

Dual Function Materials for Direct Air Capture of CO₂

SBIR DE-SC0020795

Cory Sanderson / Raghbir Gupta (PI)

Susteon Inc.

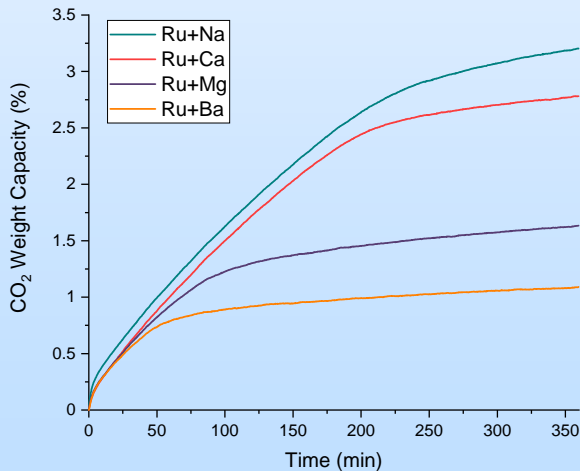
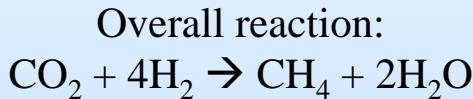
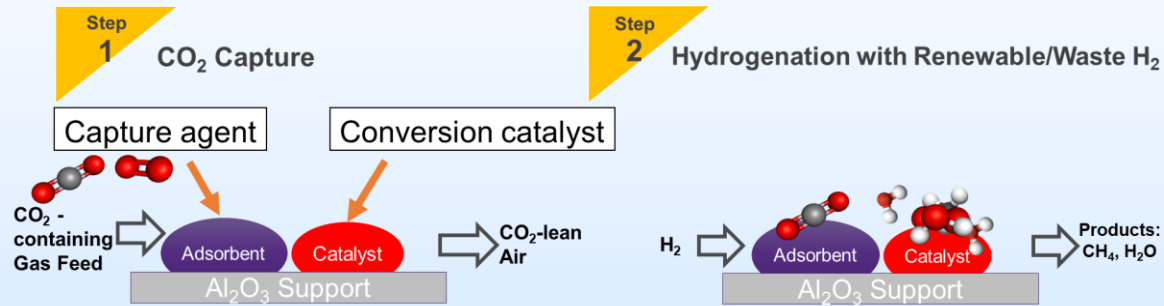
U.S. Department of Energy
National Energy Technology Laboratory
Direct Air Capture Kickoff Meeting
February 24-25, 2021

Program Overview

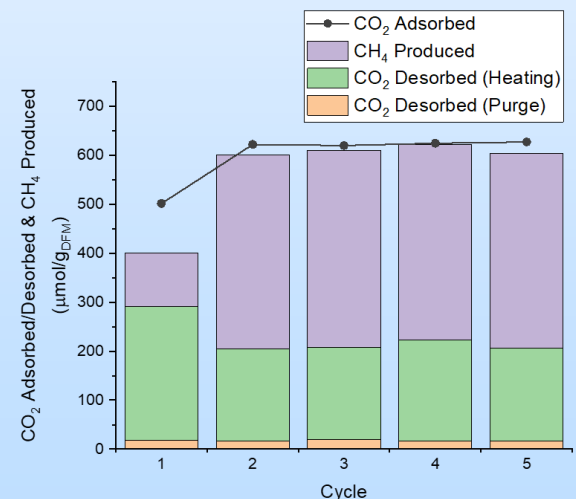
- a. Funding: \$250,000
- b. Overall Project Performance Dates: 07/2020 – 03/2021
- c. Project Participants:
 - a. Susteon Inc. (Prime)
 - b. Columbia University (Professor Robert Farrauto)
- d. Overall Project Objectives: Development of Dual Function Materials (DFM) for CO₂ capture from air (DAC) and subsequent conversion to renewable natural gas (RNG)

Technology Background

- a. Reactive DAC Technology: Capture CO₂ directly from air at ambient condition on Ru/Na₂O/Al₂O₃, followed by *in-situ* methanation at 120-300°C with waste H₂ to enable a cyclic operation.



TGA: Adsorption @ 25°C on 1% Ru, 10% sorbent/Al₂O₃ granules with 375 ppm CO₂/air

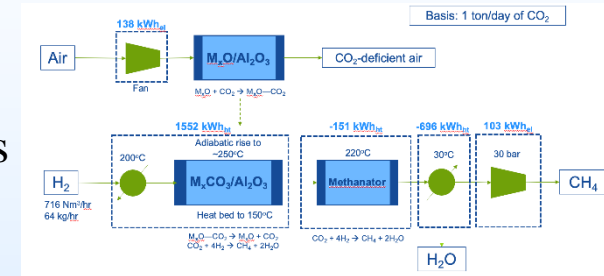


Cyclic packed bed: Adsorption @ 25°C and methanation @ 300°C on 1% Ru, 10% Na₂O/Al₂O₃ granules

Technical Approach/Project Scope

a. Experimental design and work plan

- Optimized DFM composition and test parameters
- Established kinetics with specified process conditions
- Conducting cyclic aging studies with ambient air
- Developing a process design and TEA model



b. Project schedule

Milestones:

1. Identify sorbent candidates
2. Develop a process design

| Tasks / Dates | 07/20 | 08/20 | 09/20 | 10/20 | 11/20 | 12/20 | 01/21 | 02/21 | 03/21 |
|---|-------|--------|--------|--------|--------|--------|--------|--------|-------|
| Task 1. Project management and planning | Green | Green | Green | Green | Green | Green | Green | Green | Green |
| Task 2.1. Experimental Setup | White | Maroon | Maroon | White | White | White | White | White | White |
| Task 2.2. Aging Studies for DAC | White | Maroon | Maroon | Maroon | Maroon | Maroon | White | White | White |
| Task 2.3. CO2/Air Adsorption/Desorption Rate Studies | White | Maroon | Maroon | Maroon | Maroon | Maroon | Maroon | Maroon | White |
| Task 3. Data Processing and TEA | White | White | Green | Green | Green | Green | Green | Green | Green |

c. Project success criteria

- Multicycle performance of DFM materials for their CO₂ capture rate, CO₂ capacity, regenerability to produce RNG.
- Development of a process design and TEA

Team and Facilities



Raghubir Gupta
President



S. James Zhou
Senior Director



Jian Zheng
Sr. Engineer



Cory Sanderson
Process Technologist



Vasudev Haribal
Research Chem. Engineer

Susteon



Robert Farrauto
Professor



Chae Jeong-Potter
Ph.D. Candidate

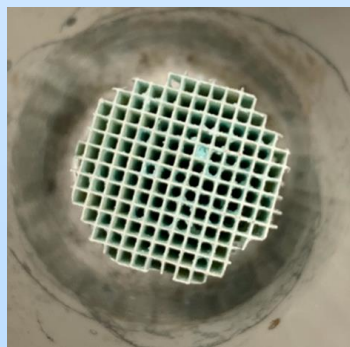
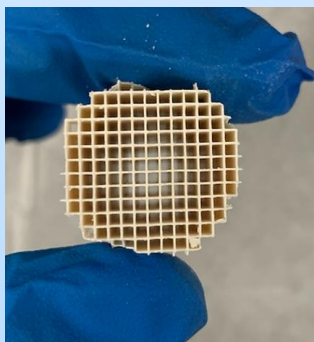


Monica Abdallah
Ph.D. Candidate

Columbia University

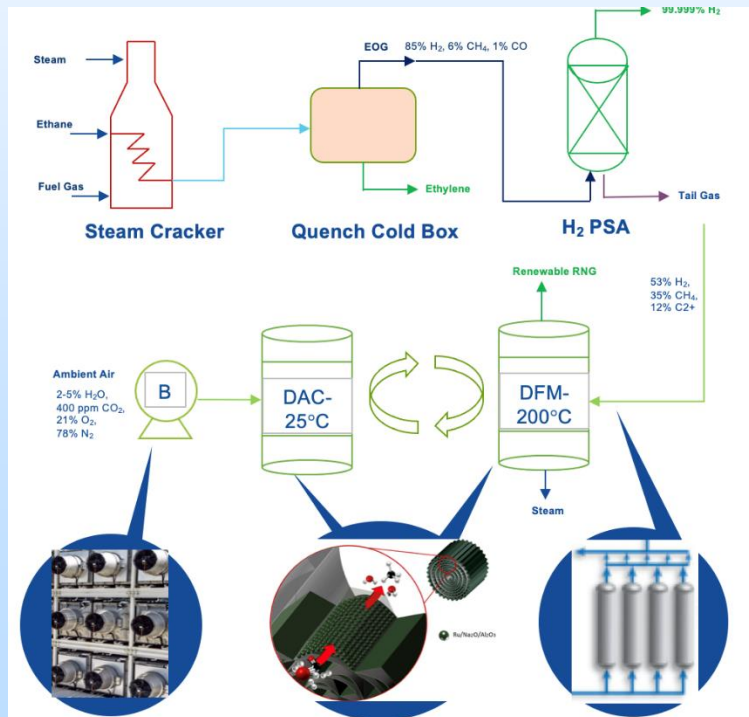
Industrial Partners

Anglo-American
Con Edison
Riogen



Progress and Current Status of Project

- Completed screening of DFM to identify leading candidate
- Evaluated various process cycle designs
- Initiated techno-economic analysis



| | |
|--------------------|--|
| Sorbent | <ul style="list-style-type: none"> Chemical Composition Structural support design Commercial manufacturing |
| Process | <ul style="list-style-type: none"> Low pressure drop Heat for regeneration Cycle design H₂ availability |
| Engineering | <ul style="list-style-type: none"> Scalability assessment Optimum module size Manufacturability |
| Economics | <ul style="list-style-type: none"> Capex Opex RNG production cost CO₂ capture cost |

Opportunities for Collaboration

- Partnership for developing structured materials
- Identification of a waste hydrogen source – refinery and petrochemical plants
- Identification of engineering partners for scale-up and manufacturing

The logo for Susteon, featuring the word "Susteon" in a bold, sans-serif font. The "Sust" is in blue and "eon" is in green.The logo for Columbia University, featuring a blue crown icon to the left of the text "COLUMBIA UNIVERSITY" in a serif font, with "IN THE CITY OF NEW YORK" in a smaller serif font below it.The logo for CORMETECH, featuring a stylized orange and white grid pattern to the left of the text "CORMETECH" in a bold, orange, sans-serif font, with "RELIABILITY. DELIVERED." in a smaller, black, sans-serif font below it.The logo for Anglo American, featuring a stylized blue and white circular graphic to the left of the text "ANGLO AMERICAN" in a bold, blue, sans-serif font.The logo for SoCalGas, featuring a stylized blue and white flame icon to the left of the text "SoCalGas" in a bold, blue, sans-serif font. Below it is the text "A Sempra Energy utility" with a small red and white logo to the left of "Sempra Energy".