Beyond Net-Zero Carbon Emissions in Industrial Processes through Catalyst-Aided Amine Solvents for the Indirect Co-Combustion of Natural Gas and Biomass.

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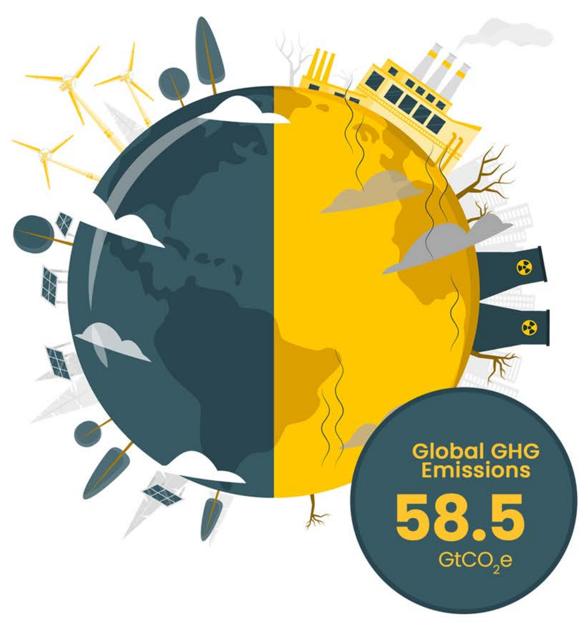
1 BACKGROUND

Global energy consumption has risen exponentially due to advancements in civilization and the world population's quickening expansion.

According to a report by the World Economic Forum (WEF) in 2019, global CO_2 emissions were at 58.5 gigatons of carbon dioxide equivalent ($GtCO_2e$). Of this, the energy sector contributed as much as 19.4 $GtCO_2e$, representing a third of all emissions, with the combustion of fossil fuels like coal (27%), petroleum (33%), and natural gas (24%).

This work seeks to highlight the issue of climate change and the impact of catalyst aided Carbon capture in the in-direct co-combustion of natural gas and biomass.



Based on the findings of this study, this research seeks to meet the following objectives:

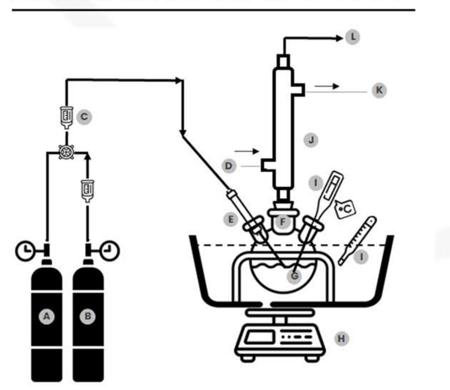
i. To contribute towards the reduction of CO_2 emissions in the energy and power space.
ii. To identify and develop a catalyst that effectively reduces the energy requirements and costs associated with the capture process.
iii. To evaluate the potential of catalyst-aided carbon capture technology towards achieving net-zero carbon emissions.

2 METHODOLOGY

SCOPE OF WORK

Literature Review » Catalyst Identi. » Catalyst Screening » Catalyst Opt. » Catalyst Characterization » Data Analysis » Net Zero Calculations

EXPERIMENTAL SETUP



EXPERIMENTAL SET-UP

A. N_2 Gas Tank	B. CO_2 Gas Tank
C. Rotameter	D. Cooling water In
E. Gas Dispersive tube	F. Round bottom flask
G. Amine Solvent	H. Dual Heater/Stirrer
I. Thermometer	J. Condensor
K. Cooling water Out	I. To gas analyzer

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WHY DOES THIS RESEARCH MATTER?

Increased solvent capacity and prolonged life.

Lower capital investment and operational cost reduction.

Lower Emissions and sustainability.

Catalysts considered to be super basic were introduced into the Amine CO_2 reaction system (solvent-acid gas-water).

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A — Wet Impregnation Method

- **A. Wet Impregnation** Physically prepare MgO support at 550 degrees Celsius for four (4) hours.
- **B. Wet Impregnation** Stir catalyst precursors in water for two hours at room temperature.
- **C. Calcination** Calcine resultant catalyst material at 500 degrees Celsius for two hours in air.
- **D. Palletisation** Pelletize the resulting catalyst in Ludox Binder.

