9	Distance from Proponent	3	3.0	9.99	29.97
1.10	Fundamental Feedstock Production Experience	3	3.0	3.33	9.99
1.11	Production Scale Experience	7	5.25	6.66	34.97
1.12	Feedstock Production Priority	4	4.0	6.66	26.64
	Category 2: Competitor Risk				
2.1	Competitor Locations and Geographical Influence on the Market	6	6.0	6.66	39.96
2.2	Historical Fluctuation on Quantity Used	2	2.0	3.33	6.66
2.3	Competitor Pricing and Price Sensitivity	6	6.0	6.66	39.96
2.4	Supply Influence of Competitor	6	6.0	6.66	39.96
2.5	Temporary Market-Driven Markets	1	1.0	3.33	3.33
2.6	Demand for Competitors' Products	8	8.0	6.66	53.28
	Category 3: Supply Chain Risk				
3.1	Biomass Availability Multiple (BAM)	1	1.0	9.99	9.99
3.2	Impact of Increased Utilization of Feedstock	5	5.0	6.66	33.30
3.3	Seasonal Feedstock Supply Variation	3	3.0	6.66	19.98
3.4	Year-to-Year Variation in Feedstock Availability	1	1.0	3.33	3.33
3.5	Front-End Validation of Data used in Feedstock Availability Models	3	3.0	9.99	29.97
3.6	Low Historical Demand for Feedstock in the BDO Zone	2	2.0	6.66	13.32
3.7	History of Production/Feedstock in a New/Secondary Crop or a By-Product	1	1.0	3.33	3.33
3.8	Diesel Prices	4	4.0	6.66	26.64
3.9	Harvest & Collection Practices & Schedules	2	2.0	3.33	6.66
3.10	Harvesting and Collection Equipment	1	1.0	3.33	3.33
3.11	Temporary Externality-Driven Markets for Feedstock	2	2.0	3.33	6.66
3.12	Variation in Densification among Different Suppliers	1	1.0	3.33	3.33
3.13	Availability of Labor for Feedstock Production	5	5.0	6.66	33.30
3.14	Feedstock Transportation Costs	5	3.8	6.66	24.98
3.15	Transportation Distances	2	2.0	6.66	13.32
3.16	Transportation of Feedstock Requires Specialized Equipment	5	5.0	3.33	16.65
3.17	Delivery through Local Communities	2	2.0	3.33	6.66
3.18	Transportation Regulations & Local Weight Limits	1	1.0	3.33	3.33
3.19	Road Infrastructure	3	3.0	6.66	19.98
3.20	Number, Size, Mix, and Locations of Suppliers	5	5.0	3.33	16.65
3.21	Suppliers Subject to Same External Risk Factors	3	3.0	9.99	29.97
3.22	Seasonal Weather Impacts on Feedstock Supply	2	2.0	6.66	13.32
3.23	Long-Term Weather and Climate Trends	1	1.0	6.66	6.66
3.24	Government Subsidies for Feedstock Production or Utilization	1	1.0	3.33	3.33
3.25	Local, Provincial, and National Laws, Regulations, and Permitting pertaining to Biomass	2	2.0	3.33	6.66
3.26	Backlash against Biomass Development, Procurement or Usage in the Region	1	1.0	3.33	3.33
3.27	Feedstock Sustainability, including risks to soil quality and surface and groundwaters.	1	1.0	9.99	9.99
3.28	GHG Emissions from Production, Harvest and Transport	5	2.5	6.66	16.65
3.29	Geographic Location Influence on Feedstock Variability	1	1.0	3.33	3.33
3.30	Capacity of Supply Chain Components and Equipment to Scale	8	6.0	6.66	39.96
	Category 4: Infrastructure				
4.1	Physical Infrastructure	1.7	1.7	3.33	5.66
4.2	Logistics	4	4.0	3.33	13.32
4.3	Social Infrastructure	4	4.0	3.33	13.32
4.4	Workforce and Permitting	2	2.0	6.66	13.32
				Average	**15.06**



Tazewell, VA BDO Zone Independent Review Committee (IRC)

Todd Campbell – Principal Development Advisor, Clean Economy Works
Rick Brenner – Director, Agricultural Technology Innovation Partnership
Wes Jurey – CEO, Agricultural Technology Innovation Partnership
Scotty Wampler – Executive Director, Cumberland Plateau Planning District Commission
Sabina Dhungana – Utilization and Marketing Program Manager, Virginia Department of Forestry
Jim Lambert – Systems Engineering Professor, University of Virginia
Burt English – Professor, University of Tennessee
Marten Jenkins – President and CEO, Partner Community Capital

APPENDIX A: RISK INDICATOR SCORING METRICS

CATEGORY 1: SUPPLIER RISK

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.	
Raw RI Score: Seven sawmills and an estimated fifty logging crews operate within the supply basin. Most sawmills and logging companies in the Zone have been in operation for at least ten years. Owner-operators hold inter-generational knowledge and experience relevant to business operations in the forest sector. Business performance varies with forest product demand, as influenced by market shifts and business cycles. Compared to other areas in the region (e.g., eastern areas of Virginia), the economic downturn since the late-2000s has had a disproportionate impact on the milling and logging businesses in the supply basin. Risk associated with businesses' longevity and history of performance is assessed as moderate. Raw RI Score is 5 out of 10.	**Score 5**
Notched Salience: No adjustment.	**Score 5.0**
Impact Level: RI Impact level is deemed *low*.	**Score 3.33**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 16.65 out of 100.	**Score 16.65**

1.2. Production Capacity

Rationale: Supplier production capacity can be a strong indicator of long-term credit worthiness and future solvency. Higher production capacities denote strength of operational elements, including cash flows, which are important to future solvency.	
Raw RI Score: A typical logging crew operating in the Tazewell area consists of a chainsaw operator felling and delimbing trees, a cable skidder operator extracting tree-lengths to roadside, and chainsaw product separation at landings. Feller-bunchers and grapple skidders are less common. Owing to this low level of mechanization and relatively small crew size (2-4 men), the average productivity of logging operations in the supply basin is likely less than 10 x 25-ton truckloads of pulpwood per week. This is not uncommon in the forest industry and does not pose a significant risk to credit worthiness and future solvency. The presence of latent terminal chipping capacity in the region (2 x stationary chippers that are currently idle) is also a strength as regards supplier production capacity: a new project could leverage the terminal chipping infrastructure and associated experience in procuring wood fiber (i.e., chipped roundwood). Production capacity risk is higher for forest residues and sawmill residuals. The latent terminal chipping capacity present in the region is unlikely to be used for forest residue supply owing to the difficulty in transporting un-delimbed trees in logging trucks. Instead, mobile chipping equipment is required. A minority of the logging contractors that operate in the BDO Zone own and operate mobile chippers. Chipped forest residue has been sent to the Hybrid Energy Center in St. Paul, VA irregularly since its	**Score 4**

establishment over a decade ago. Production capacity risk for forest residues is assessed as moderate-to-high. Production capacity is also limited for sawmill residuals. Sawmill capacity in the supply basin is small relative to neighboring regions, including areas in eastern Virginia and West Virginia. There are three medium-to-large sawmills located within the supply basin with annual lumber production capacities of 10, 15, and 30 million board feet (MMBF) and a combined sawmill residuals output of at least 135,000 green tons (gt)/yr. The four remaining sawmills have lumber production capacities of less than 2 MMBF/yr and a combined residuals output of no more than 20,000 gt/yr. Overall risk associated with supplier production capacity is deemed low-to-moderate. Raw RI Score is 4 out of 10.	
Notched Salience: No mitigation measures could be identified.	**Score 4.0**
Impact Level: RI Impact level is deemed *low*.	**Score 3.33**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 13.32 out of 100.	**Score 13.32**

1.3. Suppliers' Dependence on, or Preference for, Competing Markets

Rationale: Suppliers may have a vested interest in or preference for supplying specific competitors for biomass feedstock. Preferences may be due to historical, long-term, or personal relationships, less stringent feedstock quality requirements, more flexible operating hours by competing markets, or suppliers' dependences on competing markets to accept or purchase other products/by-products. Consequently, 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 Proponent.	
Raw RI Score: There is currently a lack of markets for pulpwood and sawmill residuals in the region. Two important regional consumers of pulp-quality wood fiber closed in 2020 (Domtar – Kingsport, TN) and 2023 (Pactiv Evergreen – Canton, NC). Current markets for pulpwood are inconsistent and limited to Weyerhaeuser in Heaters, WV and the WestRock paperboard mill in Covington, VA. Sawmill residuals are sold to Dominion Energy's Virginia City Hybrid Energy Center, to WestRock – Covington, and to local pellet mills (Appendix E). Sawmill owner-operators and logging contractors contacted by Ecostrat indicated that the rated quantities of pulpwood and residuals could become available to a new entrant for the rated prices. Current markets for chipped forest residues are limited to areas further east of the BDO Zone within a ~75-mile transport distance of WestRock. Raw RI Score is 2 out of 10.	**Score 2**
Notched Salience: No adjustments.	**Score 2.0**
Impact Level: RI Impact level is deemed *moderate*.	**Score 6.66**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 13.32 out of 100.	**Score 13.32**

1.4. Supplier as a Competitor

Rationale: The risks of feedstock costs going up and availability going down increase if a supplier is also a competitor to the Proponent. In times of feedstock shortage, the risk that supply commitments will not be met increases.	
Raw RI Score: Sawmills in the region commonly utilize a portion of their residuals, particularly bark, to fulfill internal energy requirements, including kiln drying and space heating. Additionally, there have been a few instances where sawmills have expanded their operations to include pellet production capacity in recent years. However, it is unlikely that sawmills will significantly increase use of residuals for these purposes. As a result, there is high confidence in the availability of the rated quantity of sawmill residuals (25,000 gt/yr) and low risk of competition with suppliers. A supplier-as-competitor risk does not exist for pulpwood and forest residue. Raw RI Score is 1 out of 10.	**Score 1**
Notched Salience: No adjustments.	**Score 1.0**
Impact Level: RI Impact level is deemed *low*.	**Score 3.33**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 3.33 out of 100.	**Score 3.33**

1.5. 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.	
Raw RI Score: Most of the wood supply in the Zone is procured from privately owned timberlands through stumpage payments. Privately owned timberlands from which wood is procured in the supply basin tend to be small (30-40 acres) but there are larger tracts >50,000 acres owned by large companies (Penn Virginia Corporation, now Ranger Oil Corporation) that are logged. Local experts contacted by Ecostrat did not expect that procurement of pulpwood from private woodlots would be a problem. Ownership of land/means of production is assessed as low risk. Raw RI Score is 2 out of 10.	**Score 2**
Notched Salience: No adjustments.	**Score 2.0**
Impact Level: RI Impact level is deemed *moderate*.	**Score 6.66**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 13.32 out of 100.	**Score 13.32**

1.6. Ownership of Equipment

Rationale: In most cases, suppliers that own or lease equipment for harvest, collection, and processing feedstock are lower risk than those who do not. For example, third-party harvesting equipment may not	

be available when required. Short harvest windows may be missed if a contractor cannot schedule harvest times that are convenient and quantity shortages can result.	
Raw RI Score: Supply chain equipment critical for procurement of the rated biomass quantities tends to be owned by logging contractors. Future supplies of chips derived from pulpwood and forest residue are a possible exception, as ownership of the required in-woods and/or stationary chippers would likely be exclusive to a few contractors. This is common and does not impose significant risks. Raw RI Score is 2 out of 10.	**Score 2**
Notched Salience: No adjustments.	**Score 2.0**
Impact Level: RI Impact level is deemed *low*.	**Score 3.33**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 6.66 out of 100.	**Score 6.66**

1.7. Ownership of Transportation/Logistics

Rationale: In most cases, suppliers that own or lease 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 a common practice and does not contribute to risk.	
Raw RI Score: The majority of sawmills and loggers operating in the supply basin own logging trucks. Purchases of additional chip vans will be required for scale-up to the rated quantities of biomass; whether purchased by sawmills, logging contractors, or third-party transportation companies, no transportation ownership risks are foreseen Raw RI Score is 1 out of 10.	**Score 1**
Notched Salience: No adjustments.	**Score 1.0**
Impact Level: RI Impact level is deemed *low*.	**Score 3.33**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 3.33 out of 100.	**Score 3.33**

1.8. Supplier as an Aggregator

Rationale: Aggregators may effectively provide supply chain redundancy, eliminating the risk and complexity of dealing with multiple sources of supply by combining supplies into a single master contact. Aggregators can add much needed stability in BDO Zones by increasing offtake stability for both suppliers and markets. An aggregator can be a more reliable long-term offtake for suppliers by virtue of having multiple markets and can be a more reliable long-term supplier for markets by having access to multiple suppliers. Further, when a single supplier breaches, the aggregator can source from another.	
Raw RI Score: Aggregators present in the supply basin include three medium-to-large capacity sawmills with large holding and satellite yards that enable stockpiling, as well as independent companies specializing in log aggregation and sale. Many forestry professionals in the Tazewell area view the growing	**Score 2**

log export business as a potential business opportunity, but there is currently only one export-oriented log aggregation yard in the area. Latent aggregation capacity also exists at three log yards with idle stationary chippers in Abington, VA (56 miles from Tazewell), Duffield, VA (96 miles from Tazewell), and Jonesborough, TN (107 miles from Tazewell). Aggregation capacity is assessed as adequate for the required scale-up in pulpwood supply. Raw RI Score is 2 out of 10.	
Notched Salience: No adjustments.	**Score 2.0**
Impact Level: RI Impact level is deemed *moderate*.	**Score 6.66**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 13.32 out of 100.	**Score 13.32**

1.9. Distance from Proponent

Rationale: The greater the distance from a supplier to a plant, the more exposure to weather and fuel cost risks and the greater the competitive pressure (to breach) that a closer competitor can exert.	
Raw RI Score: While there is no proponent identified at this stage, approximately half of the available supply of biomass is located at distances between 50-75 miles from the center point (Tazewell) (Figure F-1, Appendix F). Further, forest biomass is concentrated in counties adjacent to Tazewell County, where bio-project development is likely to occur (the Bluestone Regional Business and Technology Center). Risk is deemed to be relatively low. Raw RI Score is 3 out of 10.	**Score 3**
Notched Salience: No adjustments.	**Score 3.0**
Impact Level: RI Impact level is deemed *high*. The distance between the supplier and the proposed bio-project is a significant variable that can influence the viability of feedstock access. A project location has yet to be officially announced and therefore uncertainty remains.	**Score 9.99**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 29.97 out of 100.	**Score 29.97**

1.10. Fundamental Feedstock Production Experience

Rationale: Risk is higher when a supplier has limited experience with harvesting/processing and/or collecting biomass. Where experience is lacking, the Proponent should show that steps have been taken to ensure proper training, knowledge dissemination, and monitoring.	
Raw RI Score: Regional roundwood and sawmill residuals production experience is considerable but logging contractors and other forestry professionals within the Zone have limited experience recovering forest residue. Since its establishment in 2012, the Dominion Energy Hybrid Energy Center has co-fired biomass with coal refuse. A number of logging contractors in the region purchased in-woods chipping equipment with the purpose of supplying the facility. For reasons having to do with cost, reliability, and quality, the facility has preferred sawmill residuals over wood chips derived from forest biomass (forest	**Score 3**

residues and pulpwood). There have been periods since the Center's establishment when chipped forest residues were accepted, but willingness to pay and accept this material has varied. Forest residue recovery remains unproven at scale and would be technically challenging owing to the smaller landing sizes in the area. There are logging contractors located further east in Virginia that regularly produce in-woods chips for WestRock – Covington, VA. With regards to pulpwood, the presence of the three terminal chipping sites in the region and associated experience with terminal pulpwood chipping and chip van transport (once used to supply paper mills in Kingsport, TN and Canton, NC) results in a low assessed risk. Overall feedstock production experience risk is assessed as low-to-moderate.

