CO_2 capture - Current/Emerging DOE Activities

USE IT Act Task Forces Meeting
May 22, 2024

NATIONAL ENERGY TECHNOLOGY LABORATORY

Ron Munson
Point Source Carbon Capture
Technology Manager
National Energy Technology Laboratory

Point Source Capture Strategic Vision and Approach

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.

	Components	Small Pilots	Large Pilots	Demo
	 Testing novel materials & processes with simulated exhaust	 Bench- and Pilot-scale technology testing with real flue gas	 Engineering scale for integrated capture system No storage	 Unit-wide Carbon transport & storage
ARPA-E	✓ FLECCS	✓ FLECCS		
FECM	✓ ✓	✓ ✓	✓ MTR, UIC, TCM	
IEDO	✓	✓		
OCED				✓ ✓ 25 MW 75 KTA **BIL Funded** ✓ ✓ unit 300+ KTA

Focus Areas and Recent Activity

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.

FOA 2614 Round 3: Selections announced

Power and Industrial Pilots - Test transformational, carbon capture technologies under real flue gas conditions from gas-fired power production or process streams at an industrial facility

- ✓ *95% or greater carbon capture efficiency/95% CO_2 purity.*
- ✓ *Industrial sectors of interest : (i) chemical production (e.g., petrochemicals) excluding ethanol, ammonia and hydrogen production, (ii) mineral production (e.g., cement and lime), (iii) pulp and paper production, (iv) iron and steel production, (v) glass production, and (vi) oil refining (e.g., catalytic cracker, hydrocracking), excluding steam methane reforming for hydrogen production and natural gas processing.*
- ✓ *design capacity to capture a minimum of 5 (gas) or 3 (industrial tonne CO_2/day.*

FOA 2614 Round 4: Selections announced

AOI 3D: Decarbonization of Industrial Processes Using Oxygen-Based (Oxy-combustion and Chemical Looping) Approaches

- ✓ *Conceptual design studies followed by a laboratory validation of cost-effective processes for employing oxygen-based approaches (i.e., oxy-combustion, chemical looping) that lead to reductions in CO_2 emissions associated with industrial production processes.*
- ✓ *Phased approach is currently planned with a competitive down-select between Phase 1 (Conceptual Design and Feasibility) and Phase 2 (Continuous Lab-Scale Validation)*
  - ✓ Only entities that receive a Phase 1 award will be permitted to submit a Phase 2 renewal application for consideration.

Focus Areas and Recent Activity cont.

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.

FOA 2614 Round 5: Applications received/under review

AOI 3E: Support the development of technologies that enable the scale-up and demonstration of point source carbon capture systems installed at electric generation facilities and industrial facilities

✓ *Technologies of interest include but are not limited to processes and approaches to: (a) reduce carbon capture media degradation; (b) reclaim the degraded carbon capture media; (c) reduce non-CO2 emission through engineering controls (e.g., flue gas pre-treatment, and capture system emissions); and (d) monitor, report, and verify (MRV) non-CO2 emissions.*

FOA 3219 (with IEDO): FOA active

AOI 3 – Integrated Process Pre-FEED

✓ *pre-FEED studies that support the integration of multiple innovative technologies across an industrial process to achieve a combined emissions reduction > 95%.*

✓ *Projects may consider technologies including, but not limited to, carbon capture, clean hydrogen production and storage, energy efficiency, electrification, process feed substitutions, and process heating innovations (e.g., hydrogen).*

Demonstration Scale FEED Studies – Selections for award negotiations

Company	Sector	Fuel	Host Site	Capacity	CO2 Technology
Duke Energy Indiana, LLC	Electricity Generation	Coal/NG	Duke Energy Edwardsport	3.6 MTA CO2	Honeywell, UOP
Entergy Services, LLC	Electricity Generation	NG	Lake Charles Power Station	2.5 MTA CO2	MHI, KS-21
Lehigh Hanson	Cement Production		Mitchell Cement Plant in Mitchell, Indiana	2 MTA CO2	MHI, KS-21
Navajo Transitional Energy Company, LLC (NTEC)	Electricity Generation	Coal	Four Corners Power Plant (FCPP)	10+ MTA CO2	MHI, KS-21
Southern States Energy Board	Cement Production		Ash Grove Foreman Cement Plant, Foreman, Arkansas		Air Liquide's CryocapTM
Taft Carbon Capture, LLC	CHP	NG	Taft cogeneration power plant	3 MTA CO2	Post combustion capture, solvent
Tampa Electric Company	Electricity Generation	NG	Polk Power Station in Mulberry, Florida	3.7 MTA CO2	ION, post combustion capture
University of Illinois at Urbana-Champaign	Electricity Generation	Coal	Dallman 4, PC coal power plant at City Water, Light and Power in Springfield, Illinois	2 MTA CO2	Linde-BASF
MTR	Electricity	Coal	Dry For Power Station, Gillette,	2.2 MTA CO2	MTR

