



# 45Q and Commercialization Opportunities for CCUS

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# Economic Incentives - 45Q



- The Bipartisan Budget Act of 2018 was passed by congress and signed by the President on February 9<sup>th</sup>, 2018. Included in the Act was the **F**urthering carbon capture, **U**tilization, **T**echnology, **U**nderground storage, and **R**educed **E**missions (FUTURE Act). The FUTURE Act provides for tax credits (45Q) for CO<sub>2</sub> capture, utilization, and/or storage.
- 45Q provides a tax credit of
  - \$12.83 per metric ton captured rising to \$35 per metric ton captured in the next 10 years for CO<sub>2</sub> utilization. Credit is indexed to inflation after 10 years
  - \$22.66 per metric ton captured rising to \$50 per metric ton captured in the next 10 years for geologic storage without utilization. Credit is indexed to inflation after 10 years
- Original planning and design includes carbon capture equipment
  - 25,000 t/CO<sub>2</sub> captured and used or facilities that emit less than 500,000 tons
  - 500,000 t/CO<sub>2</sub> captured for electric generating facilities
- Construction must begin prior to January 1, 2024
- Credit is received for a 12–year period after equipment is originally placed in service
- Credit may be transferred from capture to utilization or storage
- IRS to provide guidelines on program specifics

# 45Q Update – Key Dates



- **February 9, 2018**
  - The Bipartisan Budget Act of 2018 (the ACT) was passed by Congress and signed by the President
- **May 2, 2019**
  - Internal Revenue Service (IRS) released Notice 2019-32 requesting comments on anticipated regulations and other guidance under section 45Q of the Internal Revenue Code
- **June 16, 2019**
  - Last date to submit comments under Notice 2019-32 (45 days)
- **November 12-14, 2019**
  - Multiple conversations on current status of IRS
    - DOE had expected initial guidance to be released prior to end of year – currently concerned that date may slip into 2020
- **November 19, 2019**
  - Representative Terri Sewell (D-AL) introduced the Carbon Capture and Sequestration Extension Act that provides for a one-year extension of the federal Section 45Q tax credit from January 1, 2024 to January 1, 2025
  - Ways and Means Committee Chairman Richard Neal (D-MA) and Ways and Means Subcommittee on Select Revenue Measures Chairman Mike Thompson (D-CA) include the 45Q extension in the Discussion Draft of the Growing Renewable Energy and Efficiency Now (GREEN) Act
- **December 31<sup>st</sup>, 2023**
  - Construction must commence prior to January 1, 2024 to qualify for 45Q tax Credits

# Integrated CCUS Project



- Potential Revenue**
- Tax Credits (45Q)
  - Additional Oil Sales (EOR)
  - Storage Fee (Geologic Storage)
  - Value Added Product Sales (Utilization)

## Potential Costs/Expenses

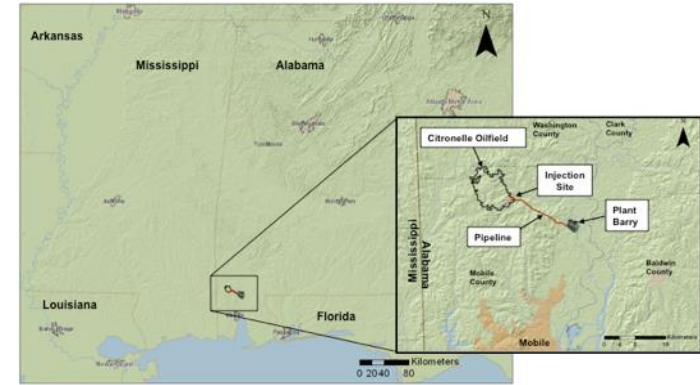
- Characterization and Permitting
  - Class VI for Geologic Storage
- Pore Space Rights
- Capture and Compression
  - Installation and Ongoing Operating Costs
- Pipeline Construction/Operations
- Oil Field Upgrades
  - Well Upgrades/New Drilling
  - CO<sub>2</sub> Separation and Compression
- Closure Costs
- Long Term Monitoring and Liability