Raw RI Score is 3 out of 10.

Notched Salience: No adjustments.	**Score 3.0**
Impact Level: RI Impact level is deemed *low*.	**Score 3.33**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 9.99 out of 100.	**Score 9.99**

1.11 Production Scale Experience

Rationale: Scale-up entails risk. Risk is higher when a supplier has limited experience with the production of the quantity of feedstock required.	
Raw RI Score: Harvesting of the rated quantity of pulpwood (500,000 gt/yr) was likely sustained in the supply basin throughout the 1990s and early-to-mid 2000s when forest product markets were at an all-time high. As markets declined over the past 15-20 years, the capacity of logging contractors, trucking companies, and other supply chain professionals has declined. The risk associated with previous production scale experience of pulpwood is therefore deemed to be moderate. A moderate-to-high risk exists for forest residue, as integrated operations are relatively uncommon in the area. Contractors with experience in full-tree harvesting and roadside chipping engage in forest residue recovery infrequently. Recent examples include periodic residue production for the Hybrid Energy Center in St. Paul, VA and for the now closed Domtar paper mill in Kingsport, TN. There is no risk of scale-up for sawmill residuals owing to the nature of residual production (zero cost by-product of lumber production that is easily collected and delivered).	**Score 7**

Raw RI Score is 7 out of 10.

Notched Salience: The Virginia Department of Forestry (VDOF) maintains close relationships with loggers in the state. For instance, logging contractors must notify the VDOF before commencing operations, and the VDOF maintains a directory of logging contractors. The regular contact between government authorities and loggers in VA may support an organized scale-up of logging operations, including for example, the coordinated identification of sites suitable for harvesting, coordination of timing and logistics among independent logging crews to improve productivity, and equipment financing. Coordination and financing could also be provided by a new bio-project developer. Raw RI is notched down 25%. Notched Salience is 5.25.	**Score 5.25**
Impact Level: RI Impact level is deemed *moderate*.	**Score 6.66**

Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 34.97 out of 100.	**Score 34.97**

1.12. 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.	
Raw RI Score: Pulpwood production does not decrease the production of higher value sawlogs. Pulpwood recovery increases revenue (when markets are available) and can improve the long-term value of timberlands by freeing up space for additional growing stock. Conversely, forest residue production can reduce the efficiency of conventional logging operations, including felling/delimbing and product separation at landings. Contractors in the region have some familiarity with integrated operations and mobile chipping, and therefore risk of inconsistency of production owing to inefficiency is reduced. The rated quantity of forest residue (100,000 gt/yr) is assessed as having a moderate feedstock production priority risk. There is no feedstock production priority risk associated with sawmill residuals. Raw RI Score is 4 out of 10.	**Score 4**
Notched Salience: No mitigation measures could be identified.	**Score 4.0**
Impact Level: RI Impact level is deemed *moderate*. Recent experience with forest residue recovery in the region is limited and therefore uncertainty remains regarding whether residue can be produced without compromising higher value product recovery during forest operations.	**Score 6.66**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 26.64 out of 100.	**Score 26.64**

CATEGORY 2: COMPETITOR RISK

2.1. Competitor Locations and Geographical Influence on the Market

Rationale: Competitors' locations relative to a Proponent plant can affect the viability of procuring feedstock and its cost. Accurate and detailed competitor mapping provides an understanding of the geographical influence a competitor may have, including competitive advantages such as short hauling.	
Raw RI Score: There are a total of ten competitors within the competition basin, including three coal generating stations that co-fire biomass, the Weyerhaeuser – Heaters WV OSB mill, the WestRock – Covington VA paperboard mill, and five pellet mills (Appendix E). Only four competitors are located within a 75-mile drive distance from Tazewell, none of which have significant annual feedstock intake quantities (a total of ~350,000 gt/yr of sawmill residuals and, to a lesser extent, forest residue, see Table E-1, Appendix E). The Covington mill is located 120 miles from Tazewell and regularly sources sawmill residuals from the area. With the exception of the Hybrid Energy Center in St. Paul, VA, all of the larger consumers of biomass in the BDO Zone are located over 120 miles from Tazewell. Overall, there is a relatively low density of competitors in the BDO Zone and demand for pulpwood and forest residue is currently depressed as a result of mill closures and biomass co-firing policy uncertainty. Recent legislation supporting biomass co-firing in Virginia's coal generating fleet could lead to competition with a new bio-	**Score 6**

project, as large coal power plants are located within 150 miles of Tazewell. Competitor location risk is deemed moderate.

Raw RI Score is 6 out of 10.

Notched Salience: No adjustments.	**Score 6.0**
Impact Level: RI Impact level is deemed *moderate*. The coal-fired power plants could create significant demands for woody biomass in the region with the increasing pressures to reduce the use of coal for power generation in the US. Continued growth in pellet markets is also likely.	**Score 6.66**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 39.96 out of 100.	**Score 39.96**

2.2. Historical Fluctuation of Quantity Used

Rationale: Clear understanding of key competitors' consumption of each type of feedstock utilized by the Proponent is essential to quantifying the risks associated with each competitor. Understanding historical trends of feedstock utilization can provide valuable information about feedstock price elasticity during shortages and insights into events impacting future supply conditions. It can also 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).	
Raw RI Score: The two main consumers of pulpwood in the region ceased operations in 2020 and 2023 (Domtar – Kingsport, TN, and Pactiv Evergreen – Canton, NC). Pulpwood markets in the region are restricted to eastern areas of the supply basin located near the WestRock paperboard mill in Covington, VA. Sawmill residuals produced within the Zone are consumed by WestRock – Covington, the three Dominion Energy coal generating stations, and the five local pellet mills. Residuals consumption by WestRock and the pellet mills has been stable over the past five years, whereas demand from the Dominion Energy coal generating assets has varied owing to changes in policies that incentivize biomass co-firing. Forest biomass (pulpwood and forest residue) supply for these biopower installations has been sporadic over the past decade owing to the inconsistency of pricing and imposition of quotas on weekly deliveries. Demand for woody biomass within the supply basin is variable and weak relative to adjacent regions and therefore risk is assessed as low.	**Score 2**

Raw RI Score is 2 out of 10.

Notched Salience: No adjustments.	**Score 2.0**
Impact Level: RI Impact level is deemed *low*.	**Score 3.33**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 6.66 out of 100.	**Score 6.66**

2.3. Competitor Pricing and Price Sensitivity

Rationale: Understanding how much competitors pay for different feedstock types is an essential step in determining competitiveness of Proponent. Historical prices paid by competitors provide insights into their procurement behaviors and ability/willingness to pay premiums for feedstock and exert pressure on Proponent's suppliers during times of feedstock shortage. Competitors who are able to offer higher prices for feedstock during feedstock shortages can pose significant risks to Proponent.	
Raw RI Score: In most areas of the BDO Zone, there is no market for pulpwood. Low-quality roundwood is typically left standing during logging operations. A new project is expected to successfully procure pulpwood for a delivered price of $40-$50/gt. The Hybrid Energy Center in St. Paul, VA has had a sporadic demand for forest residue over the past decade but prices could not be obtained. We estimate that procurement would succeed at the rated price of $40-$60/gt. Current prices for sawmill residuals range from approx. $30-$40/gt FOB and competitors typically pay up to $60/gt delivered for residuals. Informants believed that a new project willing to pay marginally more than the current price would successfully capture a share of annual residuals output ($30-$60/gt). There is significant uncertainty regarding the price that Dominion Energy's coal generating stations will be willing to pay for biomass in the context of Virginia's renewable energy targets and incentives, and therefore competitor pricing risk is deemed to be moderate. Raw RI Score is 6 out of 10.	**Score 6**
Notched Salience: No mitigation measures were identified.	**Score 6.0**
Impact Level: RI Impact level is deemed *moderate*. There is a high degree of uncertainty related to our understanding of competitors' price sensitivity.	**Score 6.66**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 39.96 out of 100.	**Score 39.96**

2.4. Supply Influence of Competitor

Rationale: In some cases, competitors may be able to exert high degrees of pressure on local suppliers, effectively enabling them to control feedstock, especially during shortages. This control can derive from long previous relationships between suppliers and competitors, from verbal or "understood" agreements, or from a competitor being able to assist suppliers in times of surplus by maintaining large inventories that enable suppliers to continue supplying when other markets impose quotas. Understanding and planning around such soft risk factors is important. If such relationships exist in the Proponent's procurement area, they may indicate an increased risk of feedstock shortage or pricing changes.	
Raw RI Score: The only current competitors with long-standing connections to suppliers in the Zone are the WestRock – Covington paperboard mill and the Hybrid Energy Center in St. Paul. Both facilities have regularly procured sawmill residuals from the region for over a decade. The Covington mill procures pulpwood from the region infrequently and the St. Paul facility has some experience sourcing forest residue. There are no other large competitors present within a 150-mile drive distance from Tazewell. However, there is risk that coal generating stations in the state could develop significant influence on the market under revised rules for renewable energy portfolio standards, which allow for biomass co-firing. Risk is deemed moderate.	**Score 6**

Raw RI Score is 6 out of 10.

Notched Salience: No adjustments.	**Score 6.0**
Impact Level: RI Impact level is deemed *moderate*. The coal-fired power plants could create significant demands for woody biomass in the region with the increasing pressures to reduce the use of coal for power generation in the US. Continued growth in pellet markets is also likely.	**Score 6.66**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 39.96 out of 100.	**Score 39.96**

2.5. Temporary Market-Driven Markets

Rationale: Alternative, non-traditional, market-driven competitors for feedstock can increase feedstock demand in unusual circumstances.	
Raw RI Score: None of the rated feedstock types face significant risks of supply disruptions or sharp price increases due to non-traditional markets. While certain species commonly utilized in OSB and paper mills can potentially be substituted for firewood, there are no plausible scenarios where such substitutions would occur on a large scale. Therefore, the risk level associated with this possibility is low.	**Score 1**

Raw RI Score is 1 out of 10.

Notched Salience: No adjustments.	**Score 1.0**
Impact Level: RI Impact level is deemed *low*.	**Score 3.33**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 3.33 out of 100.	**Score 3.33**

2.6. Demand for Competitors' Products

Rationale: Increased demand for competitors' products can cause greater demand for feedstock by the competitor. For example, greater demand for biofuels due to a clean fuels policy can cause increased biofuel production by the competitor, thereby increasing demand for feedstock.	
Raw RI Score: General market trends for competitors' products suggest a probable increase in feedstock demand. The Covington mill is involved in manufacturing or has shown interest in manufacturing products such as paperboard, raw kraft lignin (Indulin C), and sustainable paper packaging, all of which are anticipated to experience long-term growth in demand. As a result, there is a moderate level of risk that the mill's demand for wood chips, sawdust, bark, pulpwood, and potentially forest residues will increase. There are also risks of policy- and market-driven feedstock demand increases for the three Dominion Energy coal generating stations. The Virginia legislature recently extended permitting for biomass co-firing in the state's coal fleet up to the year 2045. Procurement of biomass for co-firing purposes is likely to increase under future climate and clean energy policies. It is relatively certain that an increase in biomass co-firing will increase demand for sawmill residuals. The low capture rate assumed for residuals (20%) partially accounts for this. It is possible that policy incentives will be of sufficient strength to support	**Score 8**

pulpwood and forest residue procurement for co-firing purposes. Continued growth in pellet markets is also likely. Risk is deemed to be high. Raw RI Score is 8 out of 10.	
Notched Salience: No adjustments.	**Score 8.0**
Impact Level: RI Impact level is deemed *moderate*. The extent to which Virginia's coal fleet will utilize biomass for co-firing is uncertain.	**Score 6.66**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 53.28 out of 100.	**Score 53.28**

CATEGORY 3: SUPPLY CHAIN RISK

3.1. Biomass Availability Multiple (BAM)

Rationale: Biomass Availability Multiple (BAM) indicates the degree of redundancy in a Proponent's supply chain. BAM is the ratio of biomass feedstock available to a project, at costs, timing, and in quality feasible for the Proponent, divided by the project's feedstock requirement. BAM is a strong indicator of supply chain resilience when stressed by a supply shortage and/or supplier breach.	
Raw RI Score: The total quantity of pulpwood that could be recovered from additional logging activity in the supply basin was estimated to be 739,877 gt/yr using the US DOE's Billion-Ton Report dataset (Appendix B). For the rated quantity of pulpwood (500,000 gt/yr), the pulpwood BAM is 1.5. Forest residue availability in the supply basin was estimated to total 161,071 gt/yr using the Billion-Ton Report dataset. The rated quantity of forest residue (100,000 gt/yr) results in a BAM of 1.6. Annual residuals output from sawmills in the supply basin was estimated conservatively and therefore no BAM is reported (Appendix C). Raw RI Score is 1 out of 10.	**Score 1**
Notched Salience: No adjustments.	**Score 1.0**
Impact Level: RI Impact level is deemed *high*. Feedstock redundancy, or BAM, is an important variable when assessing feedstock supply feasibility, and its level can significantly impact the supply chain.	**Score 9.99**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 9.99 out of 100.	**Score 9.99**

3.2. Impact of Increased Utilization of Feedstock

Rationale: Feedstock utilization can change over time owing to expansion of existing facilities. Increased utilization can lead to higher prices, feedstock disruptions, shortages, or supplier breach.	
Raw RI Score: Following the recent decision by the Virginia Legislature to allow biomass co-firing up to the year 2045, it is likely that the Dominion Energy coal generating fleet will increase consumption of biomass. However, it is unlikely that the utility will expand its biomass co-firing capacity or construct new facilities due to upfront costs and uncertainty. Existing feedstock demands for pellet production in the competition basin exceed 300,000 gt/yr. Growth in wood pellet production capacity in the competition	**Score 5**

basin is expected to be marginal in the near term (<5 years) and feedstock demand increases will likely be restricted to residuals. Raw RI Score is 5 out of 10.	
Notched Salience: No mitigation measures could be identified.	**Score 5.0**
Impact Level: RI Impact level is deemed *moderate*.	**Score 6.66**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 33.30 out of 100.	**Score 33.30**

