Southeast DAC (SEDAC) Hub: An Overview

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Southern States Energy Board

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8 Rivers

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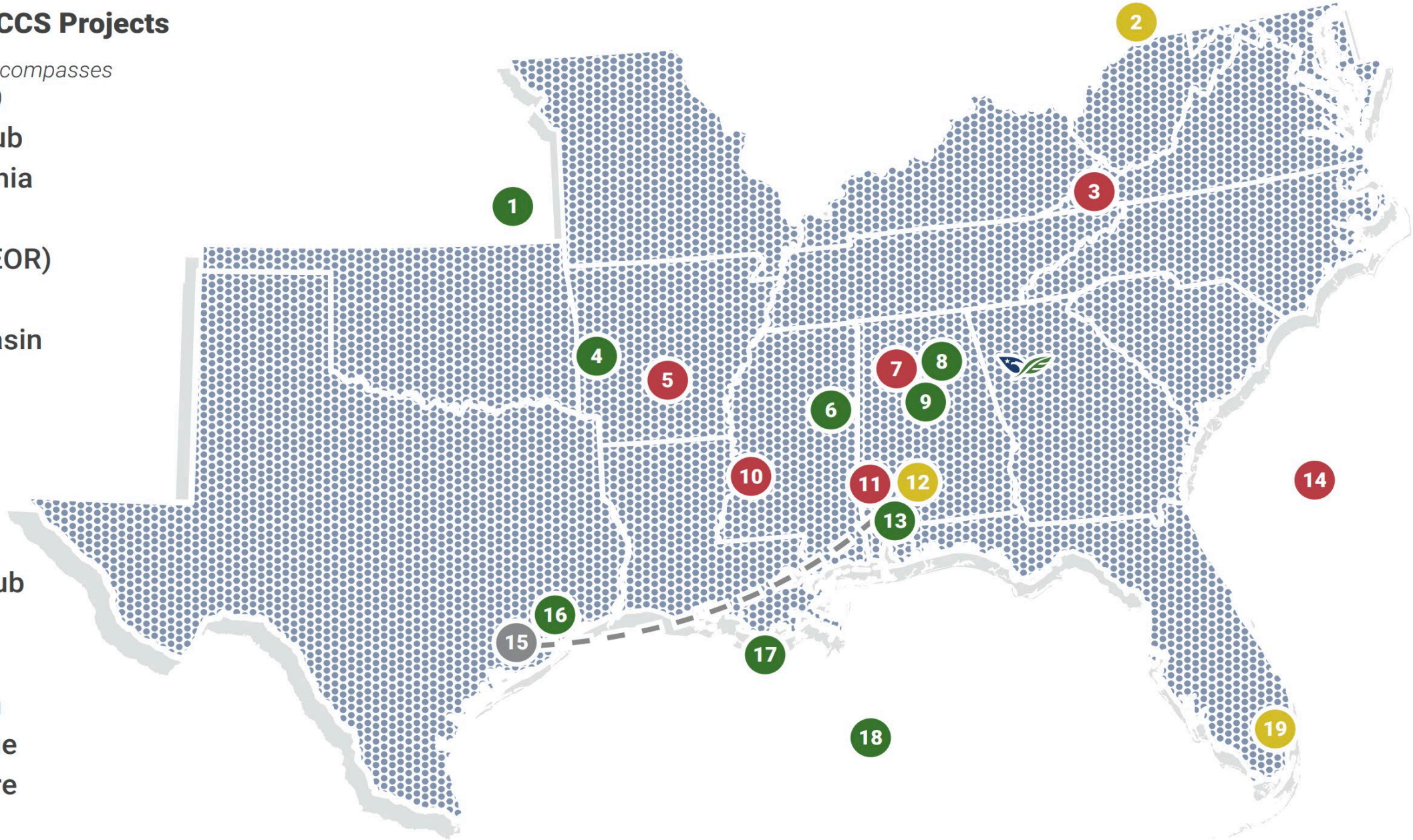
Aircapture

Standard Disclaimer

NATIONAL ENERGY TECHNOLOGY LABORATORY

Current and Former CCS Projects

1. SECARB-USA *(encompasses majority of our region)*
2. Tri-State CCS Hub
3. Central Appalachia
4. Foreman FEED
5. Arkansas (CO_2-EOR)
6. Kemper County
7. Black Warrior Basin
8. Project OASIS
9. NCCC (DAC)
10. Cranfield
11. Citronelle
12. SEDAC Hub
13. Longleaf CCS Hub
14. SOSRA
15. Petra Nova
16. Univ. of Houston
17. Project Lochridge
18. SECARB Offshore
19. Project ACCESS

