Wyoming Update:
Energy Strategy and CCUS

Presented at the 26th Annual CO_2 Conference

Dec 9th, 2020

Glen Murrell

Wyoming Energy Authority

WYOMING ENERGY AUTHORITY

2020 CO_2 Conference
December 8-10

The Wyoming Energy Authority

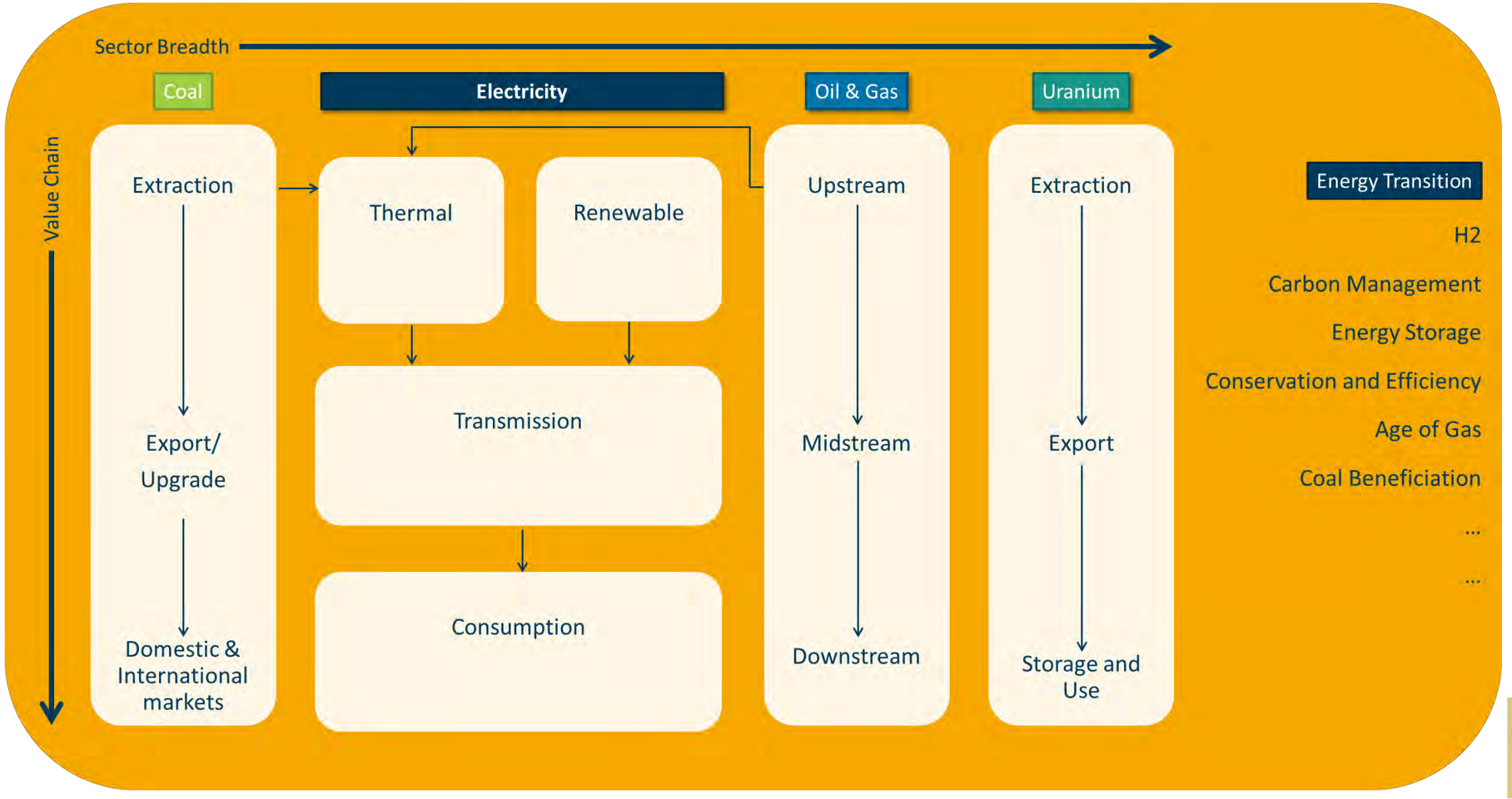
VISION

WEA advances Wyoming's energy strategy by driving data, technology, and infrastructure investments.

MISSION

WEA supports and promotes Wyoming's energy sector by implementing the state's energy strategy; delivering positive economic impact and jobs for Wyoming, fostering an environment for the sustainability and growth of Wyoming's economy, and ensuring Wyoming continues to power the nation.

