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

Project Number DE-AR0001414

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U.S. Department of Energy

National Energy Technology Laboratory

Direct Air Capture Kickoff Meeting

February 24-25, 2021

Program Overview

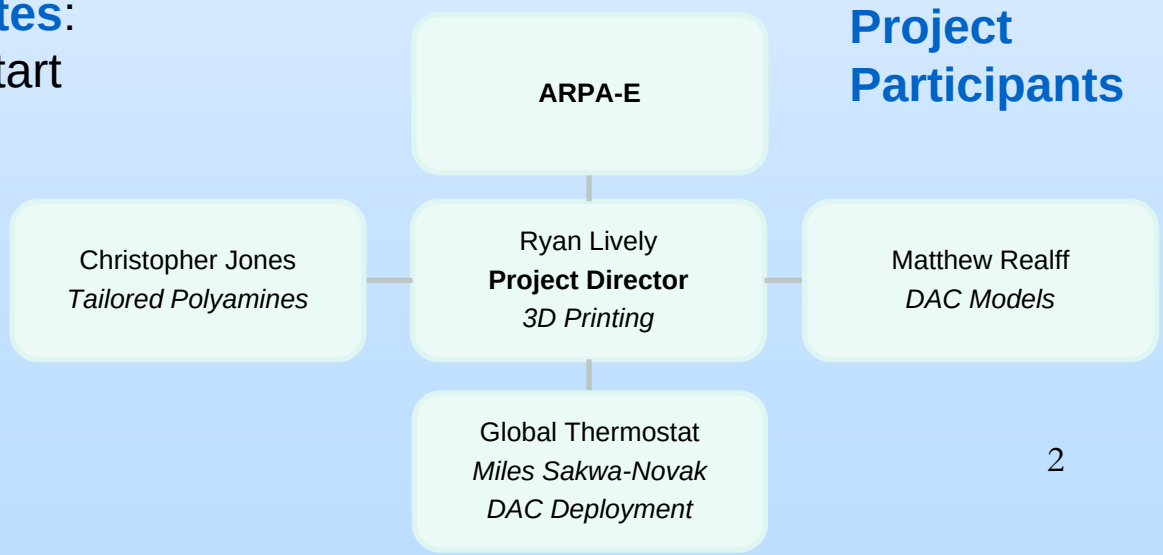
Funding	FY 2021		FY 2022		FY 2023		Total	
	DOE Funds	Cost Share	DOE Funds	Cost Share	DOE Funds	Cost Share	DOE Funds	Cost Share
Applicant	$195,935		$391,869		$195,934		$783,738	
Sub-recipient A, if proposed				$0		$0		$0
Total ($)	$195,935		$391,869	$0	$195,934	$0	$783,738	$0
Total Cost Share %			0%		0%		0%	