Selections for Large Pilots and Demonstrations

	Sector	Fuel	Host Site	Capacity	Carbon Capture Technology
PPL Corporation	Electricity Generation	NG	Cane Run Generating Station, PPL Corporation, Louisville, Kentucky	90 kTA CO2	UkY
TDA Research	Electricity Generation	Coal	Basin Electric's Dry Fork Power Station	158 kTA CO2	TDA, Carbon Sorbent
Delek US Holdings	Refinery	Crude Oil	Delek's Big Spring Refinery, an oil refinery in Big Spring, Texas	145 kTA CO2	Svante,
RTI International	Pulp and Paper	Biomass & Fossil	Vicksburg Containerboard Mill, Vicksburg, Mississippi	120 kTA CO2	RTI,

	Sector	Fuel	Host Site	Capacity	Carbon Capture Technology
Calpine Texas CCUS Holdings Calpine	CHP	NG	Baytown Energy Center, Baytown, TX	2 MTA CO2	Shell
Dakota Carbon Center East Project LLC	Electricity Generation	Coal	Milton R. Young Station near Center, North Dakota	4 MTA CO2	MHI
Sutter CCUS LLC / Calpine	Electricity Generation	NG	Sutter Energy Center, Yuba City, CA	2 MTA CO2	ION

Carbon Dioxide Removal Program…Mission

- **Mission**
  - Research, develop, and demonstrate advanced cost-effective carbon dioxide removal (CDR) technologies to support just and sustainable decarbonization pathways
  - Develop robust techno-economic and lifecycle analyses (TEA/LCA) and tailored monitoring, reporting, and verification (MRV) methods

- **Drivers/Challenges**
  - Reduce capital & operating costs across a broad CDR technology portfolio (DAC, BiCRS, EW, Mineralization, mCDR)
  - Accelerate demonstration of CDR technologies to aid in gigatonne-scale CO_2 removal by 2050

- **Goal & Metrics**
  - Support U.S. goal to achieve zero-carbon economy by 2050
  - Support DOE's CNS target of secure and scalable CO_2 removal under $100/net metric ton CO_2e within a decade


Direct Air Capture (DAC)


Biomass Carbon Removal and Storage (BiCRS)


Enhanced Weathering (EW)


Marine CDR (mCDR)

CDR Program Updates

- **FOA3082: Carbon Negative Shot Pilots released and closed April 16, 2024**
- **Received Phase 1 applications under the DAC Commercial CDR Purchase Pilot Prize**
- **Five (5) DAC Pre-Commercial EPIC Prize finalists announced**
- **Seven (7) DAC Pre-Commercial Technology Prize semifinalists announced**
- **Award negotiations in progress for FOA2735 TAs 1 & 2**
  - 24-month DAC Hub pre-FEED and FEED studies (50 KTA minimum capacity)
- **FOA2614 AOI 2F & 2G Phase 1 projects awarded. Competitive down-selection for Phase 2**
  - Phase 1 awards span 12/20/2023 – 9/19/2025 to include Admin Period. Phase 2 applications are due 12/19/2024.
- **Phase I SBIR Topics released**
- **RIC implementing Multi-Year Research Plan (MYRP)**
- **OCED RFI (DE-FOA-0003333) Opportunities to Support Mid-scale Commercial Direct Air Capture (DAC) Demonstration Facilities. Closed April 25**
- **NOI Regarding Launching a Voluntary Carbon Dioxide Removal Purchasing Challenge. Accepting comments through May 15**
- **Drafting rules for Commercial DAC Pilot Prize**
- **2024 FECM/NETL Carbon Management Research Project Review Meeting – August 5-9, 2024**