WEA Scope


Sector Breadth
Value Chain
Coal
Electricity
Oil & Gas
Uranium
Extraction
Export/
Upgrade
Domestic &
International
markets
Thermal
Renewable
Transmission
Consumption
Upstream
Midstream
Downstream
Extraction
Export
Storage and
Use
Energy Transition
H2
Carbon Management
Energy Storage
Conservation and Efficiency
Age of Gas
Coal Beneficiation
...
...

WEA Strategic Goals

Project Development	• Promote and support the development of commercial energy projects
Market Development	• Preserve existing markets, while identifying and pursuing new areas for market development
Outreach & Education	• Promote Wyoming's energy resources and provide education, data, and resources the benefits of Wyoming's energy assets
Financial Leverage	• Leverage financial opportunities to develop efforts conducive to the sustainability of the energy sector in Wyoming
Optimized Resources	• Leverage Wyoming's diverse energy resources for the benefit of Wyoming citizens, while preserving environmental stewardship
Technology Deployment	• Support transition of innovative technologies and practices into the Wyoming energy sector
Best Practice	• Navigate the Wyoming Energy sector through emerging opportunities, and help frame best-practice for other communities and states
Optimized Policy	• Develop and promote public policies and regulations ensure the sustainable use of Wyoming's energy resources

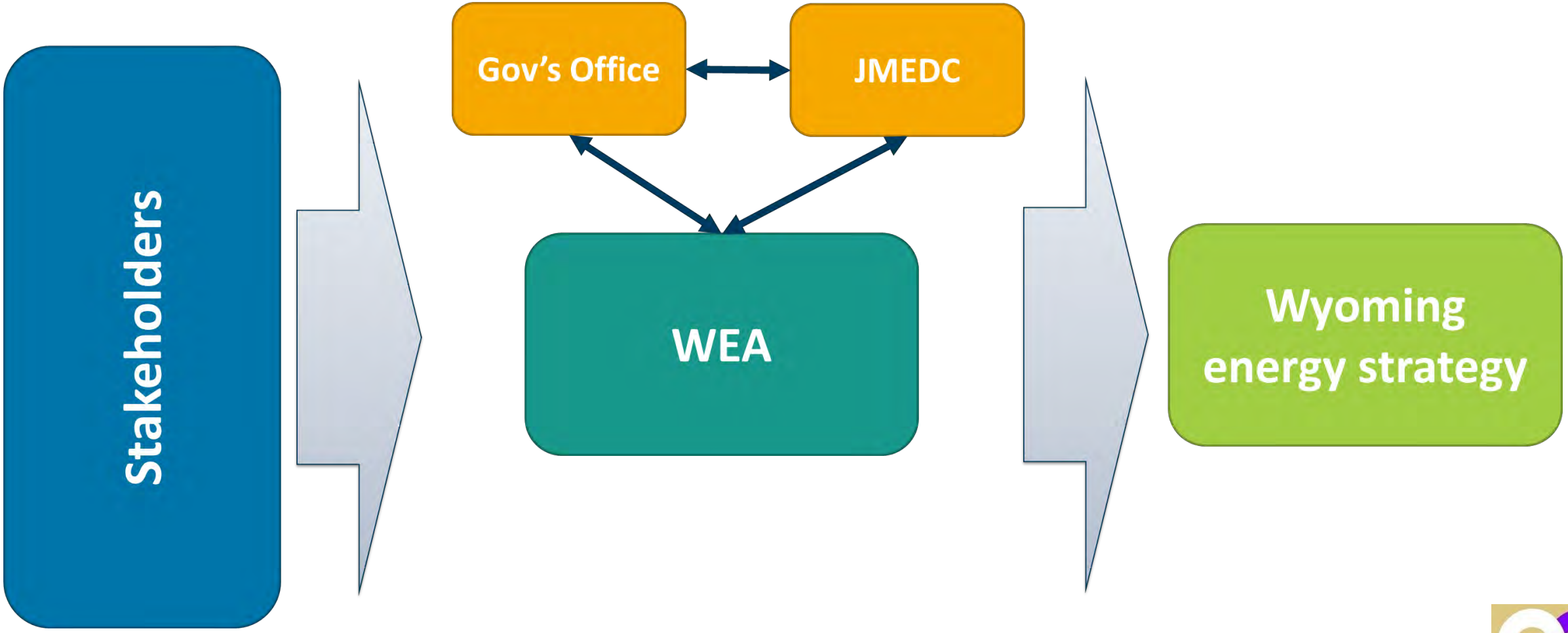
WEA Core Activities

Advocacy	Using evidence based reasoning to determine and advocate for the optimal policy, technology and economic solution.
Coordination	Providing a framework for cohesive and coordinated development efforts.
Promotion	Informing and educating the public and key stakeholders on policy, technology and development opportunities

