

September 2024

Point Source Carbon Capture Program Update

Tim Fout, Program Manager, Point Source Carbon Capture



U.S. DEPARTMENT OF
ENERGY

Fossil Energy and
Carbon Management



FECM's Office of Carbon Management

Focused on minimizing the environmental and climate impacts of fossil fuels and industrial processes, while working to achieve net-zero GHG across our economy

The Office of Carbon Management Technologies

Leads and invests in research, development, demonstration, and deployment across five divisions...



Hydrogen with Carbon Management



Carbon Transport and Storage



CO₂ Removal and Conversion



Integrated Carbon Management



Point-Source Carbon Capture



The Office of Strategic Planning, Analysis, and Engagement

Leads in strategic activities and international, domestic, and intergovernmental coordination across two divisions...



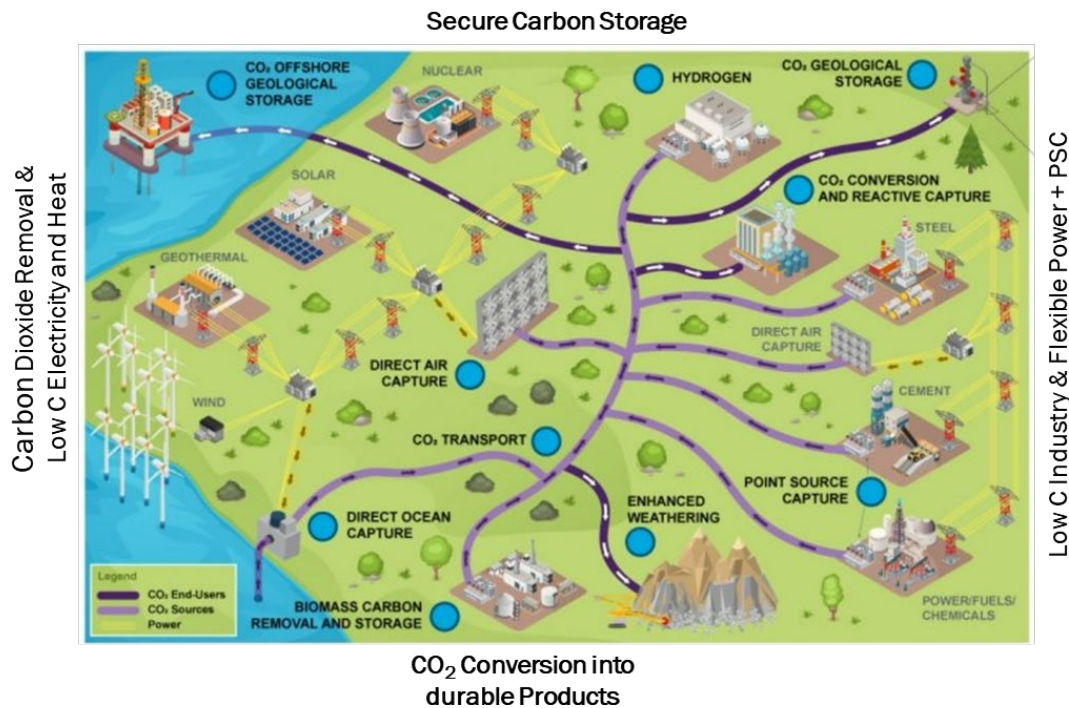
Systems, Economic, and Environmental Analysis



Strategic Engagement

PSC Strategic Vision

Support demonstration of first-of-a-kind carbon capture on power and industrial sectors coupled to dedicated and reliable carbon storage, that will lead to commercially viable carbon hub opportunities for widescale deployment and facilitate a carbon-free economy by 2050, emphasizing robust analysis of life cycle impacts, and understanding air/water quality impacts.



Focus Area 1: Support Power Retrofit Demos

- Enabling technologies

Focus Area 2: Net Zero, Flex Power

- Technology development to support flexible CCS with high capture efficiency
- FEEDs to seed the formation of Carbon Hubs.