Questions

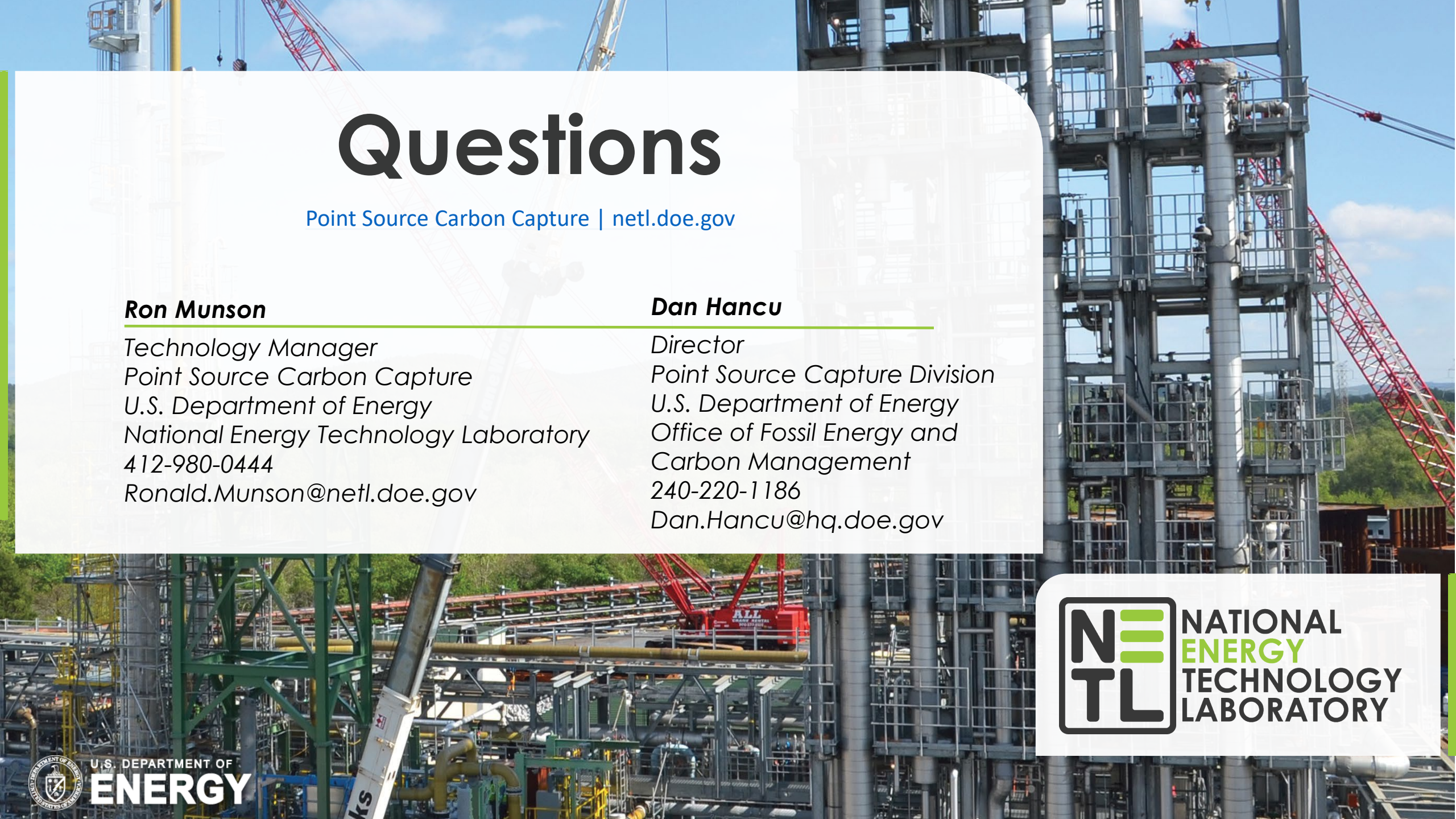
Point Source Carbon Capture | netl.doe.gov

Ron Munson

Technology Manager
Point Source Carbon Capture
U.S. Department of Energy
National Energy Technology Laboratory
412-980-0444
Ronald.Munson@netl.doe.gov

Dan Hancu

Director
Point Source Capture Division
U.S. Department of Energy
Office of Fossil Energy and
Carbon Management
240-220-1186
Dan.Hancu@hq.doe.gov



U.S. DEPARTMENT OF ENERGY

NATIONAL ENERGY TECHNOLOGY LABORATORY

Questions cont.

https://netl.doe.gov/carbon-dioxide-removal

Andrew Jones

Technology Manager
Carbon Dioxide Removal
U.S. Department of Energy
National Energy Technology Laboratory
412-386-5531
Andrew.Jones@netl.doe.gov

Rory Jacobson

Acting Director
Carbon Dioxide Removal and Conversion Division
U.S. Department of Energy
Office of Fossil Energy and Carbon Management
760-216-9596
Rory.Jacobson@hq.doe.gov

U.S. DEPARTMENT OF ENERGY

NATIONAL ENERGY TECHNOLOGY LABORATORY