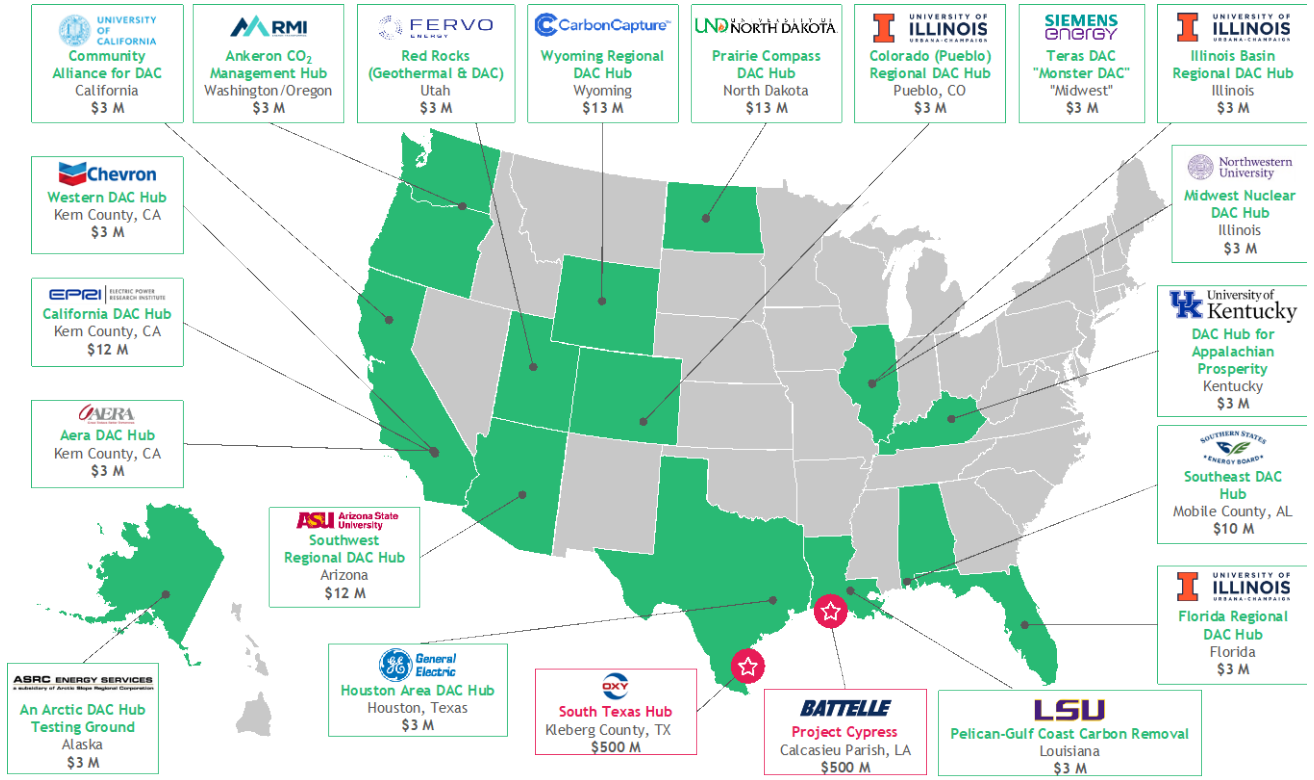


Open Project Under Negotiation

Closed Project Technology Transfer

DAC Hubs – An Overview

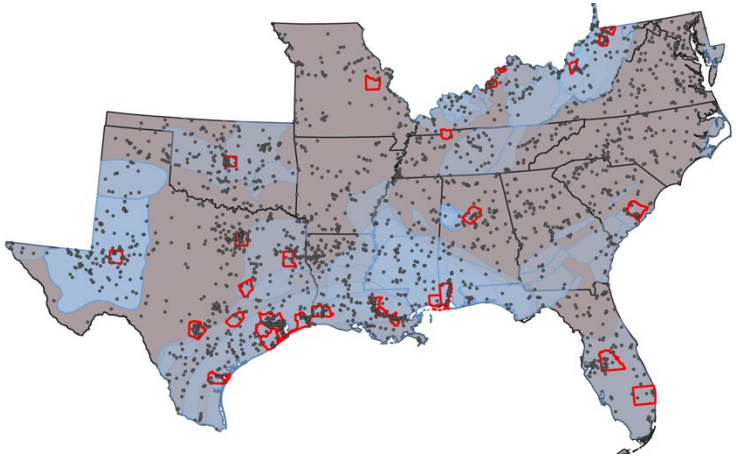
- Funding opportunity included three topic areas and closed March 13, 2023
  - TA-1: Feasibility (14)
  - TA-2: Design (5)
  - TA-3: Development (2)
- In total, 21 hub selected for negotiation
- Initial federal investment more than $1.1 billion USD
- Opportunity to advance to subsequent phases



Locations of the selected DAC Hubs across all topic areas. Figure courtesy of Mike Matson, Boston Consulting Group.

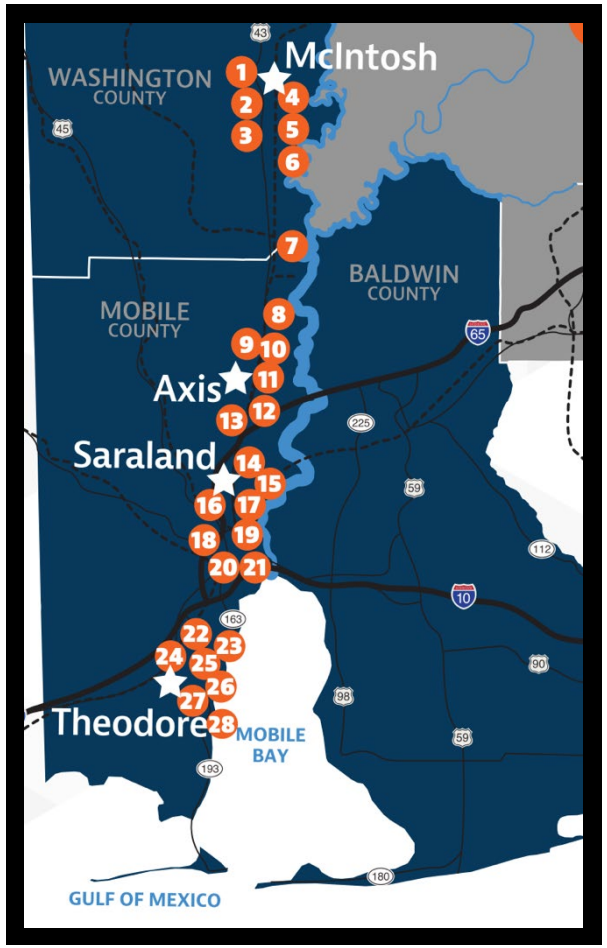
Motivation - Southeast Direct Air Capture (SEDAC) Hub

- Initial screening for potential project locations
  - Existing carbon-intensive fuel production or industrial capacity
  - Distressed communities
  - Potential for geologic storage
- Mobile County, Alabama
  - Growing chemical corridor, emissions more than 11 MMTPA, potential end use opportunities
  - Proven storage potential
  - Appropriate conditions, resources
    - Weather, land availability, access to water, Class VI permits



Initial target locations for the DAC Hub based on information available in the 2022 Notice of Intent.

Alabama's MAST chemical corridor.

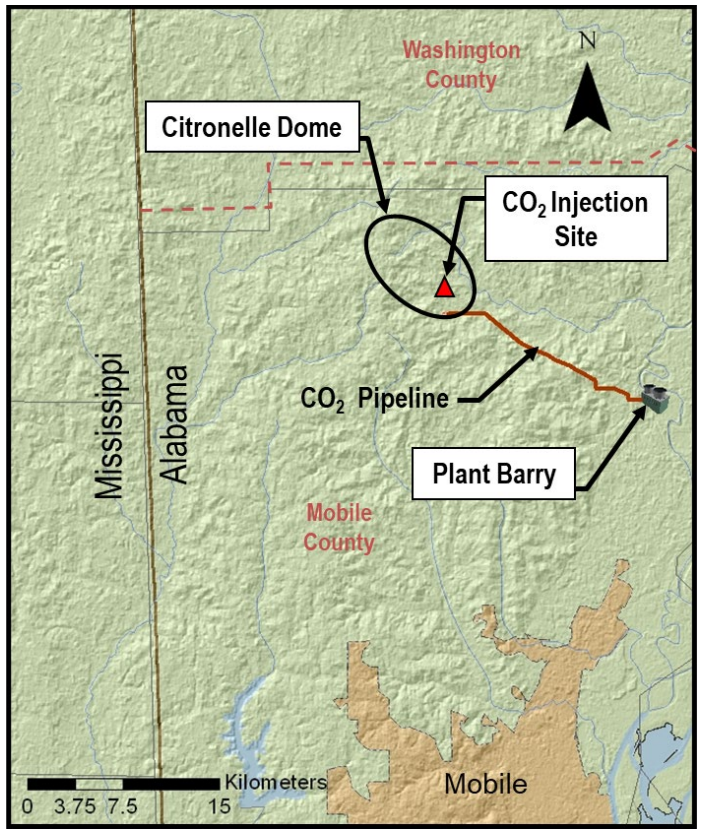


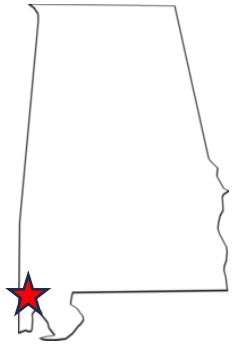
Transcending Boundaries

SECARB Anthropogenic Test Overview

- 25 MW capture unit at Alabama Power's Plant Barry (500 metric tons per day)
- Four-inch, 12-mile CO_2 pipeline
- Injection August 2012 to September 2014
- 114,104 metric tons of CO_2 injection under Class V
- Post-Injection Site Care Period 9/2014 to 5/2018
  - Permit closure in May 2018
  - Based on monitoring and modeling results