# SECARB CCUS Demo



- SSEB's SECARB Demo at Plant Barry (Bucks, AL)
- 25 MW post-combustion slip-stream carbon capture
- 12 mile pipeline to Citronelle, AL for storage
- Potential for EOR



Power Plant



Capture



Transport



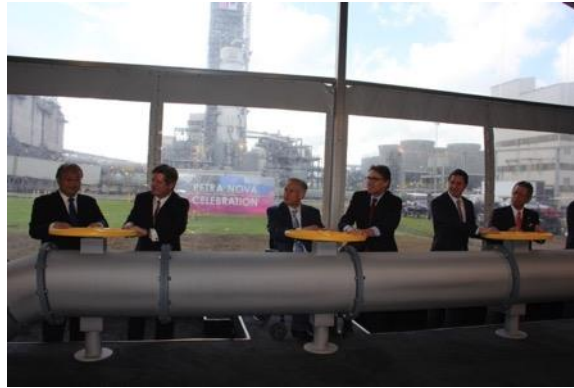
Storage

# Petra Nova- Emergence of CCUS in the South



## SSEB Demo Goes Commercial!

- NRG Energy (Houston, TX)
- Interest in Plant Barry Demonstration
- Plant scale-up to 240 MW
- Post-combustion slip-stream
- Captures 5,200 tons CO<sub>2</sub>/day or 90% of CO<sub>2</sub>
- Pipeline to Petra Nova West Ranch Oil Field (81 miles)
- EOR 300 bbls/day to 15,000 bbls/day!
- 60 million bbls Recoverable Reserves

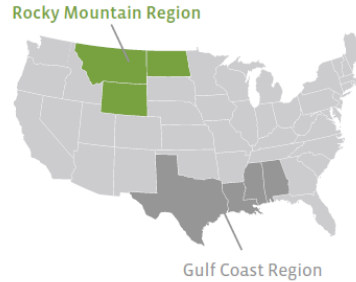


# Denbury Rocky Mountain Projects

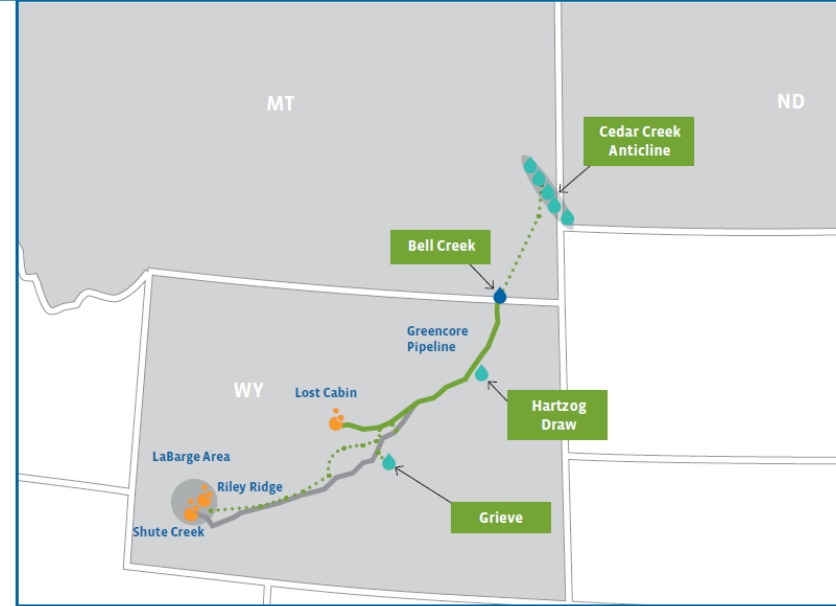


- Finished in 2012, the 20-inch 232-mile Greencore pipeline begins at the ConocoPhillips-operated Lost Cabin gas plant in Wyoming and terminates at Bell Creek Field in Montana.
- In 2014, Denbury completed construction of an interconnect between the Greencore Pipeline and an existing third-party CO<sub>2</sub> pipeline in Wyoming enabling Denbury to transport CO<sub>2</sub> from LaBarge Field to the Bell Creek Field
- In mid-2018, Denbury sanctioned the CO<sub>2</sub> enhanced oil recovery development project at Cedar Creek Anticline (CCA), which requires a 110-mile extension of the Greencore CO<sub>2</sub> pipeline
- First tertiary production from CCA is expected in the second half of 2022 or early 2023

