# Repurposing Waste Sugarcane to create Blue Hydrogen

Group P7

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## Introduction

**Geography: Rayong, Thailand**

**Background**

- Environmental and Public Safety Concerns for Locals
- Sugarcane residue: prior to post-harvesting burn to save emissions

**Objective**

- Production of more environmentally friendly hydrogen.
- A renewable source of energy that is carbon neutral

## Environmental Analysis

**Char + Ash**

- Sold as biomass char and ash to industry

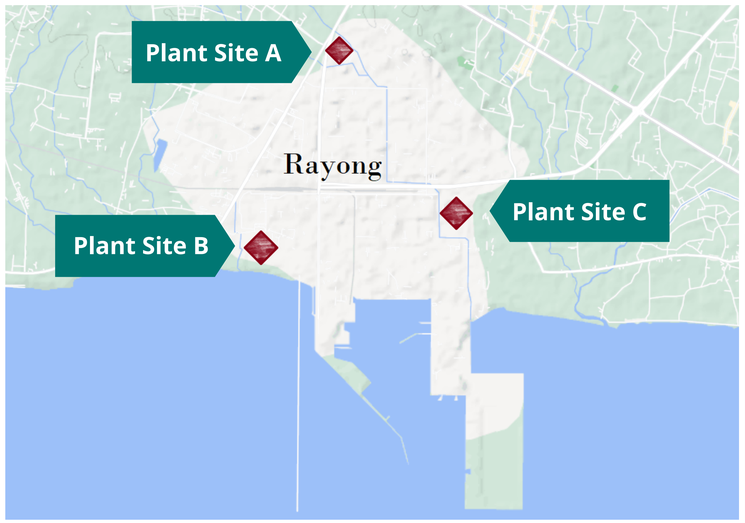
**Combustion ($CO_2$ + Water)**

- Use of pure $O_2$ gas for feed to produce water and $CO_2$

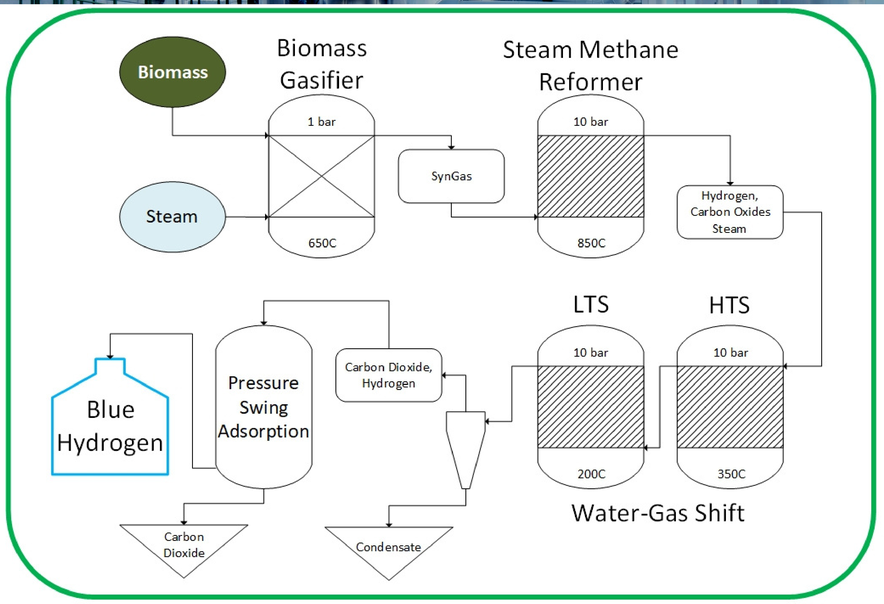
**PSA Waste ($CO_2$)**

- Underground $CO_2$ storage
- Store in depleted oil reservoir

## Plant Location




## Process Description




### Biomass Gasification

**Biomass + Steam ⟶ SynGas + Ash/Char**

- SynGas includes Hydrogen, Methane, Water, Carbon Monoxide, Carbon Dioxide
- Gasification reduces the emissions of dust particles
- Similar to pyrolysis, gasification is a greener option compared to combustion