SECARB Anthropogenic Test Footprint



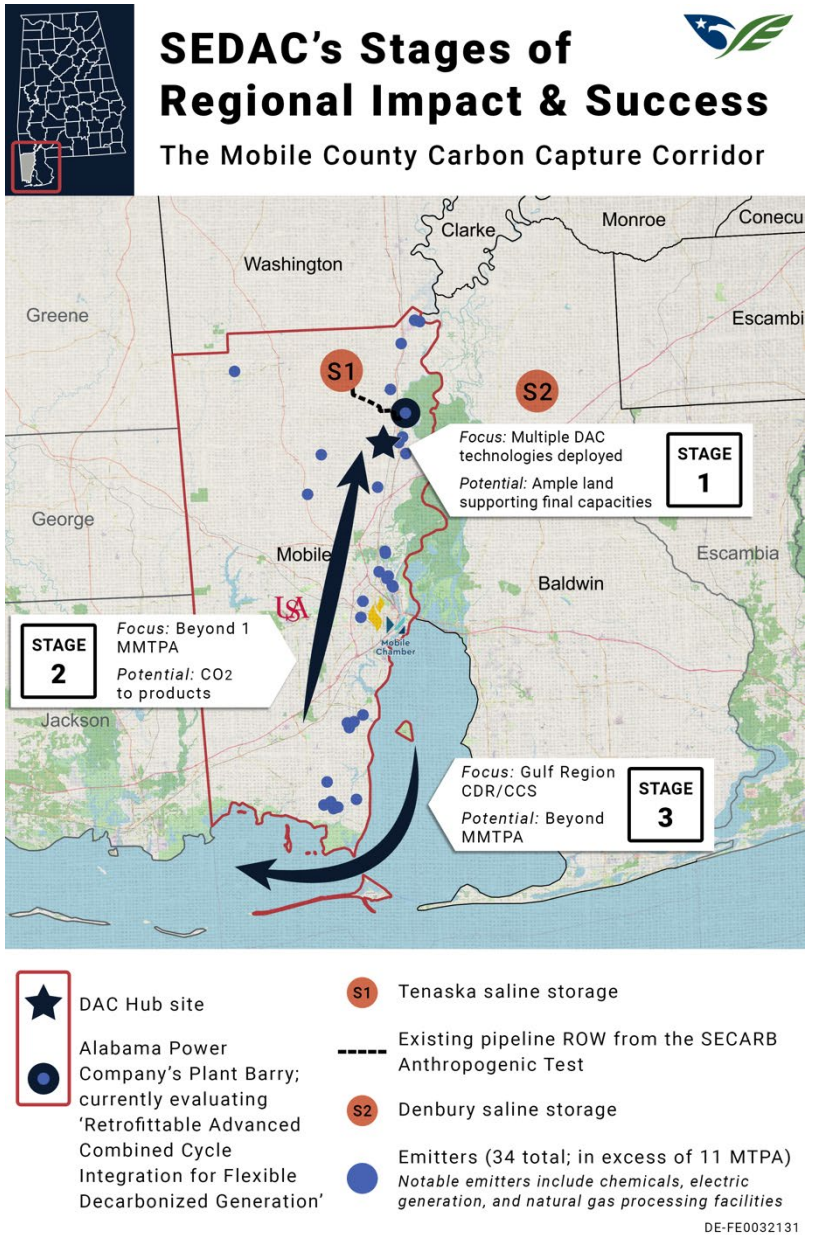


Transcending Boundaries

SEDAC Hub

Duration: 24 months
Overall Budget: $20,484,466
Cost-Share: $10,242,234

- FEED study in support of initial capacities for each technology (50 KTA, each)
- Adaptable design
- Expand capacities and utilize surrounding land, explore various use cases in industrial corridor
- Support existing workforce development in the area and beyond
- Utilize input from stakeholders to inform project planning and decision making, establish framework to support community interests outside of DAC



Objectives and Tasks

Establish the groundwork necessary to support DAC deployment in Mobile County, AL and the Gulf South more broadly

-Tasks-

Task 1 – Project Management

Task 2 – Community Benefits

Task 3 – Business Development

Task 4 – Engineering, Procurement, Construction, and Operations

Task 5 – Safety, Security, and Regulatory Requirements

Task 6 – Risk Analysis and Mitigation

Task 7 – Technical Data and Analysis

Rendering of the SEDAC Hub site at the 50 KTA scale (100 KTA total) for the 8 Rivers (left) and Aircapture (right) technologies

U.S. Department of Energy (DOE)
National Energy Technology Laboratory (NETL)

Southern States Energy Board (SSEB)

Lead PI: Kenneth Nemeth
Co-PI/Project Coordinator: Kimberly Sams-Gray, Ben Wernette, PhD
Key Personnel: Nicholas Kaylor, PhD
Tasks: 1, 2, 3, 4, 5, 6

8 Rivers (8RC)
Personnel: Adam Goff, Mario Guagnelli, Dan Kulikowski, Nicole Patterson, Rick Douglas
Tasks: 1, 2, 3, 4, 5, 6, 7

Aircapture (AC)
Personnel: Matt Atwood, Martha Goodell, Andy Louwagie, Joshua Miles, Rachel Smith
Tasks: 1, 2, 3, 4, 5, 6, 7

Crescent Resource Innovation (CRI)
Personnel: Brian Hill
Tasks: 1, 2, 3, 5, 6

ENTECH
Personnel: Pamela Tomski
Tasks: 2

Georgia Tech (GT)
Personnel: Comas Hayes, Jennifer Hirsch, Matthew Realff, Ruthie Yow
Tasks: 2, 3

Mitternight
Personnel: Lance Covan, Richard Fumoso
Tasks: 4

Research Triangle International (RTI)
Personnel: Pradeepkumar Sharma, Mustapha Soukri
Tasks: 7

University of Alabama (UA)
Personnel: Shahriar Amini,
Tasks: 2, 3

U. South Alabama (USA)
Personnel: J'oel Billingsley, Steve Duff, Steve Scyphers, Matthew Reichert
Tasks: 2

Stakeholder Network

Community
Community Members
Elected Officials
Mobile Chamber of Commerce
CO_2 Utilization
CarbonBuilt
Site Host
Alabama Power
CO_2 Storage Providers
Tenaska
Denbury
Technical Support
Southern Company Services
Other
Ansys
Corning
Carmeuse
Denominator
Frontier
Global Thermostat
Origen
Solid Carbon Products
Twelve

Vendor Arrangements

SSEB → Environmental Resource Management (Task 5)
8RC → Kiewit (Task 4.1)
AC → Mitternight (Task 4.2)

HBCU Network

ENTECH → HBCU Internships
GT → HBCU DAC Ed Capacity Building

Prime and Subrecipients

Task		8 RIVERS	Aircapture	CRESCENTRI	entech strategies	Georgia Tech	MITTERNIGHT	RTI INTERNATIONAL	THE UNIVERSITY OF ALABAMA	USA
1 - Project Management & Planning	✔	✔	✔	✔						
2 - Community Benefits Plan	✔	✔	✔	✔	✔	✔			✔	✔
3 - Business Development & Management	✔	✔	✔	✔		✔			✔	
4 - Engineering, Procurement, Construction, & Operations	✔	✔	✔				✔			
5 - Safety, Security, & Regulatory Requirements	✔	✔	✔	✔						
6 - Risk Analysis & Mitigation	✔	✔	✔	✔						
7 - Technical Data & Analysis		✔	✔					✔		

Actions to Date

- Coordinate the negotiation process
- Georgia Tech held DAC and Environmental Justice workshop on April 16, 2024
  - Local and regional Environmental Justice leaders participated in panel discussions and shared experiences
- SEDAC CBP team met with local Environmental Justice leaders in Mobile, AL on May 30 and 31, 2024
  - Mobile Environmental Justice Action Coalition
  - The Nature Conservancy
  - Partners for Environmental Progress
  - National Estuary Program
  - Local Academic Partners

Promotional material for the GT Advancing DAC for Community Benefit and Decarbonization Workshop. Keynote speaker, Dr. Simone Stewart, shown in the bottom right.