Focus Area 3: Support Industrial Retrofit Demos

- Enabling technologies

Focus Area 4: Integrated decarbonized industrial + CCS

- Technology development for integrated decarbonized industrial processes coupled with transformational CCS
- FEEDs to seed the formation of Carbon Hubs.

Carbon Capture Program: *Evolution*

1st and 2nd Generation Technologies

2025: \$40/tonne CO₂



2008 -

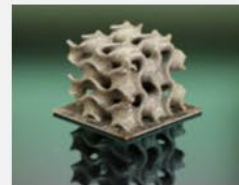
- ✓ Lower CAPEX/OPEX
- ✓ Reduced regeneration energy
- ✓ Increased working capacity

Transformational Technologies

2030: \$30/tonne CO₂



Hollow Fibers



3D Print



Biphase Solvent

2015 -

- ✓ Water Lean Solvents
- ✓ Adv. Membranes
- ✓ Hybrid Systems
- ✓ Process Intensification

Scale-up

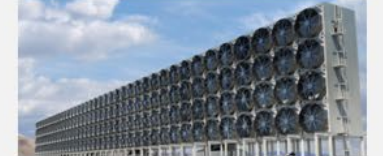


TCM

2018 -

- ✓ Engineering Scale testing
- ✓ FEED studies

Industrial, NG, CDR & CCS Demos



Carbon Engineering, DAC



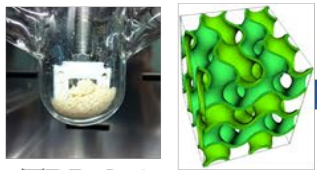
Ethanol Plant

2020 -

- ✓ CDR: DAC & BiCRS