3.3. Seasonal Feedstock Supply Variation

Rationale: Biomass supply can present significant seasonal supply variations; combined with limitations associated with longer-distance transportation and storage, can lead to regional biomass supply imbalances and manifest in shortages and higher costs for Proponents.	
Raw RI Score: There are modest seasonal variations in feedstock supply that may not be adequately buffered by regional log storage capacities. During the winter months, rainfall and freeze-thaw cycles can significantly impede the productivity of logging operations in the steeper areas of the supply basin. In some cases, logging operations will stop for a prolonged period. There is a low risk that this could result in a situation where log inventories are depleted. Risk is assessed as low-to-moderate. Raw RI Score is 3 out of 10.	**Score 3**
Notched Salience: No adjustments.	**Score 3.0**
Impact Level: RI Impact level is deemed *moderate*.	**Score 6.66**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 19.98 out of 100.	**Score 19.98**

3.4. Year-to-Year Variation in Feedstock Availability

Rationale: Biomass can have significant fluctuations in year-to-year supply due to variability in yield from biomass harvesting operations.	
Raw RI Score: Roundwood yields are expected to be stable year-to-year. Although there has been a long-term decline in roundwood yield per acre in many areas of North America, this decline has stabilized under modern forestry practices. Raw RI Score is 1 out of 10.	**Score 1**
Notched Salience: No adjustments.	**Score 1.0**
Impact Level: RI Impact level is deemed *low*.	**Score 3.33**

Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 3.33 out of 100.	**Score 3.33**

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

Rationale: Feedstock supply models can be complex. Lack of clarity about model assumptions and baseline data can result in confusion on the part of the capital markets and drive financing costs for biomass projects. The adequacy and credibility of assumptions and baseline data is paramount to credible model outputs.	
Raw RI Score: The US DOE Billion-Ton Report dataset and associated ForSEAM model are subject to several assumptions (Appendix B). These include future demand for lumber (housing starts), bioenergy, and biofuels, proportions of biomass recovered versus retained during forest operations, and harvesting equipment, for example. The assumptions are relatively coarse given the model's purpose to estimate biomass availability for the coterminous United States. The baseline data used in the model is sourced from the USFS FIA dataset, which may overestimate the available biomass unless adjusted or filtered. This introduces further uncertainty to the accuracy of the model's estimations. To mitigate potential biases in the data, the ForSEAM model employs more conservative estimates by limiting the considered timberlands to those located within 0.5 miles of existing road networks and with slopes below 40%. Due to these factors and to the estimated pulpwood BAM of 1.5, the model is considered to be a low risk. The spreadsheet model used to estimate sawmill residuals production relies on generic arithmetic factors to convert milled quantities of sawlogs into wood chips, sawdust, and bark. In the calibration process of the model outputs, an approach was adopted that is anticipated to yield underestimates of residuals availability for new projects (Appendix C). Raw RI Score is 3 out of 10.	**Score 3**
Notched Salience: No adjustments.	**Score 3.0**
Impact Level: RI Impact level is deemed *high*. Because most of our conclusions in this assessment are based on biomass availability modelling, model errors can significantly impact supply chain risk.	**Score 9.99**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 29.97 out of 100.	**Score 29.97**

3.6. Low Historical Demand for Feedstock in the BDO Zone

Rationale: If the Proponent does not have a history of developing large-scale feedstock procurement, suppliers may not have sufficient expertise in feedstock production to ensure reliable supply, especially early on.	
Raw RI Score: Up until the recent paper mill closures in Kingsport, TN and Canton, NC, pulpwood and residual supply chains had been operating more-or-less consistently within the Tazewell region for over 100 years. A terminal chipping supply chain that involved pulpwood chipping at satellite yards had been operating within the supply basin for over a decade until the closure of the Domtar mill in Kingsport, TN in 2020. Forest residue recovery using mobile chippers is more recent, has been inconsistent, and has been restricted to a couple consumers. Since large-scale pulpwood supply is proven in the area and since there is recent experience with mobile chipping of forest residue, risk is assessed as low.	**Score 2**

Raw RI Score is 2 out of 10.

Notched Salience: No adjustments.	**Score 2.0**
Impact Level: RI Impact level is deemed *moderate*.	**Score 6.66**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 13.32 out of 100.	**Score 13.32**

3.7. History of Production/Feedstock is a Secondary Crop or a Byproduct

Rationale: If the feedstock is a new/secondary crop or a by-product, suppliers may either lack sufficient experience to mitigate risk or be unable to react to such risk, and producers may be less likely to prioritize production. If the feedstock is a secondary crop, then production can be subject to variables beyond suppliers' control.	
Raw RI Score: We do not anticipate any risks related to this risk indicator.	**Score 1**

Raw RI Score is 1 out of 10.

Notched Salience: No adjustments.	**Score 1.0**
Impact Level: RI Impact level is deemed *low*.	**Score 3.33**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 3.33 out of 100.	**Score 3.33**

3.8. Diesel Prices

Rationale: Diesel, oil, and PPI can impact feedstock cost of harvest and collection over time. Sensitivities to worst case scenarios should be run.	
Raw RI Score: Nominal prices for No.2 diesel in the Lower Atlantic Petroleum Administration Defense District (PADD) 1C, encompassing Virginia, experienced historic highs in 2022. CPI-adjusted average monthly prices peaked in June 2008 at $6.79 per gallon (Figure F-3, Appendix F). The inherent volatility of diesel prices introduces uncertainty and diminishes confidence in anticipating a stable or downward long-term trend, particularly in the context of climate-related policies. Consequently, there exists a moderate level of risk that the rated prices will be surpassed as a result of increases in diesel prices.	**Score 4**

Raw RI Score is 4 out of 10.

Notched Salience: No adjustments.	**Score 4.0**
Impact Level: RI Impact level is deemed *moderate*.	**Score 6.66**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 26.64 out of 100.	**Score 26.64**

3.9. Harvest & Collection Practices & Schedules

Rationale: Differences in harvest timing and practices can create risks for both the quantity and quality of the 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.	
Raw RI Score: Pulpwood and residual supply chains generally operate without significant interruptions caused by weather conditions. However, there may be idle periods during the winter months. After trees are cut down, delimbed, and extracted to roadside, they are further processed into logs and stacked. The logs are then transported to manufacturing facilities (such as sawmills or paper mills) or stored temporarily at log yards. The handling and storage of logs follows regional standards to ensure consistent quality and moisture content that meets buyer requirements. There is no evidence indicating that weather or public image issues pose significant risks to the availability of forest residues. Raw RI Score is 1 out of 10.	**Score 2**
Notched Salience: No adjustments.	**Score 2.0**
Impact Level: RI Impact level is deemed *low*.	**Score 3.33**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 6.66 out of 100.	**Score 6.66**

3.10. Harvesting & Collection Equipment

Rationale: Different types of harvesting and collection equipment suppliers use can significantly impact the quality and availability of feedstock. The use of different types and combinations of harvesting, collection, and processing equipment can lead to non-homogeneous feedstock. In addition, equipment not designed specifically for biomass cultivation, harvesting, and collection can increase feedstock quality risks.	
Raw RI Score: None of the equipment used in the regional forestry supply chain constitutes a risk to feedstock quality and availability. A typical operation involves chainsaw felling and delimbing of trees, extraction of tree-lengths to landings with cable skidders, and product separation at landings. Logs and residuals are delivered to the destination using conventional trucks. None of this equipment poses a feedstock quality or availability risk when managed and operated properly. Raw RI Score is 1 out of 10.	**Score 1**
Notched Salience: No adjustments.	**Score 1.0**
Impact Level: RI Impact level is deemed *low*.	**Score 3.33**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 3.33 out of 100.	**Score 3.33**

3.11. Temporary Externality-Driven Markets for Feedstock

Rationale: Alternative, non-traditional, externality-driven competitors for feedstock can drive feedstock demand and cost in unusual circumstances.	
Raw RI Score: There is minimal risk of supply disruptions or significant price increases for the rated feedstock types due to shifts in alternative or non-traditional markets. Pulpwood (5-11 inches in diameter) can be substituted for firewood if hardwood roundwood becomes scarce, but there are no plausible circumstances where this might happen. Risk is assessed as low. Raw RI Score is 2 out of 10.	**Score 2**
Notched Salience: No adjustments.	**Score 2.0**
Impact Level: RI Impact level is deemed *low*.	**Score 3.33**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 6.66 out of 100.	**Score 6.66**

3.12. 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.	
Raw RI Score: Pulpwood and residuals are not typically densified for transportation. Pulp-quality wood fiber supply chains that recently operated in the region involved terminal chipping of pulpwood and chip van transport to destination. It is possible that any future forest biomass supply chain will leverage this infrastructure, but whether a pulpwood-destination or pulpwood-chipping-destination supply approach is taken is inconsequential to feedstock cost and quality when managed properly. If forest residue is to be recovered, it is expected that in-woods chippers will be used (rather than a mixture of chippers and grinders). No risk of variation in densification methods is foreseen. Raw RI Score is 1 out of 10.	**Score 1**
Notched Salience: No adjustments.	**Score 1.0**
Impact Level: RI Impact level is deemed *low*.	**Score 3.33**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 3.33 out of 100.	**Score 3.33**

3.13. 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 schedule. Labor risks are higher for facilities where supply chains are not yet active; or for Proponents for whom large feedstock requirements, or development of new (or expanded) supply chains, demand significant additions to the local labor force.

Raw RI Score: There is risk that the existing labor force is of inadequate size to recover the rated quantity of 500,000 tons of pulpwood per year. Current logging operations in the supply basin do not involve the recovery of pulpwood due to lack of markets. No additional workers would be required to bring this material to market. There is uncertainty, however, as to whether recovery of pulpwood during conventional logging operations (i.e., as driven by lumber markets) will be sufficient to recover the rated quantity of pulpwood. It is possible that additional logging crews will have to be recruited. We do not expect labor availability to affect procurement of the rated quantity of forest residue because tree branches and tops can be recovered with slight modifications to harvesting practices without requiring additional workers. Risk of labor shortages is deemed moderate. Raw RI Score is 5 out of 10.	**Score 5**
Notched Salience: No mitigation measures could be identified.	**Score 5.0**
Impact Level: RI Impact level is deemed *moderate*.	**Score 6.66**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 33.30 out of 100.	**Score 33.30**

3.14. Feedstock Transportation Costs

Rationale: Transportation can be one of the most significant cost components of biomass supply chains. The average transportation cost and percentage of total feedstock cost attributable to transportation should be known.	
Raw RI Score: Transportation costs in the supply basin are approximately $0.21/gt/loaded mile, which works out to $15.75/gt for the maximum transport distance of 75 miles, and $10.50/gt for an average transport distance of 50 miles. As of June 2023, this pricing is typical for many regions in the United States. Depending on transport distance and final pricing, transportation costs in the region can comprise as much as 50% of total delivered costs. High diesel prices, although not uncommon, present a substantial risk due to the volatility associated with diesel price fluctuations and their relative contribution to final delivered cost. Risk is moderate. Raw RI Score is 5 out of 10.	**Score 5**
Notched Salience: Forest biomass is concentrated around Tazewell County, where the development of a bio-project is most likely for the BDO Zone (Map B-1 and B-2, Appendix B). Strategic procurement of forest biomass from timberlands in these areas would reduce risk associated with feedstock transportation cost. Raw RI Score is notched down by 25%. Notched Salience is 3.75.	**Score 3.75**
Impact Level: RI Impact level is deemed *moderate*.	**Score 6.66**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 24.98 out of 100.	**Score 24.98**

3.15. Transportation Distances

Rationale: Transport distances of 50-100 km for biomass feedstocks are typical, but larger distances can be common. When the average transport distance from suppliers to the Proponent is high, the supply chain is subject to greater sensitivities to risks, such as increases in diesel cost, weather impacts, mechanical breakdown, and the demand for feedstock from competitors closer to the source.	
Raw RI Score: Pulpwood and forest residue resources are concentrated around Tazewell County (Map B-1 and B-2, Appendix B). If a new project is developed at the county's Bluestone Regional Business and Technology Center, risks associated with transportation distance would be reduced. However, risks related to transportation distances become more relevant if a new project is located on the periphery of the supply basin. A more detailed biomass resource assessment for those areas would be required. Risk is assessed as low. Raw RI Score is 2 out of 10.	**Score 2**
Notched Salience: No adjustments.	**Score 2.0**
Impact Level: RI Impact level is deemed *moderate*. There is uncertainty as to where a new bio-project will be located.	**Score 6.66**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 13.32 out of 100.	**Score 13.32**

3.16. Transportation of Feedstock Requires Specialized Equipment

Rationale: Requirements for specialized transport equipment 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.	
Raw RI Score: Increasing annual pulpwood production in the region by 500,000 gt/yr would require approximately 30 dedicated logging trucks operating full-time.[1] In reality, the existing logging truck capacity would be re-allocated to carry pulpwood in addition to sawlogs. Currently, there is a logging truck capacity shortage during the summer months when harvesting is continuous. Therefore, procuring the rated quantity of pulpwood will likely require additional trucking capacity. There is therefore moderate risk that the required logging truck capacity cannot be built up in sufficient time for a new project. There is additional uncertainty regarding chip van capacity: if a new entrant takes a terminal chipping approach to wood fiber procurement (as did Domtar – Kingsport, TN), a significant increase in chip van capacity would likely be required. The rated quantity of forest residue will also require an increased chip van capacity. Risk is deemed to be moderate. Raw RI Score is 5 out of 10.	**Score 5**
Notched Salience: No mitigation measures were identified.	**Score 5.0**
Impact Level: RI Impact level is deemed *low*.	**Score 3.33**

[1] Assuming 25 gt per truckload, 2 truckloads per day per truck, and a 48-week work year per truck.

Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 16.65 out of 100.	**Score 16.65**

3.17. Delivery Routes through Local Communities

Rationale: Biomass transportation can become a nuisance to local communities, especially if large numbers of trucks pass through residential and school areas. Local communities often have the power to force regulations regarding truck transport, impeding a Proponent's ability to transport feedstock. This risk is greater in greenfield projects than operational ones.	
Raw RI Score: The public within the Tazewell BDO Zone generally view forestry favorably. There is a low risk that regulations impeding truck transport through particular areas will materialize as a result of public discontent with truck traffic and noise levels. Raw RI Score is 2 out of 10.	**Score 2**
Notched Salience: No adjustments.	**Score 2.0**
Impact Level: RI Impact level is deemed *low*.	**Score 3.33**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 6.66 out of 100.	**Score 6.66**

3.18. Transportation Regulations & Local Weight Limits

Rationale: In many regions, 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.	
Raw RI Score: The standard weight limit for interstate highways is 80,000 pounds. No exemptions are available for logging trucks and chip vans. Permits for a 5-percent tolerance for logging trucks hauling Virginia-grown roundwood are common for the Virginia state highway system, such that a GVW of 84,000 pounds is possible. Permits for weights up to 90,000 pounds are available. Forestry professionals consulted during outreach did not view transportation regulations and weight limits as a significant concern. Raw RI Score is 1 out of 10.	**Score 1**
Notched Salience: No adjustments.	**Score 1.0**
Impact Level: RI Impact level is deemed *low*.	**Score 3.33**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 3.33 out of 100.	**Score 3.33**

3.19. Road Infrastructure

Rationale: Feedstock cost and availability can be a function of the accessibility of road infrastructure**.** Problems with road networks will translate directly to risks to feedstock supply.	
Raw RI Score: Forest residue recovery will likely be affected by narrow roads in some of the more mountainous areas of supply basin. In these areas, logistics can become complicated with the addition of in-woods chippers and chip vans. In other areas, road networks are sufficient for high-volume logging truck traffic and forest operations logistics. This includes the timberlands in the coalfields in the northwestern portion of the supply basin where road infrastructure is particularly well developed. We could not identify any other irregularities in road infrastructure regarding transport supply routes or meteorological effects on road conditions beyond what is deemed manageable. Raw RI Score is 3 out of 10.	**Score 3**
Notched Salience: No adjustments.	**Score 3.0**
Impact Level: RI Impact level is deemed *moderate*.	**Score 6.66**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 19.98 out of 100.	**Score 19.98**

3.20. Number, Size, Mix, & Locations of Suppliers

Rationale: In general, a portfolio of multiple suppliers of various sizes is important for ensuring steady and uninterrupted feedstock supply with minimal price fluctuations. If a small number of large suppliers provide a high proportion of total feedstock, a disruption or supplier breach will have a greater impact on the supply chain. In such cases, the risk of disruption is lower, but the impact of those disruptions is higher. Conversely, a large number of small suppliers is less likely to have the capacity to withstand internal disruptions and may be more likely to breach. Here, the risk of disruption is higher, but the likely impact is lower. The number of suppliers and the ratio of small to large suppliers should be optimized. There is no pre-determined number or optimal ratio of suppliers—either too many or too few can pose higher degrees of risk.	
Raw RI Score: The estimated lumber production capacity of the seven sawmills in the supply basin ranges from 1 to 30 MMBF (with an average of 9 MMBF). As estimated using the Ecostrat sawmill model and adjusted using local data, the corresponding residuals production capacity ranges from 5,000 gt/yr to 70,000 gt/yr per sawmill (average of 20,000 gt/yr). The logging contractor population in the area is estimated at approximately 50 crews, the majority of which consist of chainsaw-cable skidder harvesting systems. No contractors with multiple crews could be identified. Risk associated with supplier size is deemed moderate owing to the low mechanization of operations and the absence of large, multi-crew logging companies. Raw RI Score is 5 out of 10.	**Score 5**
Notched Salience: No adjustments.	**Score 5.0**

Impact Level: RI Impact level is deemed *low*.	**Score 3.33**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 16.65 out of 100.	**Score 16.65**

3.21. Suppliers Subject to Same External Risk Factors (Non-Weather & Equipment Based)

Rationale: When a single risk event can impact the feedstock production ability of all (or most) suppliers, then feedstock risk is higher and supply chain resiliency is lower. Resilience is maximized when biomass supply chains exhibit diversity in their locations, production practices, and other elements of supply chain structure such that the impact of single, high-risk events have varying impacts on suppliers.	
Raw RI Score: Suppliers operating in the Tazewell BDO Zone are exposed to various common external risks relating to inputs (e.g., energy) and outputs (e.g., final product markets). These risks are common to all areas of North America and are considered low-to-moderate. Raw RI Score is 3 out of 10.	**Score 3**
Notched Salience: No adjustments.	**Score 3.0**
Impact Level: RI Impact level is deemed *high*. Although unlikely, major economic shifts can have significant impact on the entire forest products industry in the BDO Zone.	**Score 9.99**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 29.97 out of 100.	**Score 29.97**

3.22. Seasonal Weather Impacts on Feedstock Supply

Rationale: Seasonal weather impacts are defined as deriving from natural weather variations (e.g., spring thaws, rainy seasons, or dry seasons) as opposed to singular weather events (like fires, droughts, or hurricanes). Seasonal weather changes can be a significant risk factor affecting feedstock availability, quality, and price.	
Raw RI Score: Owing to milder winters, logging operations tend to slow down in the winter months. Log yards in the region mitigate against this risk. Raw RI Score is 2 out of 10.	**Score 2**
Notched Salience: No adjustments.	**Score 2.0**
Impact Level: RI Impact level is deemed *moderate*.	**Score 6.66**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 13.32 out of 100.	**Score 13.32**

3.23. Long-Term Weather and Climate Trends

Rationale: In certain regions, climate trends and significant potential changes to future weather patterns can create feedstock risk.

Raw RI Score: No significant weather and climate risks are foreseen. Raw RI Score is 1 out of 10.	**Score 1**
Notched Salience: No adjustments.	**Score 1.0**
Impact Level: RI Impact level is deemed *moderate*.	**Score 6.66**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 6.66 out of 100.	**Score 6.66**

3.24. Government Subsidies for Feedstock Production or Utilization

Rationale: Feedstock that is directly subsidized through government programs can pose greater long-term risks than feedstock that is not. Subsidies may be subject to amendment or repeal, sometimes with minimal notice. This risk indicator refers to direct feedstock subsides only; it does not apply to government subsidies that pertain indirectly to the operations of the Proponent, such as Loan Guarantees, or to the markets for products produced by the Proponent.	
Raw RI Score: No direct subsidies for feedstock production/utilization were identified. Raw RI Score is 1 out of 10.	**Score 1**
Notched Salience: No adjustments.	**Score 1.0**
Impact Level: RI Impact level is deemed *low*.	**Score 3.33**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 3.33 out of 100.	**Score 3.33**

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

Rationale: Feedstock production 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 (e.g., 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, a chain of custody, or certification of sustainability), the likelihood of obtaining such permits and/or complying with permitting requirements should be examined.	
Raw RI Score: Forest harvesting regulations in Virginia include the requirement to notify the Virginia Department of Forestry of harvesting activity (harvested acreage, harvesting method, and planned starting and completion dates). This does not impede productivity, as harvesting notifications can be registered online. Other regulations, like workers' compensation policies, are present in most states and do not constitute a risk. Raw RI Score is 2 out of 10.	**Score 2**

Notched Salience: No adjustments.	**Score 2.0**
Impact Level: RI Impact level is deemed *low*.	**Score 3.33**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 6.66 out of 100.	**Score 6.66**

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

Rationale: Public backlash against biomass development in the Proponent region can directly impact Proponent's ability to procure, transport, trans-load, store, or utilize feedstock by affecting local policies, regulations, and Proponent's ability to obtain necessary permitting.	
Raw RI Score: There were no indications during outreach that negative public opinion constitutes a risk. Raw RI Score is 1 out of 10.	**Score 1**
Notched Salience: No adjustments.	**Score 1.0**
Impact Level: RI Impact level is deemed *low*.	**Score 3.33**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 3.33 out of 100.	**Score 3.33**

3.27. Feedstock Sustainability, Including Risks to Soil Quality, & Surface & Groundwaters

Rationale: Public concerns about the 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. Soil sustainability can be defined as the management of soil in a way that does not exert any negative or irreparable effects on the soil or any other systems. There is a diversity of approaches to soil sustainability in jurisdictional guidelines for biomass harvesting and production. Different feedstock types have unique thresholds at which feedstock removal causes significant negative consequences on the soil. 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 a social and regulatory backlash. Water intake issues can also increase risk.	
Raw RI Score: Outreach did not detect public concerns around the environmental sustainability of biomass procurement. The licensing system, close regulatory oversight by the VDOF (e.g., harvesting notification system), and the large acreage of protected areas within the BDO Zone mitigate against any future public concerns. Loggers are encouraged by the state to engage in sustainable harvesting through the Sustainable Harvesting and Resource Professional (SHARP) program. The Nature Conservancy acts as a steward for forest sustainability in the region, encouraging sustainable forestry on a portion of its approx. 250,000 acres of forested land.	**Score 1**

Raw RI Score is 1 out of 10.	
Notched Salience: No adjustments.	**Score 1.0**
Impact Level: RI Impact level is deemed *high*.	**Score 9.99**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 9.99 out of 100.	**Score 9.99**

3.28. GHG Emissions from Production, Harvest, & Transport

Rationale: Understanding a project's overall emissions and the carbon intensity throughout the feedstock supply chain is essential to reducing risks related to carbon pricing mechanisms and related regulations. Greenhouse gas (GHG) emissions from production, harvest, and transportation can be a significant challenge to Proponent claims of carbon neutrality for biomass projects. Carbon emissions from harvested soils, as well as emissions from harvesting machinery or delivery trucks, can make it difficult to achievement net-zero GHG emissions. If a Proponent's financial model relies on carbon neutrality/GHG regulatory pricing frameworks, it is essential to investigate the feedstock's carbon emission status.	
Raw RI Score: The GHG (Greenhouse Gas) impacts of a biomass-based project are heavily influenced by the specific product being produced. If the project involves bioenergy production, the carbon accounting methods used for managed forests typically discourage the use of stemwood (such as pulpwood) for energy purposes. This is because it can take up to a century for a seedling to grow into a harvestable tree of comparable size to that previously harvested. Studies indicate that it can take over 100 years for the carbon balance of an energy production system fueled by stemwood to reach carbon neutrality or become carbon negative. In contrast, systems utilizing forest residues or sawmill residuals tend to achieve carbon neutrality or negativity in less than 20 years. This is because waste products do not require accounting for the regrowth of trees from which they were derived. Considering the project's reliance on stemwood, there is a significant risk that it will not be able to qualify as carbon neutral. The prolonged timeframe required to offset carbon emissions associated with stemwood-based energy production poses a risk to the project's ability to achieve carbon neutrality within a reasonable period. Raw RI Score is 5 out of 10.	**Score 5**
Notched Salience: There is significant uncertainty associated with carbon accounting and pricing frameworks. Sustainable forest management schemes are often sufficient to incent bio-project development. Raw RI is notched down by 50%. Notched Salience is 2.5.	**Score 2.5**
Impact Level: RI Impact level is deemed *moderate*.	**Score 6.66**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 16.65 out of 100.	**Score 16.65**

3.29. Geographic Location Influence on Feedstock Variability

Rationale: Feedstock from different regions may differ in quality due to variations in soil quality, topography, harvest practices, weather, fertilizer applied, etc.	

Raw RI Score: There is no significant risk associated with feedstock quality variability as a result of geographic factors. Raw RI Score is 1 out of 10.	**Score 1**
Notched Salience: No adjustments.	**Score 1.0**
Impact Level: RI Impact level is deemed *low*.	**Score 3.33**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 3.33 out of 100.	**Score 3.33**

3.30. 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 Proponent feedstock requirements and throughput capacity. Capacity to scale should be demonstrated.	
Raw RI Score: Procuring the rated quantity of pulpwood (500,000 gt/yr) would require investment in additional feller bunchers and grapple skidders. Currently, there is an over-reliance on chainsaws and cable skidders, which have lower productivity (ten 25-ton truckloads of pulpwood per week). There are an estimated 50 logging crews that operate in the supply basin annually. For a production of 10 x 25-ton truckloads of pulpwood per week, the logging contractors in the region would produce ~600,000 gt/yr of pulpwood annually (assuming a 48-week work year). Unless production is maintained near 10 x 25-ton truckloads of pulpwood per week, additional contractors and/or new equipment would need to be introduced to procure the rated quantity. The risk of scale-up for pulpwood production is assessed as low-to-moderate. Equipment scale-up for forest residue is also a significant risk owing to the need for purchases of comminution equipment and the establishment of new logistics networks. Risk of scale-up for forest residues is deemed high. Scale-up is not a significant risk for sawmill residuals. Raw RI Score is 8 out of 10.	**Score 8**
Notched Salience: There are a number of measures that could reduce scale-up risk: (1) improvements in the productivity of the existing contractor base through logistics management and/or new equipment purchases, (2) the establishment of an efficient terminal chipping supply chain using the existing network of stationary chippers in the region, (3) the introduction of new crews with feller bunchers and grapple skidders, and/or (4) government- or Proponent-mediated logistics management and equipment financing. Raw RI is notched down 25%. Notched Salience is 6.	**Score 6.0**
Impact Level: RI Impact level is deemed *moderate*.	**Score 6.66**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 39.96 out of 100.	**Score 39.96**

CATEGORY 4.0: INFRASTRUCTURE RISKS

4.1 RISK FACTOR: PHYSICAL INFRASTRUCTURE

4.1.1 Land Parcel

Raw RI Score: Tazewell County presents a diverse selection of land parcels suitable for industrial development, offering promising prospects for bioproducts initiatives without the burden of restrictive building regulations. We focused the infrastructure risk assessment on the Bluestone Regional Business and Technology Center. The Center spans over 180 acres and is conveniently located off of Interstate 77, providing ample space for potential facility construction. Raw RI Score is 1 out of 10.	**Score 1**
Notched Salience: No adjustments.	**Score 1.0**
Impact Level: RI Impact level is deemed *low*.	**Score 3.33**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 3.33 out of 100.	**Score 3.33**

4.1.2 City Ownership

Raw RI Score: The county owns most parts of the Bluestone Regional Business and Technology Center. The land in the adjacent areas is privately owned, and situated in relatively close proximity to other industrial parks within the county. Raw RI Score is 1 out of 10.	**Score 1**
Notched Salience: No adjustments.	**Score 1.0**
Impact Level: RI Impact level is deemed *low*.	**Score 3.33**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 3.33 out of 100.	**Score 3.33**

4.1.3 Industrial Land Use Zone

Raw RI Score: The County has no zoning ordinance in place. This grants potential investors the freedom to purchase land anywhere within the county's boundaries and establish their production facilities. The absence of zoning permits enables prospective companies to select locations that align with specific operational requirements, fostering flexibility and adaptability. Raw RI Score is 2 out of 10.	**Score 2**
Notched Salience: No adjustments.	**Score 2.0**

Impact Level: RI Impact level is deemed *low*.	**Score 3.33**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 6.66 out of 100.	**Score 6.66**

4.1.4 Natural Gas Line

Raw RI Score: The Bluestone Regional Business and Technology Center and surrounding area benefits from a robust natural gas infrastructure, with multiple companies providing natural gas lines across the region. Providers such as Appalachian Natural Gas Distribution Company and Virginia Natural Gas ensure reliable access to this essential energy resource. Moreover, the presence of natural gas lines in former coal production sites offers an added advantage to biobased projects considering conversion opportunities. Raw RI Score is 2 out of 10.	**Score 2**
Notched Salience: No adjustments.	**Score 2.0**
Impact Level: RI Impact level is deemed *low*.	**Score 3.33**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 6.66 out of 100.	**Score 6.66**

4.1.5 Electrical

Raw RI Score: Tazewell's electrical energy needs are effectively met through a diverse array of power providers. Appalachian Power Company, Richlands, Virginia Electric Utility, Strategic Energy LLC, and Texas Retail Energy contribute to the county's robust electrical infrastructure, ensuring a stable and efficient power supply for potential businesses. The Bluestone Regional Business Center Site is served by Dominion Energy and Rappahannock Electric Cooperative specifically with 12 MW of available capacity. Raw RI Score is 1 out of 10.	**Score 1**
Notched Salience: No adjustments.	**Score 1.0**
Impact Level: RI Impact level is deemed *low*.	**Score 3.33**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 3.33 out of 100.	**Score 3.33**

4.1.6 Fresh Water Supply

Raw RI Score: The County benefits from a dependable network of companies and organizations that provide fresh water. Sydnor Hydro Inc., Tazewell Water Department, Town of Tazewell WWTP, and Tazewell County PSA are among the key players responsible for delivering high-quality fresh water to the county's residents and businesses. The region's abundant fresh water resources further enhance its suitability for various industrial and commercial activities.	**Score 1**

Raw RI Score is 1 out of 10.