DAC in the Context of Environmental Justice in the Southeast panel. From left to right: Jay Bassett, Gary Harris, Dr. Yomi Noibi, Janelle Wright, and Dr. Erica Holloman-Hill.

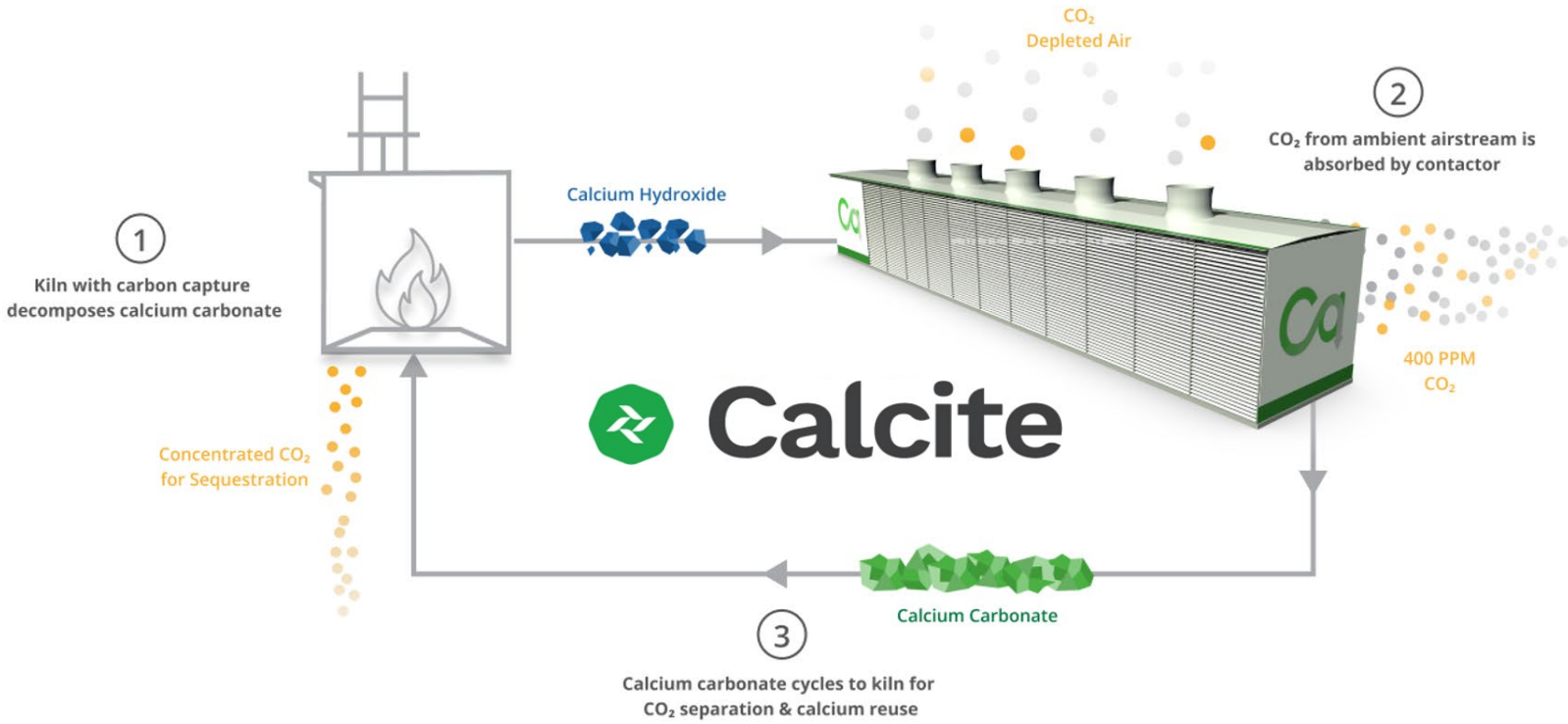
8 Rivers

Calcite

Lime-Based Direct Air Capture Technology

What is it?
Low-cost and low-complexity Direct Air Capture system using the calcium cycle

How does it work?
Calcite captures carbon from the air by accelerating CO_2 absorption properties of calcium hydroxide



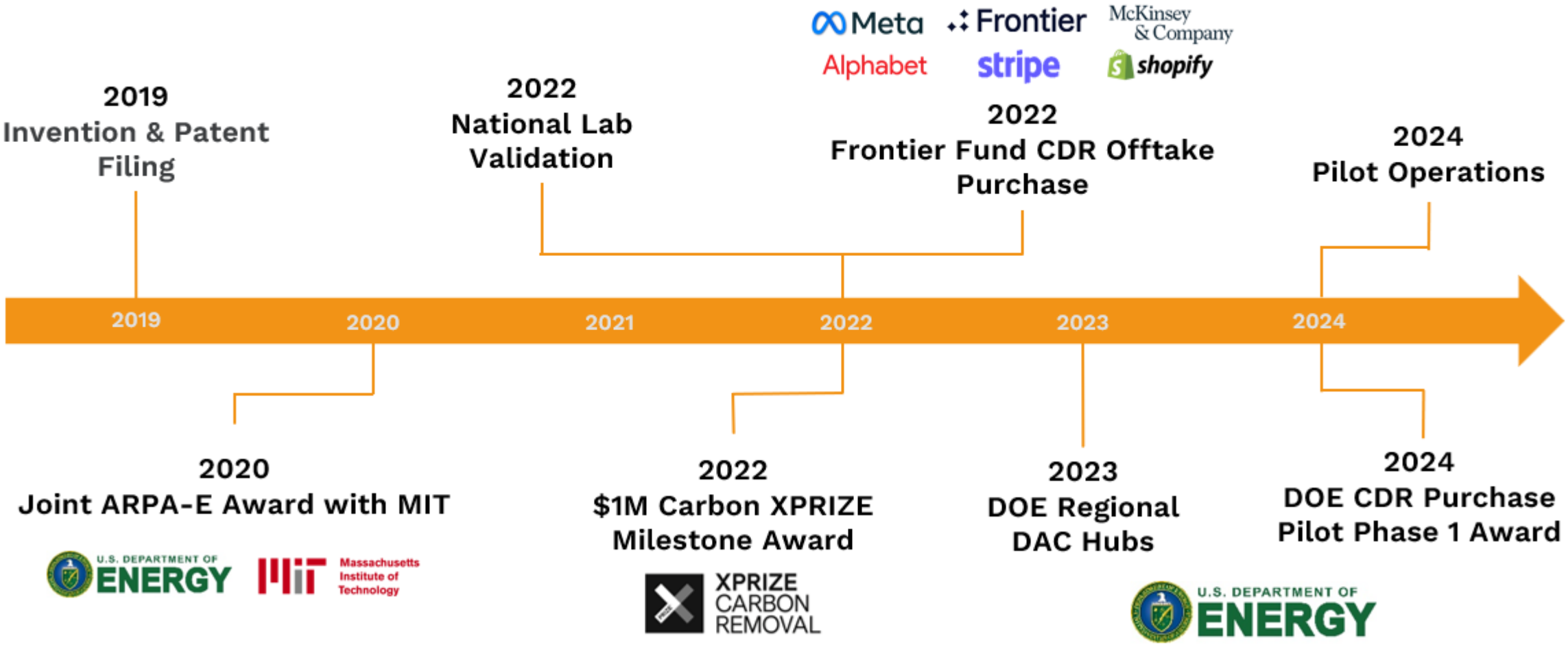
Simple. Scalable. Durable.

