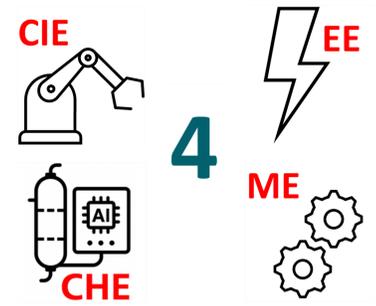


# Utilizing Carbon Emissions for Biofuels Production Employing Photobioreactors Technology

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## Background & Motivation

- Oil and gas industries emit large amounts of CO<sub>2</sub>.
- Traditional carbon capture methods are costly and temporary.
- Our goal: turn CO<sub>2</sub> into valuable biofuels using microalgae.
- Aligns with Saudi Green Initiative and global sustainability goals.

## Problem Statement

Develop a microalgae photobioreactor system to convert industrial CO<sub>2</sub> emissions into biofuel, integrating reactor design, optimized light exposure, and automated processes.

## Constraints

1. Corrosion Resistance Material
2. Six Thousand Saudi Riyal Fund
3. Scalability of the design
4. 220 AC Power Supply
5. Safety of Materials and Chemicals
6. Minimum light intensity
7. Sensors and Actuators compatibility
8. Real-Time Data

## Specifications

1. Flow rate: 1-5 L/min
2. Pressure: 1.2-2 bar
3. Lipid content: 20-30% (Chlorella)
4. Temperature: 24-26°C
5. Temperature sensor accuracy:  $\pm 0.5^\circ\text{C}$
6. CO<sub>2</sub> sensor accuracy:  $\pm 0.2\%$
7. Valve/pump response time:  $\leq 2$  s
8. pH level:  $\approx 7$
9. Photobioreactor: Flat-plate
10. Automation: 70%
11. CO<sub>2</sub> concentration: 1-2%

## Results & Performance

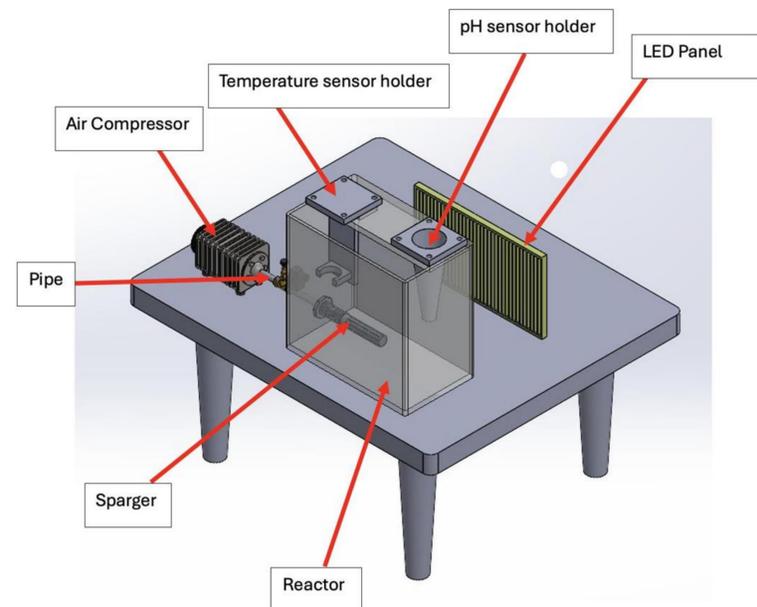
- Temperature sensor maintains accuracy of  $\pm 0.5^\circ\text{C}$
- Air flow maintained at 3.79 L/min
- CO<sub>2</sub> fixation: 0.0275 g/L/day
- Biomass concentration: 0.5 g/L
- Lipid content in biomass: 20% suitable for biofuel
- Light absorption efficiency:  $\sim 12.85\%$
- PBR components validated; partial prototype tested

## Aspects of Impact

- ✓ **Economic:**
  - Boosting the renewable energy sector.
  - Reducing the unemployment rate.
  - Diversifying local revenue sources.
- ✓ **Societal:**
  - Promoting green energy awareness.
  - Raising living standards by cutting unemployment.
  - Speeding up green tech innovation..
- ✓ **Environmental:**
  - Easing climate change.
  - Cutting pollution.
  - Building sustainable green energy

## Prototype Design

1. Photobioreactor: FlatPlate, glass, 50 L capacity
2. Lighting: LED panel (2700K, 12W), controlled by Raspberry Pi
3. Control System: Raspberry Pi with sensors (temperature, pH, pressure, flow) and digital valves
4. Air Supply: Air pump (60 L/min), regulated to 1-5 L/min per liter
5. 3D Printed Components: Spargers, sensor holders (PETG)



## Conclusion

- Successfully demonstrated proof of concept for CO<sub>2</sub>-to-biofuel conversion using a photobioreactor.
- Challenges: Real-time data processing and sensor integration.

## Recommendations

- Implement green energy resources
- Explore machine learning for optimization