CornerPost
CO2 LLC

Economic Carbon Capture and the Missing Letter from CCUS

CCUS in Kansas Forum

Keith Tracy | July 26, 2018

Overview

- Using Industrial-Sourced CO_2 for Mid-Continent EOR
- The Missing Letter from “CCUS”
- Commercial Impact of 45Q Tax Credits
- CO_2-EOR and Geologic Sequestration Opportunities
- Conclusions

Cornerpost CO_2 LLC

- Consultant to CO_2 Sources and CO_2-EOR Operators
  - Anthropogenic CO_2-EOR expert
  - Authority on Section 45Q tax credits
- CO_2 Midstream Asset Development Company
  - Securing CO_2 sources for underground injection throughout the US
  - Financial backing to build, own and operate CO_2 capture plants and pipelines
- Originator of CO_2 Injection Projects
  - Develop new CO_2-EOR projects
  - Geologic sequestration well permitting and operations
  - 45Q tax credit opportunities

Using Ethanol-Sourced CO_2 for EOR

- Kansas has the only ethanol plants that capture CO_2 emissions used for CO_2-EOR
  - Arkalon (Liberal KS)
  - Bonanza (Garden City KS)
- First-of-a-kind CO_2 capture plant (Arkalon) has been operational for ~9 years
  - Led to improved design, economics and efficiencies at Bonanza and ADM-Decatur (and future plants)

Arkalon CO_2 Plant – Boundary (red); capture line (green)

