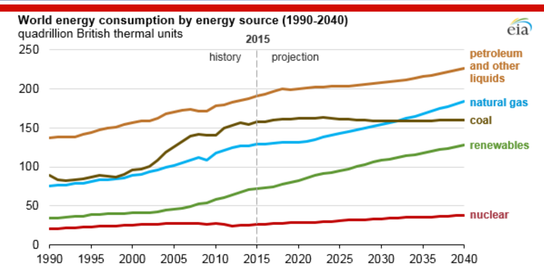
NC STATE UNIVERSITY
College of Engineering

Dual Fluidized Bed Biomass Gasification

Team 7: Sebastian Almanza, Eric Giavedoni, Titus Szobody, Tyler Void | Mentor: Dr. Hassan Golpour

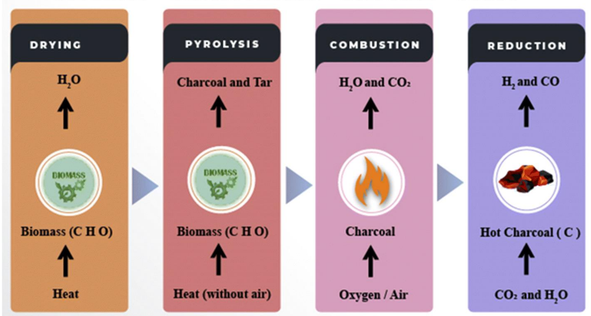
CBE

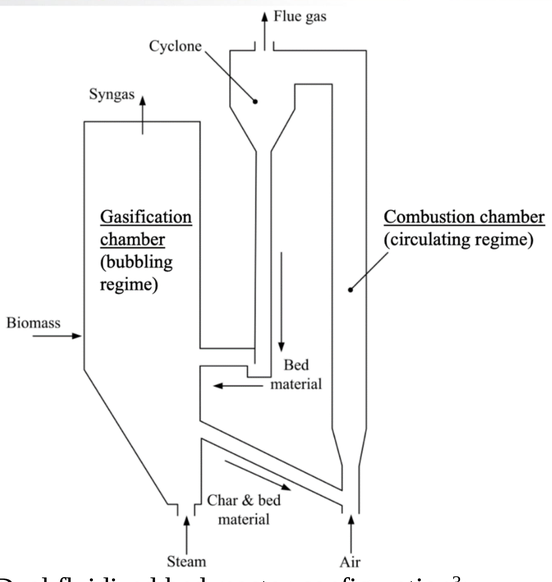
1. Motivation and Goals



- A shift to renewables is paramount as world energy consumption is projected to rise[1].
- Our objective is to design and analyze a biomass gasification plant to produce a CO and H_2 rich syngas as an economically viable energy source with minimal negative environmental and safety implications.

2. Background

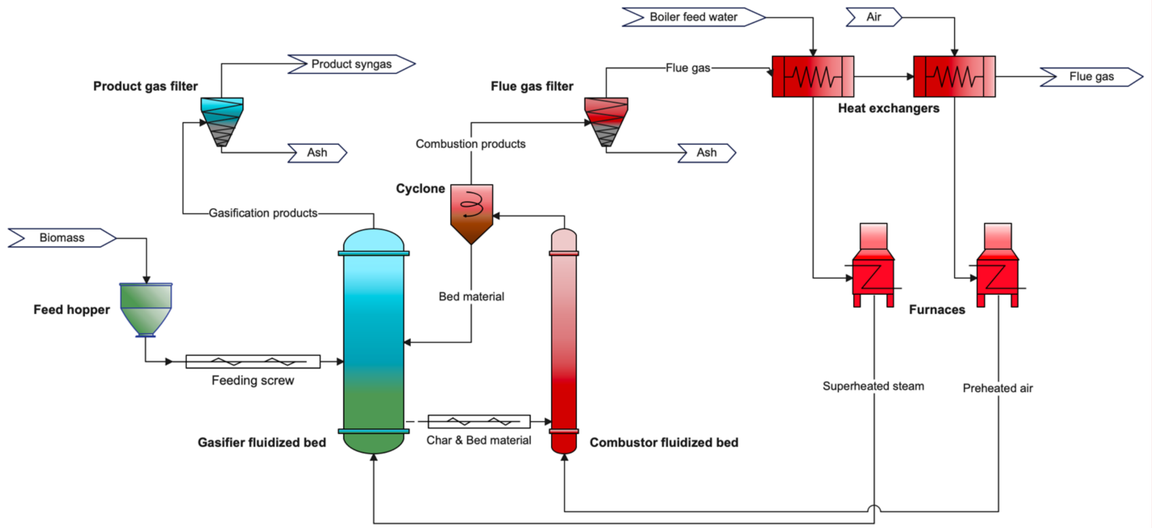




Dual fluidized bed reactor configuration[3]:

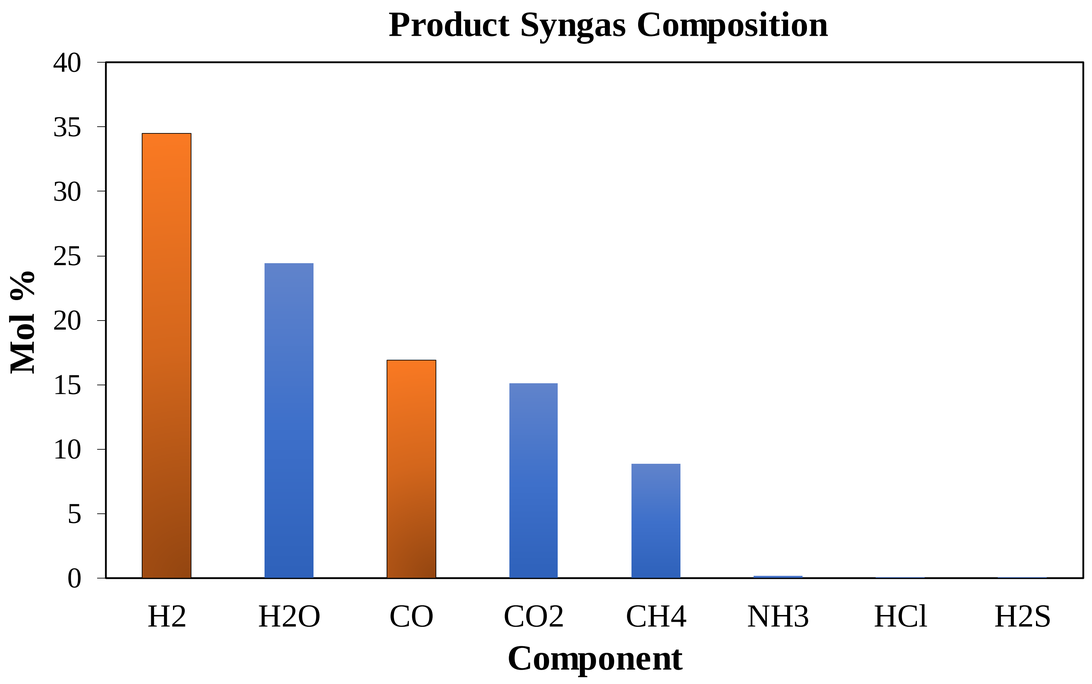
- Avoids N_2 dilution and combustion of syngas.
- Heat from combustion chamber drives endothermic reactions in gasification chamber.

3. Process Design



- Biomass feed is composed of wood chips at a flowrate of 1900 kg/hr (~50 tons/day).
- Hot flue gas from combustion chamber is used to pre-heat air and evaporate boiler feed water.
- Further heating of air and steam is provided by natural gas furnaces.

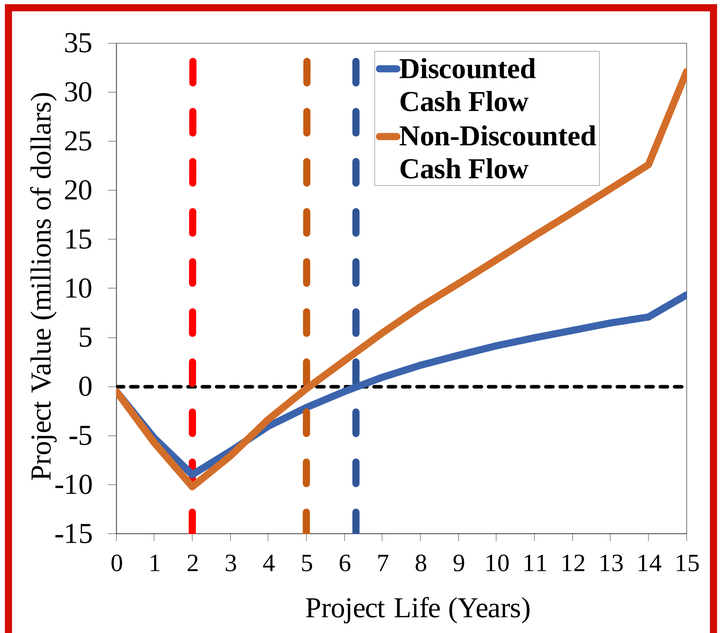
4. Aspen Plus Results



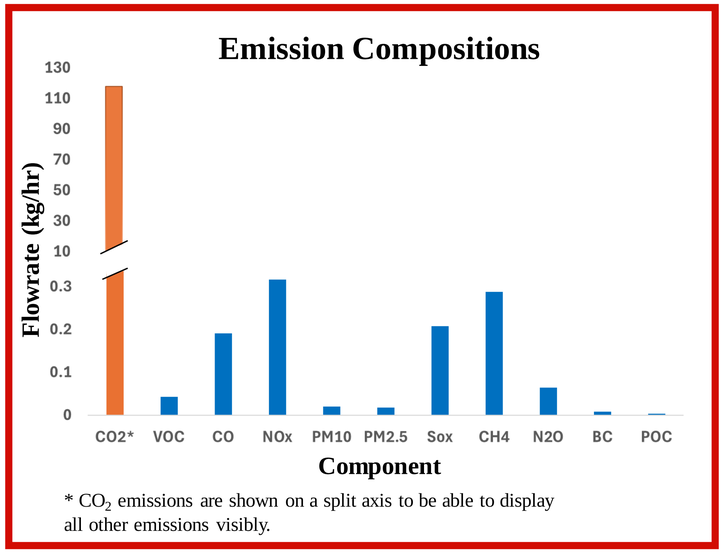
Product syngas results:

- 2200.0 kg/hr flowrate
- High CO and H_2 compositions
- High H_2O composition
- Low amounts of undesirable contaminants (NH_3, HCl, H_2S)

5. Economic Analysis



6. Plant Emissions



* CO_2 emissions are shown on a split axis to be able to display all other emissions visibly.

7. Conclusions

- Simulations proved plant could be feasible and profitable with minimal environmental impact.
- Further analysis and testing would be needed before plant production.
- Deeper understanding of Aspen Plus, GREET, CAPCOST, and the gasification process was gained.

1. Doman, Linda. EIA Projects 28% Increase in World Energy Use by 2040 - U.S. Energy Information Administration (EIA), 14 Sept. 2017
2. Maham Hussain, et al. *RSC Advances*, Royal Society of Chemistry, 8 Aug. 2023
3. W. Doherty, et al. *Materials and Processes for Energy*, Technological University Dublin, 2022.