

Alternative Uses for Woody Biomass in Humboldt County - Team Jamo

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Executive Summary

A large portion (23%) of the Redwood Coast Energy Authority's (RCEA) electricity portfolio for Humboldt County is sourced from two local biomass incineration plants, using local logging and mill waste as feedstock. Because the biomass that is sourced for incineration meets California's sustainable forestry requirements, the biomass plants are considered GHG neutral, renewable power sources to the state. Despite this, the community has mixed opinions on the local air quality impact and actual climate change contribution resulting from the biomass plants. As a result, RCEA has commissioned the authors to provide a technical, economic, and environmental assessment of alternative uses of biomass feedstock in Humboldt County.

The team developed four alternative use cases for the biomass feedstock, subject to the following constraints:

1. The alternative must meet or exceed all federal, state, and local water and air pollutant standards concerning criteria pollutants and CO₂.
2. The alternative must not create a demand for imported biomass or use a non-waste source of biomass.

Alternative One proposed the creation of a composting facility to convert the woody biomass into a valuable organic soil amendment. Alternative Two used the woody biomass as raw material for the production of particleboard. Alternative Three consisted of a gasification and refining facility that would produce a substitute natural gas for local residential gas customers. Alternative Four proposed the construction of a 500 thousand ton per year wood pellet facility, creating a valuable export product from the waste biomass.

The four proposed alternatives were evaluated against nine different criteria, themselves separated into four categories: Economic, Environmental, Technical, and Social. Each criterion was given a weight from 1-10, based on recommendations from RCEA. The sole Economic criteria was the payback period of the project, in years. The Environmental criteria included the net GHG emission difference between implementation of the alternative and the current baseline. The Technical criteria examined included system robustness, technological maturity, and overall operator skill level required. The Social criteria considered consisted of the amount of new criteria air and water pollutants, and number of jobs provided by the alternative proposal.

The preferred alternative was determined using the Delphi matrix method, and a Wood Pellet manufacturing facility was chosen. This alternative would use all of the available biomass currently being used by the two biomass power plants in Humboldt. The facility is proposed to be sited at the Redwood Marine Terminal 2, the site of a former pulp mill, with access to a dock for loading finished pellets onto cargo ships,

shown in Figure 1. The recommendation of the report is an optimized production line with an output capacity of 72 tons of pellets per hour. The economic analysis performed indicated a payback period of 2.4 years for this proposed facility.



Fig. 1. Location of Redwood Marine Terminal 2 and surrounding parcels for proposed site (California Air Resources Board 2020a; Reed et al. 2012; California Air Resources Board 2020b)

The emissions, including criteria and GHG pollutants, were calculated for each of the power generation facilities, the manufacturing of pellets, and the combustion of the pellets. Figure 2 represents the proportionate effect of each process in respect to criteria pollutant emissions, including the combined effect of the two power generation facilities. The manufacturing of pellets does not produce any carbon monoxide (CO) or particulate matter (PM). Furthermore, emissions from the pellet manufacturing is lower than the two power generations combined, especially in regards to CO. The combustion of pellets, however, appears to significantly increase all emissions, resulting in significantly higher emission values.

Carbon dioxide (CO₂) emissions can be seen in Table 1. Pellet manufacturing, when compared to the combined power generation facilities, is estimated to produce approximately 82% less CO₂ emissions. If including the combustion of pellets, the amount of CO₂ produced is roughly 44% higher than that of the combined power generation facilities. However, because it has the same "renewable" source material, pellets made from the biomass are considered to be carbon neutral to the state of CA. Depending on which governmental jurisdiction the pellets are combusted in, the emissions could be ruled carbon neutral, a GHG source, or even a carbon credit.

