Greenhouse Gas Study

for the

Biomass Utilization Fund,

Tuolomne BioEnergy Inc., Woody Biomass Pellet Manufacturing Facility

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1 INTRODUCTION

Ascent Environmental (Ascent) is conducting a comprehensive greenhouse gas (GHG) emissions assessment for the Tuolumne Bioenergy Woody Biomass Pellet Manufacturing Facility (Project) to determine the significance of the Project's estimated emissions to support environmental review pursuant to the National Environmental Policy Act (NEPA) and the California Environmental Quality Act (CEQA). The Project proposes to construct and operate a woody biomass pellet manufacturing facility in Sonora, CA. The biomass feedstocks would be sourced from low-market value biomass piles accumulated at and left over from various forestry thinning and logging sites within 40 miles of the Project site. Without the Project, these biomass piles would otherwise be subject to open pile burning.

This report presents the methodology and results of the estimated the GHG emissions from the Project in comparison with emissions offset through the avoidance of open pile burning of the same biomass feedstock.

2 PROJECT DESCRIPTION

The project proposes to construct and operate a woody biomass pellet manufacturing facility (pellet mill) on a 3.27 acre leased property in an industrial business park in Sonora, CA, located in Tuolumne County. According to the California Biomass Utilization Facility Feedstock Supply Report, the project would have access up to 44,000 bone dry tons (BDT) of biomass annually (Department of Housing and Community Development 2018: Table 5.3). The pellet mill is expected to produce between 29,000 and 31,000 tons of wood pellets per year, with a maximum production capacity of 31,200 tons per year. Approximately 9,293 BDT of additional biomass would be used to fuel the on-site combined heat and power (CHP) system proposed for the facility. In total, the facility would consume between 38,293 and 40,493 BDT of biomass. The CHP system will provide heat and electricity for biomass drying, the pellet mill, and other on-site energy needs (e.g., office space, outdoor lighting). The biomass on-site would also be handled via enclosed electrical receivers and conveyers and off-road material handling equipment. The pellet mill would have the ability to run 24 hours per day (up to 8,000 hours per year), 7 days per week, and 333 days per year. Haul trucks are assumed to operate 5 days per week and 42 weeks per year (240 days per year).

The project would source its biomass from small understory trees, shrubs, and limbs and branches left over from forest thinning and fire fuel reduction on U.S. Forest Service and private lands within 40 miles of the project site. In the absence of the project, under existing conditions, the 44,000 BDT of biomass is pile burned annually, generating criteria air pollutants and greenhouse gas (GHG) emissions. GHG emissions from the project are evaluated in a separate Greenhouse Gas Study for this project.

Under the project, the biomass piles would be collected and chipped at two different zones, located up to 20 miles (Zone 1) and 40 miles (Zone 2) from the project site. Deliveries would be made to the project site five days per week. At the project site, the chipped biomass would be dried in a biomass dryer, heated by the CHP system, until it reaches a 12 percent moisture content. About 24 percent of the dried biomass would be used to fuel the CHP system and the remaining biomass would be processed in the pellet mill to manufacture wood pellets. Most material handling will be done via electric conveyer belts and receivers. On-site material handling would also include the use of off-road equipment, such as a yard tractor with a hooklift trailer to dump bins into a receiver or stack and store pallets of finished bagged pellets. The manufactured wood pellets would then be shipped for retail distribution. Waste ash (approximately 700 tons per year) would also be disposed at a compost facility less than one mile from the project site.

The project would purchase all new off-road equipment and on-road trucks to support the operations.

3 SIGNIFICANCE CRITERIA

Impacts from the Project would be significant if the project would exceed either of the following significance criteria. Because no applicable local or federal criteria have been adopted for GHG emissions for this type of facility, significance criteria are based on Appendix G of the State CEQA Guidelines, which account for the context and intensity of direct, indirect, and cumulative effects:

- generate GHGs, either directly or indirectly, that may have a significant impact on the environment; or
- conflict with an applicable plan, policy, or regulation adopted for the purpose of reducing the emissions of GHGs.

