

Introduction

This poster presents a preliminary design of a 20 MW biomass power plant for southern Louisiana using a blended fuel stream of rice hulls, bagasse, and switchgrass. A Rankine cycle model is used to estimate the thermal energy input required to maintain the target electrical output and determine the annual biomass demand. Using heating value data for each feedstock, the study calculates the amount of biomass needed per year and evaluates the contribution of each material in the proposed blend. The project also considers key logistical factors, including truck transportation requirements and the land area needed to support switchgrass production. Overall, the analysis provides a first-order assessment of the technical feasibility of a biomass power plant operating with regionally available feedstocks.

System

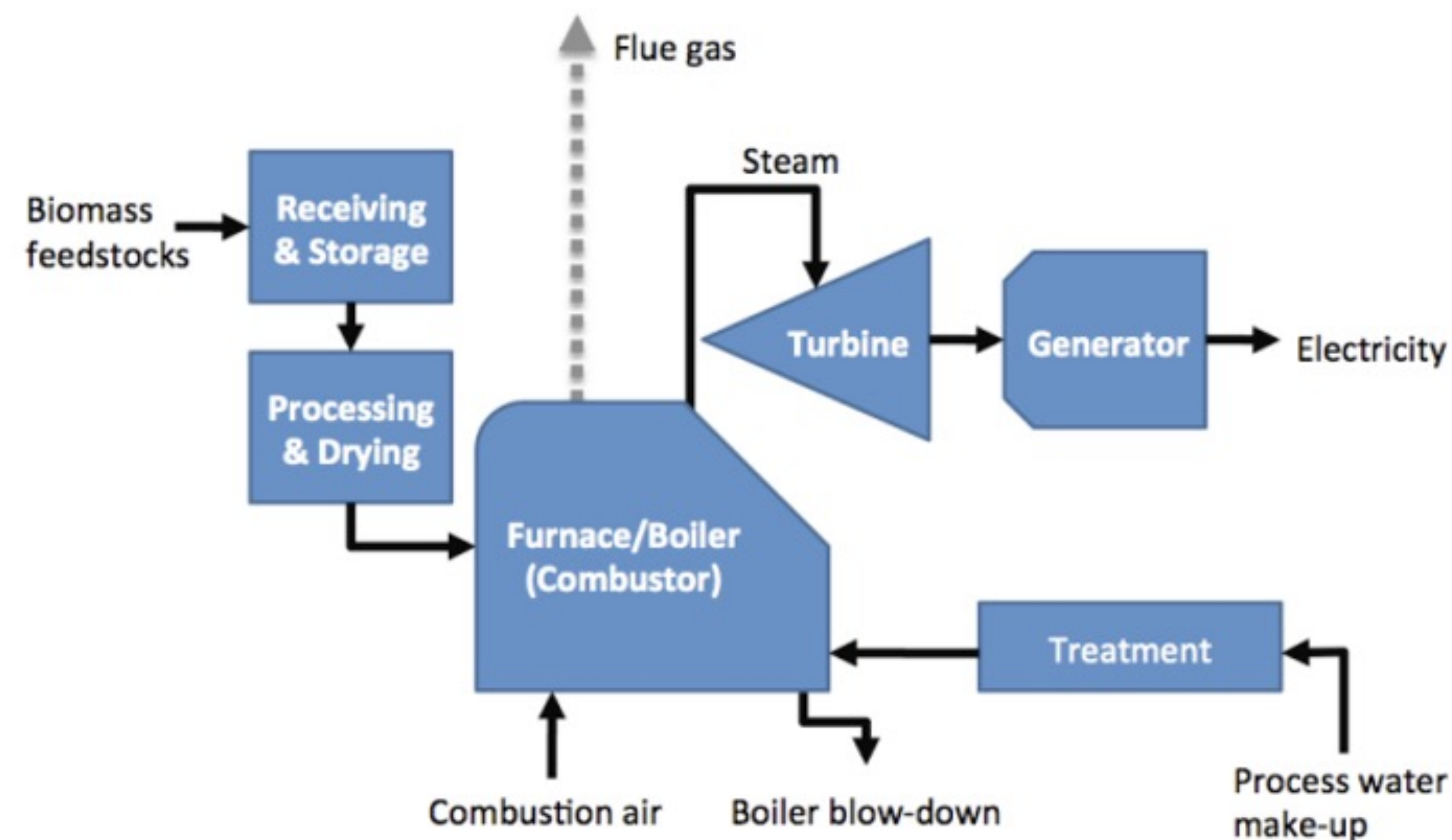
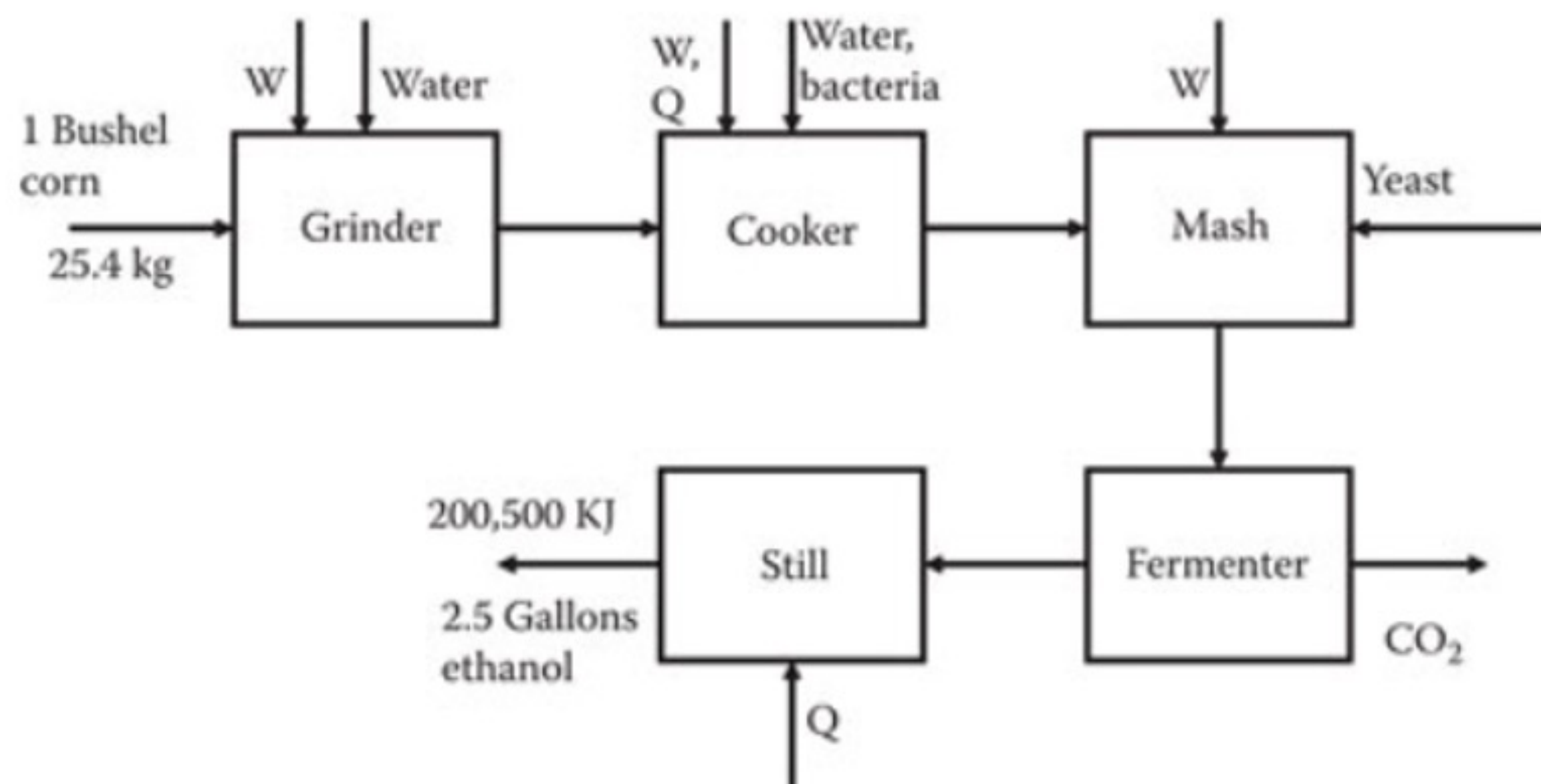