TOOLS: Integrated Test Center, $3B Bonding authority, may “Plan, finance, construct, develop, acquire, own, maintain and operate…”, may enter into PPPs, State Energy Program, cost-share management, clearing house function, Wyoming Energy Strategy,…

The Wyoming Energy Strategy

"…develop, administer, update and communicate the Wyoming energy strategy."



The Wyoming Energy Strategy

What is the public perception?
- Within WY and beyond

Where are Wyoming's markets?

Which markets are most important?
- How do we define 'important'? Jobs? Commodity value? State Revenue?

How are those markets evolving? What macro-trends are we subject to?
- How do we preserve them? Volume or added value? What are the implications?

What solutions are available? What can we do?
- Technology? Infrastructure? Policy? What is the optimal mix?

What are other states doing? How do we compete for capital?
- What about Federal policy? Global initiatives?

Collation of Public Surveys and polls

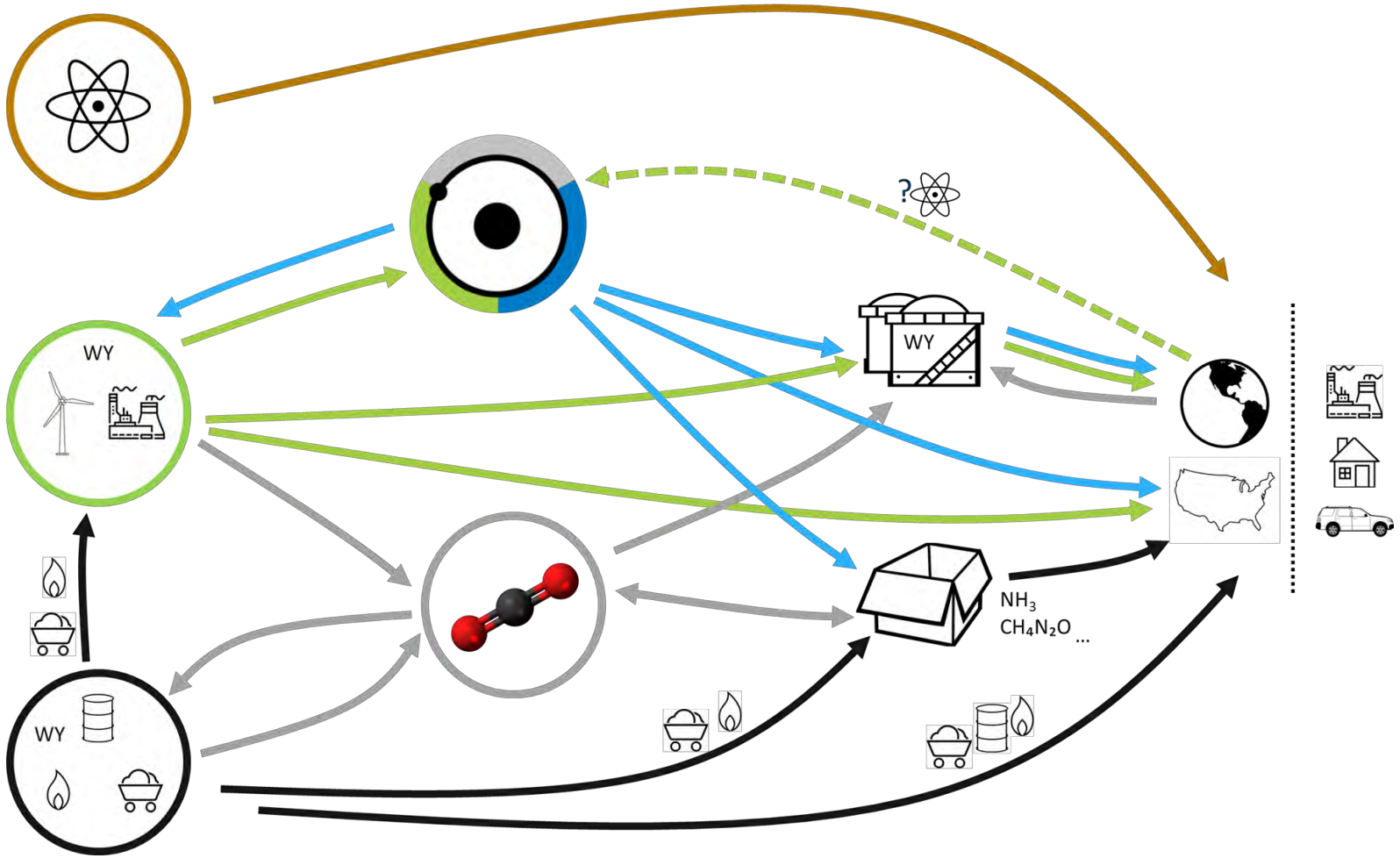
In-house market research

Neighbor State Benchmarking

Stakeholder Engagement
Energy Roundtable

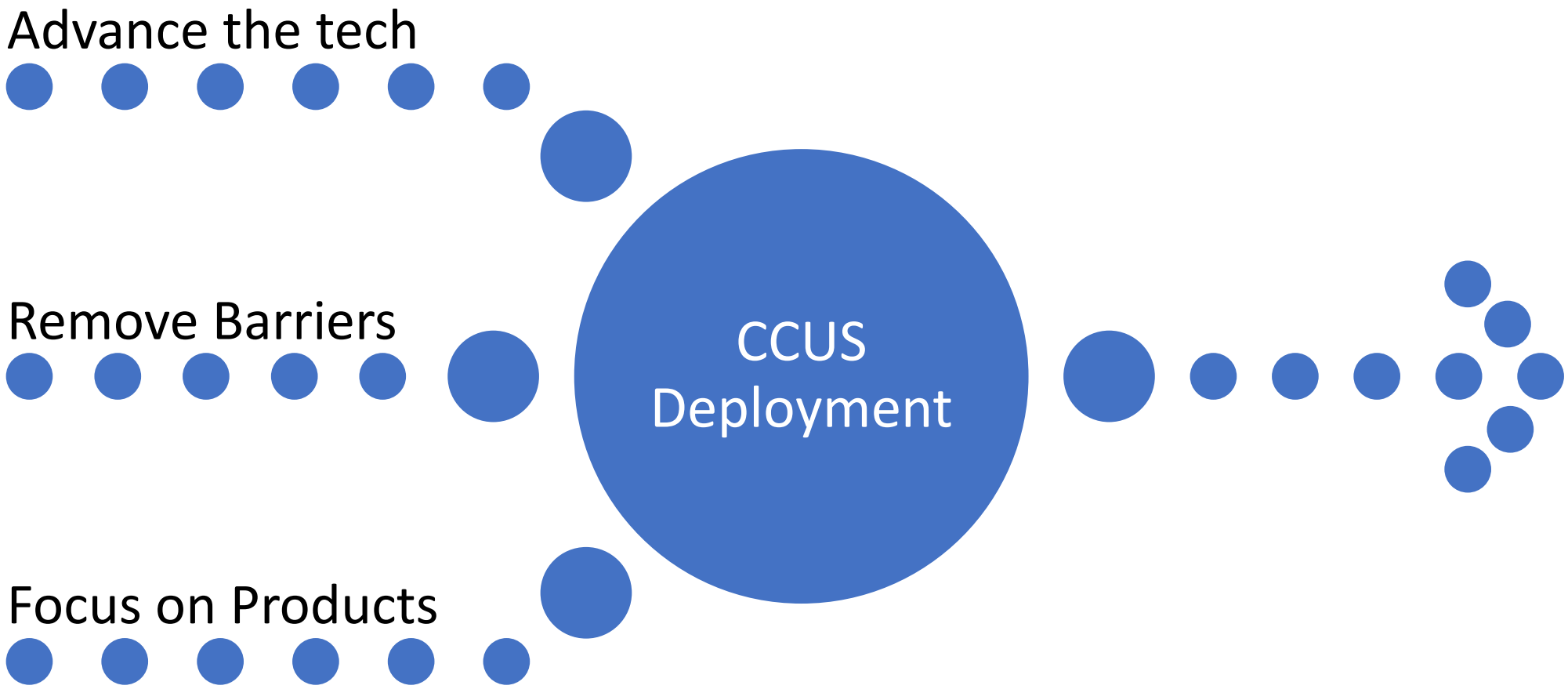
- **Highly complicated and interconnected answers.**
- **Each geo-commodity market has unique characteristics**
- **Each potential solution has implications for employment, revenue etc**
- **Themes do emerge:**
  - ***Low-carbon***
  - ***Hydrogen***
  - ***Value added products***
  - ***Non-linear value chains***