Transcending Boundaries

8 Rivers

Calcite

The History of Calcite



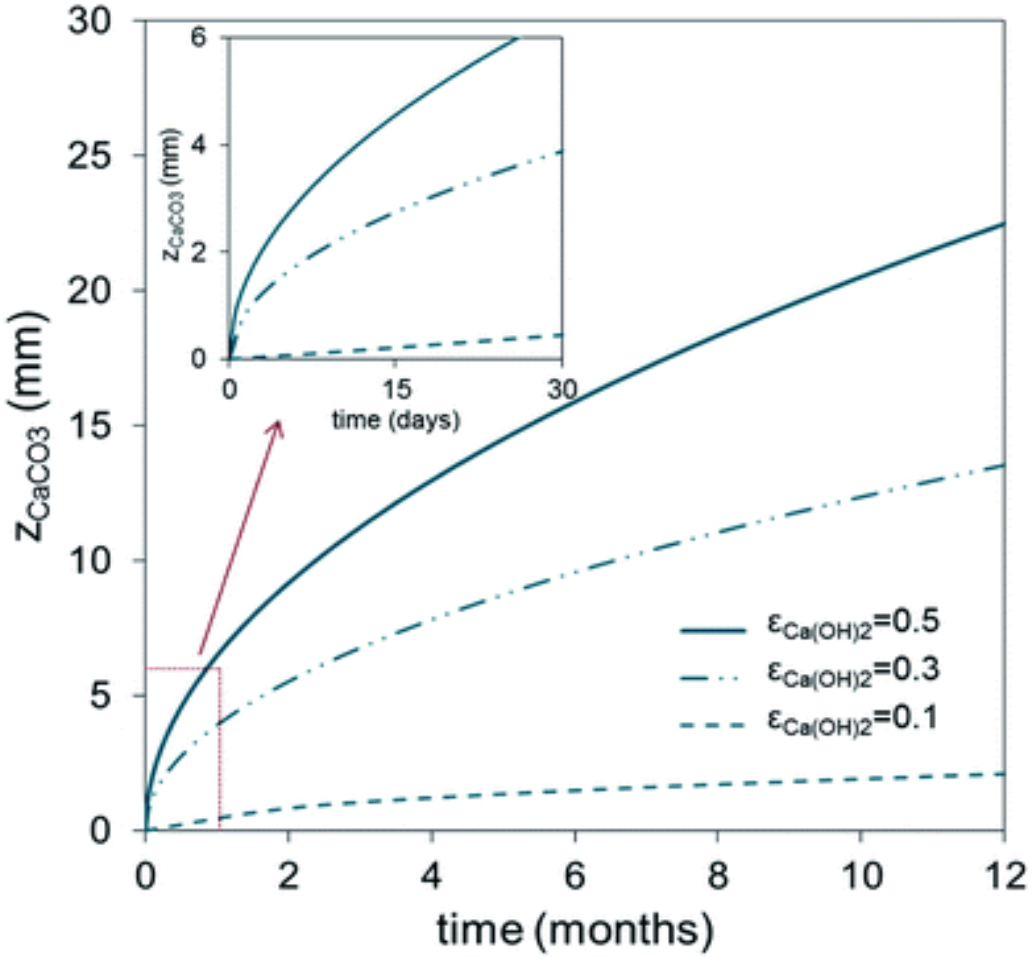
Transcending Boundaries

8 Rivers

Calcite

Calcite:
Thin-layer solid calcium-based DAC

Reduces rate-limiting diffusion gradient through solid phase, while minimizing particulate generation



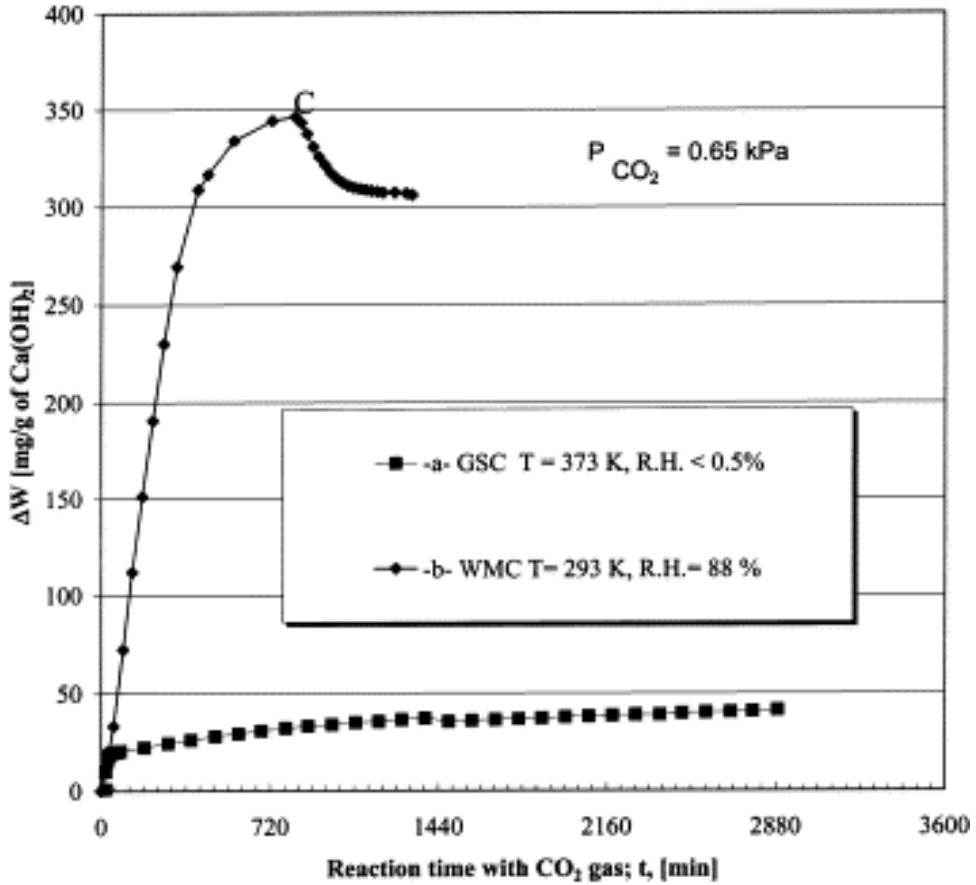
J. Carlos Abanades, Yolanda A. Criado, Jose R. Fernandez,
An air CO2 capture system based on the passive carbonation
of large Ca(OH)2 structures (2020)

