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Update on Carbon Dioxide Use in Public Projects

Testimony before the Wyoming Legislature
Joint Appropriations Committee
Dr. Holly Krutka
Cheyenne, Wyoming
October 27, 2022

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Authorizing Legislation: SF0001

Enrolled Act No. 12, Senate, 66th Legislature of the State of Wyoming, 2022 Budget Session, p. 38, n. 8

6. Of this general fund appropriation, three hundred thousand dollars ($300,000.00) is appropriated for a feasibility study on using carbon dioxide in public works projects. The feasibility study shall include an analysis of the economic feasibility of requiring that a specified percentage of concrete used in public works projects be made using carbon dioxide emissions from coal fired or natural gas fired electric generation facilities and shall also include the feasibility of establishing a potential carbon dioxide storage hub in Wyoming. The feasibility study report shall be completed and submitted by December 1, 2022 to the joint minerals, business and economic development interim committee and the joint appropriations committee. It is the intent of the legislature that this appropriation not be included in the University of Wyoming's standard budget for the immediately succeeding fiscal biennium. This appropriation shall not be transferred or expended for any other purpose. This appropriation is effective immediately.

Source: https://wyoleg.gov/2022/Enroll/SF0001.pdf

HB0061 Provides More Context

(i) The advantages and disadvantages of a requirement for a specified percentage of concrete used in public works projects to be made using carbon dioxide emissions from coal-fired or natural gas fired electric 6 generation facilities;

(ii) Whether any requirement for carbon dioxide use in public works projects should be phased in as a requirement;

(iii) Whether there would be additional costs or savings for public works projects as a result of a carbon dioxide use requirement;

(iv) What types of public works projects in the state could utilize carbon dioxide as part of the project;

(v) How much carbon dioxide could be captured in Wyoming to be used for public works projects;

(vi) Possible infrastructure and transportation needs for which carbon dioxide could be used in public works projects throughout the state;

(vii) Any disruptions or disadvantages to other industries and Wyoming businesses if a carbon dioxide use requirement is imposed;

(viii) Whether the use of carbon dioxide in public works projects may extend or prolong the operation of coal-fired and natural gas electric generation facilities in Wyoming; and

(ix) Whether proposed or enacted federal legislation or regulation may impact the use of, and the advantages and disadvantages of using, carbon dioxide in public works projects.

Source: https://wyoleg.gov/2022/Introduced/HB0061.pdf

Background

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Novel CO_2 Utilization Opportunities

- $CO_2 + H_2$ to fuels
- CO_2 to disposable products
- CO_2 in public works - XPRIZE winners - $7.5M each
  - CarbonCURE - extracts the CO_2 generated in the production of concrete and recycles it back into the product
  - UCLA CarbonBuilt - designed a system to take CO_2 and create a stronger concrete which is less reliant on Portland cement

UCLA CarbonBuilt XPRIZE Team

Carbon Dioxide Use in Public Projects Project Update

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SER Activities Since Passage of Legislation

- Late Spring 2022: Internal scoping meeting held

- June 2022: Outreach conducted to potential consultants and other key third parties to include
  - UW Department of Civil and Architectural Engineering (Drs. Jenny Tanner & Haibo Zhai)
  - Consultants: Dr. Isgor Burkan & Dr. Jason Weiss
  - McGill University, Department of Civil Engineering: Dr. Yixin Shao
  - Concrete Association of Wyoming
  - Portland Cement Association
  - California Nevada Cement Association
  - Colorado Ready Mixed Concrete Association

  Selected

- July 2022: (1) Responses reviewed & consultants identified; and (2) informal outreach commences with the Wyoming Department of Transportation, industry and others