## Rocky Mountain Region: Potential Tertiary Oil Reserves



- Existing Denbury CO<sub>2</sub> Pipelines
- ⋯ Denbury Proposed CO<sub>2</sub> Pipelines
- CO<sub>2</sub> Pipelines Not Owned or Operated by Denbury
- 💧 Denbury CO<sub>2</sub> EOR Fields
- 💧 Denbury Future CO<sub>2</sub> EOR Fields
- 🔴 CO<sub>2</sub> Resources Owned or Contracted

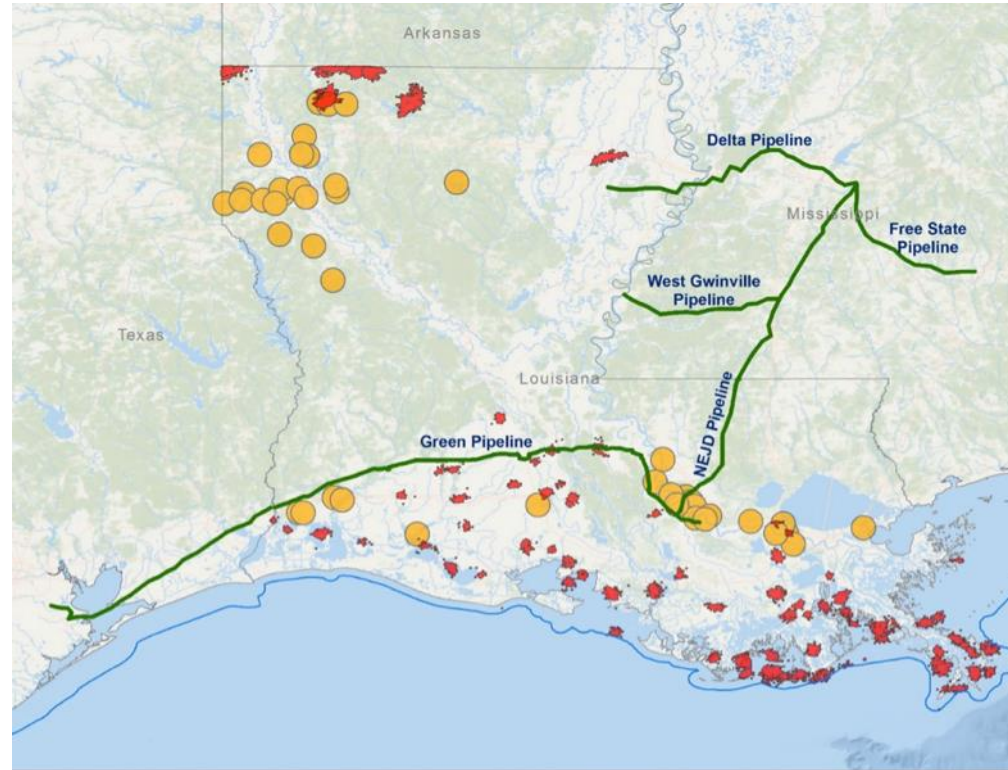






- CO<sub>2</sub> Utilization and Storage Acceleration (CO<sub>2</sub> USA) - Gulf Coast used a market-driven approach to identify opportunities to accelerate CCUS commercialization within the industrial sector
- SSEB and DOE-FE developing roadmap and toolkit
- Central Gulf Coast Region is prime area for Industrial-CCUS
- Louisiana and industrial corridor along Mississippi uniquely situated to benefit from integrated CCUS System
  - Industrial sources produce large amount of CO<sub>2</sub>
  - Green pipeline runs across southern Louisiana
  - Many existing oilfields could benefit from Enhanced Oil Recovery (EOR)

