Algae-based CO\textsubscript{2} Capture from Power Plants and Conversion to Value Added Products
B. Lam, L. Schideman, K. Prasad, F. Harrington, J. J. Maloney*, R. Prasad*

Project Overview

**Overall Objective**
1. Develop a novel algae technology for efficient CO\textsubscript{2} capture from coal power plant flue gas
2. Make bio-fuels & other products from algae to mitigate the cost of carbon capture

**Strategy**

1. Utilize micro-algae to metabolize and capture CO\textsubscript{2}
2. Enable high CO\textsubscript{2} capture efficiency and productivity
3. De-water the algae at low energy & cost
4. Recycle water & nutrients to minimize consumption
5. Convert the algae to fuel via HTL process
6. Extract high value co-products

**Challenges in Algae CO\textsubscript{2} Capture**
1. Complex living system – prediction difficult
2. 12% CO\textsubscript{2} is 300x of ambient
3. Impact of SO\textsubscript{X} and NO\textsubscript{X} unknown
4. Growth rate & capture efficiency often inversely related
5. Achieving 90% CO\textsubscript{2} capture efficiency is difficult
6. All downstream applications require dewatering

**Microalgae Strains**

H-1903  H-0322

**Algae Survival in Template Post FGD gas**

**Algae Species:** H-1903

- Natural algae growth environment
- 1% CO\textsubscript{2} + 75ppm NO\textsubscript{X} + 12% CO\textsubscript{2} + 75ppm SO\textsubscript{X}

- Major contaminants induce significant change in algae environment

**Stable algae growth demonstrated for H-0322 and H-1903 at 12% CO\textsubscript{2} + 75ppm SO\textsubscript{X} + 75ppm NO\textsubscript{X}**

**Advanced Algae Process for CO\textsubscript{2} Capture**

1. Continuous process
2. 90% CO\textsubscript{2} capture efficiency achievable
3. Design of each stage remains optimal over time
4. Enables stable capture efficiency with time
5. High productivity
6. Suitable for integrating with upstream/downstream processes

**Model Simulation**

**Experimental Results**

- Stable algae concentration and CO\textsubscript{2} capture efficiency demonstrated
- High overall CO\textsubscript{2} capture efficiency achieved

**Conclusions**

- Survival & growth of two algae species validated in simulated flue gas
- >80% CO\textsubscript{2} capture efficiency demonstrated
- Good HTL conversion of algae to bio-crude demonstrated
- Co-product generation economically valuable
- Preliminary economic assessment shows potential for CO\textsubscript{2} capture cost <$30/ton

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* Individuals to contact