- ✓ Industrial, NG
- ✓ CCS Demos

◆ FECCM Point Source Carbon Capture

Lab & Bench



TRL 2-4

Small Pilots



TRL 4-5

Large Pilots

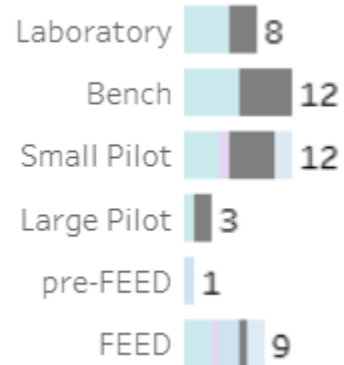


TRL 5-7

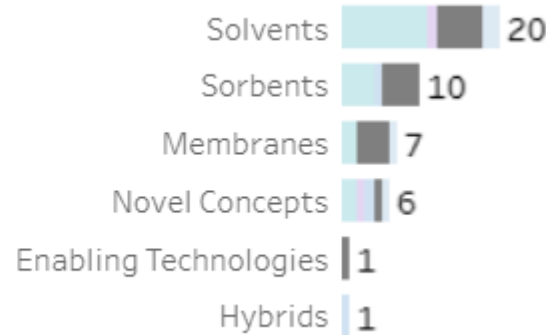
FEED Studies



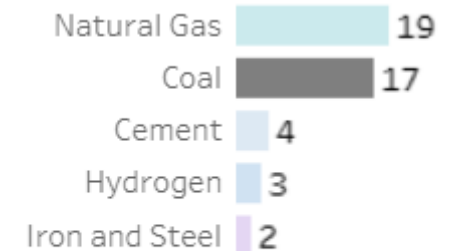
Ending Scale



Key Technology



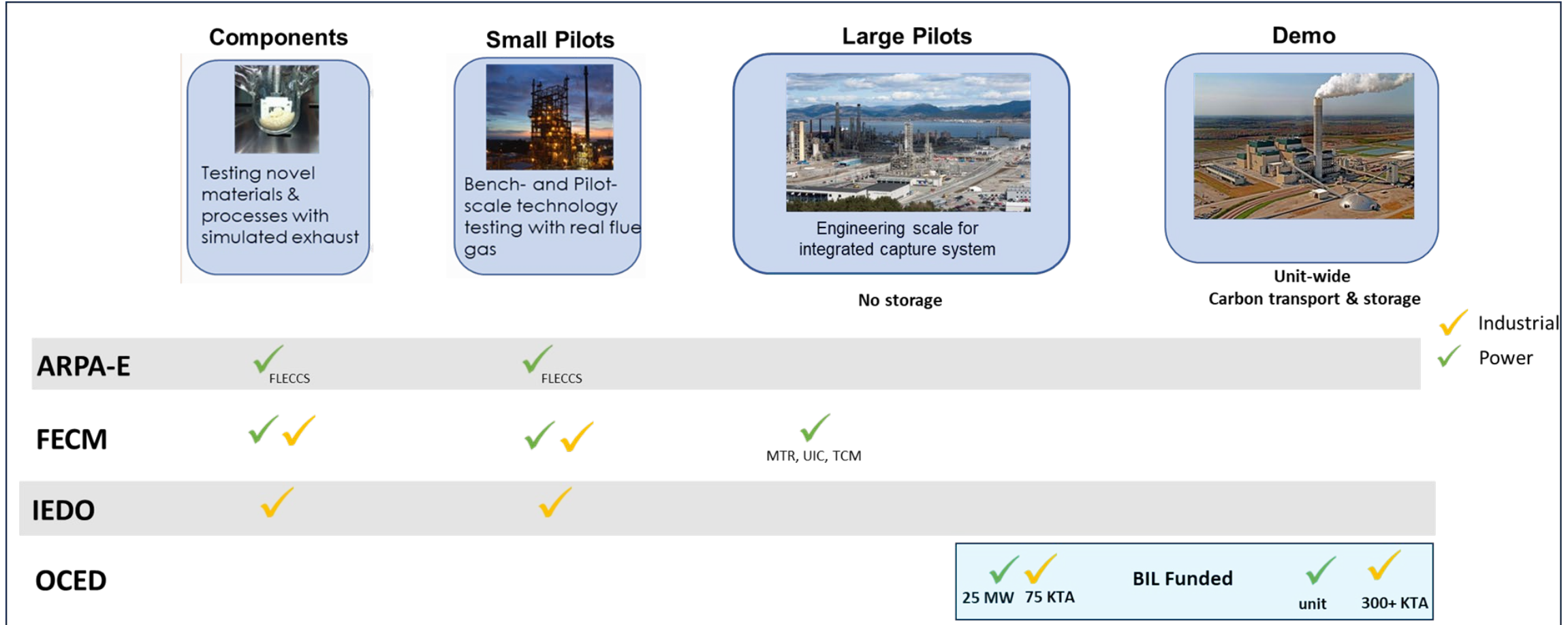
Application Type



[Point Source Carbon Capture Project Map | netl.doe.gov](https://www.netl.doe.gov/Point-Source-Carbon-Capture-Project-Map)



DOE Point Source Carbon Capture Portfolio



ARPA-E: Advanced Research Program Agency – Energy
OCED: Office of Clean Energy Demonstration

FECM: Fossil Energy and Carbon Management;
IEDO: Industrial Efficiency & Decarbonization Office



Imminent small pilots FECM/NETL

- Honeywell-UT Advanced Solvent – TCM
- PNNL EEMPA – NCCC
- SRI Mixed Salt – NCCC
- Linde/BASF OASE Blue – Dahlman Plant, IL
- ION ICE-31 – Los Medanos Energy Center, CA
- MTR Membrane – WITC