As of May 2021, Tuolumne County and the Tuolumne County Air Pollution Control District (TCAPCD) does not have an adopted GHG threshold for the purposes of determining significance under CEQA or NEPA. California Air Resources Board's *California's 2017 Climate Change Scoping Plan* (Scoping Plan) states that, for project-level GHG thresholds,

> *Absent conformity with an adequate geographically-specific GHG reduction plan as described in the preceding section above, CARB recommends that projects incorporate design features and GHG reduction measures, to the degree feasible, to minimize GHG emissions. Achieving no net additional increase in GHG emissions, resulting in no contribution to GHG impacts, is an appropriate overall objective for new development. (CARB 2017:101)*

As such, the project would be considered significant if it results in a net increase in GHG emissions compared to existing conditions. This threshold is specific to the proposed Project and may not necessarily apply to other projects in the county.

4 METHODOLOGY AND RESULTS

Construction and operation of the Project would result in GHG emissions. The primary GHGs of concern generated by the Project would be carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O). These GHGs are collectively represented as "carbon dioxide equivalents" (CO_2e), using global warming potential (GWP) factors recommended in the Intergovernmental Panel on Climate Change's (IPCC) Fourth Assessment Report to be consistent with the State's GHG inventory methodology (CARB 2021a). For example, a gas with a GWP of 10 is 10 times more potent than CO_2 over 100 years. The use of GWP allows GHG emissions to be reported using CO_2 as a baseline. Carbon dioxide equivalents are the sum of each GHG multiplied by its associated GWP. This essentially means that 1 metric ton of a GHG with a GWP of 10 has the same climate change impacts as 10 metric tons of CO_2. For CH_4 and N_2O, the GWP factors recommended by IPCC's Fourth Assessment Report are 25 and 298, respectively.

Detailed calculations and assumptions can be found in Appendix A.

4.1 CONSTRUCTION EMISSIONS

The Project would construct the proposed woody biomass pellet manufacturing facility on a 3.27-acre lot. The existing lot is undeveloped and has minimal vegetative cover. Construction of the proposed facilities would require site preparation and grading activities. Based on the Project site plan, the Project would construct a 4,000 square foot (sf) manufacturing facility, a 5,000-sf covered outdoor storage area, two 100-foot diameter chip storage silos, outdoor standalone equipment (e.g., dryer, battery, bins, chip receivers, furnace), 10,200 sf of flatwork concrete, 3,300 sf of landscaped area, 3,600 sf of pavement, and a 22,000-sf graveled storage yard. According to TBI, the outdoor standalone equipment is assumed to come preassembled and would require cranes for equipment placement (TBI 2021). Construction is assumed to begin in February 2022. The Project site plan is included in Appendix B.

GHG emissions from construction of the proposed Project were modeled using the California Emissions Estimator Model (CalEEMod), version 2016.3.2 (California Air Pollution Control Officers Association 2016). A newer version of

CalEEMod (version 2020.4.0) is available, but was released on June 23, 2020, after the first draft of the Greenhouse Gas Study was already completed. Based on the information and assumptions described above, CalEEMod estimated a construction duration period of approximately four months, with construction activities ending by June 2022. Construction activities were assumed to occur for 8 hours per day and 5 days per week. The proposed land uses were matched to the most similar land use types available in CalEEMod, which CalEEMod uses to estimate default modeling assumptions (e.g., the construction phasing durations, number of equipment, equipment hours per day, and worker trips). These assumptions are shown in the CalEEMod output remarks in Appendix C. Material hauling emissions during the grading phase were adjusted to account for the gravel that would be needed for the storage yard, assuming a depth of eight inches and an average weight of 1.35 tons per cubic yard of gravel (Inch Calculator 2021). Additional modeling details can be found in Appendix C.

Based on the modeling conducted, construction activities are estimated to result in 92 metric tons (MT) of MT CO_2e over the four-month construction period. In absence of guidance from the TCAPCD and in light of recommendations from other air districts, the construction emissions were amortized this across an average 30-year project lifetime, resulting in an annualized emissions of 3 MT CO_2e per year (Placer County 2016). Based on the modeling conducted, Table 1 shows the estimated annual and amortized GHG that would result from construction activities over the four-month construction period.

Table 1 Estimated Construction Criteria Air Pollutant Emissions (Annual)

Phase	CO_2e (MT/year)
Site Preparation	1.61
Grading	3.46
Building Construction	78.39
Paving	6.64
Architectural Coating	1.50
Construction Total (MT/year)	91.60
Amortized Construction Emissions over 30 years (MT/year)	3.05

Note: CO_2e = carbon dioxide equivalent, MT = metric tons, PM_{10} = inhalable particle with diameters of 10 micrometers or smaller, CO = carbon monoxide, TCAPCD = Tuolumne County Air Pollution Control District, NA = not applicable, lb = pounds.