Figure 1. Biomass power process flow diagram



Methodology

Time for the Generation of Biomass Forms in Years

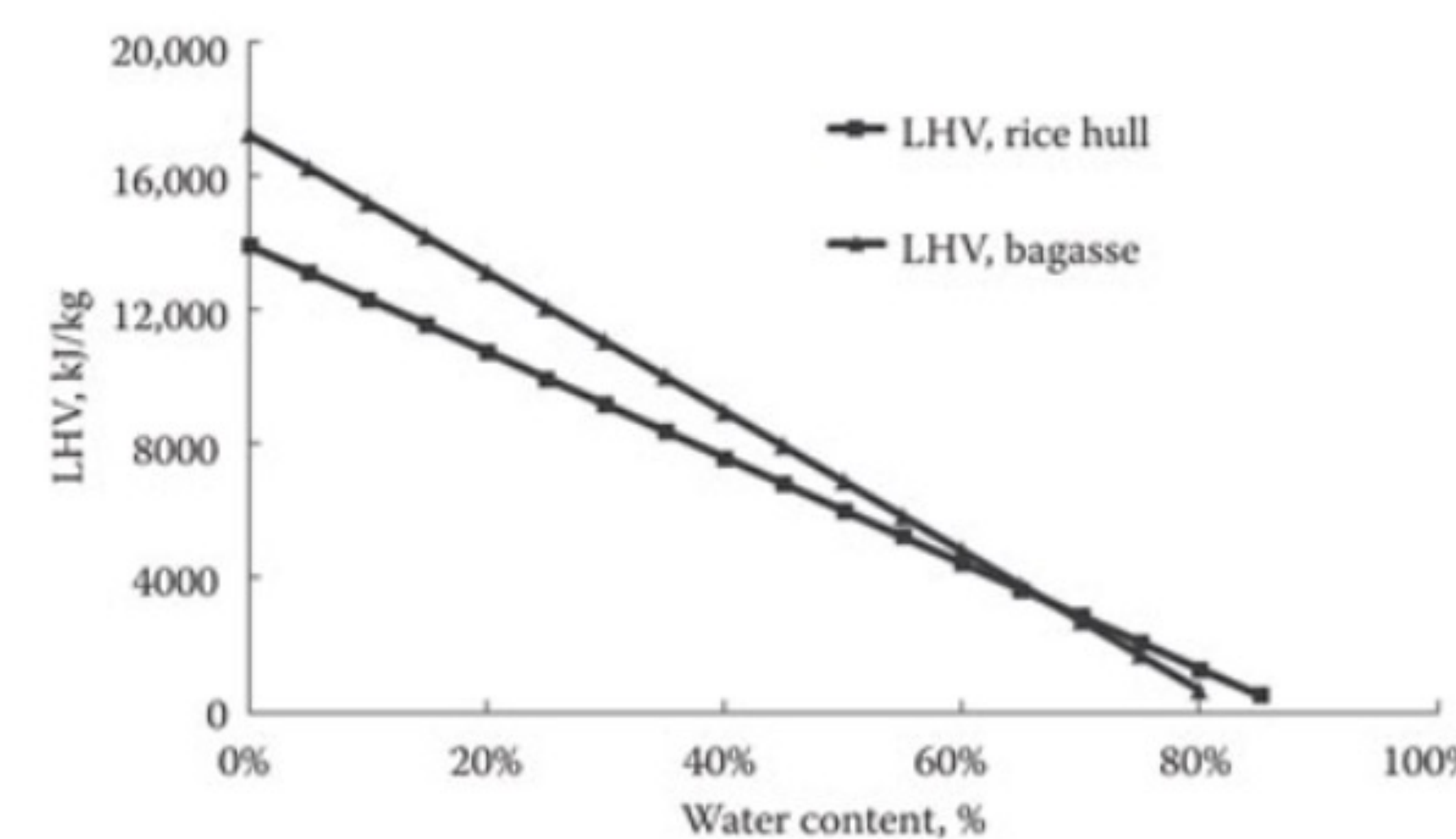
Biomass Form	Time to Form or Regenerate, Years
Switch grass, corn and sugar cane	0.5
Fast-growing timber, sycamore	2-3
Forest/timber, southern temperate zone	25
Forest/timber, northern temperate zone	91
1 t MSW in US per person	1.2
1 t MSW in the EU per person	4.3