Overall Project Performance Dates:
TBD – 18 months, Spring 2021 Start

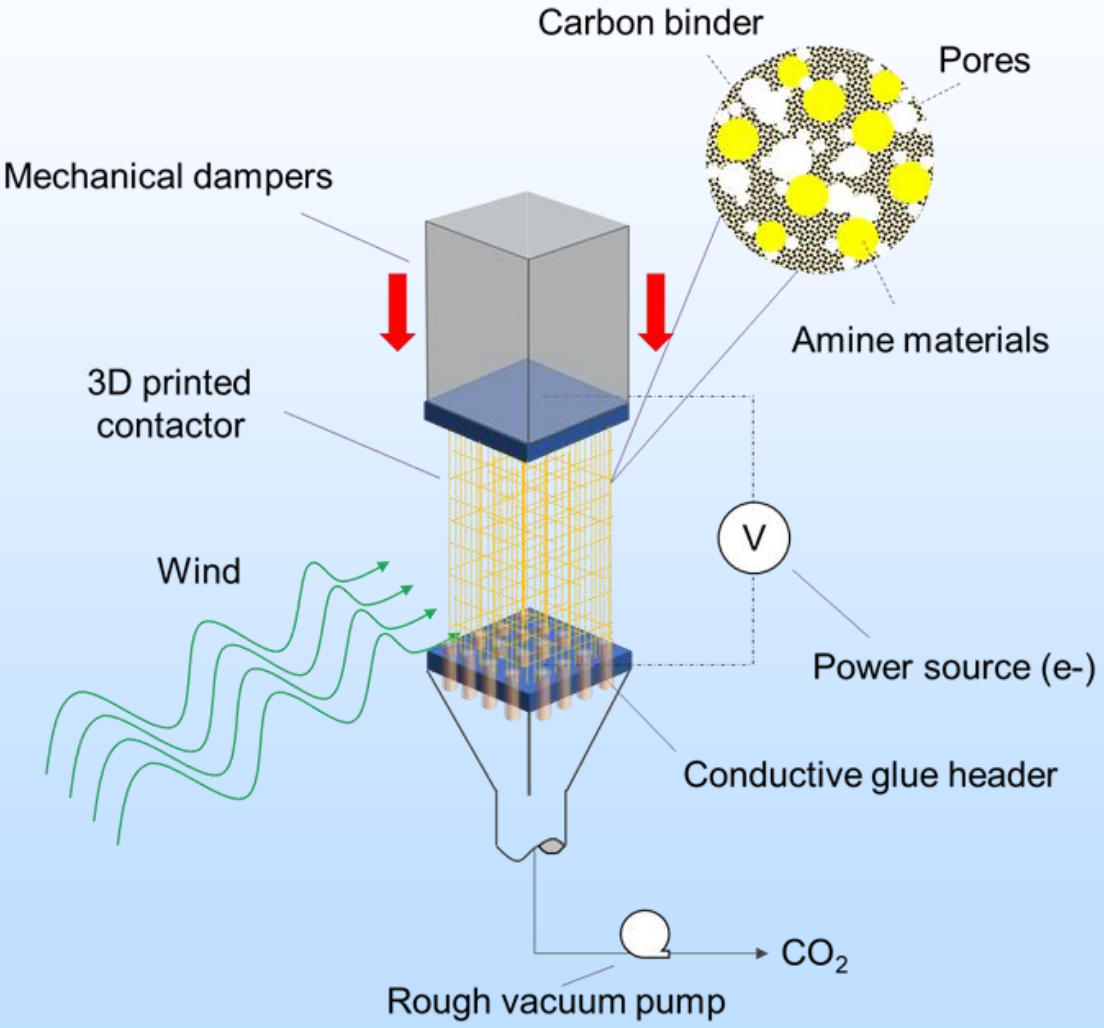
Overall Project Objective:

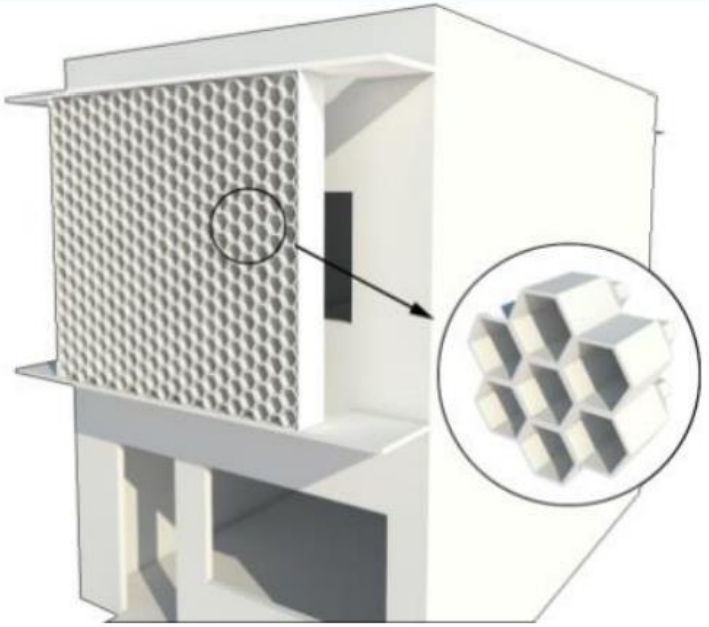
- ❑ design a "passive" contactor designed to facilitate wind flow through the contactor without the use of external fans

Project Participants



Technology Background





Advantages	Challenges
• Simple, passive device • Low energy requirements	• 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

Key Milestones

Milestone Title & Description	Planned Completion Date
Sorbent developed with sorption enthalpy of -65 kJ/mol and projected working capacity and capital cost at scale consistent with $100/t CO2 removed	Quarter 3
Define optimal carbon material for resistive heating, as well as loading and maximum contactor height	Quarter 2
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 > 5,000 m2/m3	Quarter 4
Demonstrate 95% CO2 purity in the outlet stream using synthetic air with 400 ppm CO2.	Quarter 7

Success Criteria

Provide 2 weeks of operating data using outdoor air. Target productivity is 1.5 kg CO_2 per kg sorbent per day. Target purity is >95 mol% CO_2 using real air. Target energy consumption is < 4 GJ_e/tonne CO_2. 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.