*\*Orange = Industries Red = Oil Fields*



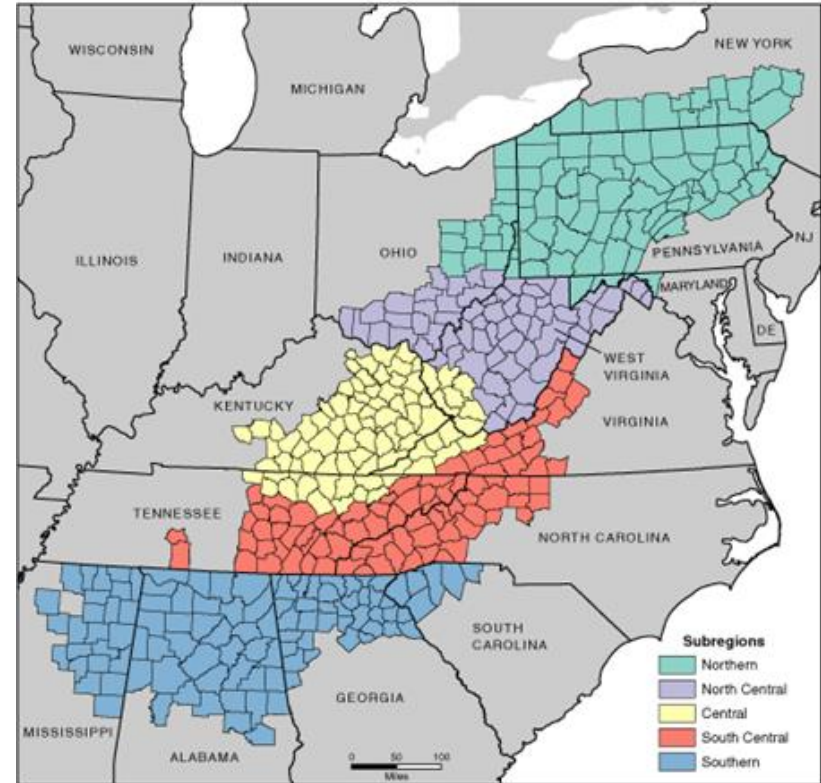
**CO<sub>2</sub> Emission Clusters, Pipeline Infrastructure, and Oil Fields**

Source: Louisiana State University, Center for Energy Studies, 2016

# CO<sub>2</sub> USA - Appalachia



- Closely related to CO<sub>2</sub> USA - Gulf Coast and designed to educate and inform interested parties about possible beneficial uses of CO<sub>2</sub> across Appalachia
- Project was comprised of three regions within Appalachia (Northern, Central and Southern).
- Within each region, specific opportunities may exist that could lead to viable business opportunities to capture and utilize existing CO<sub>2</sub> emissions
- Regional workshops were held in each region to explore potential business opportunities and solicit feedback on perceived barriers to advancing these potential business opportunities
- Feedback may be used to identify additional research that could reduce existing data gaps and assist market participants in advancing potential CO<sub>2</sub> focused business opportunities.

