

## Executive Summary - Team BioJJacs

Redwood Coast Energy Authority (RCEA) has received complaints from community members in Humboldt County due to the current combustion of biomass to supply electricity, which releases pollutants into the air. Humboldt State University’s Environmental Resources Engineering Spring 2020 Capstone class has been tasked with assessing alternative uses for biomass in Humboldt County.

Alternative solutions were sought that were 1) capable of managing 80% of Humboldt County’s woody biomass residues, 2) reduced associated greenhouse gas emissions, 3) was in compliance with all local, state, federal, and OSHA standards and permitting processes, 4) was economically feasible and had a means of funding the project, and 5) was in compliance with all soil and water quality regulations such as the CWA, CERCLA, and RCRA. To select the preferred alternative use of biomass, a set of environmental, economic, and social criteria were established; the environmental criteria include minimizing particulate matter emissions, greenhouse gas emissions, and required footprint, the economic criteria include minimizing payback period and maximizing local job production, and the social criteria include maximizing public perception and ease of use. Each criterion was weighted by RCEA depending on the relative importance to the project needs. These weights were used in the Delphi method to determine what alternative is the best solution. The alternatives considered for this project were modular gasification, woodchip bioreactors, bioplastics, and composting.

Composting was found to be the best alternative for the project, as it best fit the client-weighted criteria. The net emissions for composting were estimated at approximately –887,000 MTCO<sub>2e</sub>, including the direct emissions from the compost piles and transportation of feedstock, and the indirect emissions that are avoided from the diversion of biomass and food waste, as well as carbon sequestration. A summary of the emissions can be seen in Table 0.1 below, where a negative sign represents the emissions that are being avoided by composting.

**Table 0.1: Emissions associated with the current system and composting**

<b>Source</b>	<b>Emissions (MTCO<sub>2e</sub>)</b>
DG Fairhaven biomass power plant	-176,738
HSC Scotia biomass power plant	-258,042
Landfill (food waste)	-473,648
Composting	17,269
Carbon Sequestration	-4.07
Transportation of feedstock to compost facility	4,357
<b>TOTAL</b>	<b>-886,807</b>

After optimizing the feedstocks and the design of the compost piles, the area requirement was found to be 504 acres. The feedstocks considered were woody biomass and food waste with required mass inputs of 10,800,000 kg/week and 16,800,000 kg/week respectively. The woody biomass will come from Korbel Sawmill, Britt Lumber, Mad River Lumber, Sierra Pacific Industries, Schmidbauer Lumber, CW Wood Products, and Redwood Lumber Company, and the food waste will come from the Humboldt Waste Management Authority (HWMA) transfer station in Eureka, with the possible need for sources outside of Humboldt County. Additional work would be required for source separation, which would be included in the next steps of the analysis. To sustain the required area for the composting system, four vacant agricultural parcels are being proposed as shown in Table 0.2 below.

Table 0.2 Proposed parcels of land for composting facilities (Humboldt County GIS 2020).

Humboldt County APN	Area (acres)
106-081-002	161
106-111-008	240
204-391-004	153
309-251-002	168

The materials needed for operation of the composting facilities are windrow turners (two per site) for aeration of the compost piles, grinders (one per site) to create a homogeneous composting mixture, stacking conveyors (one per site) to organize the finished material into piles for distribution, front-end loaders (two per site) for the removal of windrows and loading of grinders and stackers, and dump trucks (one per site) for the reforming of windrow piles. A diagram illustrating a proposed composting facility, including area distributions for each stage of composting plus additional land allocated to equipment storage, can be seen in Figure 0.1.