Construction status as of 7-29-24



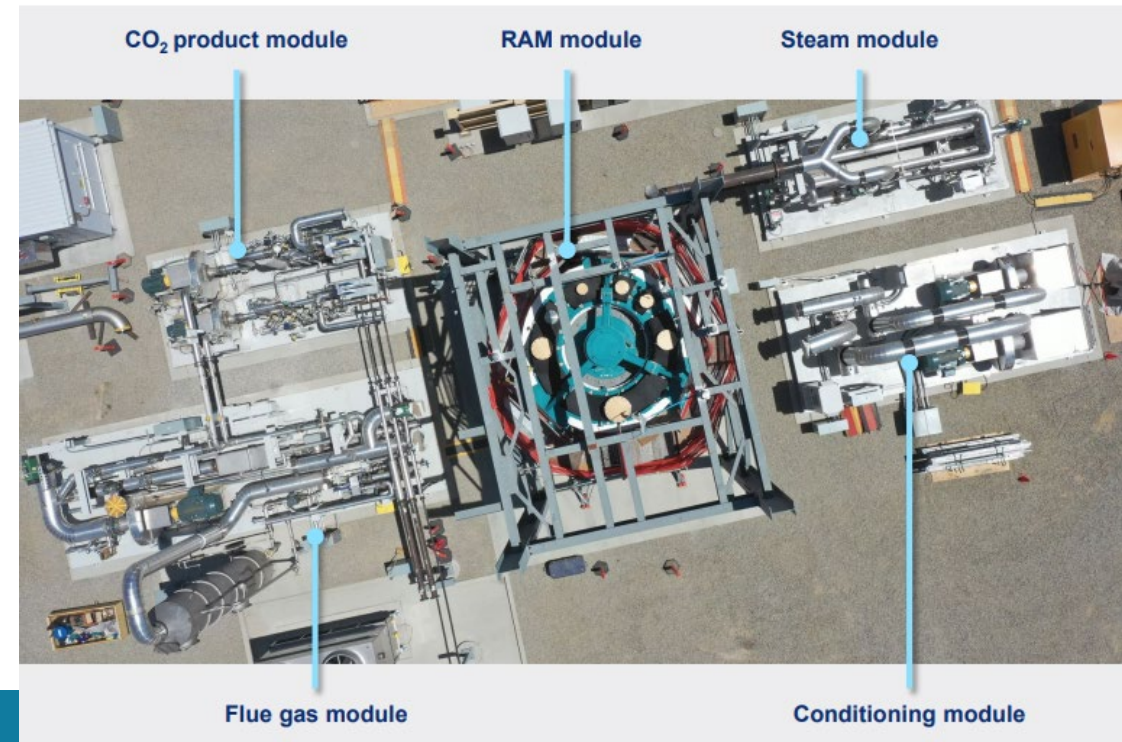
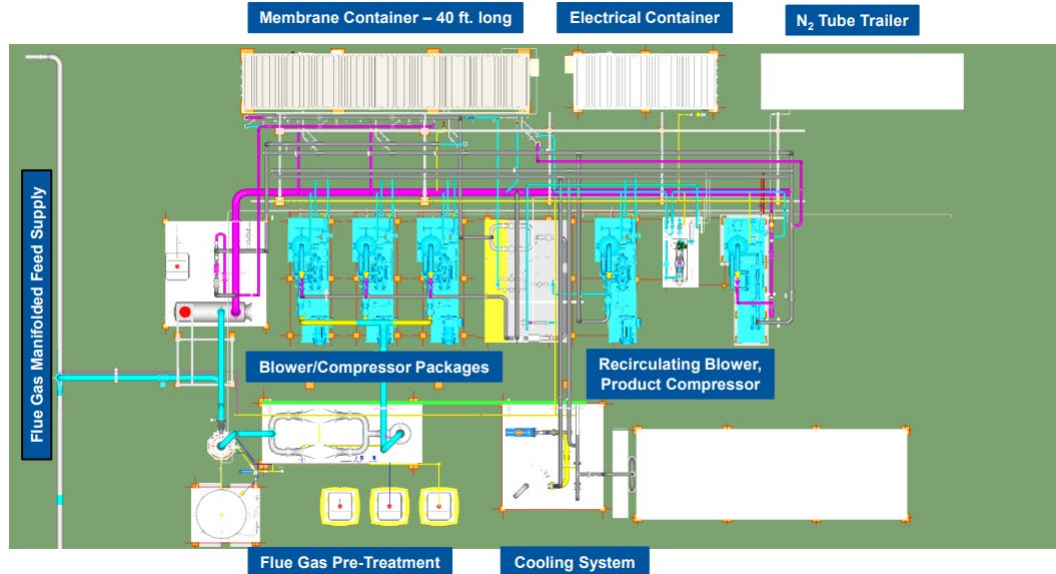
Linde-BASF w
UIUC