Source: Google Earth

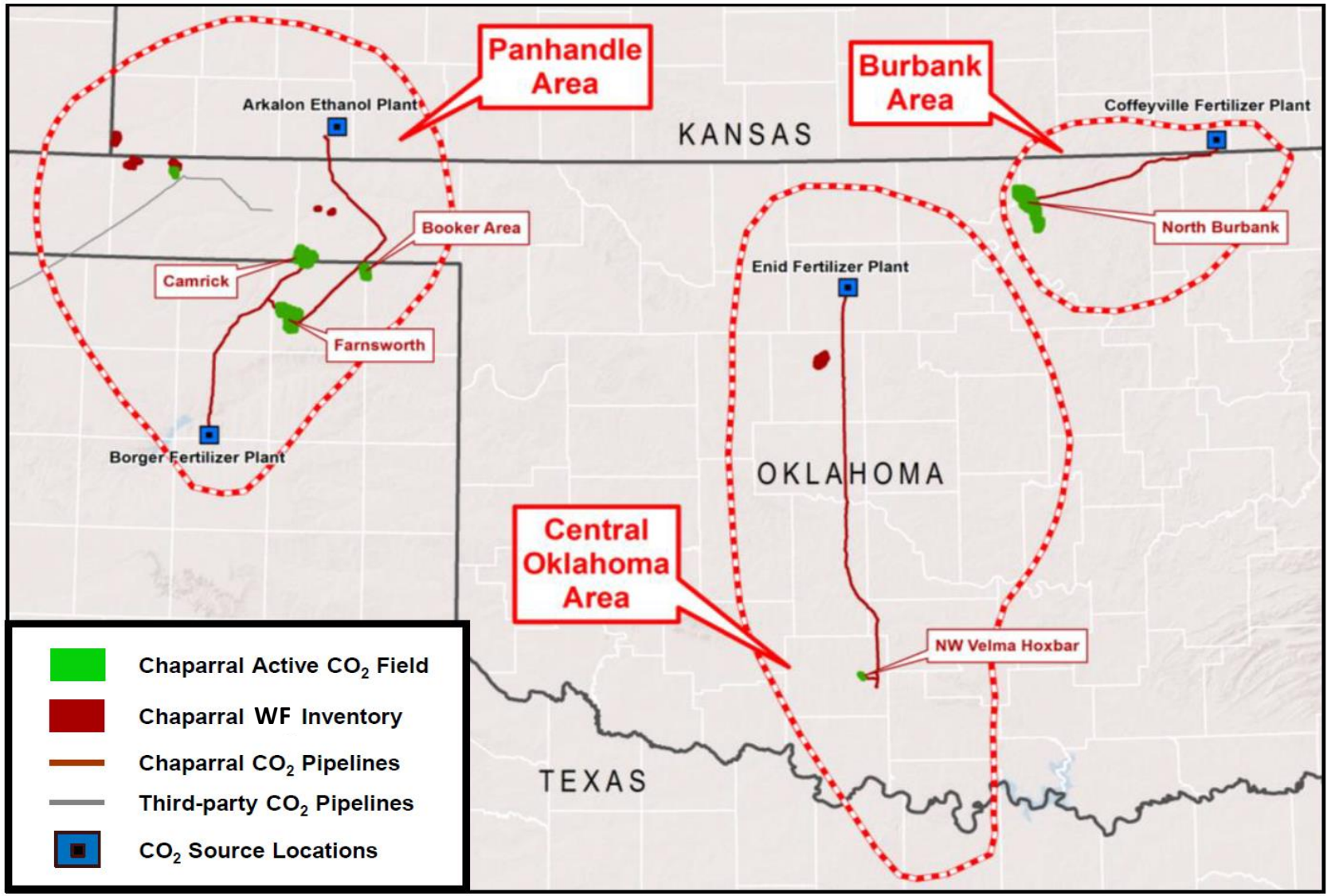
Using Fertilizer-Sourced CO_2 for EOR

- Kansas has the largest fertilizer plant that captures CO_2 emissions used for CO_2-EOR
  - CVR Partners (Coffeyville KS)
- Area fertilizer plants have the same opportunity:
  - Dodge City, KS
  - Beatrice, NE
  - Woodward, OK
  - Verdigris, OK
  - Pryor, OK

Coffeyville CO_2 Plant

Source: Google Earth

CO_2-EOR in Southern Kansas and Oklahoma



Source: Chaparral Energy

Additional Thoughts on Industrial CO_2 Capture

- Power availability is critical
- Water source is helpful
- Downtime planning is important
- Footprint: ~3-5 acres, near the industrial source's CO_2 vent
- Construction timetable: typically 20-24 months
- Who Pays Who?
  - CO_2 sources in Kansas typically receive $0.25 to $0.75 million/year, when pipelines/oilfields are nearby
  - Future: CO_2 sources may pay for emissions to be captured and injected
    - 45Q tax credits
    - Ethanol plants may earn a premium on low-carbon fuel (i.e. CA LCFS)

The Missing Letter from “CCUS”

- CC“T”US
  - **C**arbon **C**apture
  - **T**ransportation
  - **U**tilization and **S**torage
- Pipeline transport is most efficient for large volumes and long distances
  - Large initial capital investment
  - Minimal operational costs
  - Master Limited Partnership (MLP) eligible