Team and Facilities

Georgia Tech Team

Christopher Jones

Ryan Lively

Matthew Realff

Facilities

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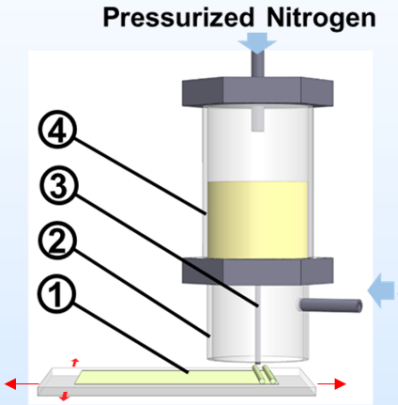

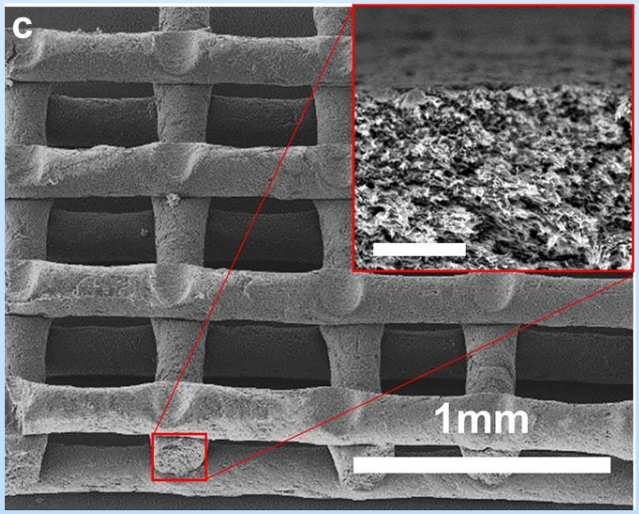

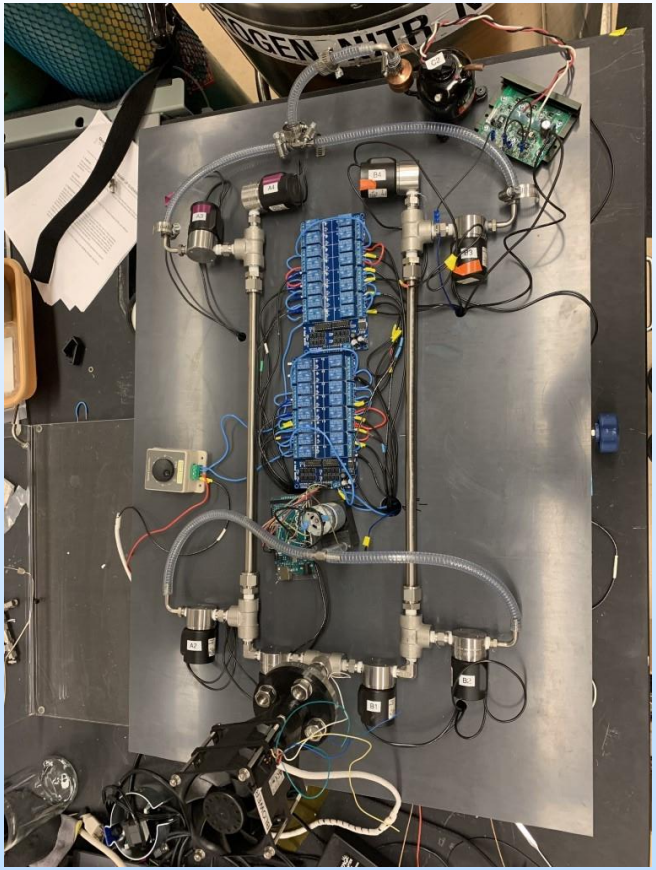

Opportunities for Collaboration

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