### Steam Methane Reform

$CH_4 + H_2O \longrightarrow CO + 3H_2$

$CH_4 + 2H_2O \longrightarrow CO_2 + 4H_2$

- SMR has one primary and one secondary reaction
- The process can be run at a higher pressure, up to 32 bar
- It effectively removes up to 95% of the existing methane without a recycling stream

### Water-Gas Shift

$CO + H_2O \longrightarrow CO_2 + H_2$

- Carbon monoxide is produces at high amounts from upstream processes
- Carbon dioxide can be recovered more easily downstream
- This process is exothermic so it requires cooling in between columns

### Pressure Swing Adsorption

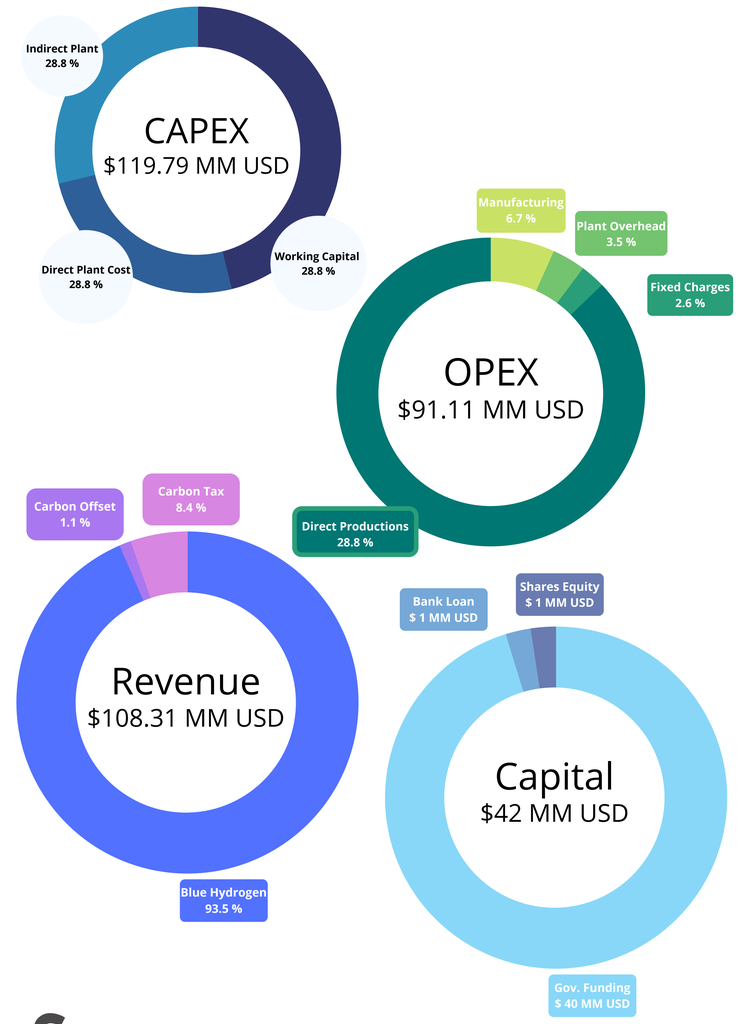
**Traps Carbon Dioxide, Water Vapor, Various Gases**

- Most common Carbon Capture System used in hydrogen production plants
- Filters products to achieve a hydrogen purity of at least 99%
- Higher yield can be obtained if recycling stream is introduced, but deemed unprofitable

## Production Summary

21,000 kg/hr Sugarcane ⟶ 6000 kg/hr Blue Hydrogen

## Economic Analysis




## Summary

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|---|---|---|---|---|---|
| Hydrogen Sale Price | $ 2.09 USD/kg | Total Revenue | $ 108 MM | Payback Period | 3 Years 10 Months |
| Estimated Plant Life | 15 Years | MARR | 10% | IRR | 15.3% |

## Acknowledgement

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