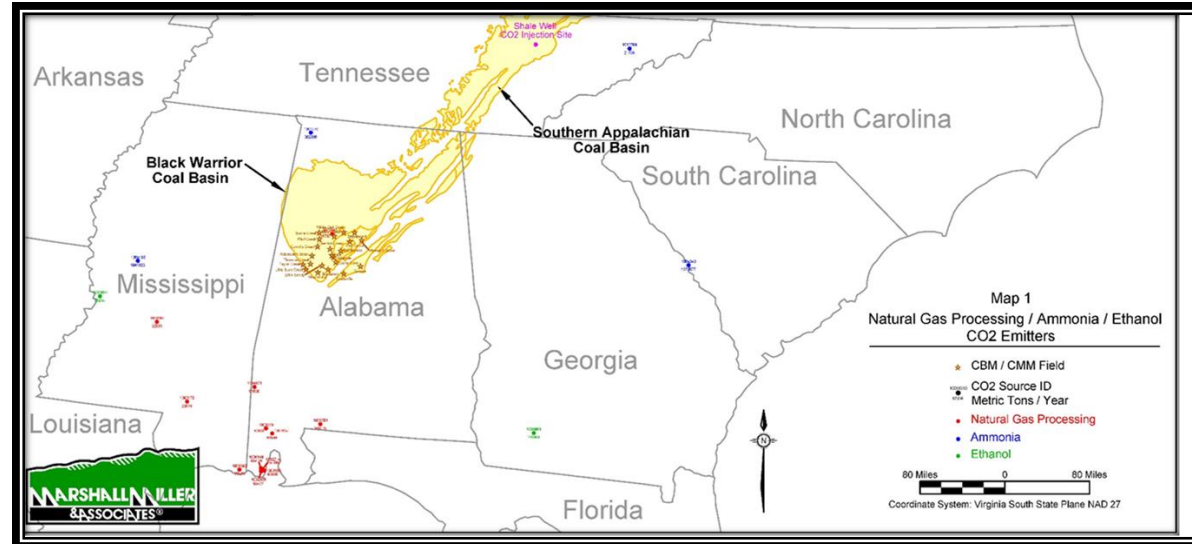


Map by: Appalachian Regional Commission, November 2009.

# CO<sub>2</sub> USA – Southern Appalachia



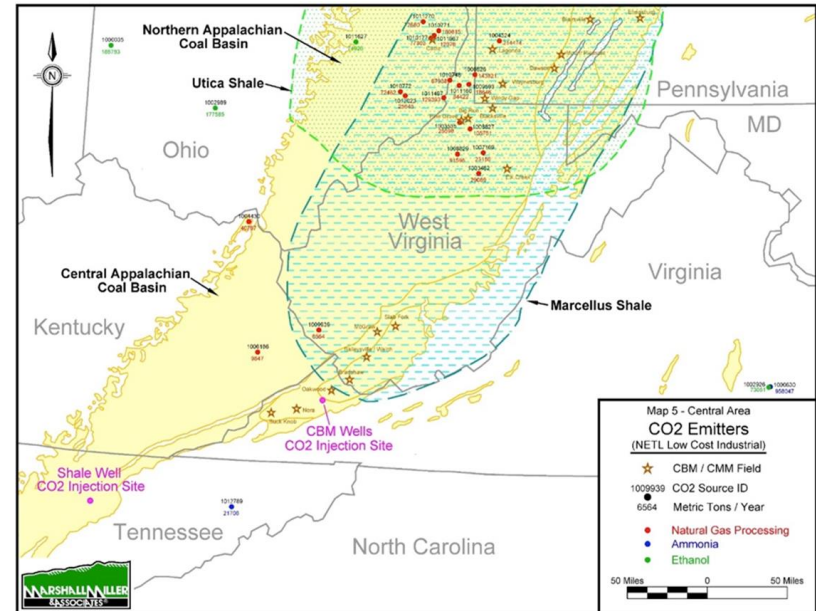
- Key findings/Opportunities
- **Southern Appalachia**
  - CO<sub>2</sub> could be captured from natural gas processing facilities, refineries or the Hatter's Pond Field CO<sub>2</sub> reinjection facility in Southern Alabama. Additional opportunities to capture CO<sub>2</sub> exist at ammonia plants in Yazoo City, Mississippi, and Cherokee, Alabama. CO<sub>2</sub> captured in Cherokee, Alabama, could be used for future Enhanced Coal Bed Methane (ECBM) in the Black Warrior Basin (BWB).
  - Captured CO<sub>2</sub> could be used for utilization in EOR fields in Southern and Central Mississippi and Southern Alabama
  - Research opportunities in Southern Appalachia include additional ECBM tests in the BWB including testing to see if results can be reproduced on a consistent basis as well as studies to determine if a single well can be stimulated or treated multiple times
  - EOR research opportunities include stranded oil in the Hartselle Sandstone



