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TEST CENTER

Powering the Nation, Fueling Innovation

What is Wyoming's strategy?

Commercialization of new technologies will ensure the long-term viability of Wyoming's natural resources.

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The Integrated Test Center

- 20+ MW of coal derived flue gas from the Dry Fork Power Station.
- 300 gpm of service water and a 22 kV electrical service loop to provide power to the facility.
- Simple design minimizes costs, provides flexibility & quick turnaround times.
- Designed for maximum flexibility and scalability for testing.
- Focused on larger scales to compliment NCCC and create a space for further scale up.

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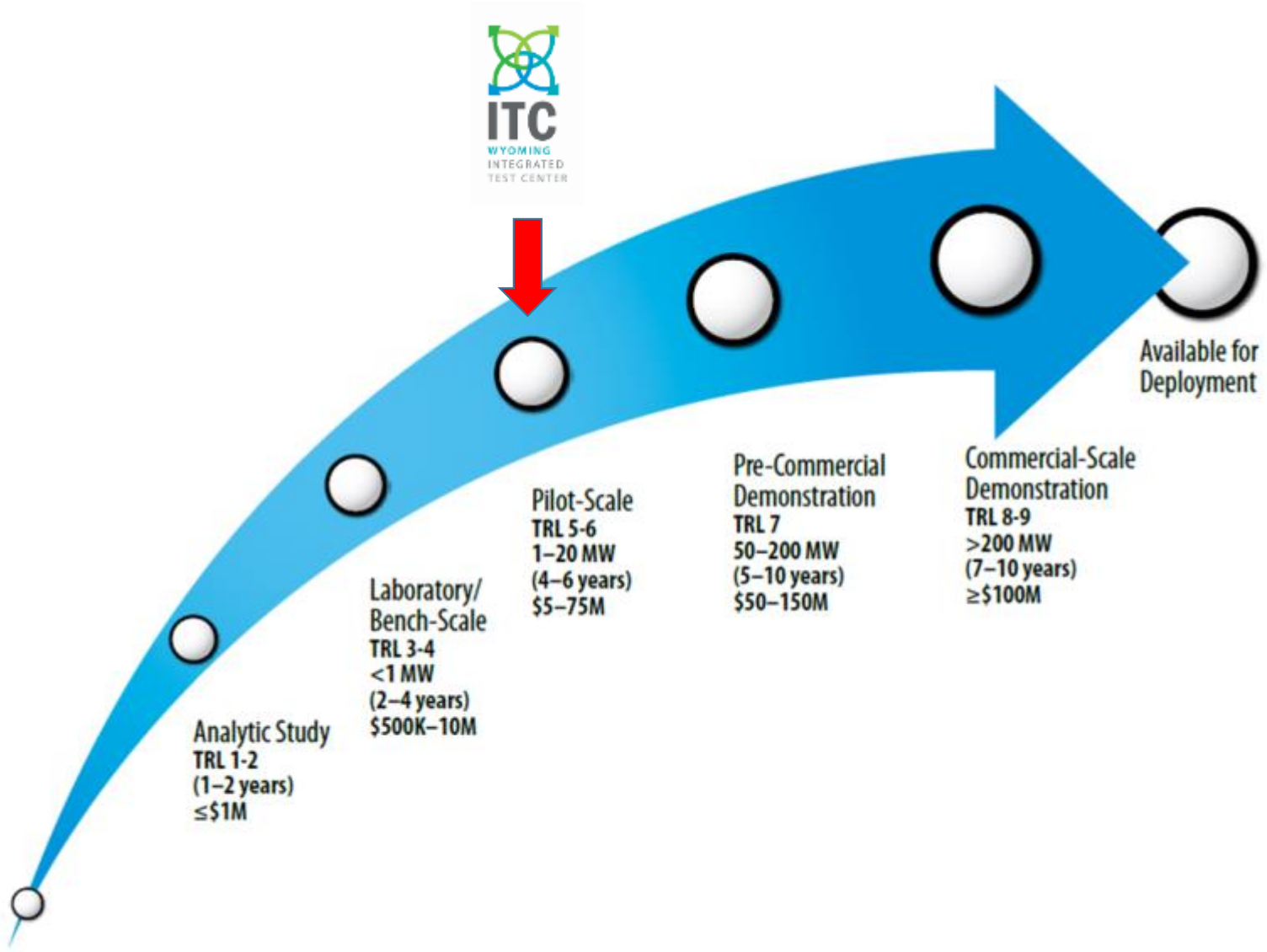
R&D Timeline