B — Hydrothermal Treatment Method

- **A. Hydrothermal treatment** Carbon source is hydrothermally treated at 190 degrees Celsius.
- **B. Catalyst Washing** Resulting carbon material is washed with DI water under vacuum.
- **C. Activation** Catalyst is reacted with KOH and then calcined before washing with DI water.
- **D.** Pelletize the resulting catalyst in Ludox Binder.

CATALYST SYNTHESIS

SCAN ME

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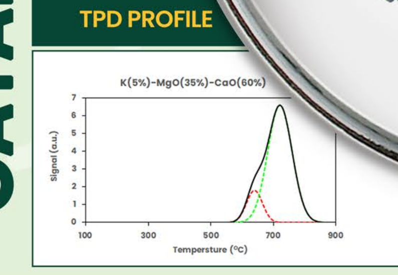
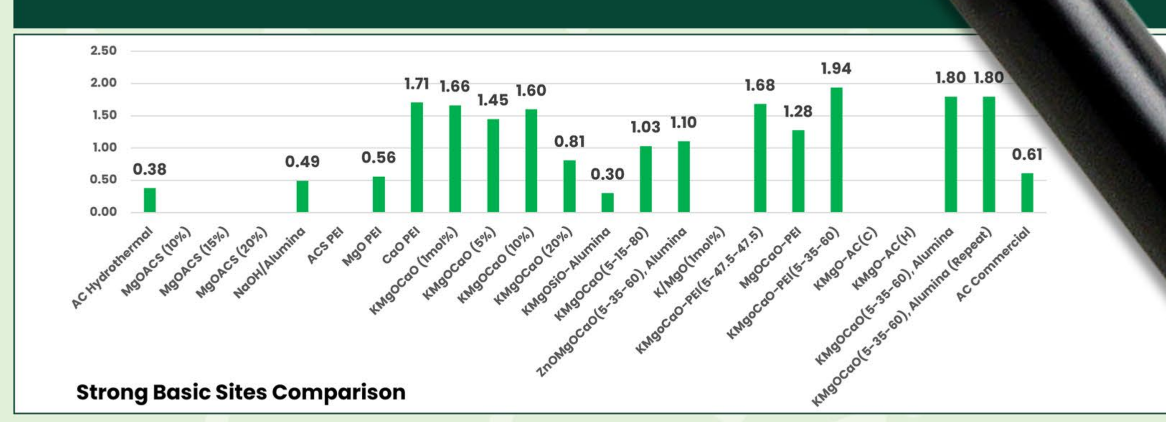
**Activated Carbon Catalyst