Source: Tester, J. W. et al., *Sustainable Energy*, MIT Press, Cambridge, MA, 2005.

LHV or Energy Density of Biomass

Biomass	LHV, kJ/kg	LHV, Btu/lb
Rice hull, 0% moisture	13,905	5,970
Rice hull, 30% moisture	9,175	3,940
Bagasse, 0% moisture	17,266	7,414
Bagasse, 30% moisture	11,038	4,740
Dry wood (average)	18,500	7,934
Wood chips	13,600	5,860
MSW	4,000-8,000	1,715-3,430
Sewage/animal waste	1,164-1,863	500-800
Anthracite	31,952	13,720
Corn stover (dry)	17,470	7,502
Corn stover (30% moisture)	12,229	5,251

Source: El-Wakil, M. M., *Power Plant Technology*, McGraw-Hill, New York, 1984; Lizotte, P. L. et al., *Energies*, 8, 4827-4838, 2015.



Calculations

Annual energy = Plant capacity × Hours per year × Capacity factor
 80 percent capacity factor
 20 percent net electric efficiency

$$Area \left(\frac{acres}{year} \right) = \frac{Amount \left(\frac{bushels}{year} \right)}{Yield \left(\frac{bushels}{acre} \right)}$$

$$E_{year} = 20 \cdot 8760 \cdot 0.80 = 140,160 \text{ MWh/yr}$$

$$E_{month} = 11,680 \text{ MWh/month}$$

$$E_{day} = 384 \text{ MWh/day}$$

$$Q_{year} = \frac{E_{year} \cdot 3.412}{\eta}$$

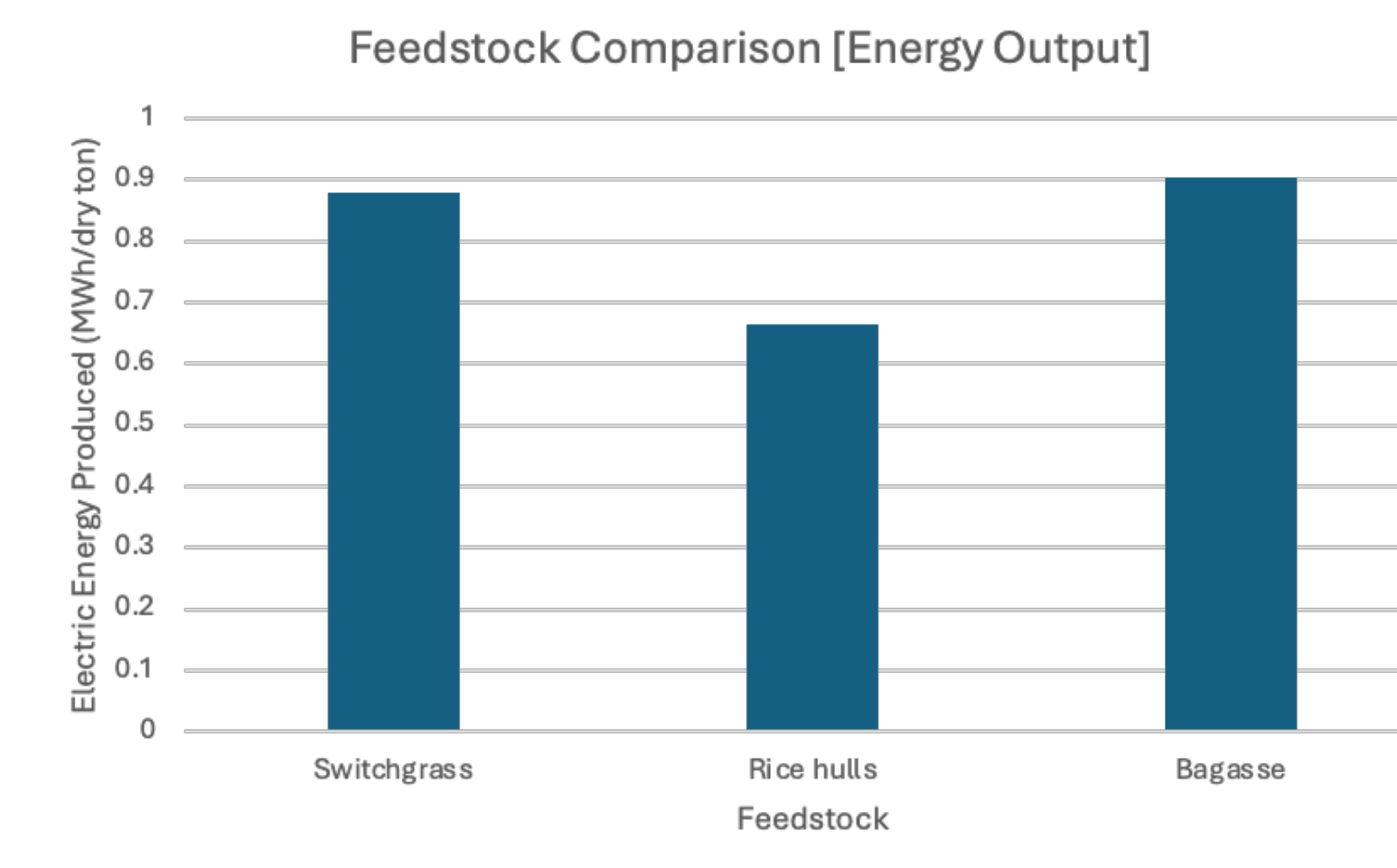
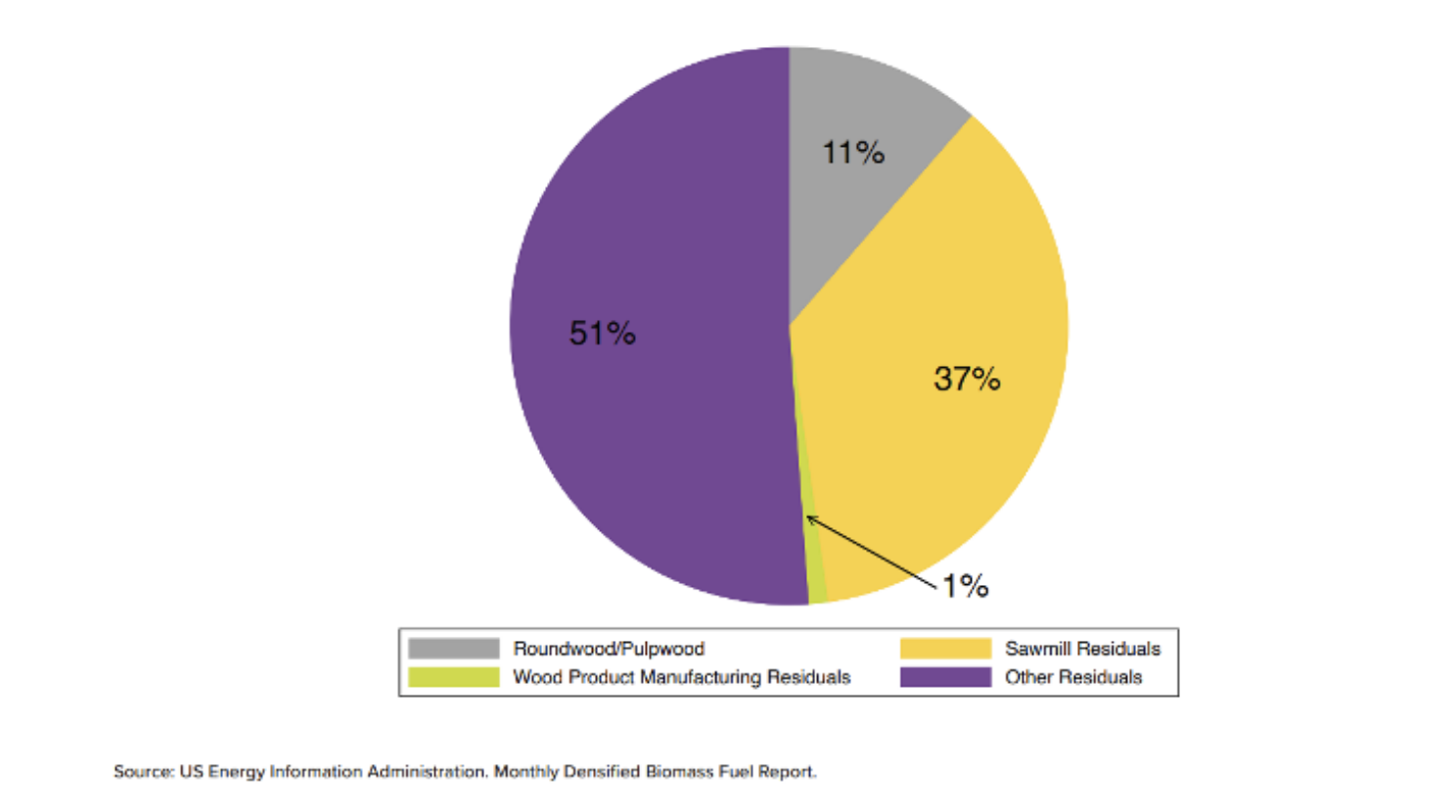
$$m_i = \frac{x_i \cdot Q_{year}}{HV_i}$$

