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Plant Waste Utilization for Energy Generation

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Introduction

Our groundbreaking initiative leverages flare systems to not only generate energy but also capture CO_2 concurrently. By harnessing this dual capability, we aim to address the pressing issues of energy scarcity and climate change in a symbiotic and efficient manner. This project marks a significant leap forward in clean energy solutions, offering a pioneering approach that aligns economic viability with ecological responsibility. Join us on this transformative journey towards a more sustainable and greener future.

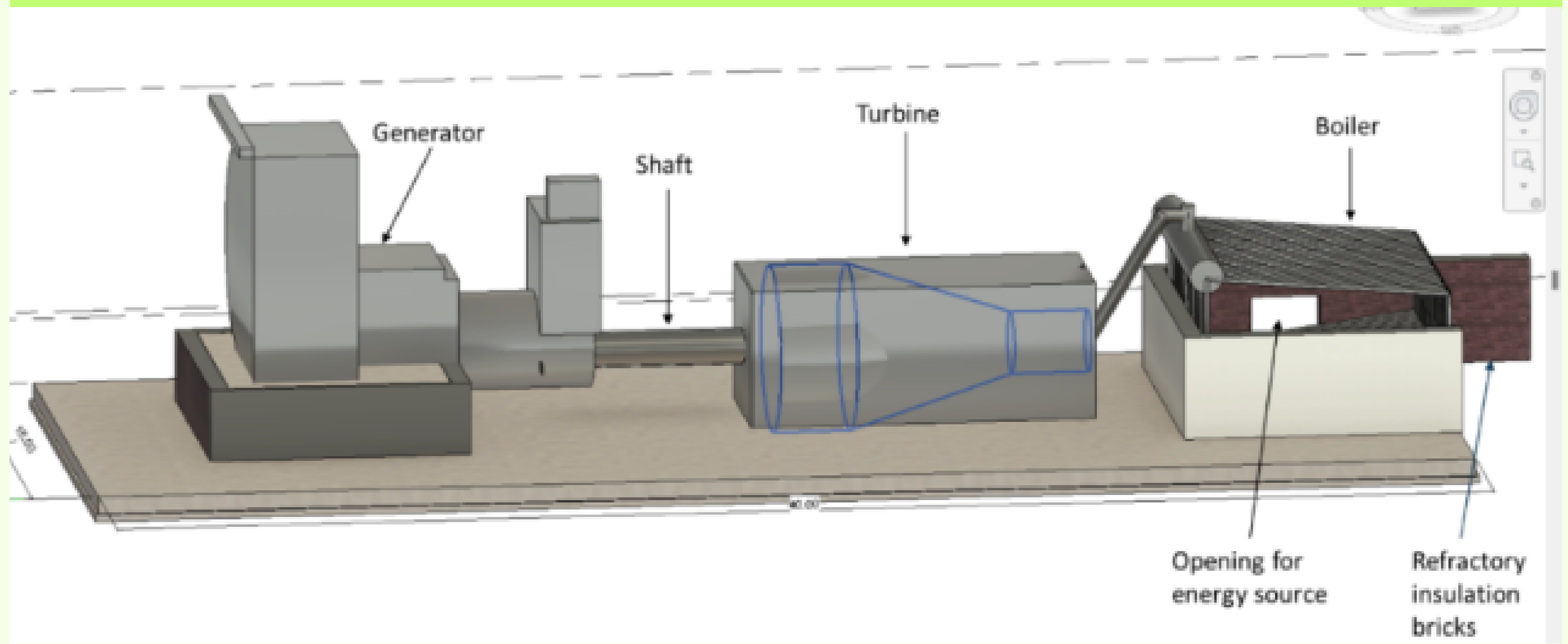
Problem Statement

How to utilize the wasted gas through flaring system in oil&gas and polymer industries to maximize profit by generating electrical energy and capturing the CO_2 emitted in the Kingdom of Saudi Arabia.

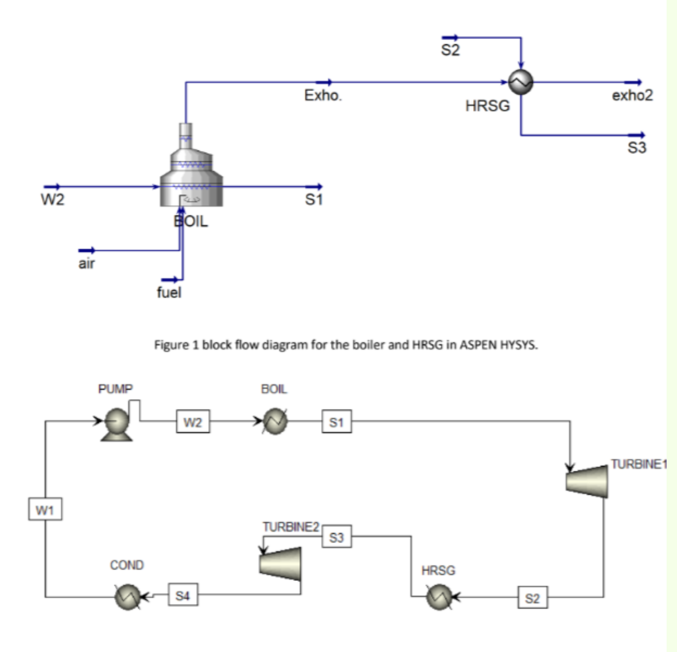
Constraints

- Government Regulations
- Capital- operational cost
- Energy efficiency
- Long term viability
- Infrastructure and logistics
- Energy market dynamic