8 Rivers

Calcite:
Thin-layer solid calcium-based DAC

Calcite

Enables wide range of control of airflow conditions to maximize operational efficiency



Dario Beruto, Rodolfo Botter
Liquid-like H2O adsorption layers to catalyze the Ca(OH)2/CO2 solid–gas reaction and to form a non-protective solid product layer at 20°C (2000)

8 Rivers

Calcite

Low Risk

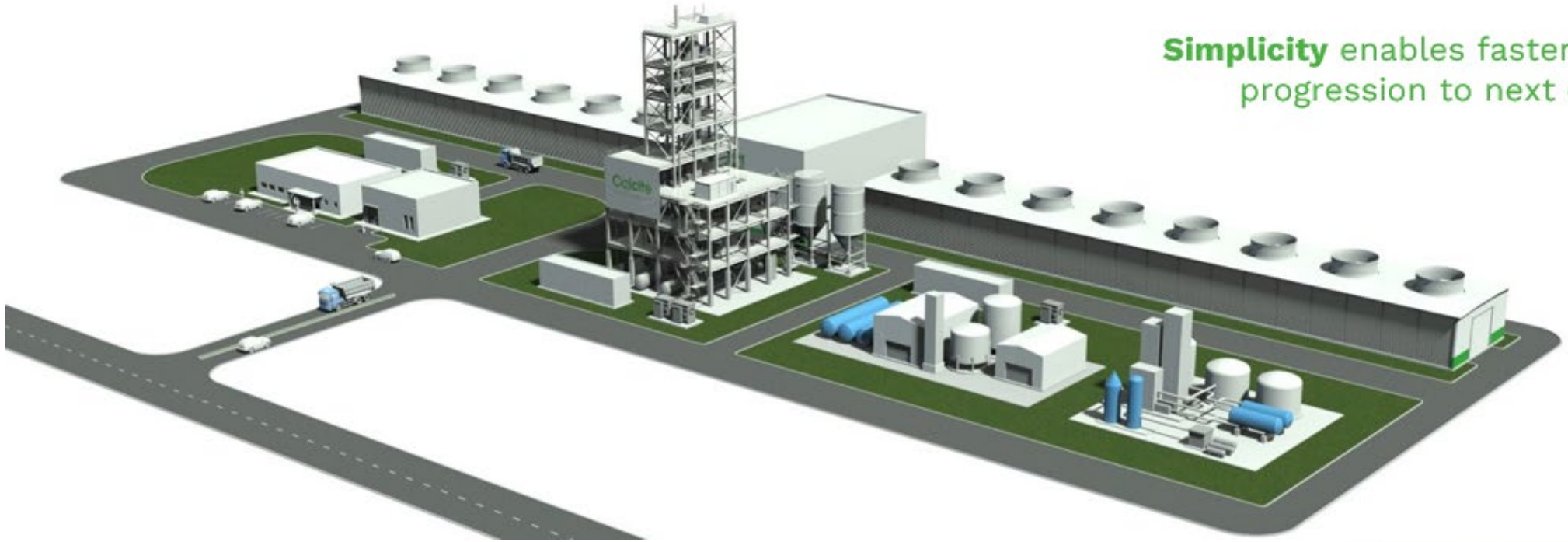
- Key equipment is widely used & limestone is abundant
- Validation by US National Laboratory confirmed carbonation performance

Low Complexity

- No complicated components, new catalysts, or materials
- Leverages the well understood calcium cycle

Low Cost

- Minimizes redundant CapEx for sorbent processing equipment
- Vertical scalability of contactor reduces land use per ton DAC

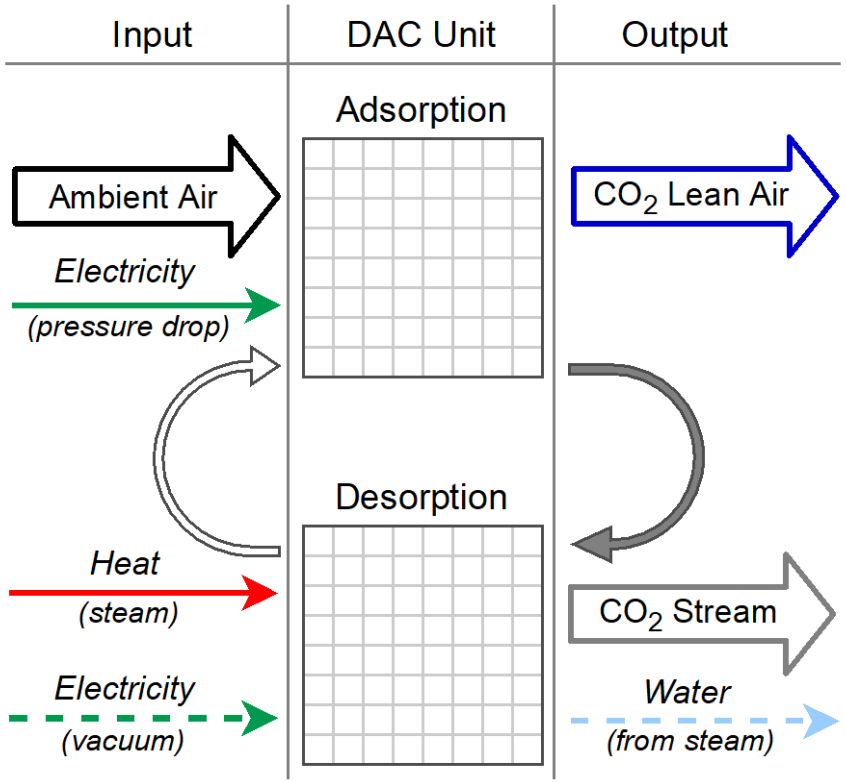


Simplicity enables faster scale-up and progression to next of-a-kind

Aircapture Technology Background

Step 1 (Capture): CO_2 is collected by moving air or mixtures of air and CO_2 rich gases across a proprietary contactor which adsorbs CO_2.

Step 2 (Regeneration): The contactor is moved into a regeneration box where low-temperature steam flows across the contactor, removing CO_2 from the contactor, and the CO_2 is collected.



Goal: Use commercially available contactors and sorbents in an efficient system design to decrease the cost of DAC.