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Source: National Energy Technology Laboratory, "Carbon Storage Technology Program Plan," December 2014

ITC Partners

- State of Wyoming - $15 million
- Basin Electric – Host at Dry Fork Station
- Tri-State G&T - $5 million
- National Rural Electric Cooperatives Association - $1 million
- Black Hills Corp. and Rocky Mountain Power providing technical expertise and in-kind contributions

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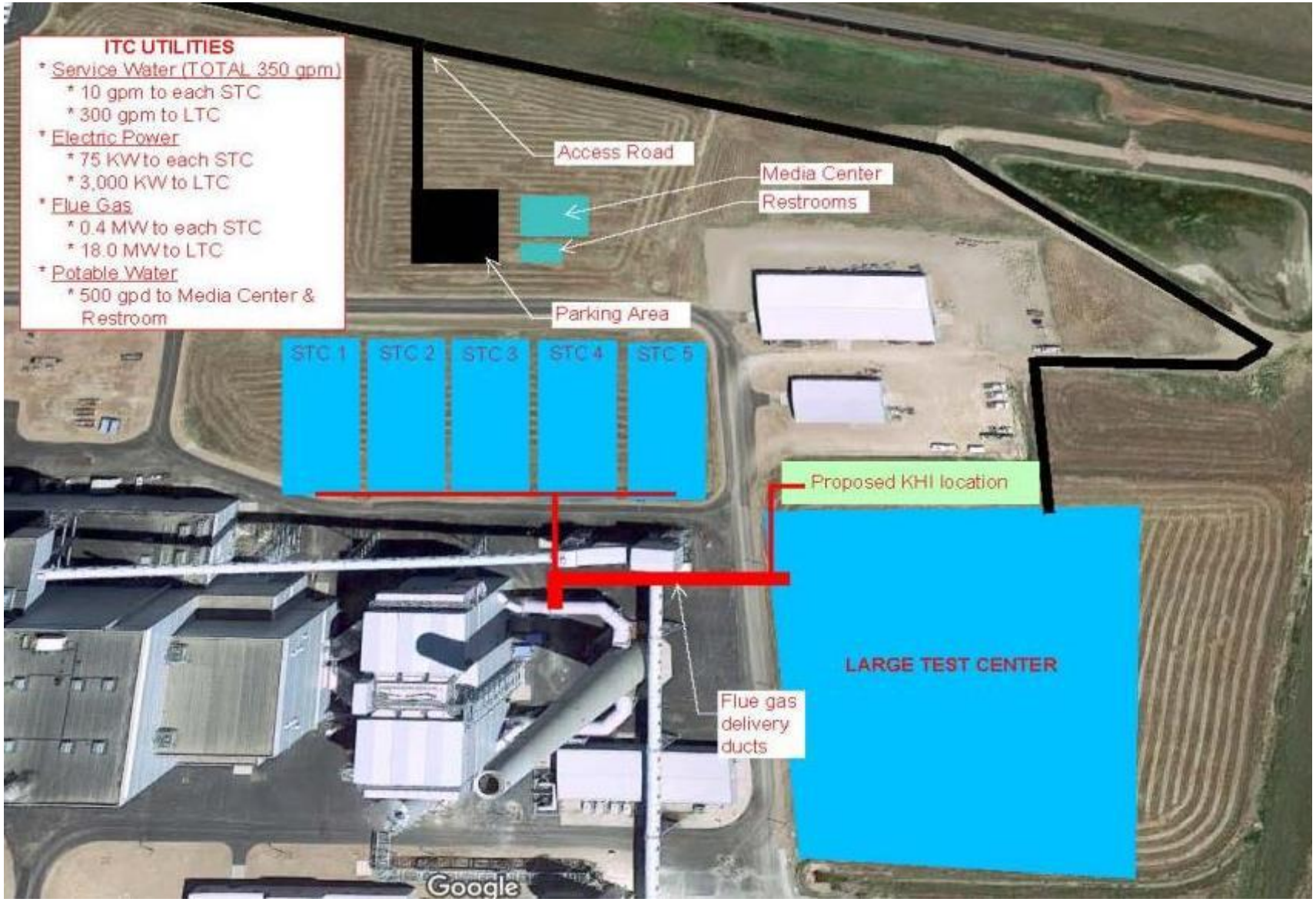
BASIN ELECTRIC POWER COOPERATIVE
A Touchstone Energy® Cooperative