- Late August 2022: Research commenced

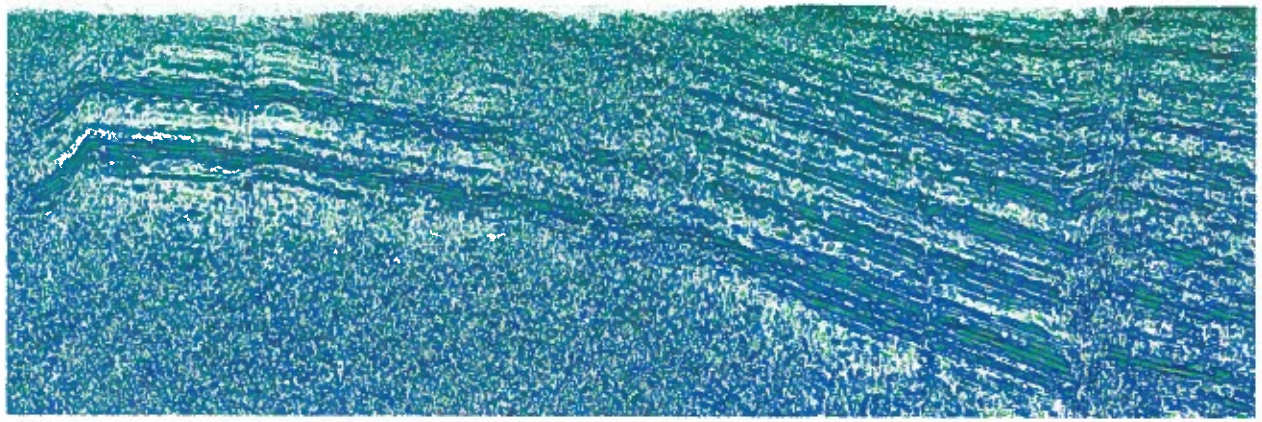
Research Team

- Dr. Jenny Eisenhauer Tanner, Associate Professor of Civil and Architectural Engineering, College of Engineering and Physical Sciences (CEPS), University of Wyoming (UW)
- Dr. Haibo Zhai, Roy & Caryl Cline Chair of Engineering, Environment and Natural Resources, Associate Professor, Civil and Architectural Engineering, CEPS, UW
- Dr. Fred McLaughlin, Director, Center for Economic Geology Research, School of Energy Resources, UW
- Dr. Burkan Isgor, Consultant
- Dr. Jason Weiss, Consultant
- Kipp Coddington, Senior Advisor, School of Energy Resources, UW

Research Team Responsibilities: CO_2 Storage Hub

- Determine the feasibility of developing a carbon storage hub in Southwest Wyoming
- Important parallel study for CO_2 in public works projects
- Building on a legacy of research in the region
  - WyCUSP
  - CarbonSAFE Phase II: Rock Springs Uplift
  - Engaging with commercial entities

CENTER FOR ECONOMIC GEOLOGY RESEARCH



Seismic data collected across the Rock Spring Uplift

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Schedule, Deliverables and Preliminary Conclusions

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Schedule

August 29, 2022: (1) Contracts executed with consultants; (2) formal kick-off meeting held; and (3) technical research officially commences

Mid-November 2022: Internal deadline for draft of the report

Late-November 2022: Final report completed

AUGUST | OCTOBER | NOVEMBER | DECEMBER

October 31, 2022: Initial results expected

December 1, 2022: Reports communicated to Joint Minerals, Business & Economic Development and Joint Appropriations per SF0001

Work anticipated to continue through the end of the current fiscal year

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Preliminary Conclusions from Study Results

- CO_2 utilization in products remain a topic of interest on various fronts, so Wyoming is wise to stay abreast of developments in this area
- CO_2 utilization in concrete is an early-stage opportunity with many technical, economic and related challenges in addition to issues related to CO_2 sourcing from the coal fleet
- CO_2 utilization in CO_2-EOR and CO_2 storage (Class VI saline) should remain a focus for volumetric, economic and related considerations
- Additional research on coal-derived building materials and low-carbon concrete is recommended

Coming Evaluations

- Amount of Wyoming's coal-power generated CO_2 that may be useable in publics works
- Potential market opportunities
  - In Wyoming
  - Exported
- Opportunities to support such projects
  - Incentives
  - Requirements