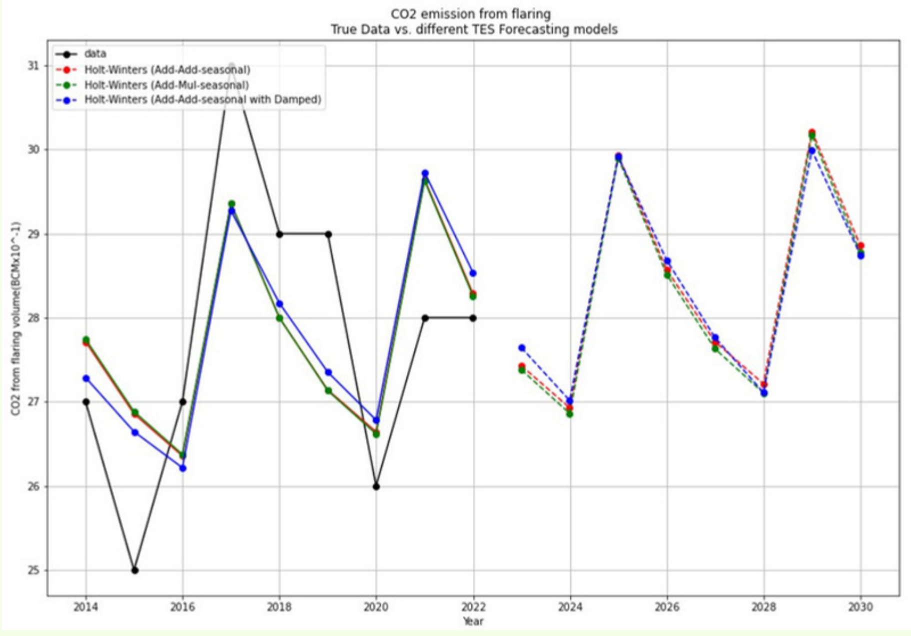
Prototype Design



Aspen Simulation



Forecasted data for Co2 emissions from flaring



Target Specifications

Specification	Target
1-Amount of Power Generated	> 2000kwh/ ton of gas
2-Efficiency of Capturing Co2	> 70%
3-Heat insulation	> 75%
4-Number of Suitable industries	⩾ 2
5-Efficiency of Water Recycle	> 50%

Co2 selling plan model

Parameters

- Dij = demand at year i of market j
- Ki = annual capacity of our plant at year i
- Rj = revenue of selling one unit to market j ;185$ for B-D and 30$ for E market
- Cj = cost of producing and shipping one unit (barrel) from factory to market *j*

Decision variables

- Xij = quantity shipped from factory at year i to market *j*

Objective function

$$\max \sum_{i=1}^{I}\sum_{j=1}^{J} X_{ij}(R_j - C_j)$$

Subjected to

$$X_{ij} \leq D_{ij}, \forall i,j \quad ....(1)$$

$$\sum_{j=1}^{J} X_{ij} = K_i, \forall i \quad ....(2)$$

$$X_{ij} \in Z^+, \forall i,j \quad ....(3)$$

Testing outputs

Name	TURBINE1	TURBINE2
Property method	IAPWS-95	IAPWS-95
Henry's component list ID		
Electrolyte chemistry ID		
Use true species approach for electrolytes	YES	YES
Free-water phase properties method	STEAM-TA	STEAM-TA
Water solubility method	3	3
Model Type		
Specified discharge pressure [bar]	30	1
Specified pressure increase [bar]		
Specified pressure ratio		
Specified power required [kW]		
Isentropic efficiency		
Mechanical efficiency		
Polytropic efficiency		
EO Model components		
Indicated horsepower [kW]	-1039.17	-2140.53
Calculated brake horsepower [kW]	-1039.17	-2140.53
Net work required [kW]	-1039.17	-2140.53
Power loss [kW]	0	0
Efficiency (polytropic / isentropic) used	0.72	0.72
Calculated discharge pressure [bar]	30	1
Calculated pressure change [bar]	90	39
Calculated pressure ratio	0.25	0.025

validtion

1- Proofed by Aspen HYSYS
2- By using PCC technology which has an efficacy of 87.5%
3- By using the Refractory Bricks material which insulates up to 1000 C
4- Since Polymer and oil&gas industries can use it directly.
5- Proofed by Aspen HYSYS

Conclusion

our project has been successful achieved the final target specifications. Not only we have utilized 100% of the wasted gases and generated required energy needed for medium-sized polymers plant, but also contributed to reduce electricity costs by 21% . We believe that implementing our waste-to-energy unit on larger scale would hugely improve sustainability and contribute towards achieving the Net Zero emission vision widely.