TRI-STATE G&T
A Touchstone Energy® Cooperative

National Rural Electric Cooperative Association
A Touchstone Energy® Cooperative

The ITC Layout



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Credit: Basin Electric Cooperative

Tenant Summary

- **TDA Research**
  - Currently testing hybrid membrane/solid sorbent capture system.
- **Kawasaki Heavy Industries (KHI)**
  - Fixed bed adsorbent optimization testing.
- **GreenOre**
  - Carbon dioxide and fly ash utilization to calcium carbonate.
- **Membrane Technology Research (MTR)**
  - 200 ton per day CO_2 capture project in the large test bay using membrane separation system combined with cryogenic distillation – subject to DOE Phase III funding.
- **University of Kentucky (UK)**
  - 10 MWe large pilot also awaiting phase 2 funding decision announcement – subject to DOE Phase III funding.
- **XPRIZE**
  - 5 teams competing for best commercial CO_2 utilization offering will produce building materials, polymers, and methanol using various CO_2 capture technologies.
- **GTI**
  - 1 MWe membrane system

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TDA Research

- Extensive research program in cooperation with DOE/NETL.
- Hybrid skid system using membrane and adsorbent technology.
- Testing underway!

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XPRIZE competition

Breathe (Bangalore, India) – Led by Dr. Sebastian Peter, the team is producing methanol, a common fuel and petrochemical feedstock, using a novel catalyst.

Carbon Capture Machine (Aberdeen, Scotland) – Based out of the University of Aberdeen, the team is producing solid carbonates with applications to building materials.

C4X (Suzhou, China) – Led by Dr. Wayne Song and Dr. Yuehui Li, the team is producing chemicals and bio-composite foamed plastics.

Dimensional Energy (Ithica, New York, US) – CEO Jason Salfi is using photocatalysis to convert CO2 to fuel.

Carbon Upcycling UCLA (Los Angeles, CA, USA) – Led by Dr. Gaurav Sant, the team is producing building materials that absorb CO_2 during the production process to replace concrete.

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XPRIZE is a temporary tenant of the ITC and at the completion of the competition, the space will be available to new testers.

JCOAL – GreenOre

- June 2019 – Wyoming Infrastructure Authority, JCOAL (Japan Coal Energy Center), Columbia University MOU.
- November 2019 – ITC site visit
- Fall 2020 – Laboratory testing at Columbia University
- 2021 – Tentative site deployment

A slag carbonation pilot plant owned by the JV between GreenOre and Baotou Steel Group (China), commissioned Spring 2019.

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JCOAL – Kawasaki Heavy Industries

- July 2016 – State of Wyoming - JCOAL (Japan Coal Energy Center) MOU.
- April 2018 – Announcement of JCOAL-KHI (Kawasaki Heavy Industries) test at ITC – 0.2 MWe dry adsorbent, fixed bed system.
- Completed initial engineering design.
- Currently conducting detailed engineering.
- Construction to commence in 2021.