Polymeric Amine Sorbent

Monolithic Contactor

- Low pressure drop
- Low thermal mass
- High geometric surface area
- Compatible with various construction methods

Adsorption

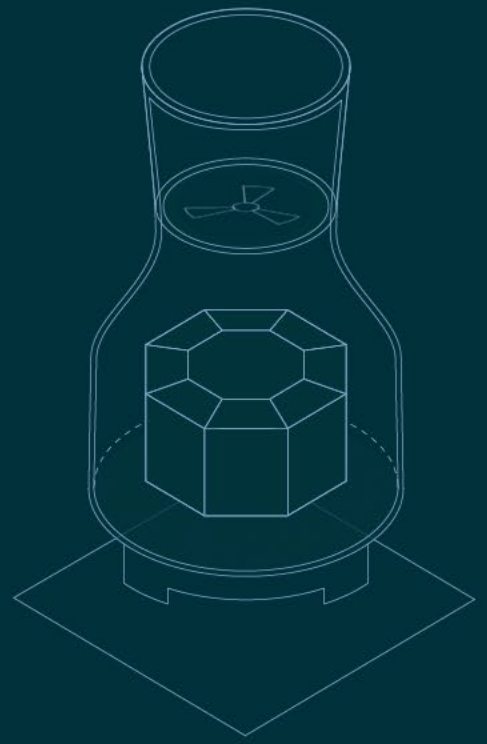
- 900 seconds / monolith in ambient air

Desorption

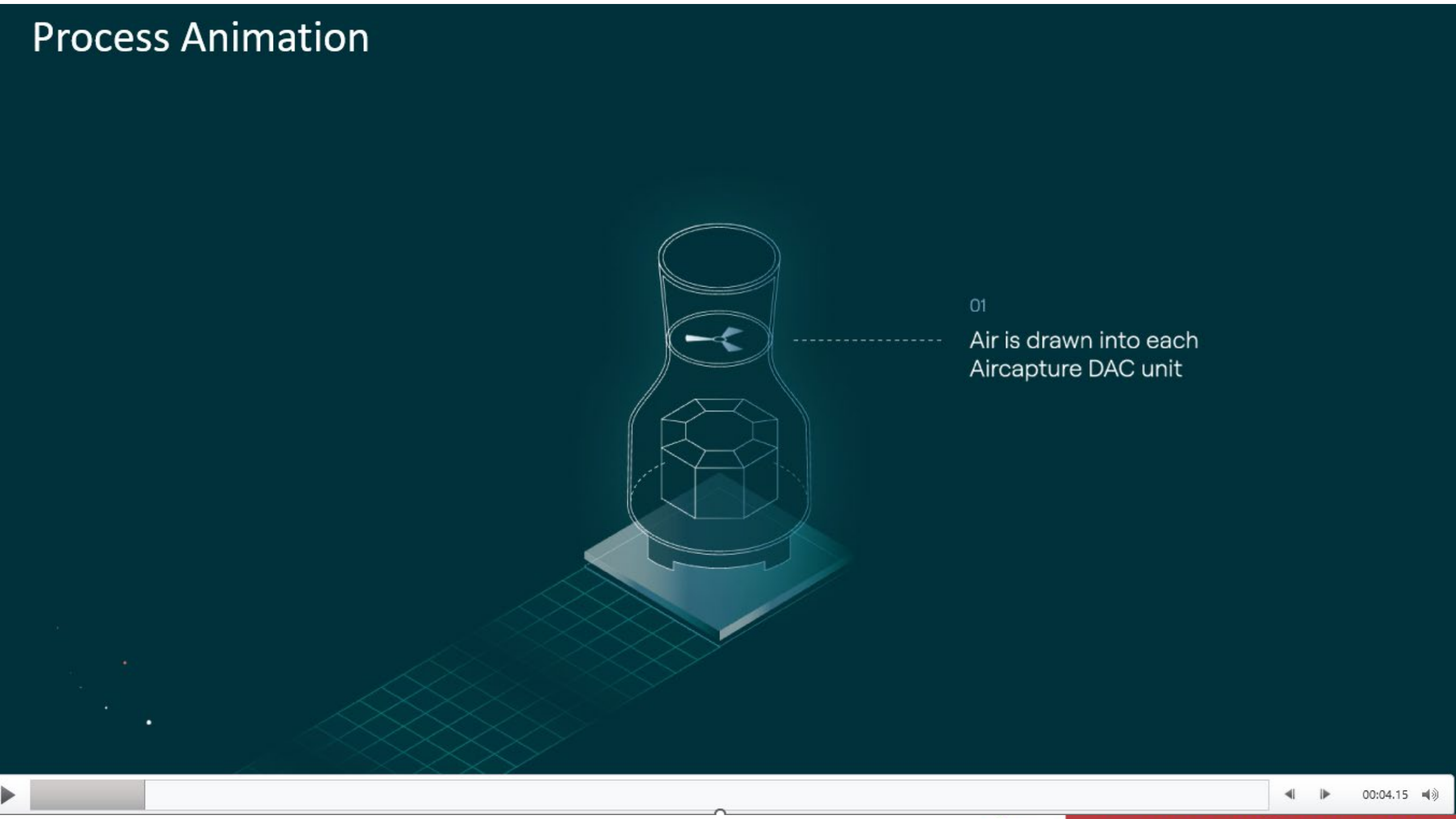
- Saturated Steam in less than 90 seconds