Notched Salience: No adjustments.	**Score 1.0**
Impact Level: RI Impact level is deemed *low*.	**Score 3.33**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 3.33 out of 100.	**Score 3.33**

4.1.7 Sewage Disposal Trunk Line

Raw RI Score: Tazewell has implemented a comprehensive sewage disposal infrastructure. This includes a county landfill expertly managed by Republic Services, wastewater treatment plants overseen by the Tazewell County Public Service Authority, and an extensive network of sewer lines. The presence of previous coal sites further suggests the existence of established arrangements for efficient sewage disposal, streamlining the process for potential biobased projects.	**Score 2**

Raw RI Score is 2 out of 10.

Notched Salience: No adjustments.	**Score 2.0**
Impact Level: RI Impact level is deemed *low*.	**Score 3.33**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 6.66 out of 100.	**Score 6.66**

4.1.8 Drainage and Stormwater Management

Raw RI Score: There is a prioritization of effective stormwater management, overseen by the County Public Service Authority Capital, Tazewell County PSA, Virginia Department of Environmental Protection, and Virginia Department of Transportation. A comprehensive range of techniques, such as pipes, culverts, infiltration systems, detention basins, floodwalls, and levees, are employed to efficiently manage stormwater runoff and maintain optimal drainage across the county.	**Score 2**

Raw RI Score is 2 out of 10.

Notched Salience: No adjustments.	**Score 2.0**
Impact Level: RI Impact level is deemed *low*.	**Score 3.33**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 6.66 out of 100.	**Score 6.66**

4.1.9 Available ICT (Information & Communication Technology) Services

Raw RI Score: The County retains modern and reliable information and communication facilities. The county has robust telecommunications infrastructure, providing high-speed internet connectivity and reliable communication services to support the needs of enterprises. Major providers such as T-Mobile, Verizon, Xfinity, Spectrum, HughesNet, ViaSat, and EarthLink offer comprehensive coverage throughout the area, ensuring seamless connectivity for businesses. Moreover, over 80% of the population in Tazewell County has access to broadband and telecommunication services, enabling efficient communication and data exchange. Raw RI Score is 2 out of 10.	**Score 2**
Notched Salience: No adjustments.	**Score 2.0**
Impact Level: RI Impact level is deemed *low*.	**Score 3.33**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 6.66 out of 100.	**Score 6.66**

4.1.10 Infrastructure – Landfill/Alternative Markets for Waste Disposal

Raw RI Score: Tazewell County benefits from well-managed landfills operated by Republic Services, providing efficient waste disposal solutions. Additionally, the county actively promotes recycling and composting programs, emphasizing sustainable practices and environmental stewardship. Biomass plants generate biochar, a valuable byproduct containing plant nutrients that can be used as a soil amendment, further enhancing the county's commitment to waste management and resource conservation. Raw RI Score is 3 out of 10.	**Score 3**
Notched Salience: No adjustments.	**Score 3.0**
Impact Level: RI Impact level is deemed *low*.	**Score 3.33**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 9.99 out of 100.	**Score 9.99**

4.2 Risk Factor: Logistics

4.2.1 Road and Highway Access and Intersection

Raw RI Score: Tazewell County has an extensive and well-connected road system, facilitating efficient transportation of raw materials and finished products. Major roads and interstates, including US 19, US 460, SR 16, SR 16 Alt., SR 61, SR 67, SR 91, and SR 102, traverse the county, enabling seamless connectivity to neighboring cities and regions. Additionally, the proximity to the I-77 and I-81 interstates provides convenient access to larger markets and distribution channels. Raw RI Score is 2 out of 10.	**Score 2**

Notched Salience: No adjustments.	**Score 2.0**
Impact Level: RI Impact level is deemed *low*.	**Score 3.33**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 6.66 out of 100.	**Score 6.66**

4.2.2 Ocean/River Access

Raw RI Score: The Clinch River offers navigability from the town of Richlands in Tazewell County to the Virginia/Tennessee border in Scott County. Although the river is dammed twice (limiting access to the ocean) it remains a valuable resource for industries operating in the region. Moreover, the Port of Virginia, with its four marine terminals located in Newport News, Norfolk, and Portsmouth, serves as a crucial gateway for shipping goods to various domestic and international markets. The nearest port to Tazewell County (Port of Virginia) handles roughly 3.2 million TEUs of cargo per annum, facilitating substantial import and export activity. The port's robust infrastructure and ancillary trade lanes for Tazewell County provide businesses in the area with access to a significant gateway for international shipping and trade. Raw RI Score is 2 out of 10.	**Score 2**
Notched Salience: No adjustments.	**Score 2.0**
Impact Level: RI Impact level is deemed *low*.	**Score 3.33**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 6.66 out of 100.	**Score 6.66**

4.2.3 Railway Service

Raw RI Score: The County enjoys the presence of railway services provided by Norfolk Southern and Amtrak. The rail infrastructure comprises approximately 75 miles of railroad tracks operating through the county. These rail connections not only offer transportation solutions within the county but also facilitate access to nearby large cities and key markets. Former coal production sites are particularly well-suited for railway transportation, further enhancing the county's logistics capabilities. It is estimated that Norfolk Southern moves several hundred thousand tons worth of freight annually through its rail infrastructure in the county, alongside Amtrak providing services to thousands of commuters in the region each year. Raw RI Score is 2 out of 10.	**Score 2**
Notched Salience: No adjustments.	**Score 2.0**
Impact Level: RI Impact level is deemed *low*.	**Score 3.33**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 6.66 out of 100.	**Score 6.66**

4.2.4 Accessibility to Airport

Raw RI Score: Tazewell is located in close proximity to multiple airports, facilitating efficient air transportation. Mercer County Airport (32 miles), Beckley Raleigh County Memorial Airport (73 miles), Tri-Cities Regional Airport (89 miles), Roanoke Regional Airport (117 miles), Greenbrier Valley Airport (119 miles), Yeager Airport (129 miles), Charlotte Douglas International Airport (186 miles), and Raleigh-Durham International Airport (223 miles) provide a range of domestic and international flight options, ensuring easy access for business travelers and cargo transportation. Raw RI Score is 3 out of 10.	**Score 3**
Notched Salience: No adjustments.	**Score 3.0**
Impact Level: RI Impact level is deemed *low*.	**Score 3.33**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 9.99 out of 100.	**Score 9.99**

4.3 Risk Factor: Social Infrastructure

4.3.1 Healthcare Facilities

Raw RI Score: The County has comprehensive healthcare infrastructure, encompassing multiple hospitals and outpatient clinics. These facilities, coupled with nationally recognized hospitals in nearby counties, ensure residents have access to quality healthcare services. The county's healthcare ecosystem caters to a wide range of medical needs, providing residents with reliable medical care and support. Raw RI Score is 3 out of 10.	**Score 3**
Notched Salience: No adjustments.	**Score 3.0**
Impact Level: RI Impact level is deemed *low*.	**Score 3.33**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 9.99 out of 100.	**Score 9.99**

4.3.2 Educational Facilities

Raw RI Score: Virginia boasts a strong educational foundation, and Tazewell County is no exception. The region is home to renowned universities and research institutions, positioning it as a hub for forestry-related research, these include: Virginia Tech, Radford University, Bluefield College, Concord University and New River Community College. The availability of skilled professionals and the state's emphasis on wood products manufacturing research make Tazewell an ideal location for a biobased project. Raw RI Score is 2 out of 10.	**Score 2**
Notched Salience: No adjustments.	**Score 2.0**

Impact Level: RI Impact level is deemed *low*.	**Score 3.33**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 6.66 out of 100.	**Score 6.66**

4.3.3. Recreational Facilities

Raw RI Score: Tazewell offers a diverse range of recreational facilities, creating an attractive environment for potential project developers. The county's stunning natural landscapes, including mountains, rivers, and forests, provide a picturesque backdrop for outdoor activities. Hiking and walking trails, such as the renowned Appalachian Trail and Burkes Garden Trail, allow visitors to immerse themselves in the region's natural beauty. The Clinch River offers opportunities for fishing, kayaking, and canoeing, appealing to water enthusiasts. Tazewell County's parks and recreational areas, equipped with amenities like playgrounds, picnic areas, and sports fields, provide spaces for community events and leisure activities. Raw RI Score is 3 out of 10.	**Score 3**
Notched Salience: No adjustments.	**Score 3.0**
Impact Level: RI Impact level is deemed *low*.	**Score 3.33**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 9.99 out of 100.	**Score 9.99**

4.3.4. Cultural Facilities

Raw RI Score: Tazewell retains a rich cultural landscape that presents an enticing opportunity for project developers. The county is home to a variety of cultural facilities that contribute to the vibrant fabric of the community. The Appalachian Arts Center serves as a hub for showcasing local artisans' talents and hosting art exhibitions, workshops, and performances. The Pocahontas Exhibition Mine and Museum provide a unique glimpse into the region's mining heritage, offering educational experiences and guided tours. The Richlands Area Museum preserves the county's history through its extensive collection of artifacts and exhibits. Raw RI Score is 4 out of 10.	**Score 4**
Notched Salience: No adjustments.	**Score 4.0**
Impact Level: RI Impact level is deemed *low*.	**Score 3.33**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 13.32 out of 100.	**Score 13.32**

4.3.5. Public Safety Facilities

Raw RI Score: There is a robust network of public safety facilities within the County, making it an appealing location for project developers seeking to prioritize community well-being and security. The county is served by dedicated law enforcement agencies, including the Tazewell County Sheriff's Office and local police departments, ensuring a safe and secure environment for residents and businesses. In addition, Tazewell County boasts well-equipped fire departments strategically located throughout the area, providing efficient emergency response capabilities. The county also benefits from a comprehensive healthcare system, including hospitals and medical clinics, ensuring prompt medical care. Raw RI Score is 3 out of 10.	**Score 3**
Notched Salience: No adjustments.	**Score 3.0**
Impact Level: RI Impact level is deemed *low*.	**Score 3.33**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 9.99 out of 100.	**Score 9.99**

4.3.6 Housing

Raw RI Score: According to Federal government housing data, the median home values in Tazewell as of May 2023, range from $137,000 to $145,000. These prices show a slight decrease compared to the previous year. In comparison, the median home value for the state of Virginia is reported as $390,000. Additionally, the US Census Bureau indicates that the median gross rent in Tazewell for the period of 2017-2021 is $671 per month, while the median rent for Virginia as a whole is $1,956. These figures indicate affordable housing options, ensuring that the housing needs of the residents can be adequately met. Raw RI Score is 1 out of 10.	**Score 1**
Notched Salience: No adjustments.	**Score 1.0**
Impact Level: RI Impact level is deemed *low*.	**Score 3.33**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 3.33 out of 100.	**Score 3.33**

4.4 Risk Factor: Workforce and Permitting

4.4.1 Labor Availability

Raw RI Score: According to the latest data from the United States Census Bureau in 2021, Tazewell County demonstrates a vibrant employment landscape with a total employment count of 15,680 individuals and a low unemployment rate of 4.4%. The county's population composition skews towards a mature workforce, with a median age of 45. Additionally, a substantial portion of the population, approximately 58%, falls within the working-age bracket of 18 to 64 years, amounting to a significant pool of 23,557 individuals. These demographic indicators highlight the presence of an experienced and capable labor force, providing a solid foundation for industrial growth and investment in Tazewell County.	**Score 2**

Raw RI Score is 2 out of 10.

Notched Salience: No adjustments.	**Score 2.0**
Impact Level: RI Impact level is deemed *low*.	**Score 3.33**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 6.66 out of 100.	**Score 6.66**

4.4.2 Labor Cost

Raw RI Score: Tazewell offers competitive labor costs for businesses seeking to establish operations in the region. The county reports an unemployment rate of 4.4%, reflecting a robust labor force. The median household income in Tazewell County is $42,937, providing insight into the prevailing wage levels. With a diverse workforce and access to skilled labor from the Bluefield, WV-VA micropolitan area, Tazewell County presents an opportunity for cost-effective hiring and favorable labor economics.	**Score 2**

Raw RI Score is 2 out of 10.

Notched Salience: No adjustments.	**Score 2.0**
Impact Level: RI Impact level is deemed *low*.	**Score 3.33**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 6.66 out of 100.	**Score 6.66**

4.4.3 Training Programs / Community College

Raw RI Score: The County maintains strong training programs and collaboration with esteemed community colleges, ensuring a highly skilled workforce and continuous professional development opportunities. Institutions such as Southwest Virginia Community College offer an array of specialized programs tailored to meet industry needs. For instance, they provide training in advanced manufacturing technologies, healthcare fields such as nursing and medical assisting, as well as information technology programs that cover cybersecurity and software development. These programs equip individuals with in-demand skills and expertise, positioning them for success in the modern job market. Partnering with these institutions opens avenues for customized training initiatives, empowering businesses in Tazewell County to access a qualified talent pool.	**Score 3**

Raw RI Score is 3 out of 10.