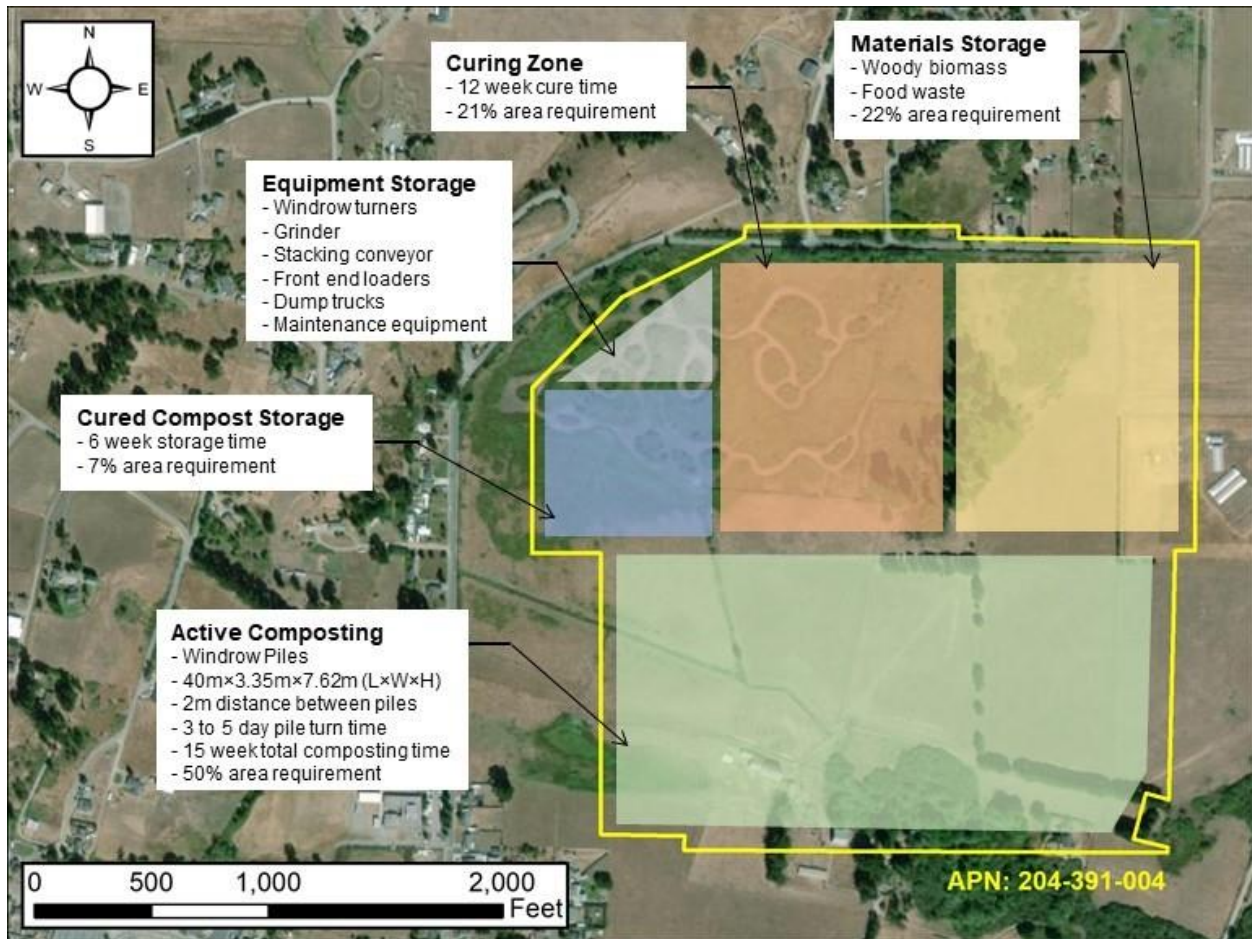


Figure 0.1. Proposed composting facility footprint illustrating zone parameters and area requirements.

Land procurement costs plus the costs associated with the aforementioned equipment resulted in a total capital cost of \$3,086,024. A sensitivity analysis on the effect of density of the compost on the difference in annual returns showed that profit increases with an increased density. Another sensitivity analysis was conducted to assess the effect of density on the required area, which showed that area decreases with an increased density of compost.

In conclusion, large-scale industrial windrow composting facilities were proposed to provide an alternative use to the biomass currently being incinerated for power production in Humboldt County. In order to ensure a proper environment for full decomposition of compost consistent of both food waste and woody biomass, and to ensure feasibility of meeting regulation requirements and adequately maintaining windrows by use of heavy machinery, four individual composting facilities were proposed in southern Humboldt County. The success of this project is directly dependent on the availability of feedstocks. With the option of including local agricultural waste in the form of manure, and sourcing food waste from neighboring municipalities outside of Humboldt County, windrow composting as a method to utilize woody biomass increases in feasibility and practicality and may hold promise both for future state waste diversion goals and the minimization of greenhouse gas emissions in California.