Source: Modeled by Ascent Environmental., Inc. in 2021

4.2 OPERATIONAL EMISSIONS

Operation of the proposed Project would involve chipping at the forest biomass pile collection sites, hauling the chips to the pellet mill, drying and milling of the chips at the mill, and delivery of the wood pellets for retail sale. These activities would result in GHG emissions from the operation of diesel chipping and biomass handling equipment, worker trips to the collection sites and pellet mill, diesel truck haul trips between the biomass collection sites, pellet mill, and retail distribution; and combustion of a portion of the biomass in a CHP system to provide heat and electricity to power the pellet mill and other accessory buildings and lighting. The proposed Project would not use natural gas or grid-based electricity but would operate a standby generator for initial system start-up and emergencies. Pellet mill operations are assumed to occur 33 days per year and up to 8,000 hours per year, and the first full year of operation would begin in 2023. Haul trucks and field operations are assumed to operate 240 days per year, or 5 days per week and 48 weeks per year.

The modeling assumptions for the off-road mobile sources, on-road mobile sources, biomass combustion at the pellet mill, and offset emissions from avoided pile burning are described in the following sections. Detailed calculations and assumptions can be found in Appendix A.

4.2.1 Off-Road Mobile Sources

Off-road mobile sources used during project operations include diesel-fueled chippers, forwarders, tractors, and other material handling equipment. Based on information provided by TBI, equipment at the forest collection sites would include all new 500-horsepower (hp) Bruks chippers attached to 285-hp Ponsse forwarders and one 217-hp JBC 4220 field tractor (TBI 2021). During biomass collection, three chippers and three forwarders are assumed to operate, one set in Zone 1 and two sets in Zone 2, based on the amount of biomass available in each Zone (TBI 2021). This equipment would operate 8 hours per day and 240 days per year. During pellet mill operations, diesel off-road equipment, such as tractors, are assumed to handle material at various stages of the manufacturing process (TBI 2021). (Patenaude pers. comm., 2021a, 2021b).

The proposed off-road equipment was matched with emission factors from the CARB's OFFROAD 2017-ORION model, version 1.0.1 (CARB 2021b), corresponding to the equipment type, 2022 model years, and horsepower rating, to quantify the GHG emissions from off-road mobile sources. The activity and equipment assumptions, emission factors, and calculated emissions are shown in Table 2. Additional modeling information is available in Appendix A.

Table 2 Off-Road Mobile Sources Activity and Emissions

Activity	Off-Road Equipment	Number of Equipment	OFFROAD 2017 Engine Bin (hp)	Hours per year per equipment	Load Factor[3]	Emissions Factor (kg CO_2/hr)	Emissions (MT CO_2/year)
Forest Biomass Collection	Chipper (450 hp)	3	600	2080	0.4	75.7[1]	188.9
	Forwarder (200 hp)	3	175	2080	0.4	63.4[2]	62.4
Forest Biomass Collection Subtotal							**251.2**
Pellet Mill Operations	Yard Tractor	1	175	2080	0.4	4.5[4]	3.7
	Field Tractor	1	175	2080	0.4	4.5[4]	1.5
	Bin Trucks	1	300	2080	0.4	42.3[5]	7.3
Pellet Mill Operations Subtotal							**12.6**
Total Off-Road Mobile Sources							**263.8**

Note: kg = kilograms, MT CO_2e = metric tons of carbon dioxide, hp = horsepower

[1] Based on factors for the "Industrial - Other Material Handling Equipment" equipment type in OFFROAD 2017.

[2] Based on factors for the "OFF - Logging – Skidders" equipment type in OFFROAD 2017.

[3] The load factors are based on assumptions for material handling equipment and off-highway trucks, as assumed in Table 3.3 of Appendix D of the CalEEMod User's Guide.

[4] Based on factors for the "Agricultural - Agricultural Tractors" equipment type in OFFROAD 2017.

[5] Based on factors for the "ConstMin - Off-Highway Trucks" equipment type in OFFROAD 2017.

Source: Modeled by Ascent Environmental. Inc., in 2021 based on information received from TBI (TBI 2021).

