Biochar Production Facility for Carbon Sequestration

Team 13: Brandon Bauguess, Lydia Gillan, Connor Hoke, and Danielle Meyer | Mentor: Dr. Bill Linak

1. Objective

Primary

Determine the feasibility of a biochar process for carbon capture.

Secondary

Create a detailed design of a carbon negative facility.

Tertiary

Determine its sustainability and environmental impact.

2. Motivation

2°C

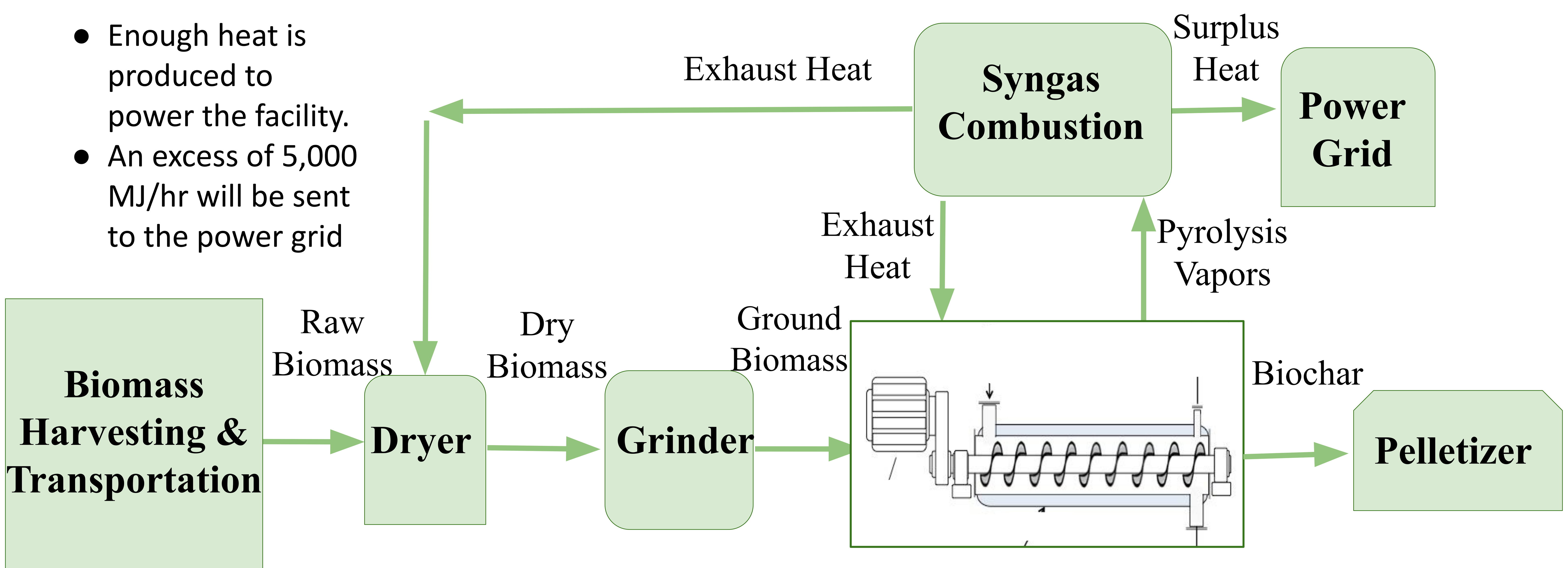
- Carbon emissions aid in raising the global surface temperature
- When that temperature reaches 2°C, catastrophic effects are predicted to occur

3. Background

- Biochar is a promising carbon capture technology
  - Can sequester carbon for thousands of years
- Corn stove is an abundant agricultural residue with small moisture content:
  - 75 million dry tons of usable corn stover produced annually
- Slow pyrolysis maximizes biochar production

4. Design

- Enough heat is produced to power the facility.
- An excess of 5,000 MJ/hr will be sent to the power grid