Image courtesy of Southern Company Services
PSDF at NCCC





Next small pilots FECCM/NETL

- SES, Cryogenic – Sugar Creek Cement Plant, MO
- University of Kentucky, Solvent – Nucor Steel
- Chevron, Svante Sorbent – Kern River, CA
- GTI, OSU Membrane - WITC





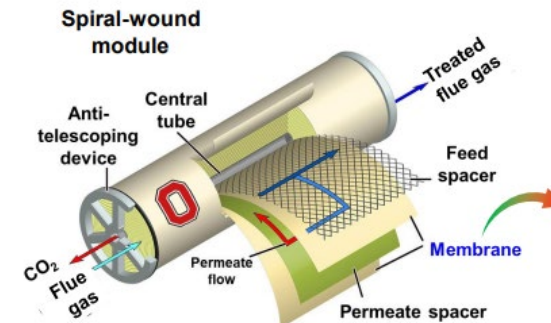
FOA 2614 – Release 3.. AOI-3A Selections



AOI	Applicant	Material/Process	Industry / Conditions	Prior / Related Work
3A		Generation III facilitated transport membrane	Pilot at Holcim's Holly Hill Cement Plant Holly Hill, SC 22% CO ₂ Flue Gas 3 Ton CO ₂ /day	DE-FE0007632 – membrane development DE-FE00026919 – process development DE-FE00031731 – testing at NCCC
		2 nd generation UKy amine-based solvent Innovative UKy process with split rich feed to the stripper	Pilot at Vitro Architectural Glass- Meadville Flat Glass Plant , Cochranton, PA High H ₂ O, SO ₂ , NO _x and CO ₂ concentration (30-50 vol% H ₂ O, 13-32 vol% CO ₂ , depending on controlled air ingress to the flue gas)	DE-FE0007395 – power-based pilot testing DE-FE0032133 – steel production pilot test low concentration gas stream
		Hybrid approach MTR's advanced Polaris membrane and TDA's advanced sorbent	Pilot at Argos Cement Plant, Harleyville, SC	DE-FE0031596 – membrane/process development DE-FE0031949 – FEED for cement membrane-only application DE-FE00031603 - hybrid system testing @ TCM
		ROTA-CAP absorber / desorber	Pilot at U.S. Steel's Edgar Thomson , Braddock, PA. Blast furnace based process 95% Capture 3 Ton CO ₂ /day	DE-FE00031630 – bench scale testing on real flue gas at NCCC

FOA 2614 – Release 3.. AOI-3C Selections

AOI	Applicant	Material/Process	Conditions	Prior / Related Work
3C	 THE OHIO STATE UNIVERSITY	three-stage membrane process Gen 3 facilitated transport membrane (amine-containing polymer into a thin-film composite (TFC) membrane)	5 TPD engineering-scale carbon capture system for NGCC at WITC 95% Capture > 95% CO ₂ purity	Bench scale validation at NCCC DE-FE0007632, DE-FE0026919, and DE-FE0031731 CO ₂ permeance of 4,200 GPU) CO ₂ /N ₂ selectivity of 160
		SUSTENOL™ : mixed amine water-lean solvent with amino acid salt (potassium lysinate) promotor; reduced solvent make-up rate, reduced emissions and 2.2 GJ/ton	5 tonne CO ₂ /day, Pilot at NCCC	Non-DOE bench scale validation