TPD PROFILE



TPD RESULTS



FROM LAB TO LIFE: TRANSFORMING IDEAS INTO ACTION

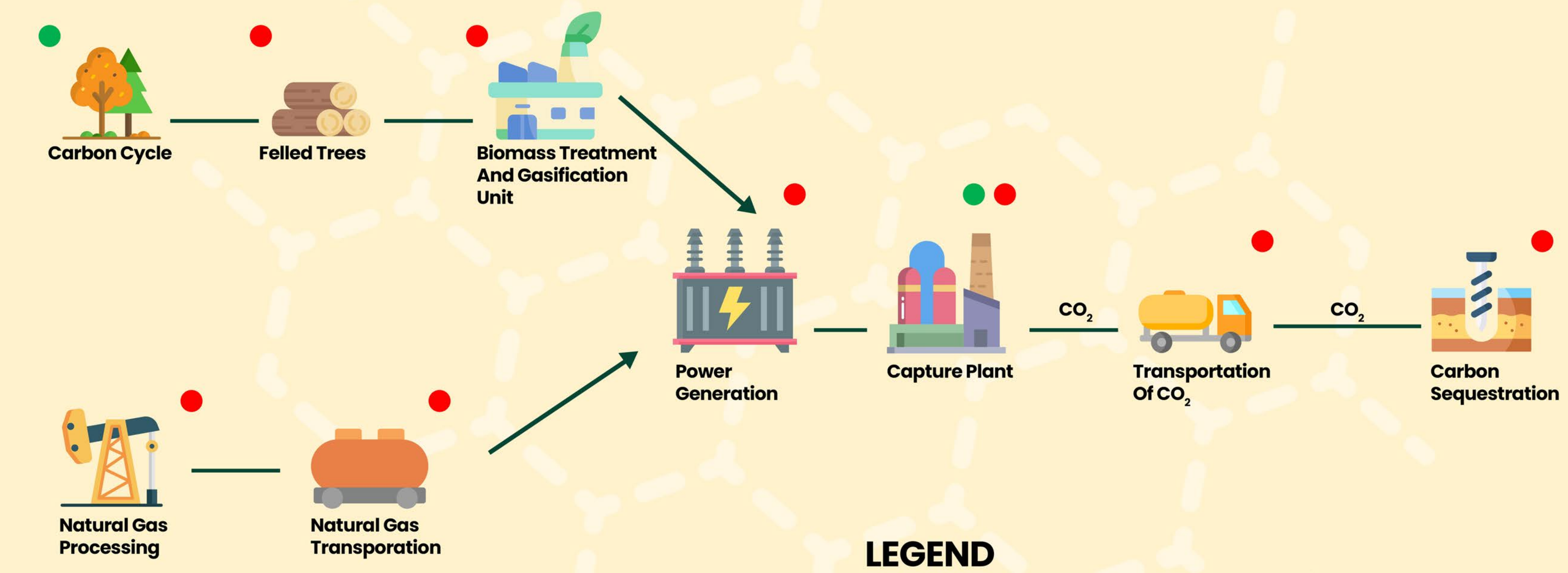
MEA — **112,470 BULBS** A YEAR

NOVEL SOLVENT — **5,365 CARS** EACH DAY

CATALYST — **31 TONS** OF COAL EACH DAY

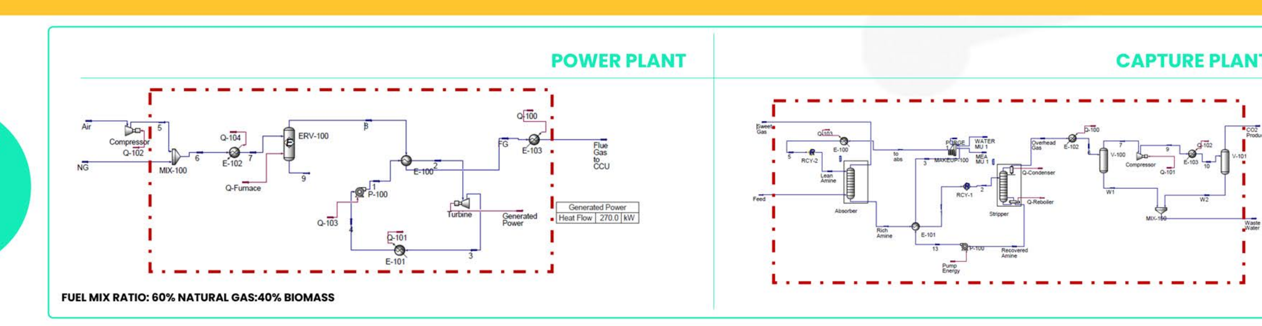
3 RESULTS AND DISCUSSIONS

LIFE CYCLE ANALYSIS - BIG/GTCC WITH CCUS

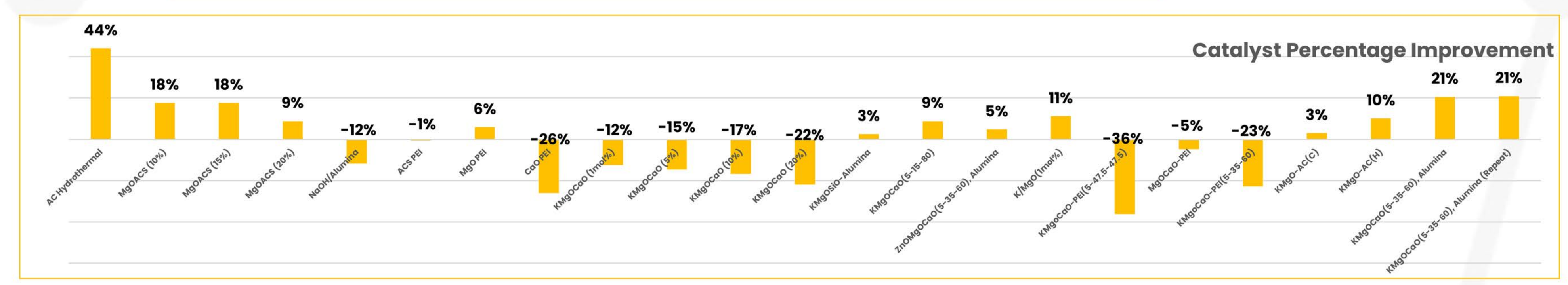


LEGEND
- Processes that require the use of energy.
- Processes that remove CO_2 from the atmosphere.