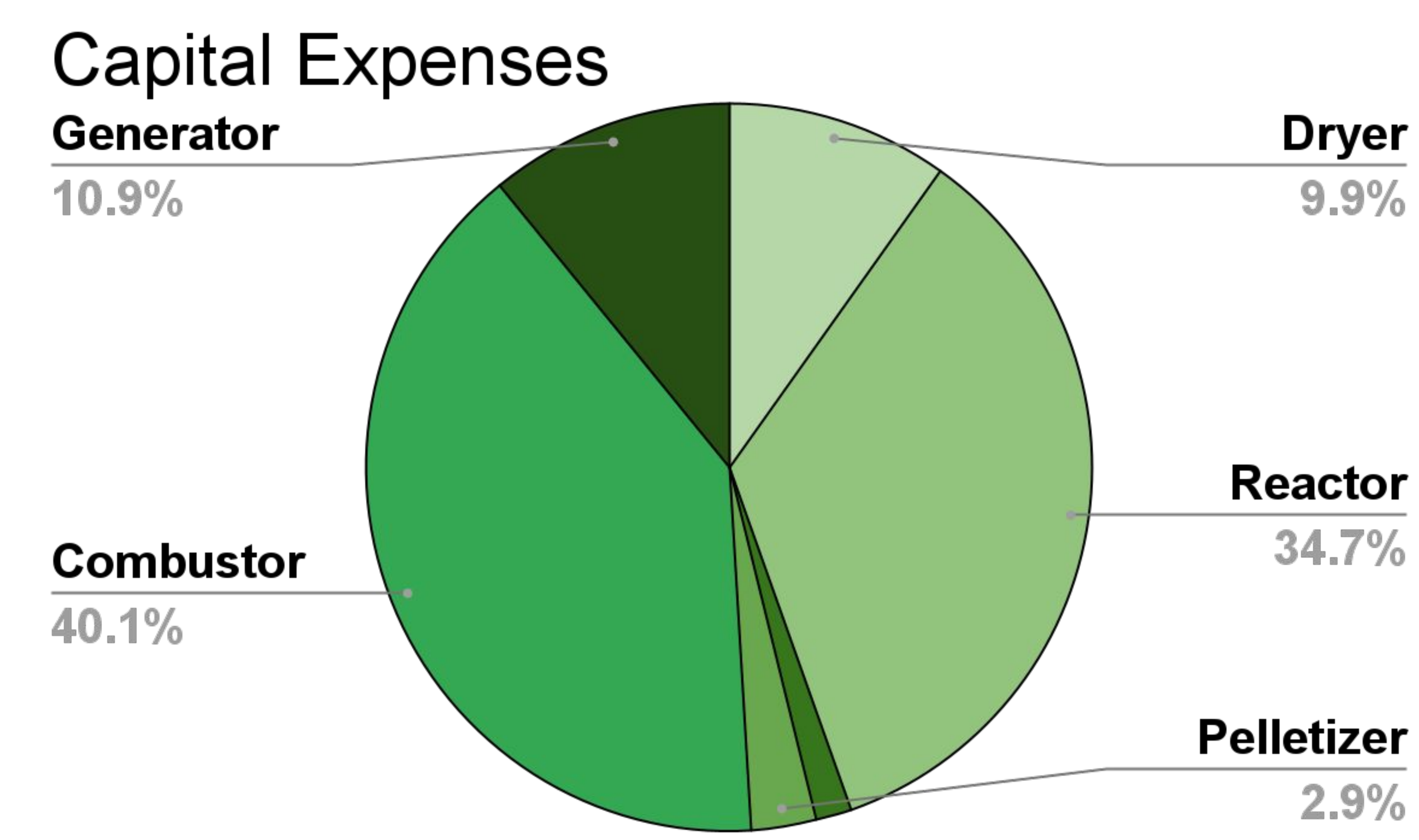


- Capacity of 1,000 kg/hr
- A rotary dryer uses 500 MJ/hr to reach 7% moisture content

- A hammermill grinder uses 0.161 MJ/hr to unify the corn stover to less than 5mm

- The screw auger reactor operates at 550 °C at a 30 minute residence time
- Approximately 3,600 MJ/hr are needed to fix 90% of the carbon

5. Economic Analysis



Cost per Ton of Carbon Sequestered: $1,270

Social Cost of Carbon Sequestered: $209,019

6. Conclusions

- 1,097,000 Kg of Carbon Sequestered annually
- This plant is equivalent to planting 180,000 mature trees or taking 900 economy cars off the road
- 8,900 MJ are generated per hour sustaining a cyclic process with left over energy for the power grid
- The capital expenses total $3,800,000 and the annual operating cost total $1,400,000
- It will cost $1,270 per ton of Carbon Captured that is equivalent to a social carbon cost of $209,019.

7. Recommendations

- This process design was found to be carbon negative and more economical compared to other carbon capture methods, but $1270 per ton of carbon sequestered is higher than desired
- Carbon sequestered may be further maximized by:
  - Scaling up this plant
  - Investigating alternative sources of waste biomass with a higher fixed carbon composition

8.Safety and Sustainability

9. Acknowledgements

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