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GTI

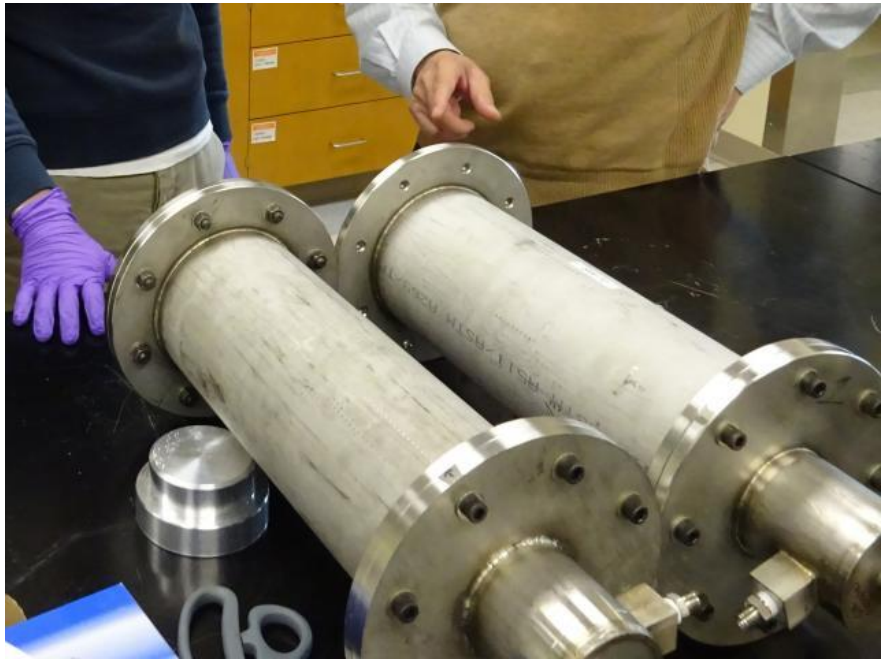

Photo credit: Ohio State University

- August 2020 – Awarded DOE grant to test
- Host site for 1 MWe post combustion capture system using advanced membrane technology developed by the Ohio State University with budget period 1 beginning 2021 which was previously tested at NCCC.
- Completed initial engineering design.
- Tentative on-site testing in late 2021/early 2022.

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Membrane Technology and Research

Photo Credit: NETL

- MTR has a successful CO_2 capture research portfolio.
- Has received initial phase 1 funding from U.S. DOE.
- Partnering with Wyoming ITC for phase 2 application for design and permitting and phase 3 operation.
- 200 ton per day of liquid CO_2 product system will be located in the large test bay.

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University of Kentucky

Photo Credit: NETL

- UK has a successful CO_2 capture research portfolio.
- Has received initial phase 1 funding from U.S. DOE for a large pilot.
- Partnering with Wyoming ITC for phase 2 application for engineering design.
- 10 MWe scale.
- Currently have a 0.7 MWe pilot at LGE's Brown Station (left)