4.2.2 On-Road Mobile Sources

On-road mobile sources include worker trips (to the forest biomass collection sites and the pellet mill) and diesel haul truck trips (between the forest biomass collection sites, the pellet mill, and retail sales distribution). For worker trips, each Zone is assumed to have 6 workers and the pellet mill is assumed to employ 25 workers (TBI 2021). Based on the default worker commute assumptions in CalEEMod, each worker's commute trip is assumed to be an average of 16.8 miles. The calculated vehicle miles traveled (VMT) for worker commute trips were then applied to the average GHG emission factors for light duty vehicles in Tuolumne County for calendar year 2023, as derived from CARB's EMission FACtor model (EMFAC), version EMFAC 2021 (CARB 2021c).

Emissions from haul trucks include exhaust from on-road transportation and from idling during loading and unloading at each terminal site. Haul truck activities are divided into two categories: transportation from the biomass collection site to the pellet mill and transportation from the pellet mill to retail sales and ash disposal. The number of

haul trips for each category was calculated based on the tonnage of material needed to be transported, the capacity of the trucks, and the trip lengths. The project is anticipated to haul up to 12,821 BDT of biomass from Zone 1 and up to 27,473 BDT from Zone 2 annually to the project site. BDT refers to the equivalent tonnage of the biomass at zero percent moisture. Assuming the collected green biomass has a moisture content of 35 percent, the haul trucks are assumed to carry up to 19,724 tons of green biomass from Zone 1 and up to 42,265 tons from Zone 2. In all cases, trucks are assumed to carry 20 tons per load. The trip lengths from Zone 1 and 2 to the Project site were assumed to be 20 and 40 miles per trip, respectively, based on information provided by TBI. The trip length between the pellet mill and retail sales was assumed to be 50 miles, which is the approximate driving distance between the Project site and Merced, CA, which is the closest urban center. Trips outside of this range were not included due to the speculative nature of further retail destinations and the tonnages shipped beyond this range. Trucks were assumed to idle for a maximum of five minutes at each site (biomass collection and pellet mill) to account for loading and unloading activities. Under its adopted Airborne Toxic Control Measure set forth in Title 13 of the California Code of Regulations, Section 2485, CARB requires that diesel-fueled commercial motor vehicles with gross vehicle weight ratings greater than 10,000 pounds not idles for longer than five minutes at any location (CARB 2021d).

To calculate the emissions from haul trucks, the calculated VMT and total idling time for haul truck trips were applied to the average GHG emission factors for T6 in-state heavy duty diesel trucks in Tuolumne County for calendar year 2023 for 2022 truck model years, as derived from EMFAC 2021 (CARB 2021c). The project applicant has identified that all new vehicles would be purchased for this project, which would begin full operations in 2023 (Patenaude, pers comm., 2021b). Additional modeling information is available in Appendix A.

The on-road mobile source activity and vehicle trip assumptions, emission factors, and calculated emissions are shown in Table 3.

Table 3 On-Road Mobile Source Emissions

Activity	Trips per day	Trip length	VMT per year	Average Emissions Factor [1] (g CO_2e/mi)	Emissions (MT CO_2e/year)
Commute Trips					
Biomass Collection – Worker Trips	36	16.8	145,152	327.4	47.5
Pellet Mill – Worker Trips	50	16.8	279,720	327.4	91.6
Commute Trips Subtotal	**86**	**NA**	**424,872**	**NA**	**139.1**
Haul Trips					
Zone 1 Biomass Collection to Pellet Mill	4.1	20	39,448	1,135.1	44.8
Zone 2 Biomass Collection to Pellet Mill	4.4	40	84,531	1,135.1	96.0
Zone 1 Idling	4.1	5 min per trip	NA	1.3 g CO_2e/min	0.01
Zone 2 Idling	4.4	5 min per trip	NA	1.3 g CO_2e/min	0.01
Biomass Collection Subtotal	**NA**	**NA**	**123,978**	**NA**	**140.8**
Idling	8.5	5 min per trip	NA	1.7 g CO_2e/min	0.02
Pellet Mill to Ash Disposal	0.15	1	0.29	1,148.6	0.08
Pellet Mill to Retail Sales	6.25	50	625	1,148.6	170.3
Pellet Mill Trips Subtotal	**23**	**NA**	**625.3**	**NA**	**170.4**
Haul Trips Subtotal	**34.1**	**NA**	**124,604**	**NA**	**311.1**
TOTAL On-Road Mobile Sources	**120.1**	**NA**	**549,476**	**NA**	**450.2**

Note: VMT = vehicle miles traveled, g = grams, MT = metric tons, CO_2e = carbon dioxide equivalent, min = minute, NA = not applicable

[1] Commute trip average vehicle emission factors based on the LDA, LDT1, and LDT2 vehicle categories in EMFAC 2021. Haul truck emission factors based on the diesel "T6 instate heavy" vehicle category in EMFAC 2021. EMFAC 2021 results reflect conditions for Tuolumne County for calendar year 2023 and 2023 model years.