# CO<sub>2</sub> USA - Central Appalachia



- Key findings/Opportunities
- **Central Appalachia**
  - Future sources of CO<sub>2</sub> include the Dominion Virginia City Hybrid Energy Center that was built and designed to be carbon capture ready. Other attractive sources of CO<sub>2</sub> include the Eastman Chemical Plant in Kingsport, Tennessee, and potentially the US Nitrogen plant in Green County, Tennessee. Additional attractive sources of CO<sub>2</sub> are natural gas processing facilities in Virginia and West Virginia, as well as ethanol plants in Ohio.
  - Research opportunities in Central Appalachia include “Huff-and-Puff” EOR tests in Eastern Kentucky (Big Sandy Field and Berea Sandstone play) and Southwestern Virginia. Additional ECBM and shale gas projects include testing to see if results can be reproduced on a consistent basis,
  - Any research activities should also track the amount of CO<sub>2</sub> retained in the formation for future 45Q or other tax credit opportunities.

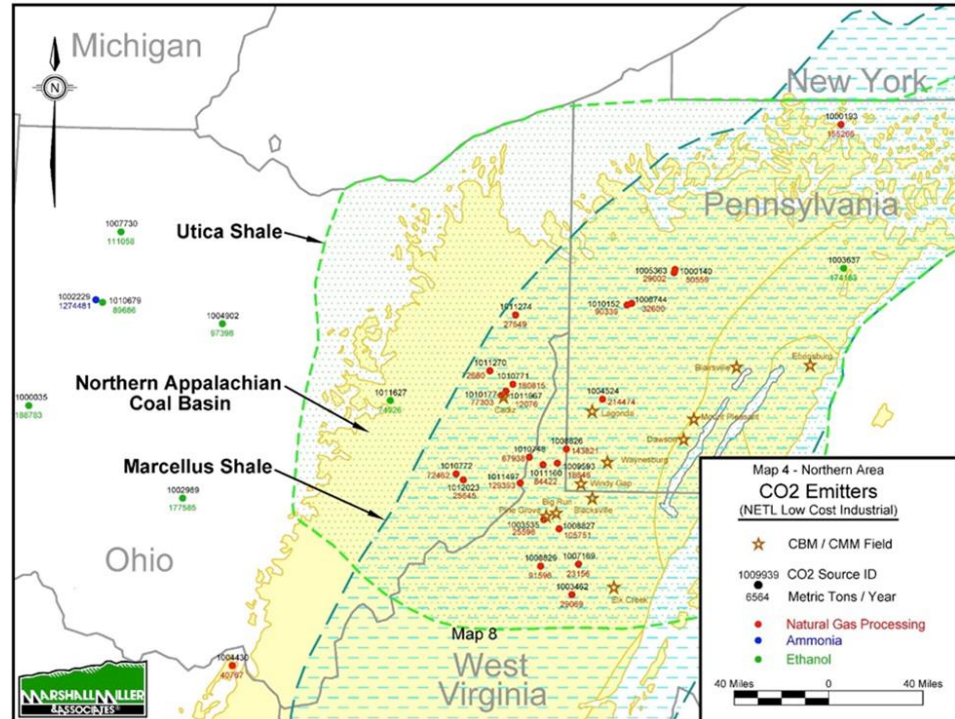


# CO<sub>2</sub> USA – Northern Appalachia



- **Northern Appalachia**

- Within Northern Appalachia, low-cost CO<sub>2</sub> could be captured from ethanol plants in Ohio as well as natural gas processing facilities in West Virginia.
- Captured CO<sub>2</sub> could be used for EOR in Southern Ohio, initial tests for EOR in Pennsylvania and further testing of CBM and shale wells in West Virginia, Ohio and Pennsylvania.
- Research projects in Northern Appalachia could advance future projects by proving consistency of results from early tests. Areas of interest include approximately 10 additional “Huff-and-Puff” EOR tests in East Canton, Ohio. A test using a traditional EOR 5-spot layout could provide significant data on the possibility of future large scale EOR opportunities in the region.



# Industrial and Commercial CO<sub>2</sub> Utilization Applications