Line Pipe for Coffeyville CO_2 Pipeline

Source: CPW America

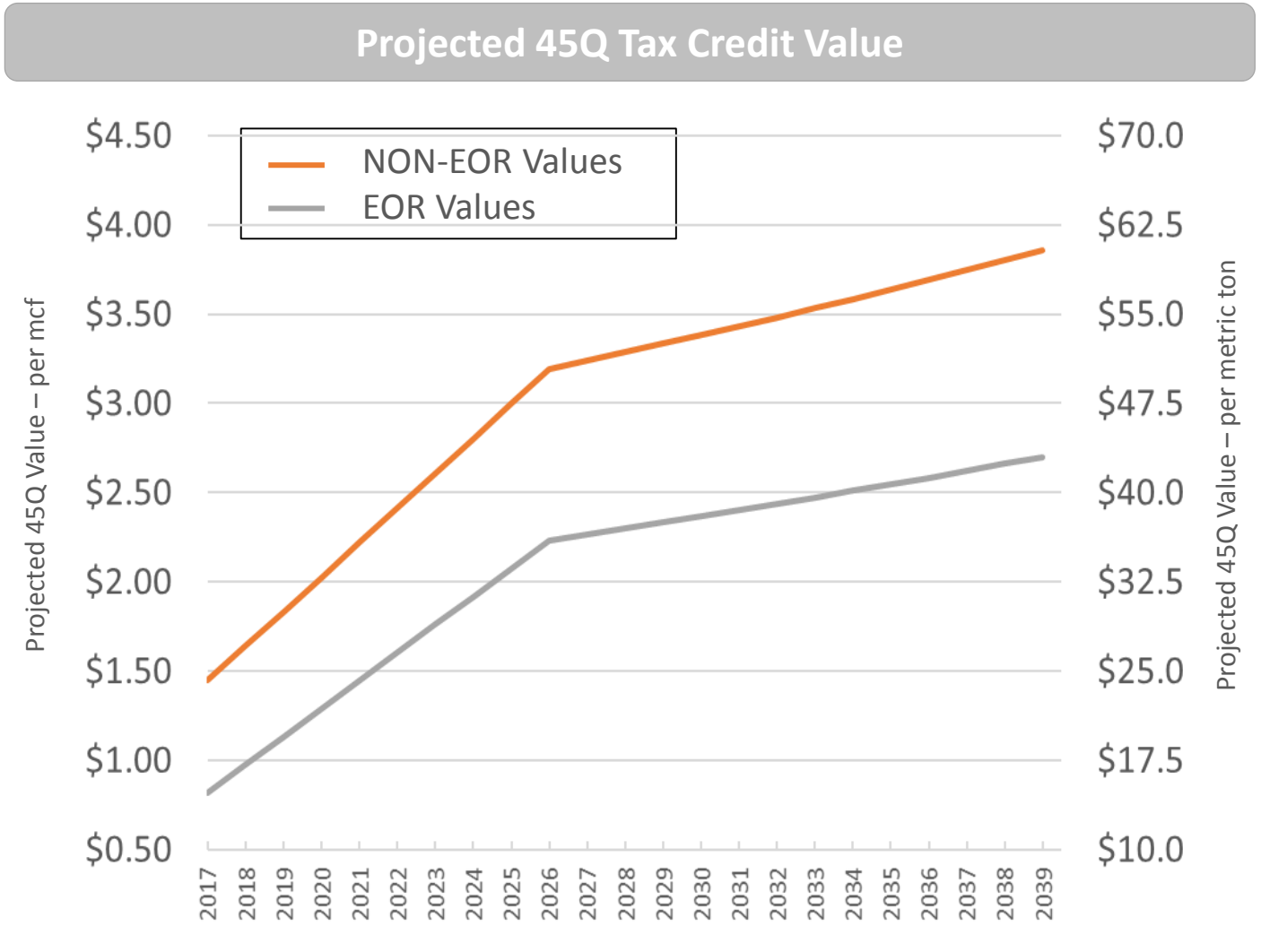
Pipeline Considerations

- Route Selection
  - Consider paralleling existing corridors
- Obtaining easements takes time
- Public perception
- Price of steel could be impacted by trade wars
- Some Federal Regulatory Issues
  - Engage PHMSA or state-equivalent pre-construction
  - Endangered Species (i.e. American Burying Beetle)
  - Army Corps of Engineers Nationwide Area Permit 12
- Construction
  - Make the pipeline “piggable”; in-line inspection tools are now the norm
  - Rock clause in construction contract creates opportunity for expense overruns

CO_2 Pipeline Meter

45Q – Projected Value of Credit

- Credit is for 12 years
- Tax credits begin on date of first operation
- Project must commence construction by 12/31/2023
- Values are set by statute through 2026
- Credit value for 2027 and beyond will be adjusted based on inflation
  - Chart assumes annual inflation rate of 1.5%



45Q – Example

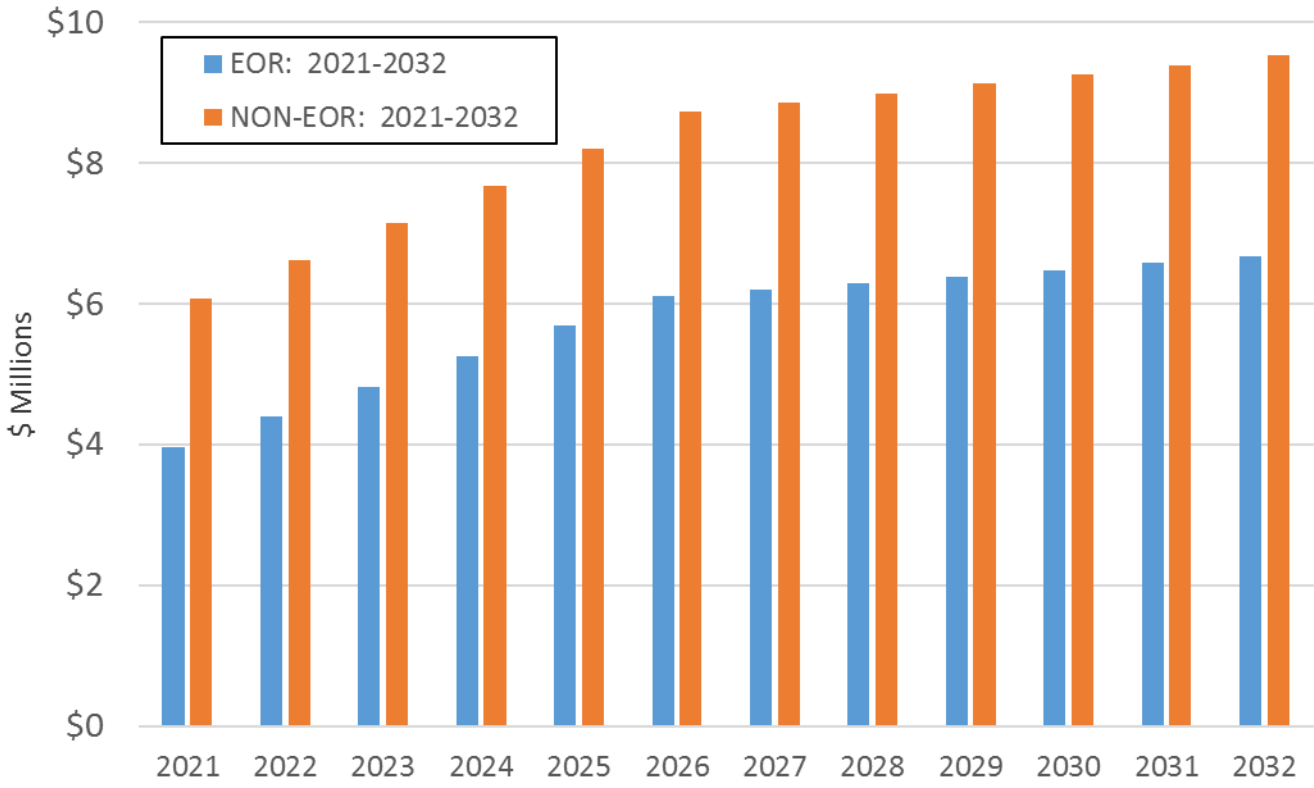
Assumptions:

- 55mgy ethanol plant
- ~7,500 mcf/d or ~144,000 metric tons/yr of CO_2
- 12 years of credit available
- Full Year Operations starting 1/1/2021

Results:

- Credit in 2021-2032
- ~$68mm total for EOR
- ~$99mm total for NON-EOR

Projected 45Q Tax Credit Value – 55mgy Ethanol Plant



- For 2017 – 2026 (values derived from statute)
- For 2027 and beyond (values estimated based on historical inflation factor rate of 1.47% annually)

CO_2-EOR and Geologic Storage Possibilities

- Oilfields in SW KS with productive Morrow formation
  - Existing CO_2-EOR from Morrow fields (i.e. Postle, Camrick, Farnsworth)
  - Example: Interstate Field (near Elkhart)
    - 92 mmbo OOIP
    - 25 mmbo produced to date
- Southeast KS, and South Central KS
  - North Burbank Unit (OK Osage County) proves successful CO_2-EOR at 3,000 ft
- Expect regulatory scrutiny on proposed sequestration in Arbuckle
  - Induced seismicity will be an important topic
  - Consider alternative geologic zones/formations for storage
- Should Kansas seek state primacy on class 6 wells?

Possible Carbon Capture Incentives in Kansas

- Existing utility sales tax exemption for manufacturing facilities (ie carbon capture plants) needs to be simplified
  - Required “energy study” is complicated and a deterrent
- Manufacturing sales tax exemption for “integrated production” equipment could be expanded to include CO_2 Pipelines
  - Current exemption only applies to facilities, such as carbon capture plants
- Compulsory unitization of oilfields could be considered
- Eminent domain for CO_2 pipelines is a frequent topic
  - Some states have it; others do not
  - Kansas has eminent domain rights for natural gas pipelines, disposal wells, cemeteries, jails, homes for the aged, and county fair associations

Corporate Structures for Carbon Capture Projects

- Integrated CO_2-EOR Company:
  - Operating company (part of WI)
  - Non-operating company (Non-Op, RI/ORRI)
  - Midstream company (carbon capture plants and pipelines)
    - Charges market-based fees for services provided; targets a lower rate of return
- A CO_2-EOR Alternative: Midstream company is separately owned
  - Allows upstream capital to focus on oil production, rather than be tied up in midstream assets at a lower rate of return
  - Requires long-term commitments by all parties
- Non-EOR Injection:
  - Joint, or separate, ownership of carbon capture plant and injection well
  - Assets may be independently owned, or be owned by CO_2 source (ie ADM)

Future Opportunities

- Timeline:
  - 5 years ago - Coffeyville/Burbank started operations in 2013
  - 10 years ago - Arkalon commenced construction in 2008
  - What will we have 5 or 10 years from now?
- 45Q will likely create a few projects in Kansas
- Paving the path to significant development and large-scale infrastructure
  - Expedite approval of Class 6 well permits – and eliminate unreasonable requirements
  - Oil price sustained at higher levels
  - Economic incentives above current levels
  - Cooperation of players within a project
    - Cooperative unitization of EOR candidate fields
    - Funding partnerships to de-risk projects and monetize 45Q tax credits

Conclusions

- Kansas is a leader in industrial-sourced CO_2 capture for EOR
- Experienced personnel are ready to implement carbon capture
- Carbon capture in Kansas is economic, depending on location
- Pipeline infrastructure (the missing “T” in CCUS) will be critical to significant development of carbon capture and EOR in Kansas
- 45Q tax credits are significant
  - 45Q will likely lead to additional carbon capture projects in Kansas
- Some state level incentives may become important considerations

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