Source: Modeled by Ascent Environmental., Inc. in 2021

4.2.3 Pellet Mill Operations (Biomass Combustion)

The proposed Project operations at the pellet mill would result in GHG emissions from the on-site combustion of 9,293 BDT of biomass per year and in fugitive dust from the processing of 31,000 BDT of biomass for pellet production. Accounting for 12 percent moisture content in oven-dried biomass, this equates to 10,560 tons per year used for combustion and 35,227 tons per year used in pellet production. With respect to combustion, oven-dried tonnage contrasts with bone dry tonnage in that BDT is a metric of the fuel contained within biomass, as any moisture cannot be combusted. Woody biomass with a 12 percent moisture content has a combustion emission factor of 1,658 kilograms per CO_2e per ton (The Climate Registry 2020). Based on this emissions factor, 10,560 tons of dried mass combusted per year results in a total emissions rate of 17,512 MT CO_2e per year. These calculations are shown in additional detail in Appendix A.

Combustion of the wood pellets manufactured by the proposed Project are not included in this analysis. This is largely because the location at which these wood pellets would be combusted would be speculative, as they could occur anywhere in the country after they have been sold for retail distribution. The location is important when considering the determination of significance for GHG emissions is based on the state's GHG reduction targets, which are based on the State's directly generated emissions. The State's GHG emissions inventory does not include combustion of fuels exported out of the state (CARB 2021e). In addition, the Project would not result in net new consumption of wood pellets, but would rather replace pellets that may be sourced from less sustainable resources (e.g., virgin timber vs. biomass burn piles).

4.2.4 Offset Pile Burning

Under a No Project alternative, the biomass collected for the proposed Project would otherwise be burned in piles at the forest collection sites. Based on a report released by the National Wildfire Coordinating Group (NWCG 2020), average pile burning generates 3,711 pounds of CO_2e per bone dry ton (NWCG 2020: Table 4.1.1, Peterson, pers. comm,. 2021). Thus, the Project would avoid 67,832 MT CO_2e that would be emitted annually from pile burning.

5 PROPOSED PROJECT EMISSIONS

Under the Project, GHG emissions would be generated by construction activities, off-road equipment, on-road haul trucks and worker trips, and combustion of biomass at the pellet mill. GHG emissions would also be avoided because the same biomass material delivered to the Project site would no longer be piled and burned in the forest. A summary breakdown of the of the emissions levels associated with these activities is provided in Table 4. See Appendix A for detailed parameters and calculations.

Table 4 Off-Road Activity and Emissions

Emissions Source	GHG Emissions (MT CO_2e)
Off-Road Equipment	53
Worker Commute	139
Haul Trips	311
Biomass Combustion at the Pellet Mill	17,512
Amortized Construction Emissions[1]	3
Total Emissions from Project	18,018
Avoided GHG Emissions from Burning of Biomass Piles	-67,832
Net Change in GHG Emissions	-49,814

Note: MT CO_2e = metric tons of carbon dioxide

[1] Based on an assumed 30-year project lifespan.

Source: Modeled by Ascent Environmental. Inc., in 2021.

As shown in Table 3, implementation of the project would result in a net reduction in GHG emissions of 49,814 MT CO_2e. This is primarily because the open burning of biomass piles generates more emissions than the combustion of biomass at the pellet mill and other supporting activities. The estimates in Table 3 do not account for emissions associated with the fate of wood pellets sold by the pellet mill. Under existing conditions, the biomass that would be used by the Project would be piled and burned on site. As part of this Project, it is certain that the biomass would be utilized as an energy source both by the pellet mill as dried biomass and by the end consumers as wood pellets. Thus, the effect of utilizing biomass from this site on the project would result in a net decrease in GHG emissions because pile burning of this biomass would be avoided.

6 CONCLUSION

In summary, because hauling and combustion of biomass for the manufacture of wood pellets is less GHG intensive than pile burning on site, this Project would not result in a net increase in GHG emissions. For these reasons, this impact would be less than significant.

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