Wyoming's Public Works Building Blocks

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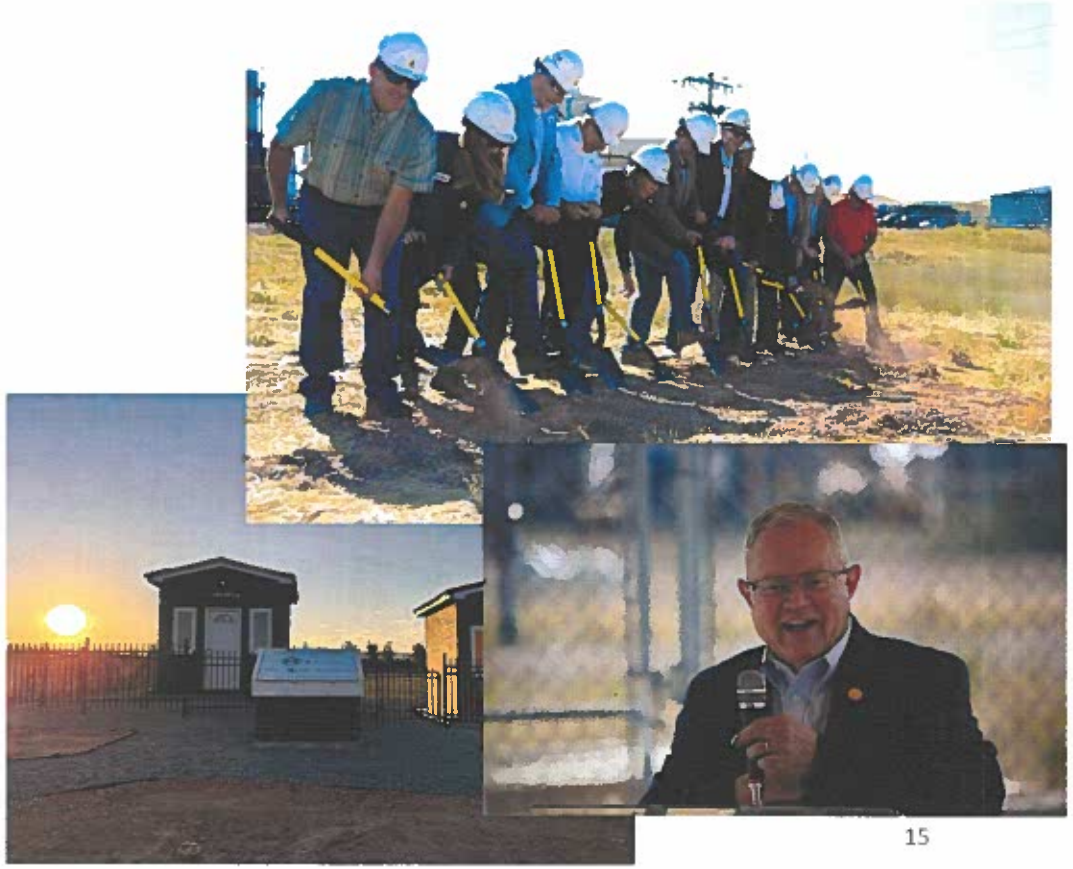
Coal-Related Research Update

- Coal refinery demonstration: Groundbreaking held and site work has begun
- Coal char brick: Demonstration house complete and data is being collected
- Soil amendments: Completed second round of greenhouse experiments using corn as a crop
- Asphalt: Continued development on coal derived asphalt binders and rejuvenators
- Increased research activity with regards to polymers and resins
- Coal transportation study nearly complete
- Increasing engagement with industry



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Oil and Gas: The Mowry Project

Phase 1 Seed Funding (Year 1):

Define research gaps, develop faculty cohort, create a workforce (graduate students), technical advisory board (Industry)

Phase 2 Feasibility (Year 2-3):

Field work and sample collection, design and conduct experiments, numerical simulations, proxy models, field test design

Phase 3: Industry Crosswalk (Year 4-5):

Graduate and place first round of students, pilot testing, experimental validation, visiting faculty

Phase 4: Field Deployment:

Field trials and demonstration

Goal: Bring together a multi-disciplinary UW team to focus on Wyoming's largest untapped unconventional resource

Phase 1 funded by the Wyoming Energy Authority

The Mowry Project

1. Fundamental study through Experimental Investigation to Advance the Geomechanical Understanding of the Mowry Shale, Kam NG, Vladimir Alvarado, and Grant Copeland.

2. Does shale stimulation improve or hamper reservoir productivity?, Vladimr Alvarado, Saman Aryana, Fred McLaughlin

3. Sweet Spot Identification in the Mowry Formation: A Synergistic Laboratory Characterization and Machine Learning Framework, Soheil Saraji

4. Interaction between Bentonites layers and hydraulic fractures: toward modeling and design of multistage hydraulic fractures for reduced uncertainty and increased productivity in Mowry Petroleum System, *Xiang Zhang*

5. Defining Potential of the Mowry Shale in Wyoming's Laramide Basins, Matt Johnson, Grant Copeland, Yuri Ganshin, Fred McLaughlin

6. Design and Fabrication of a Cylindrical True Triaxial (CTT) Experimental Set-up for Geomechanical Characterization of Mowry Shale in Wyoming, Dr. Vamegh Rasouli and Dr. Morteza Dejam