Notched Salience: No adjustments.	**Score 3.0**
Impact Level: RI Impact level is deemed *low*.	**Score 3.33**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 9.99 out of 100.	**Score 9.99**

4.4.4 Permit Process

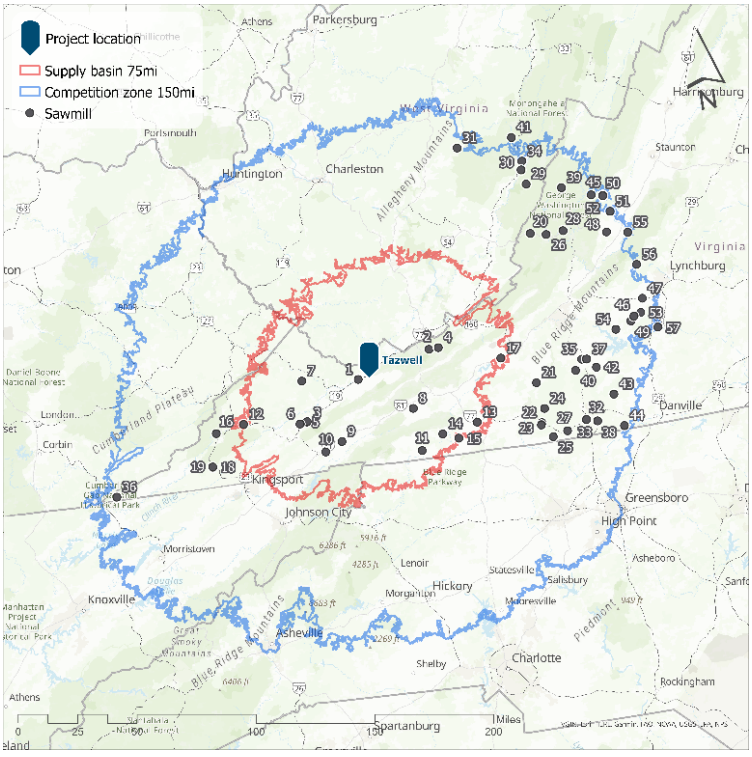
Raw RI Score: Tazewell has an efficient and business-friendly permit process, designed to support project developers throughout every step of project qualification. The process welcomes initial consultations with developers where discussion on their project plans can receive guidance on the necessary permits and regulations. The county's Permitting Department offers comprehensive support, assisting developers in completing permit applications, providing information on required documentation, and answering any inquiries. Once the applications are submitted, the county diligently reviews them for compliance, ensuring adherence to zoning ordinances, building codes, and environmental regulations. The review process is conducted in a timely manner spanning 30-60 days on average, with a commitment to minimizing delays and expediting approvals. Raw RI Score is 1 out of 10.	**Score 1**
Notched Salience: No adjustments.	**Score 1.0**
Impact Level: RI Impact level is deemed *low*.	**Score 3.33**
Loaded RI Score: Loaded RI Score (Notched Salience × Impact Level) is 3.33 out of 100.	**Score 3.33**

APPENDIX B: HARVESTING ACTIVITY AND FOREST BIOMASS ESTIMATION

Current pulpwood production in the supply basin

Logging and milling activity within the supply basin is relatively low compared to neighboring regions. Sawmills within the BDO Zone tend to be concentrated to the east, outside of the supply basin (Figure B-1). Logging contractors also tend to be concentrated further north and east in the BDO Zone: the Virginia Department of Forestry's Logger and Timber Harvester Directory lists only 14 contractors that operate within the Virginian counties included in the supply and competition basins.[2] Considering the portions of other states included within the supply basin (West Virginia, Kentucky, Tennessee, North Carolina), we estimate that there are approx. 50 logging crews that could make forest biomass (pulpwood and forest residue) available for a new project in the Tazewell area. Forestry professionals we contacted believed that this was an acceptable estimate. Current pulpwood production levels are not known with certainty but outreach determined that pulpwood is not being recovered during most logging operations. FIA removals data indicates that pulpwood production in the supply basin was as high as 280,000 gt/yr over the 2015-2019 period but current pulpwood production is likely less than half this quantity owing to recent paper mill closures. Average annual harvesting in the supply basin is ~20,000 acres/yr (inferred from Virginia Department of Forestry harvesting notification data). Current forest residue production in the region is insignificant .

Figure B-1: The distribution of sawmills and log yards in the Tazewell, VA BDO Zone. Note: There are 33 sawmills and 4 independent log yards concentrated in the east, outside of the supply basin.



[2] https://dof.virginia.gov/forest-management-health/landowner-assistance/find-a-forester/find-a-logger/

Potential harvesting activity and pulpwood production in the supply basin

The annual quantity of unharvested, standing pulpwood and forest residues in the supply basin that could be made available to a new project was estimated using datasets available from the US Department of Energy (DOE) 2016 Billion-Ton Report.[3] The 2016 Billion-Ton Report projects biomass availability up to the year 2040 using a number of assumptions, constraints, and market demand projections (Table B-1). County-level estimates of the availability of pulpwood (logs produced from trees between 5-11 inches DBH during roundwood harvesting operations) and forest residue (top, bottom and branches recovered during roundwood harvesting operations) for all available years (2015, 2020, 2025, 2030, 2040) were downloaded using the Vol. 1 Data Download Tool for the 2016 Billion-Ton Report. Using GIS software, a polygon for the supply basin (75-mile maximum transport distance) was developed and used to estimate the percentage area of each county included in the supply basin (percentage overlap value). For each county, the percentage overlap value was then multiplied by the average annual pulpwood and forest residue availability for 2015-2040 to estimate the total quantity of pulpwood and forest residue in the supply basin available for a new entrant. These quantities (739,876 gt/yr of pulpwood and 161,070 gt/yr of forest residue) were then used to inform the selection of the rated quantities (**500,000 gt/yr** of pulpwood and **100,000 gt/yr** of forest residues).[4] To develop supply curves, the supply basin polygon was used to estimate the quantity of forest biomass available based on the percentage overlap in each 5-mile transport distance segment, up to the 75-mile maximum transport distance (Figure F-2, Appendix F).

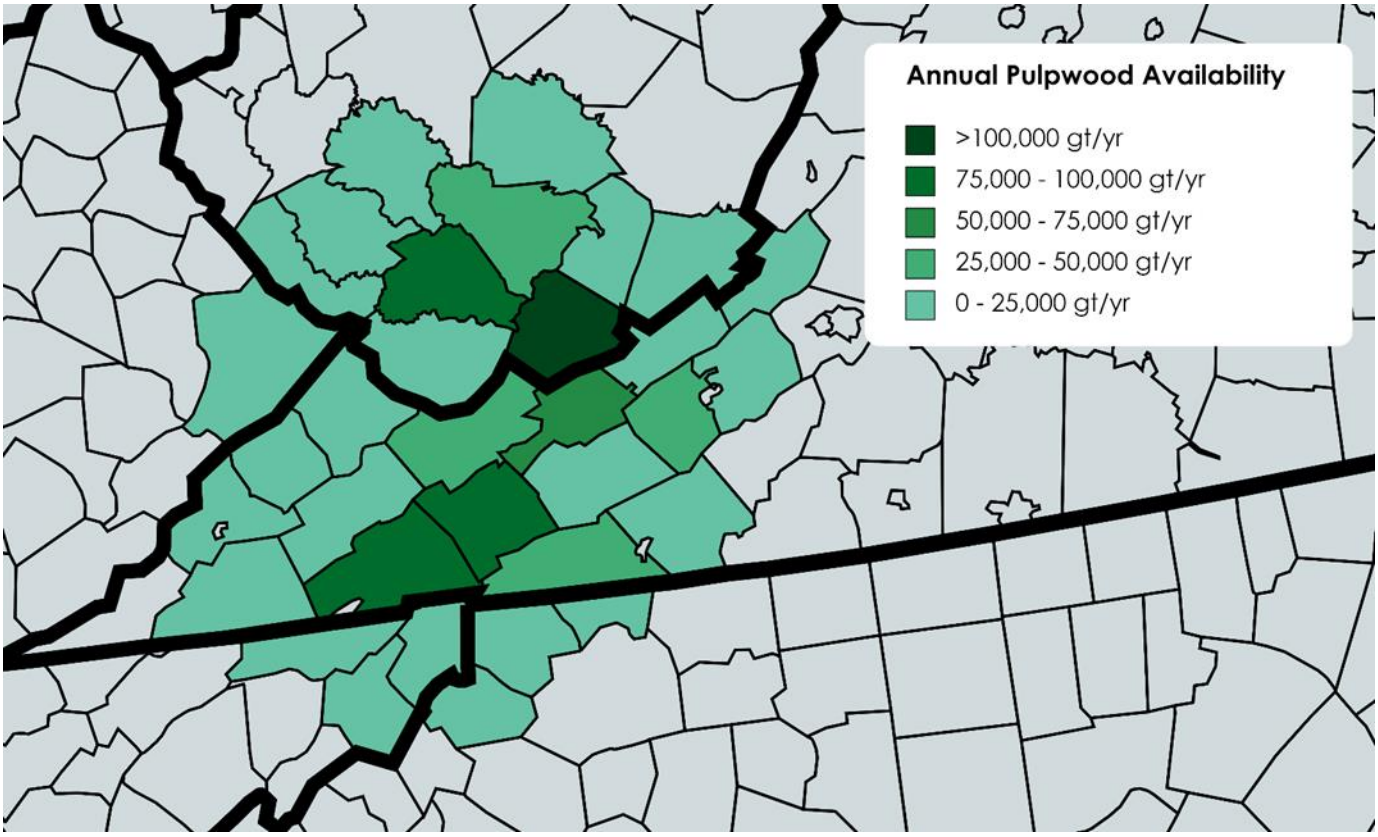
Table B-1: Billion-Ton Report assumptions and parameters included in analysis

Bioenergy – Knowledge Discovery Framework, US Department of Energy Billion-Ton Report – 2016 Vol. 1 Data Download Tool (https://bioenergykdf.net/2016-billion-ton-report)		
Data retrieval		County level
		Year 2015, 2020, 2025, 2030, 2040
Data presented as		Bone dry tons per year (bdt/yr)
		Average of the five retrieved years (2015, 2020, 2025, 2030, 2040)
Resource Category	**Forestry**	All biomass resources modeled on forestland timberland, i.e., forest residues and small-diameter trees.
Demand for feedstock		Based on 2016
Scenario	**Medium housing, medium energy demands**	**1.)** Growth in housing starts returns to long-term average by 2025. The long-term average of housing starts from 1959 through 2011 is slightly less than 1.1 million per year. **2.)** Growth in wood biomass demand for energy increases by 86% by 2040. Actual wood biomass production in 2010 was 58.2 million dry tons for all scenarios. **3.)** New plantation management intensity in the South - Based on current FIA pine plantation growth rate. Current average FIA growth rate on pine plantations across the South (all owners, all ages) is approximately 108 cubic feet/acre per year (1.6 dry ton/acre per year). Increasing management intensity by 50% only on new plantations results in an increase in the average South-wide growth

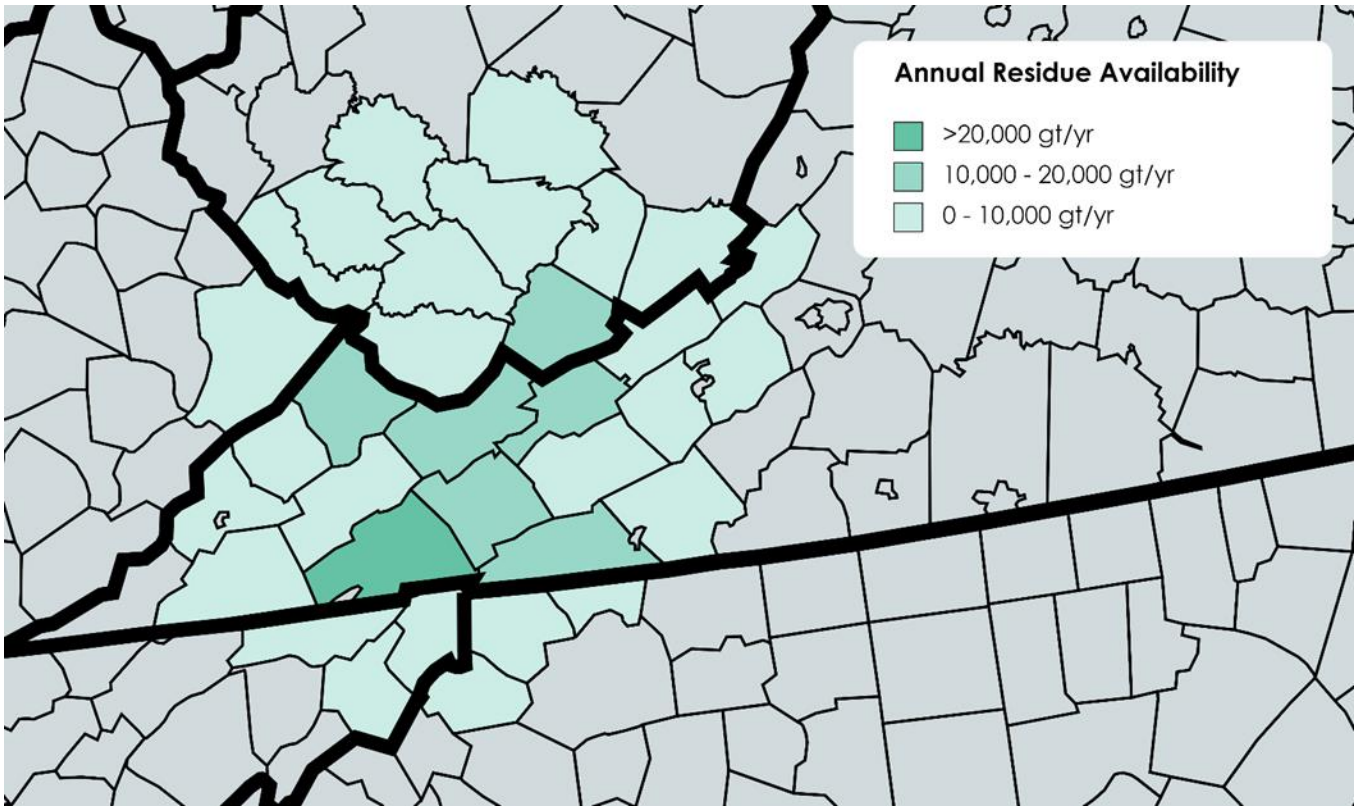
[3] https://bioenergykdf.net/2016-billion-ton-report
[4] Dry tons (0% moisture content) were converted to green tons using a moisture content assumption of 50%.

		rate over time up to 140 cubic feet/ac per year in 2040 (2.1 dry tons/acre per year).
Biomass price	Specified biomass price after harvest cost as applicable but before transportation costs, in 2014 dollars per dry ton equivalent. *If these prices are used within the report, they will include inflation rates and newest transportation costs.*	
Resources	Hardwood, lowland forest residues, Hardwood, lowland whole trees, Hardwood, upland forest residues, Hardwood, upland whole trees, Mixedwood forest residues, Mixedwood whole trees, Softwood, natural forest residues, Softwood, natural whole trees, Softwood, planted forest residues, Softwood, planted whole trees – logging resides = harvest/forest residues; whole trees = only small diameter trees = pulpwood.	
Class	**RSDF**	Residues, forestry (i.e., forest residues)
	TREE	Small-diameter trees
Section	**PFRS**	Primary forestland resources including forest residues (i.e., Class RSDF) and small-diameter trees (i.e., class TREE).
Diameter class	**2**	Timberland trees with diameter at breast height 5-11 inches.
Operation Type	**Clear Cut**	Clearcut harvest of small-diameter trees or production of forest residues.
	Thinning	Thinning harvest of small-diameter trees or production of forest residues.
Supply Class	**LE40**	Timberland resources harvested from slopes less than or equal to 40 degrees.