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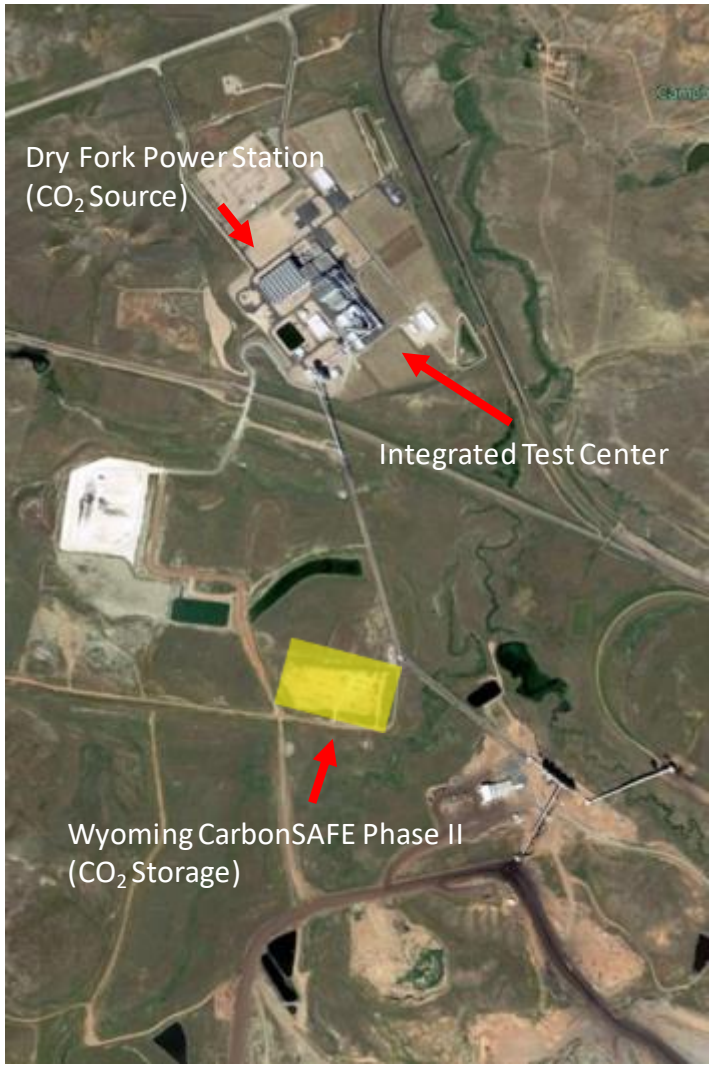
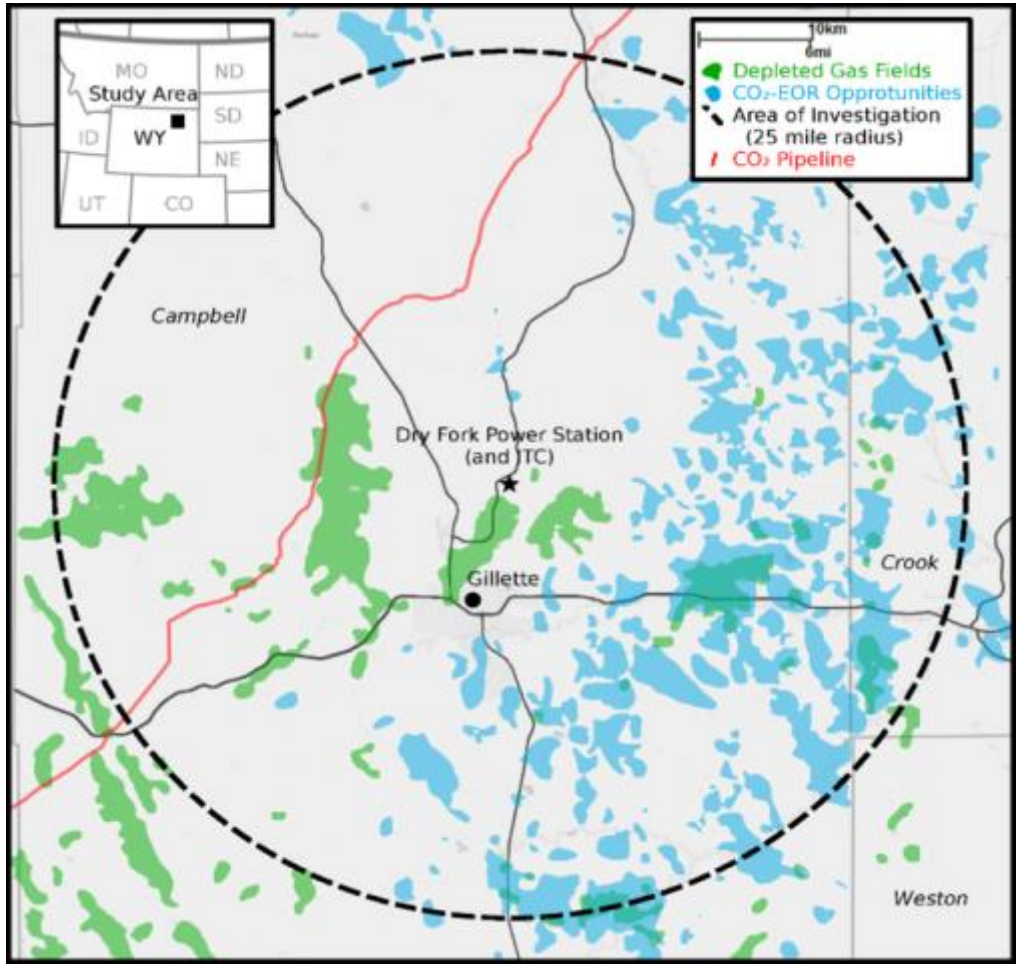
The value proposition





Credit: School of Energy Resources University of Wyoming

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Stay in Touch!

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