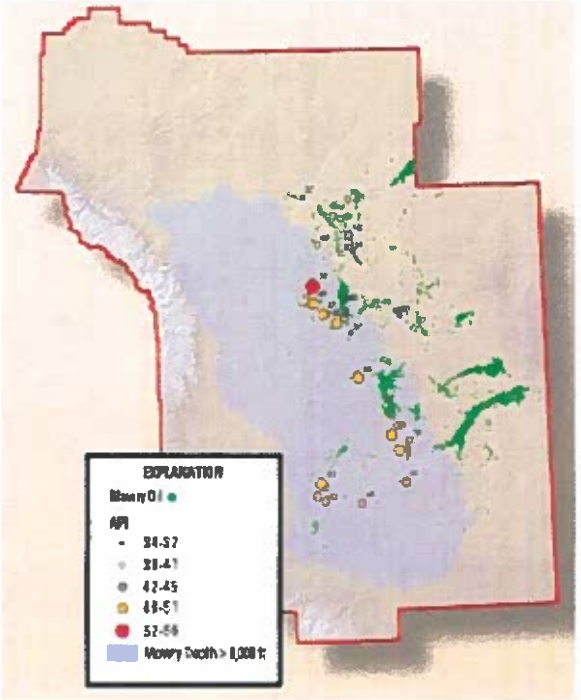
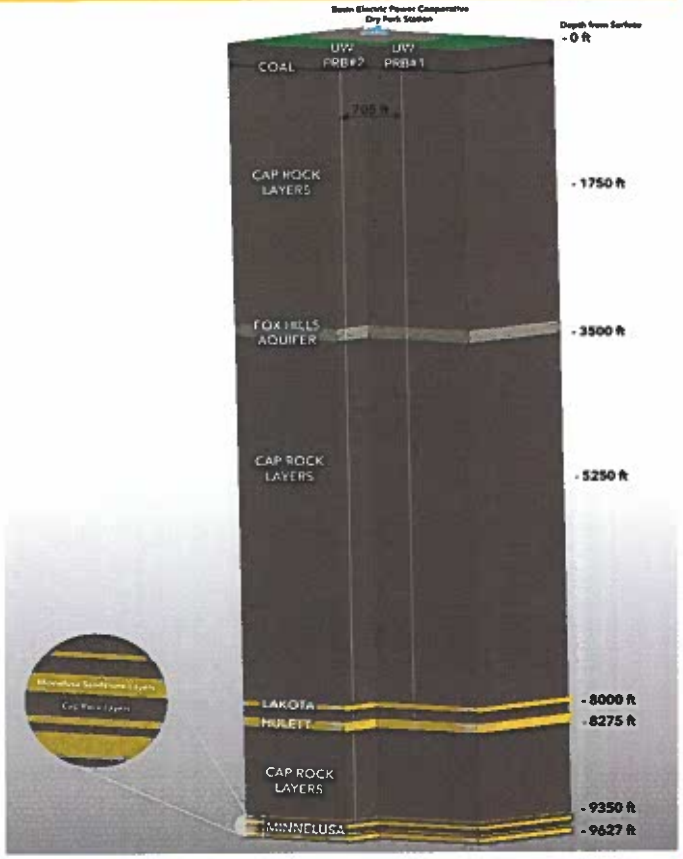


Figure 1. Mowry API gravity of several fields producing from Lower Cretaceous reservoirs.

CCUS Update

- Wyoming CarbonSAFE
  - Two test wells completed and sampled
  - Completed baseline monitoring assessments
  - 3D seismic survey
  - Storage hub property models and injection feasibility simulations
  - Regulatory assessments
  - Economic/business case assessments
  - Developing risk and MVA assessments
  - Completing permits to construct
- Building the commercial strategy
  - Supporting commercial developers on CCUS projects
  - Partnering with industry on IIJA funding requests
- Public engagement



Infrastructure Investment and Jobs Act

IIJA Program	Total Program Funding	Notes
CCUS Demo	$2.537B	50% cost share (Total program cost share could be $250M-$500M)
Carbon Storage and Validation (CarbonSAFE IV)	$2.5B	50% cost share
CO_2 Transport Feed Study	$92M	20% cost share
DAC Hub	$3.5B	20% cost share
Hydrogen Hub	$8B	50% cost share divided by the four states
Rare Earth Element Demonstration	$140M	50% cost share
Critical Materials Innovation	$651M	20% cost share

Select Private Support

Major Gifts to Support Research at SER

WOLD FOUNDATION

THE ANSCHUTZ CORPORATION

Williams

Charles Koch
CHARLES KOCH FOUNDATION

ARCH RESOURCES

BASIN ELECTRIC POWER COOPERATIVE
A Touchstone Energy® Cooperative
DRY FORK STATION

Schlumberger

Major Gifts and Sponsors to Support Students and Events at SER

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PACER ENERGY

LONG REIMER WINEGAR

Rare Element Resources

RESEARCH FOUNDATION

Baker Hughes

Dry Fork Mine

TALEN ENERGY

RAMACO CARBON

Supplemental Requests

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FY24-25 Supplemental Requests

Amount	SER Purpose	Why is this needed? What is the benefit to Wyoming?
$12,250,000	Carbon Engineering	**Need:** Pivot carbon engineering program towards commercialization **Benefit:** Support Wyoming coal production by developing new markets
$2,500,000	Mowry Research	**Need:** This is needed to invest in Wyoming's oil production at a time when DOE and private investment is lagging – which is also an opportunity for the state **Benefit:** Increase knowledge and drive investment (and ultimately production) in the Powder River Basin
$1,500,000	Endowment /gift match	**Need:** Match a private-sector gifts **Benefit:** Long-term investment in SER

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