Map B-1. Annual pulpwood availability in supply basin by county



Map B-2. Annual forest residue availability in supply basin by county



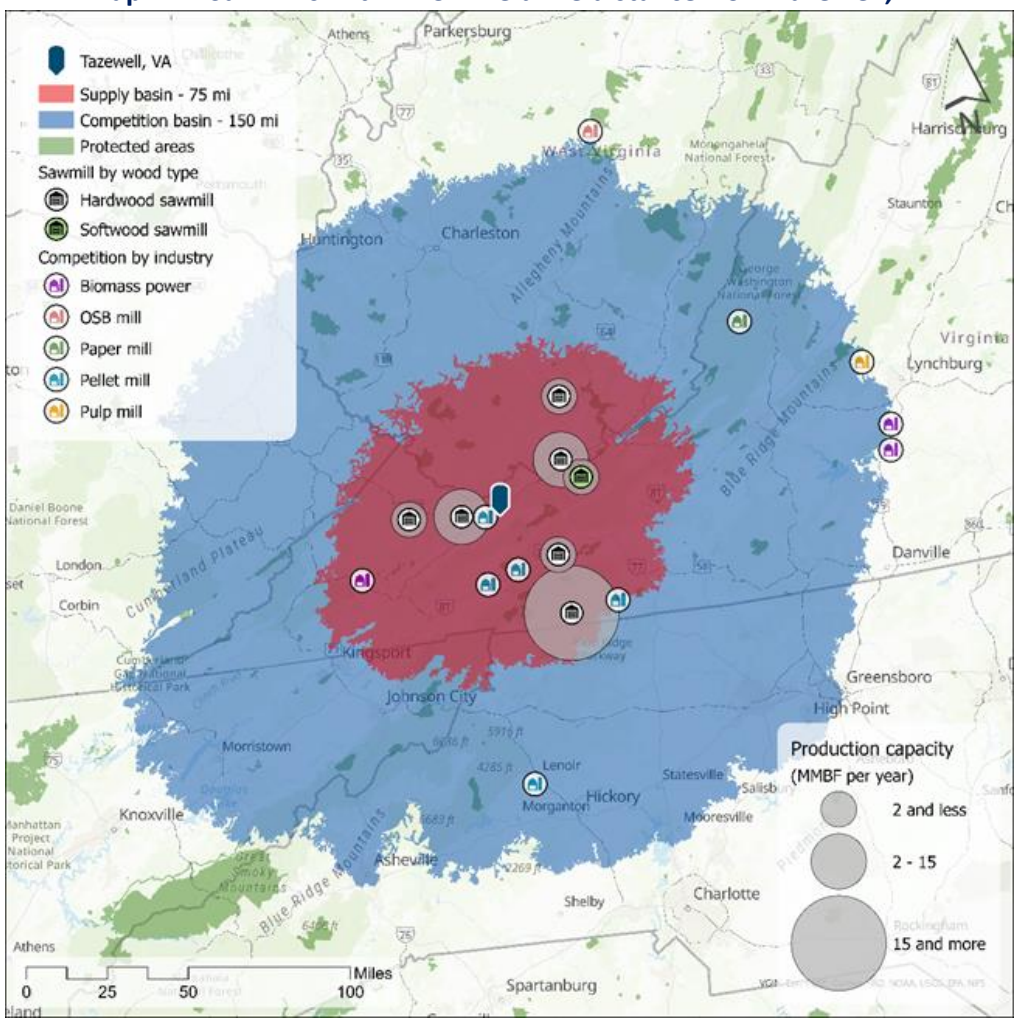
APPENDIX C: SAWMILL RESIDUAL ESTIMATION

Sawmill residuals production in the supply basin was estimated using the Ecostrat sawmill residual model, which estimates wood chip, sawdust, and bark production as a function of lumber production (MMBF/year). The model uses generic conversion factors for hardwood sawmills. The final residuals estimates must be adjusted using local data because of regional differences in log sizes, dimensions, and sawmill product output and efficiency. Four sawmill owner-operators were contacted and asked to estimate their mill's lumber production capacity (MMBF/yr) and residual output (gt/yr). This information was used to calibrate the model by calculating adjustment factors for the reporting mills (actual residuals production per year/estimated residuals production per year). The adjustment factors calculated for the four sawmills ranged from 0.53 to 0.79. A final adjustment factor of 0.5 was selected such that residual production quantities estimated by the model were reduced by half.

To run the Ecostrat sawmill residuals model, estimates of the lumber production capacity of each sawmill are required. If lumber production capacity could not be determined from secondary sources or interviews with local experts, satellite imagery was used to visually compare the size of sawmills with unknown lumber production capacities to those of known lumber production capacity. The model was then run, and the final adjustment factor of 0.5 was applied to the resulting residuals estimates, generating a final estimate of 149,883 gt/yr. A conservative capture rate of 20% was applied to the adjusted model estimates of sawmill residuals production, resulting in the rated quantity of 25,000 gt/yr.

APPENDIX D: SAWMILLS

Map D-1. Sawmills within 75-mile drive distance from Tazewell, VA



APPENDIX E: CURRENT COMPETITION

Map E-1. Current competitors for feedstock within 150-mile drive distance from Tazewell, VA

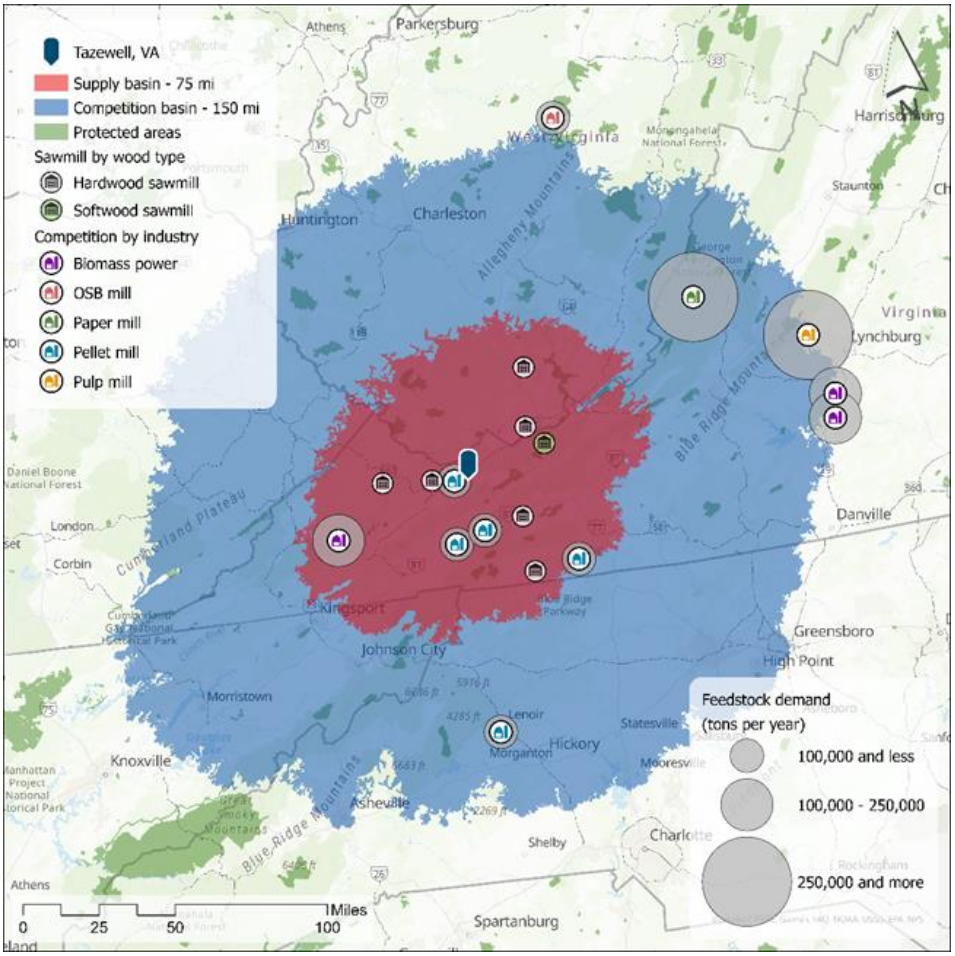


Table E-1: Location and feedstock intake quantities of competitors

Competitor type	Distance from Tazewell, VA	Feedstock types consumed	Estimated annual intake (gt/yr)
Pellet mill	8.9 mi	Sawdust	50,000
Pellet mill	35 mi	Sawdust	50,000
Pellet mill	38 mi	Sawdust	90,000
Biomass power	59 mi	Bark, chips, forest residue	150,000
Pellet mill	80 mi	Sawdust	60,000
Paper mill	120 mi	Bark, chips, sawdust, pulpwood, forest residue	300,000
Pellet mill	120 mi	Sawdust	60,000
OSB mill	156 mi	Pulpwood	100,000
Biomass power	164 mi	Bark, chips, sawdust	190,000
Biomass power	165 mi	Bark, chips, sawdust	225,000

APPENDIX F: OTHER CHARTS AND FIGURES

Figure F-1: Biomass supply curve: potential availability as a function of distance from Tazewell, VA

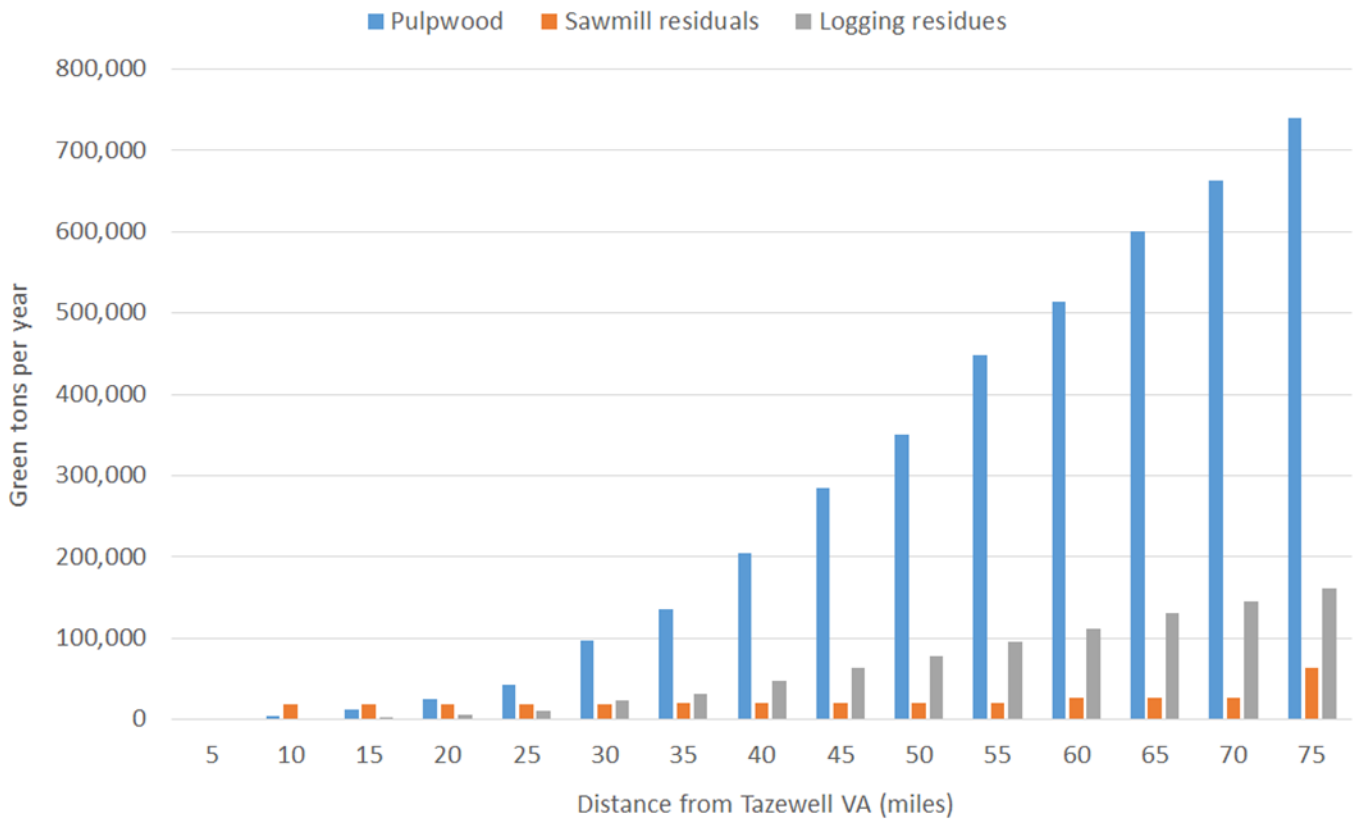
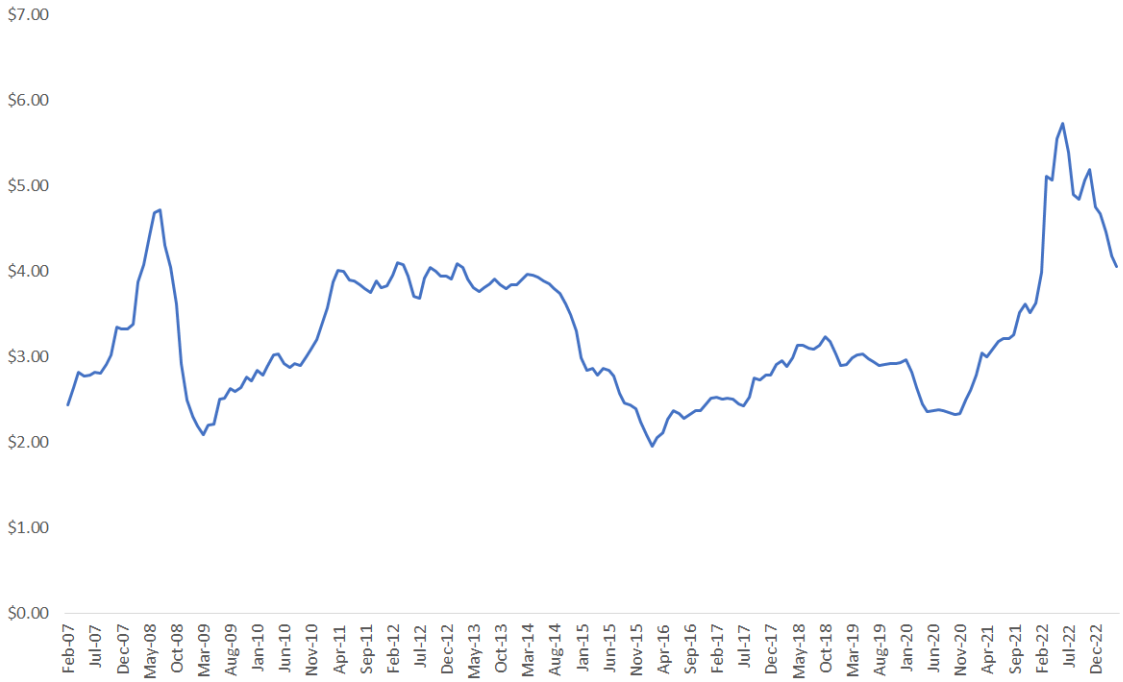


Figure F-2: Nominal No.2 diesel prices ($/gallon) for the US Lower Atlantic region, 2007–2022.[5]



[5] https://www.eia.gov/dnav/pet/hist/LeafHandler.ashx?n=pet&s=emd_epd2dxl0_pte_r1z_dpg&f=m

Figure F-3: Real No.2 diesel prices ($/gallon) for the US Lower Atlantic region, 2007–2022 (2022 USD).[6]



[6] https://www.eia.gov/dnav/pet/hist/LeafHandler.ashx?n=pet&s=emd_epd2dxl0_pte_r1z_dpg&f=m

APPENDIX G: INFRASTRUCTURE

Site selection of Tazewell, VA

LOCATION

The County of Tazewell retains a strategic position within the southwestern quadrant of Virginia, the town of Tazewell. It is approximately 85 miles towards the southwest of Roanoke and 80 miles towards the northeast of Bristol. Two significant U.S. highways, namely U.S. 19 and U.S. 460, traverse Tazewell County. These connect Bluefield to the town of Tazewell, extending northwards towards Richland's, and then curving southwest towards Bristol. State Route 16 offers a convenient pathway leading north into West Virginia and south into North Carolina. In addition, State Route 61 serves as a vital connector between Tazewell and Rocky Gap to the east.