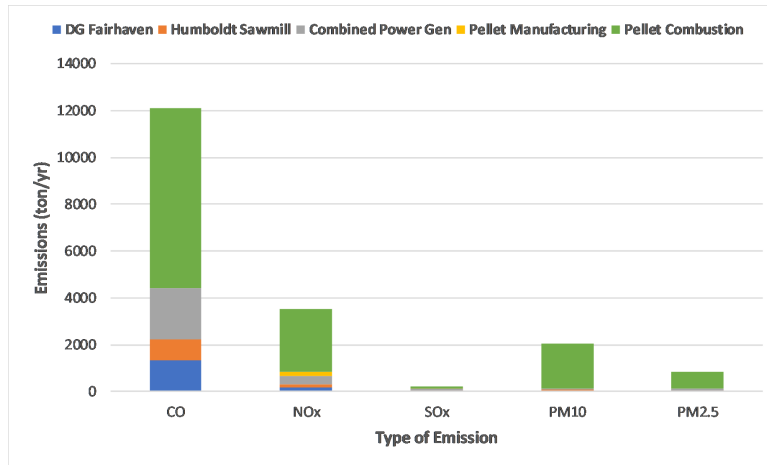


Fig. 2. A stacked chart of criteria pollutants and GHG emissions associated with DG Fairhaven, Humboldt Sawmill Company, pellet manufacturing, and pellet combustion (United States Environmental Protection Agency 1996; California Air Resources Board 2020a; Reed et al. 2012).

Table 1. Carbon dioxide emissions for the power generation facilities, pellet manufacturing, and pellet combustion.

Source of CO ₂ Emission	Emissions (kton/yr)
DG Fairhaven	200
Humboldt Sawmill Company	218
Combined Power Generation	419
Pellet Manufacturing	77
Combustion of Pellets	666

A sensitivity analysis was performed on several economic inputs to determine the effect on the payback period for the facility. The operation costs, transportation costs, and capital costs of the facility all had a significant effect on the payback period, but the most significant change was caused by reducing the sale price of the finished pellets. A 35% reduction in the pellet price results in more than a 1000% increase in the payback period, and a reduction of more than 40% in price results in a negative yearly net profit. Sensitivity was also performed on the amount of pellets sold annually, which had a slightly weaker effect on the payback period, and is compared to the pellet sale price in Figure 3.

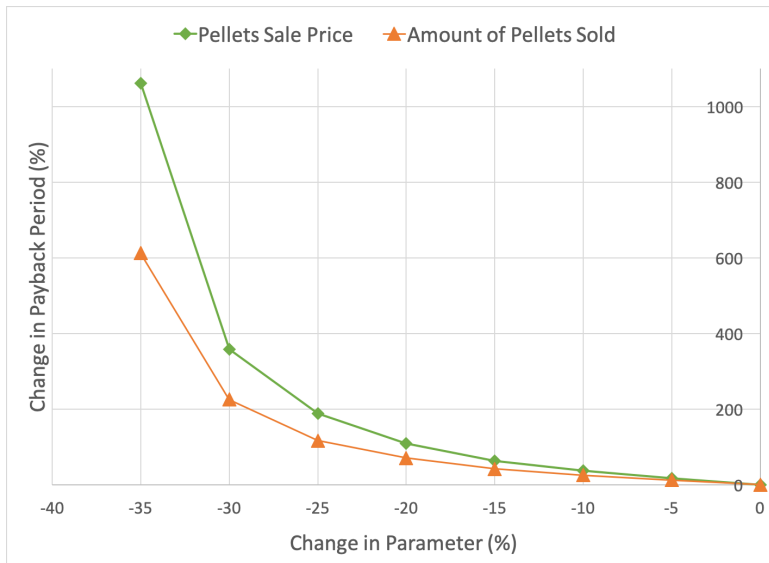


Fig. 3. Sensitivity Analysis of sale price of pellets and amount sold

Further feasibility studies would be required to implement the preferred alternative. Topics of future research would investigate overseas or domestic bulk pellet customers, particularly in states and countries with favorable carbon credit programs. Additionally, rigorous testing would need to be performed to optimize the pelletizing process with the specific biomass material available. More intensive economic analysis is also needed for accurate long-term planning, including feedstock pricing and availability projections, as well as demand and price sensitivity analysis.

REFERENCES

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