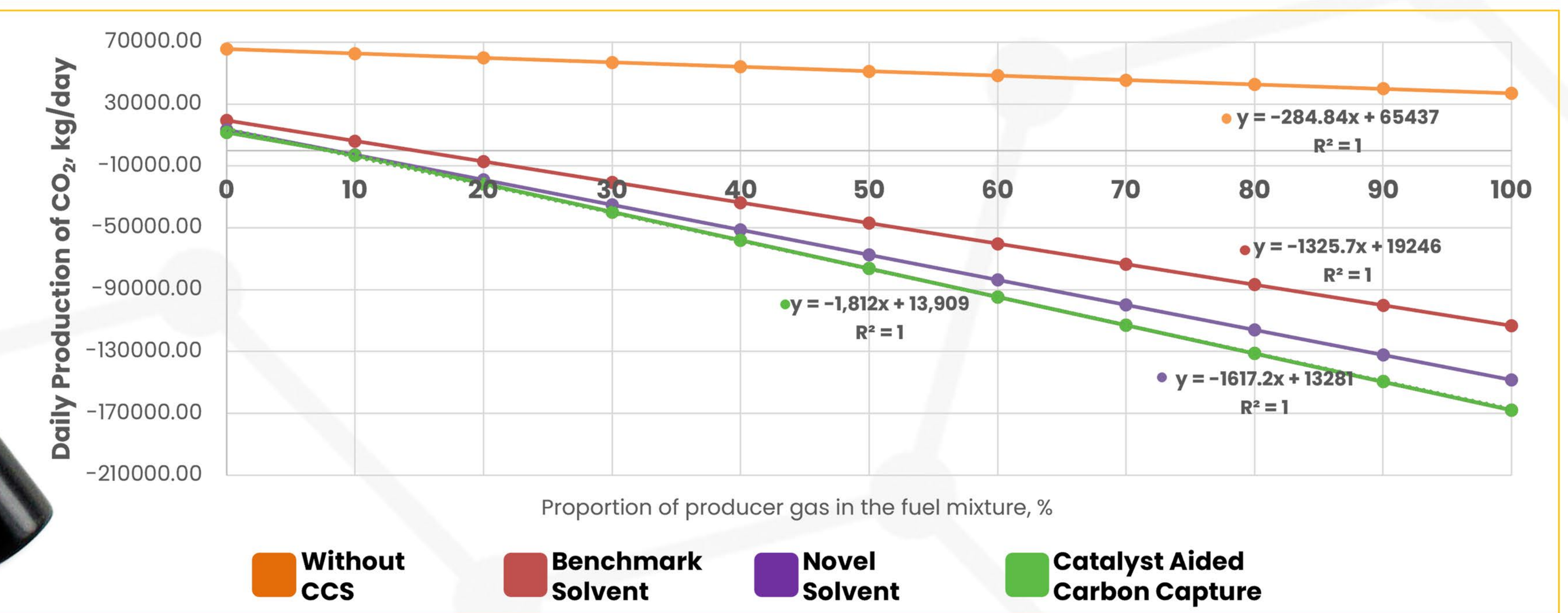
CATALYST PERFORMANCE



ASPEN Hysis was employed in simulating the carbon capture unit and power plant for the LCA to be conducted.



NET ZERO IMPACT MEASURED



CONCLUSIONS

The integration of biomass as a renewable energy source with natural gas in an indirect co-combustion setup, supplemented by catalytic CO_2 capture, supports sustainable electricity generation.

The life cycle analysis (LCA) indicated a notable reduction in greenhouse gas emissions over the entire lifecycle of the electricity generation process.

REFERENCES:
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