$$N_{day} = \frac{m_{day}}{payload}$$

$$V_{Ref} \left(\frac{10^3 \text{ bbl}}{day} \right) \times \left(365 \frac{day}{yr} \right) \times \left(42 \frac{gal}{bbl} \right) \times \left(\frac{1}{y} \frac{gal}{ton} \right) \times \left(\frac{1}{12} \frac{ton}{ac} \right)$$

Feedstock in Southern Louisiana

Figure 6: Composition of the feedstock used in the manufacture of DBF in the United States (average for 2024 for the United States)



Results

Annual Thermal input = 2,391,130 MMBtu/yr
 Annual energy = 20 MW × 8760 hr/yr × 0.80 = 140,160 MWh/yr

The Plant Needs

437 dry tons/day of switchgrass
 577 dry tons/day of rice hull
 425 dry tons/day of bagasse

Feedstock	Biomass needed per day	Trucks/day at 20 tons per truck	Trucks/day at 25 tons per truck
Switchgrass	437 dry tons/day	22	18
Rice hull	577 dry tons/day	29	24
Bagasse	425 dry tons/day	22	17

Feedstock	Heating value used	Biomass needed per year	Biomass needed per month	Biomass needed per day
Switchgrass	15.0 MMBtu/dry ton	159,409 dry tons/yr	13,284 dry tons/mo	437 dry tons/day
Rice hull	11.35 MMBtu/dry ton	210,673 dry tons/yr	17,556 dry tons/mo	577 dry tons/day
Bagasse	15.40 MMBtu/dry ton	155,268 dry tons/yr	12,939 dry tons/mo	425 dry tons/day

Acres of Land Needed
 15,941 acres at 10 dry tons/acre
 13,284 acres at 12 dry tons/acre

Conclusion

The results show that a 20 MW biomass plant in southern Louisiana is technically feasible using a blended feedstock approach based on locally available biomass resources. The energy balance demonstrates that rice hulls, bagasse, and switchgrass can provide the required annual fuel demand, while the logistics analysis highlights the importance of transportation needs and land use in the overall plant design. This preliminary study shows that biomass power generation could be a practical renewable energy option for the region, though final design decisions would depend on feedstock availability, seasonal supply, transportation distance, and economic factors.