OCED Large Carbon Capture Pilots: Selections

	Sector	Fuel	Host Site	Capacity	Carbon Capture Technology
PPL Corporation	Electricity Generation	NG	Cane Run Generating Station, PPL Corporation, Louisville, Kentucky	Up to 67 kTA CO ₂	UKy, Solvent 95% Capture
TDA Research	Electricity Generation	Coal	Basin Electric's Dry Fork Power Station	Up to 158 kTA CO ₂	TDA, Sorbent >90% Capture
Delek US Holdings	Refinery	Crude Oil	Delek's Big Spring Refinery, an oil refinery in Big Spring, Texas	145 kTA CO ₂	Svante, Sorbent
RTI International	Pulp and Paper	Biomass & Fossil	Vicksburg Containerboard Mill, Vicksburg, Mississippi	120 kTA CO ₂	RTI, Solvent

<https://www.energy.gov/oced/CCpilots>



Other Efforts

- Phase 1 Chemical Looping/Oxy for Industrial
 - Paper/feasibility studies with limited testing
 - Down-select for Phase 2



- FOA 2614 Round 5 Enabling Technology Projects
 - Soon to be selected
- FOA 3219 IEDO/FECM Industrial Decarbonization Projects
 - Soon to be selected



Funding Opportunity Announcement DE-FOA-0002614 “Carbon Management (ROUND 6)”

- AOI-1F. Reactive Carbon Capture Approaches for Point Source Capture or Atmospheric Capture with Integrated Conversion to Useful Products
- AOI-3F: Engineering-Scale Testing of Transformational Carbon Capture Technologies for Natural Gas Combined Cycle (NGCC) Power Plants
- AOI-3G: Engineering-Scale Testing of Transformational Carbon Capture Technologies in Portable Systems at Industrial Plants
- AOI-3H-a: Initial Engineering Design Studies for Carbon Capture Systems at Existing (Retrofit) Domestic NGCC Power Plants
- AOI-3H-b: Initial Engineering Design Studies for Carbon Capture Systems at Hydrogen Production Facilities Using Coal, Mixed Coal/Biomass, or Natural Gas Feedstock



Funding Opportunity Announcement DE-FOA-0003365 “Carbon Capture, Removal, and Conversion Test Centers”

AOI 1: Carbon Capture, Removal, and Conversion Test Center at an Electric Generating Unit

AOI 2: Enabling Capital Improvements at an Existing Carbon Capture Test Center

AOI 3: Carbon Capture, Removal, and Conversion Test Center at a Cement Manufacturing Facility



Carbon capture program: *Outreach*



HIGHLIGHTS
The newsletter is compiled by the National Energy Technology Laboratory to provide information on recent activities and publications related to carbon capture.

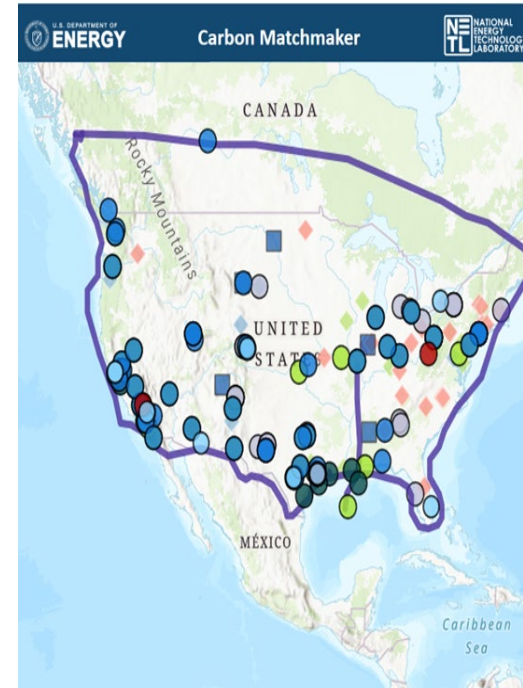
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Carbon Capture Newsletter



Carbon Capture Program R&D Compendium



Carbon Matchmaker



Commercial Liftoff Report

[Pathways to Commercial Liftoff: Carbon Management \(energy.gov\)](https://www.energy.gov/pathways-to-commercial-liftoff-carbon-management)

<https://www.netl.doe.gov/carbon-management/carbon-capture>

<https://www.energy.gov/fecm/carbon-matchmaker>

FECM Point Source Carbon Capture Team

