## Developing regional carbon hubs to support CCS in the United States

Theme 6: CCUS Case Studies and Life Cycle Analysis

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### Wyotch Hub/Carbon Blueprint

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### Why regional carbon hubs?

- Decarbonization with CCS will require an enormous infrastructure investment.
- Suitable storage is concentrated in certain locations, often very different from the distribution of CO<sub>2</sub> emissions.
- Some economies of scale can be achieved by multiple CO<sub>2</sub> sources using a common pipeline and storage location, especially for small streams or hard-to-abate facilities.
- Stronger regulatory frameworks and monitoring, reporting, and verification (MRV) systems can be developed when infrastructure is concentrated.
- Some states are "more ahead" than others.



### Emissions sources

All CO<sub>2</sub> emitting facilities

Facility Count: 7610 Emissions: 2399 Mt CO<sub>2</sub>/yr





# Emissions sources

Facilities qualifying for 45Q tax credits.

Facility Count: 5283 Emissions: 2392 Mt CO<sub>2</sub>/yr





# Emissions sources

Facilities qualifying for 45Q tax credits & Capture costs <= \$250/tonne

Facility Count: 1547 Emissions: 2051 Mt CO<sub>2</sub>/yr





### Wyoming as an example

What might it take to support a regional carbon hub?

### • Emissions

- Emissions close to storage, or ability to build pipeline
- Available storage
- Suitable regulatory/policy environment
- Nice to have: Experience in O&G sector

#### Wyoming Emissions

All: **47.76 Mt CO<sub>2</sub>/yr** 45Q: **47.68 Mt CO<sub>2</sub>/yr** 45Q & <= \$250/t: **45.3 Mt CO<sub>2</sub>/yr** 

![](_page_7_Figure_2.jpeg)

![](_page_7_Picture_3.jpeg)

Wyoming Existing Transport Network

![](_page_8_Figure_1.jpeg)

![](_page_8_Picture_2.jpeg)

## CO<sub>2</sub> pipeline background in Wyoming

### • Wyoming Pipeline Corridor Initiative\*

- Designated ~1900 miles of pipeline corridors through the state.
- Focused on finding corridors within the federal Bureau of Land Management (BLM) surface ownership to transport CO<sub>2</sub> for Enhanced Oil Recovery (EOR) and other compatible uses.
- These include trunk lines and lateral lines, and sought to connect corridors between BLM field offices that were previously non-connecting.

### • Existing CO<sub>2</sub> pipelines in Wyoming

- There are seven CO<sub>2</sub>-EOR fields in Wyoming, producing >135 million barrels of incremental oil.\*\*
- Wyoming hosts ExxonMobil's Shute Creek CCUS facility, and it's estimated 114 Mt has been sold for EOR.

![](_page_9_Picture_8.jpeg)

Wyoming Existing Transport Network

![](_page_10_Figure_1.jpeg)

![](_page_10_Picture_2.jpeg)

### Wyoming Storage

Saline basins

![](_page_11_Picture_2.jpeg)

![](_page_11_Picture_3.jpeg)

### Class VI Wells & CarbonSAFEs

- The Department of Energy (DOE) has invested in CarbonSAFEs\*, projects to identify and characterize geologic storage sites.
  - Must demonstrate both potential for capturing CO<sub>2</sub> and adequate storage during the project, funding can help with better geologic characterization.
- Class VI wells are injection wells specifically for permanent sequestration of  $CO_2$ .
  - In most states, applications for Class VI wells goes through the federal Environmental Protection Agency.
  - In some states (North Dakota, Wyoming, Louisiana, and West Virginia), approval is granted through the state agencies, allowing faster approval of these wells.
- Both CarbonSAFE and Class VI well applications demonstrate interest in and commitment to permanent storage.

![](_page_12_Picture_7.jpeg)

### Wyoming Storage

Saline basins, CarbonSAFE and Class VI well applications, and estimated storage costs

![](_page_13_Picture_2.jpeg)

CARBON SOLUTIONS

An explanation of storage cost estimates may be found here: https://engrxiv.org/preprint/view/3293/version/461414

### **Additional considerations**

#### Land ownership

- Wyoming has a mix of federal lands (~48%), Wind River Reservation, state trust land ("checkerboard" pattern), state lands, and private land (~43%).
- Permitting is complex for pipelines and Class VI wells, even without complicated surface and subsurface land ownership.

![](_page_14_Picture_4.jpeg)

![](_page_14_Picture_5.jpeg)

![](_page_15_Figure_0.jpeg)

### Where is the greatest opportunity for hubs?

![](_page_15_Picture_2.jpeg)

### What barriers still exist?

### • Permitting, especially pipelines

- CO<sub>2</sub> has some different regulatory rules that may have impact on getting approvals.
- Public attitudes
  - Is CCUS a green solution? Hurting coal? Just for EOR?

### • Risks/Hazards

- How will existing wells impacted permanent storage?
- How will faults impact plume migration?
- What areas may have concerns about Drinking Water?

### • CO<sub>2</sub> sources may be limiting factor

• Wyoming has fewer emissions than more industrialized states, and the future of coal is uncertain.

![](_page_16_Picture_11.jpeg)

## In Summary

- Federal investment in both data collection and commercial projects have benefited Wyoming
  - A range of projects, such as geologic characterization and testing capture equipment, have reduced risks for investors in the state.

### • State policies matter

- Highlighting the need for coordinated rights of way for pipelines demonstrated support for this technology.
- There is a regulatory framework for pore space ownership and permitting Class VI wells.

### Attitudes matter

- Wyoming has a long history of oil, gas, and resource extraction, allowing a workforce ready to lead CCUS and an understanding of underground storage.
- Enhanced Oil Recovery and CO<sub>2</sub> pipelines already exist in the state.

![](_page_17_Picture_9.jpeg)

![](_page_18_Picture_0.jpeg)

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![](_page_18_Picture_3.jpeg)

![](_page_18_Picture_4.jpeg)