Wind-driven direct air capture using 3D printed, amine-loaded adsorption contactors

Project Number DE-AR0001414

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Georgia Institute of Technology

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

### Funding

<table>
<thead>
<tr>
<th></th>
<th>FY 2021</th>
<th>FY 2022</th>
<th>FY 2023</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>DOE Funds</td>
<td>Cost Share</td>
<td>DOE Funds</td>
<td>Cost Share</td>
</tr>
<tr>
<td>Applicant</td>
<td>$195,935</td>
<td>$391,869</td>
<td>$195,934</td>
<td>$783,738</td>
</tr>
<tr>
<td>Sub-recipient A, if proposed</td>
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<td>$0</td>
<td>$0</td>
<td>$0</td>
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<tr>
<td>Total ($)</td>
<td>$195,935</td>
<td>$391,869</td>
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<tr>
<td>Total Cost Share %</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
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### Overall Project Performance Dates:
TBD – 18 months, Spring 2021 Start

### Overall Project Objective:
- design a “passive” contactor designed to facilitate wind flow through the contactor without the use of external fans

### Project Participants

- **ARPA-E**
  - Ryan Lively
    - Project Director
    - 3D Printing
  - Matthew Reallf
    - DAC Models
- **Global Thermostat**
  - Miles Sakwa-Novak
    - DAC Deployment
- **Christopher Jones**
  - Tailored Polyamines
Technology Background

Advantages
• Simple, passive device
• Low energy requirements

Challenges
• Productivity
• Resistance heating vs. steam stripping
Technical Approach/Project Scope

Fiber Design
a. Fiber length, diameter
b. Carbon, sorbent loading
c. Amine chemistry

Contactor Design
a. Wind speed ratio
b. Integration to power systems
c. Productivity

<table>
<thead>
<tr>
<th>Key Milestones</th>
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<tbody>
<tr>
<td><strong>Milestone Title &amp; Description</strong></td>
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<tr>
<td>Sorbent developed with sorption enthalpy of -65 kJ/mol and projected working capacity and capital cost at scale consistent with $100/t CO2 removed</td>
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<tr>
<td>Define optimal carbon material for resistive heating, as well as loading and maximum contactor height</td>
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<tr>
<td>Contactor fabricated with wind speed ratio (ratio of wind speed external to system to speed of air in a channel) of 0.15 and geometric surface area &gt; 5,000 m²/m³</td>
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<tr>
<td>Demonstrate 95% CO2 purity in the outlet stream using synthetic air with 400 ppm CO2.</td>
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**Success Criteria**

Provide 2 weeks of operating data using outdoor air. Target productivity is 1.5 kg CO₂ per kg sorbent per day. Target purity is >95 mol% CO₂ using real air. Target energy consumption is < 4 GJₑ/tonne CO₂. Target < 3% swing capacity loss over 2 week cycling period (to be assessed by high precision sorption isotherm measurement). These targets provide a clear pathway to $100/tonne.
Opportunities for Collaboration

Synergistic effects of collaboration:

- This process requires integration of materials science, fluid dynamics, process systems – collaborations in all of these areas are welcome
- Better sorbent and contactor design could result from collaborating with teams with similar research goals

Areas of complementary work that others may contribute to this technology:

- Computational fluid dynamics
- Wind mapping and planning
- 3D printing scale-out/up
- LCA analysis could help better understand the global impacts of this technology