One of the notable features of Tazewell's geographic disposition is the intersection of these major routes with Interstate 81, a critical conduit between the northeastern and southeastern regions of the United States. Also intersecting here is Interstate 77, a significant highway that crosses the Appalachian Mountain Range, linking the southern coastal states with the Midwest. This intricate network of routes bolsters the transport and logistics prospects of the region, making Tazewell a potential hotspot for developers seeking enhanced accessibility and connectivity.

POPULATION

Situated in the heart of Virginia, Tazewell County provides a distinct demographic profile for economic development. In 2023, the County had an estimated population of 39,034. However, it is crucial to identify a moderate population shrinkage that has occurred recently. Over the prior year, the county experienced a 1.18% decline, with a more pronounced 13.41% reduction from a baseline of 45,078 since 2010.

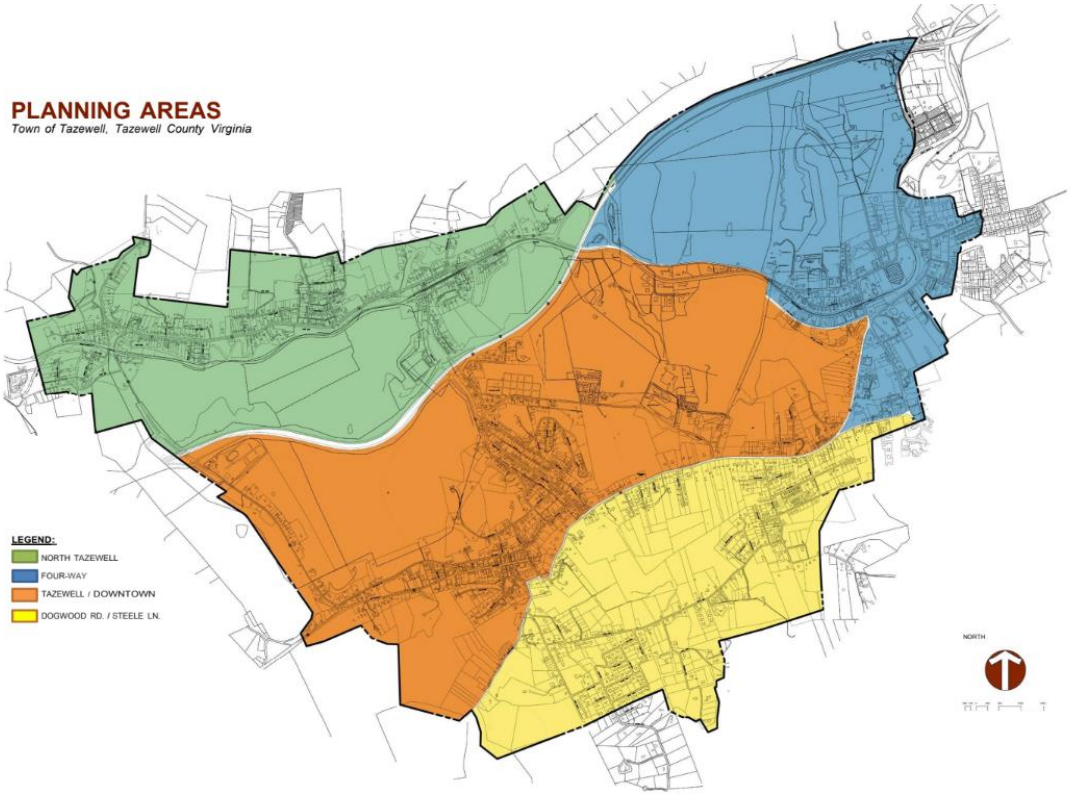
Further analysis into the county's demographics reveals an age composition steered towards a more mature populace. There are 33,000+ adults, including 9,100+ seniors, suggesting a stable, experienced community with a potentially lower rate of population turnover. This consistency could positively affect businesses and services operating in the area; however, the age demographics also highlight a significant concentration within the 40-69 age range, signifying potential gap in services for younger demographics.

EMPLOYMENT

According to recent data from the U.S Census Bureau in 2021, Tazewell County shows a promising employment landscape that offers valuable insights for investment in the region. The county has a resilient employment count of 15,680 individuals paired with a relatively low unemployment rate of 4.4%, pointing towards a healthy labor market. The county's workforce shows a bias towards maturity, with a median age of 45 years, suggesting the presence of seasoned professionals that can contribute significantly to business growth and productivity.

It is important to note that the population composition indicates a sizable fraction of about 58%, translating to a substantial 23,557 individuals within the working-age bracket of 18 to 64 years. This represents a considerable pool of potential talent, offering the capability for businesses to draw upon a diverse and sizable workforce. The presence of such a labor force offers a wide array of opportunities for diversification, innovation, and competitive advantage.

Map G-1: Image of Planning Zones of Tazewell County



Site Selection

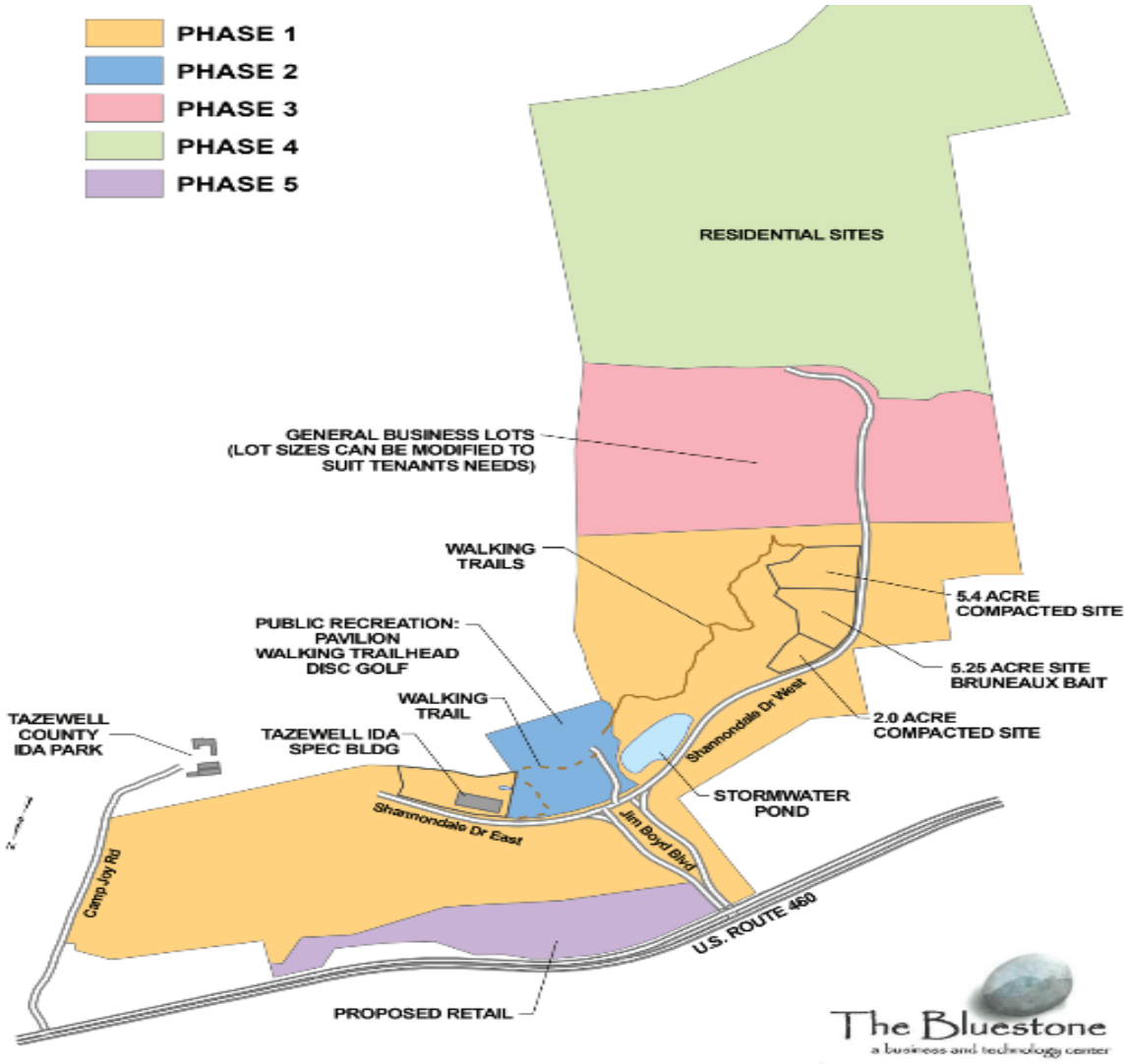
The Bluestone Business Park, situated in Tazewell County, Virginia, presents a compelling array of advantages that makes it an attractive investment opportunity in the region. The park's land use flexibility is one of its key benefits. Although there is no zoning, the restrictive covenants contained in the deeds ensure that development aligns with the park's intended use and vision. This guarantees an environment conducive to business growth, as well as preservation of the park's integrity.

The mixed-use development offers 180 acres specifically for a Business Park, with several pre-graded sites ranging from 3 to 12 acres, offering businesses flexibility in choosing the site that best fits their needs. Additionally, a readily available 40,000 SF speculative building expands the park's capacity to accommodate businesses seeking immediate occupancy. Bluestone's strategic location offers robust connectivity. Positioned on US 460, a 4-lane divided highway, it grants direct access to I-77 within a 15-mile radius, making logistics and transport convenient. The park's proximity to the prestigious Virginia Tech campus, within 1.5 hours, further enhances its appeal, potentially facilitating collaborations with academia and access to a pool of skilled graduates.

Being a part of the Virginia Enterprise Zone (VEZ) program, businesses located in the park can avail themselves of various local and state incentives, contributing to cost-effective operations. Furthermore, Tazewell County's scenic beauty and location, bordering West Virginia, make it an attractive locale for work-life balance, a factor increasingly considered by businesses and their workforce.

Its geographical positioning within Virginia affords accessibility to Interstates 77 and 81, ensuring convenience for markets east of the Mississippi and the Midwest. The state capital, Richmond, Roanoke, and Bristol are all within reachable distances, enhancing Bluestone's regional connectivity. As a consultant or investor, one would see Bluestone as an advantageous hub for business, blending connectivity, flexibility, and strategic location.

Map G-2: Image of Bluestone Regional Business and Technology Center Parcel Layout



On-site Infrastructure:

- Site has 680-acre mixed-use development, suitable for high-quality research, technology, and advanced manufacturing businesses.
- Stable business environment, aggressive business assistance, and family-focused community.
- Over 6,000+ manufacturers located in Virginia due to cost advantages providing a skilled workforce, and strong logistical support.

- The Virginia Coalfield Economic Development Authority (VCEDA) offers incentive and financing programs to stimulate job creation and economic diversification.
- Infrastructure support includes:
  - Utility providers such as Appalachian Power
  - Point Broadband
  - Tazewell County Public Service Authority
- Various connectivity options ranging from basic to high bandwidth.
- A well-educated workforce and diverse higher education options for ongoing workforce training.
- Lifestyle amenities include opportunities for outdoor recreation and a safe, community-focused environment.

Transportation Infrastructure Overview:

Map G-3: Rail and Ocean Transportation Network (Virginia)



The Tazewell area benefits from an abundant natural resource base and it is also conveniently positioned to access markets east of the Mississippi and in the Midwest, thanks to its accessibility to interstate highways. The county itself is strategically located midway between Atlanta-Pittsburgh, Charlotte-Cincinnati, and Richmond-Louisville, making it a prime location for businesses aiming to tap into over half of the U.S. population within a day's drive. The county is surrounded by seven interstates, all within close proximity, and is interconnected by four-lane highways, enhancing the region's accessibility.

The region's rail infrastructure is serviced by CSX Transportation and Norfolk Southern, ensuring a wide range of reliable and efficient shipping options. The placement of these rail lines, combined with the area's road network, allows for high connectivity, making Southwest Virginia an advantageous location for various industries. Major IT and data center companies such as Northrop Grumman, CGI, SAIC, and DP Facilities, alongside leading manufacturers like Tempur Sealy

International and Tadano Mantis, have chosen to operate in Southwest Virginia, thus underscoring the region's industrial potential and strategic importance.

As for maritime infrastructure, The Port of Virginia, which is located about 387 miles east of Tazewell County, presents an excellent option for accessing global markets. This port operates on a combined 1,864 acres and is comprised of six terminals. These terminals can process up to 4,000,000 containers on an annual basis, offering robust connectivity with ultra large container vessels arriving from across the Atlantic, inland barge service traveling up the James River, and an outstanding position in rail volume on the East Coast. The combination of excellent road, rail, and ocean port infrastructure, are inherent advantages in terms of connectivity and accessibility making Tazewell a compelling choice for businesses seeking to establish operations in a region that facilitates easy access to both national and international markets.

APPENDIX H: LEGAL DISCLAIMER

This BDO Zone Rating (the "Rating") is prepared for, and provided to, ATIP Foundation, and is intended to be read and used in its entirety and not in parts. Separation or alteration of any section or page from the main body of this Rating is expressly forbidden. In preparing this Rating, Ecostrat has used information obtained from third parties or otherwise publicly available. All such information has not been independently validated, verified, or confirmed by Ecostrat (except where otherwise specifically indicated) and Ecostrat makes no representation or warranty as to the accuracy or completeness of any information provided by third parties or otherwise publicly available.

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