Aircapture

Process Animation



Process Animation

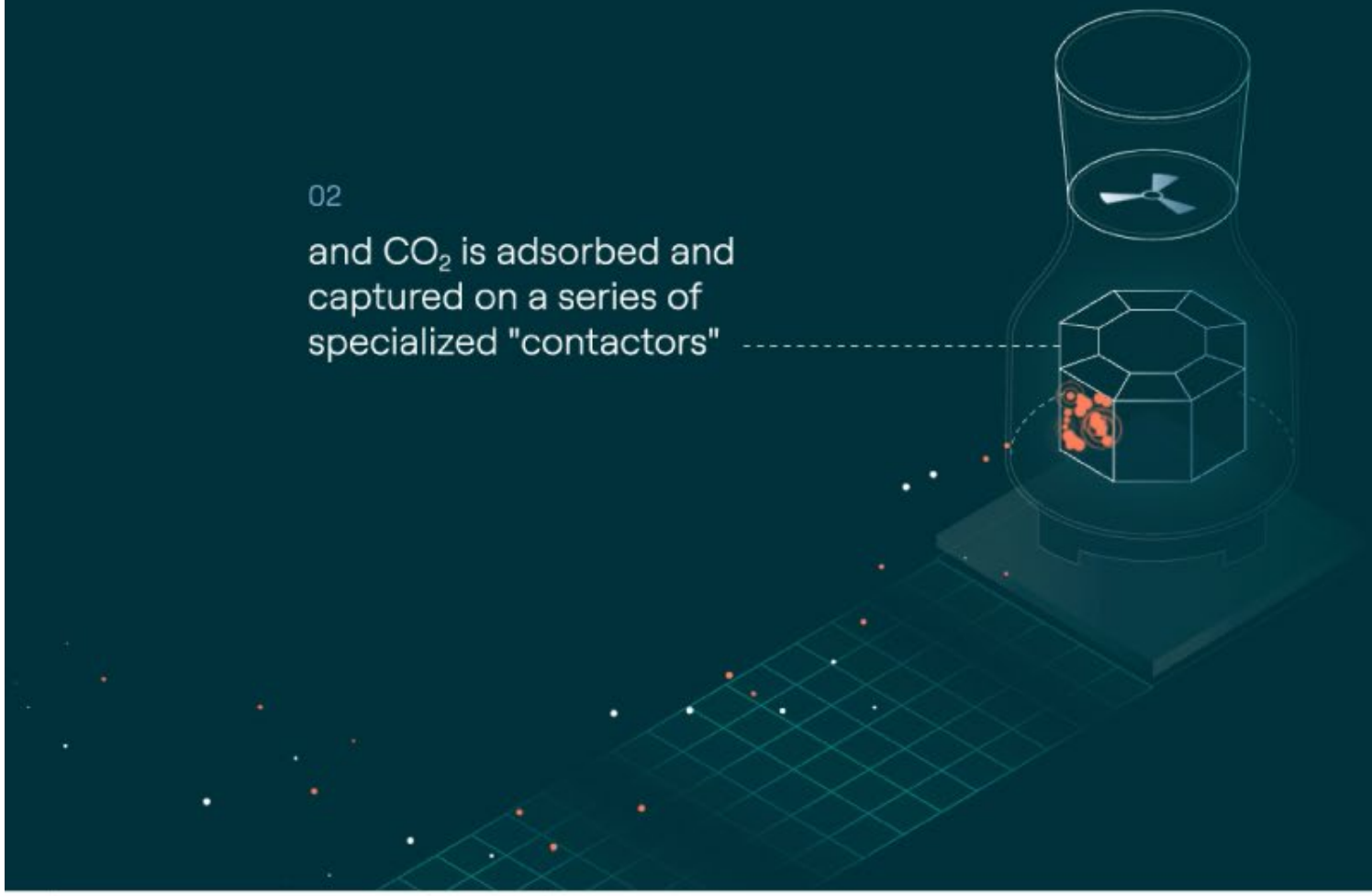


00:04.15

Process Animation

02

and CO_2 is adsorbed and captured on a series of specialized "contactors"



00:11.42

Process Animation

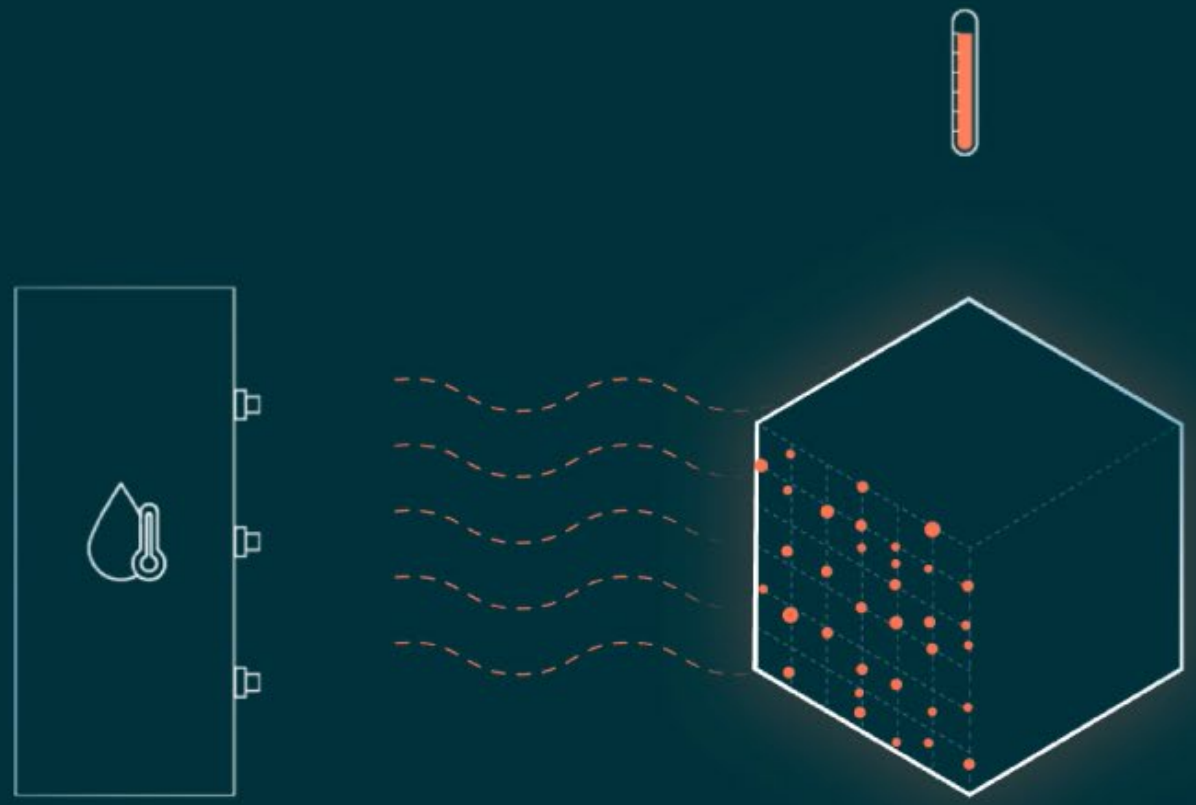
02

and CO_2 is adsorbed and captured on a series of specialized "contactors"

03

as the now CO_2-depleted air returns back to our atmosphere.

Process Animation



04

Once our contactors are saturated with CO_2, steam releases the pure CO_2

00:24.57

Process Animation

00:28.52

Process Animation

05

as a reliable stream of high quality, gaseous CO_2

00:32.71

Process Animation




for a variety of direct applications or sequestration.

Aircapture NETL Projects

- DE-FE0031961 DAC RECO$_2$Up – Decrease cost of capture through testing of existing DAC materials in integrated field unit that produce concentrated CO_2 stream of at least 95%
  - October 2020 through July 2024
  - $2,500,000 Fed Share, $635,805 Cost Share

- DE-FE0032157 ChemFADAC – Front End Engineering Design Study for Direct Air Capture Systems at Existing Domestic Industrial Plant with CO_2 Conversion Producing Low Carbon Intensity Products
  - September 2022 through September 2024
  - $2,9,43,828 Fed Share, $759,480 Cost Share

- DE-FE0032160 NuDACCS – Define system costs, performance, socio-economic impacts and business case options for leveraging available thermal energy from the nuclear plant to separate CO_2 from ambient air for off-site geologic storage
  - October 2022 through September 2024
  - $2,499,178 Fed Share, $864,446 Cost Share

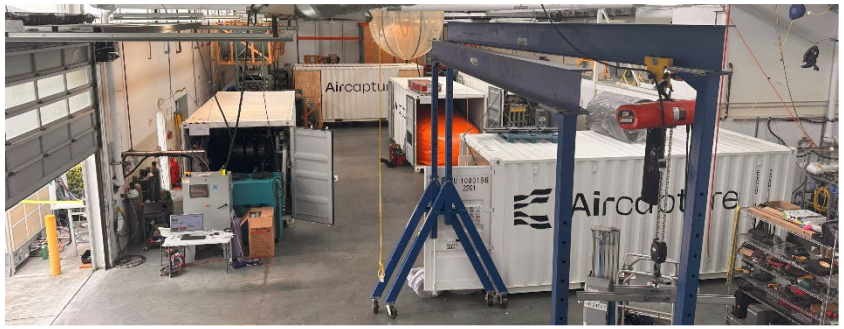
- DE-FE0032414 CO_2eMeOH – Asses the feasibility of generating carbon-neutral electrochemical methanol
  - December 2023 through December 2024
  - $396,996 Fed Share, $138,292 Cost Share

Aircapture Scale-Up/Testing

TRL 7+ achieved for DAC technology by Q4 2024

SN1: NCCC, Wilsonville, AL
March 2023 to July 2024
5 Campaigns, +140 days of operations, >92% uptime (DE-FE0031961)

SN3: Aircapture Berkeley, CA April 2024
>50% CAPEX Reduction
>20% OPEX Reduction



Project Hajar, 8 SN3 DACs + Supporting Skids June 2024
Proving out DAC Grove concept first designed in DE-FE0032160 & DE-FE0032157

Aircapture

Transcending Boundaries

Thanks!

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