Wyoming Tomorrow



- All-of-the-above energy economy
- Low-carbon intensity
- Non-linear value chains
- Preservation of Hydrocarbon Heritage
- Value added

CCUS Strategy in Wyoming



CCUS in Wyoming

- Proactive and innovative policy and regulation

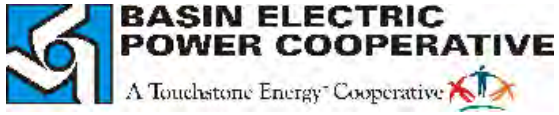
Capture…

- "Good faith effort" to evaluate CCS before closing/selling - SF159
- Low carbon energy standards including CCS/CCUS - HB200 CCUS
- Market for electrons beyond SF159 - SF21

Utilization and Storage

- Pore Space Ownership (W.S. § 34-1-152, W.S. § 34-1-513, W.S. § 30-5-501))
- Permitting procedures & requirements for CCS/CCUS sites (W.S. § 35-11-313)
- Post-closure MRV via a trust fund approach (W.S. § 35-11-318)
- Mechanism for unitization of storage interests (W.S. § 35-11-315)
- Provides certification procedure for CO2 incidentally stored during EOR (W.S. § 30-5-502)
- **State Primacy for EPA UIC Class VI (August 2020)**

Integrated Test Center



- 20+ MW of coal derived flue gas from the Dry Fork Power Station.
- 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.

- **TDA Research**
  - 2020 testing hybrid membrane/solid sorbent capture system.
- **Kawasaki Heavy Industries (KHI)**
  - Fixed bed adsorbent optimization testing. On site in late 2021.
- **GreenOre**
  - Carbon dioxide and fly ash utilization to calcium carbonate. On site in 2021.
- **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. Finished all testing in Nov. 2020.
- **GTI**
  - 1 MWe membrane system – On site in 2021.

Wyoming CarbonSAFE

Accelerating CCUS Commercialization and Deployment at Dry Fork Power Station and the Wyoming Integrated Test Center - DE-FE00311891

- ✓ **Phase 1 Integrated CCS Pre-Feasibility - Completed**
- ✓ **Phase 2 Storage Complex Feasibility – In-progress**

Phase 3

Objectives:

1. Finalize site characterization
2. Complete Class VI permitting to construct
3. Integrate MTR's CO_2 capture assessment
4. Conduct NEPA analysis

Scope:

1. Environmental and CO2 capture assessment
2. Field operations and technical research
3. Class VI permitting, business, economics, and outreach
4. CCUS commercialization plan

Wyoming CarbonSAFE

Accelerating CCUS Commercialization and Deployment at Dry Fork Power Station and the Wyoming Integrated Test Center - DE-FE00311891

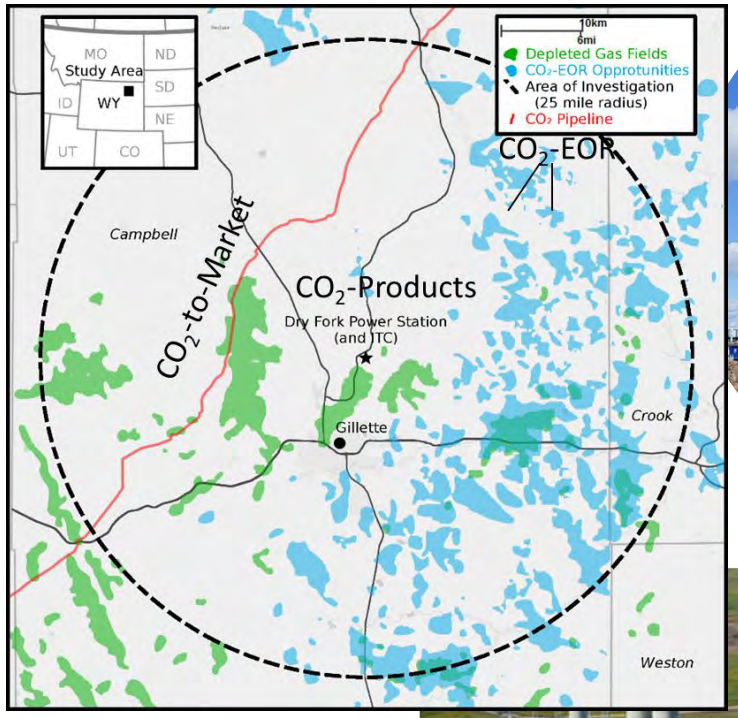
*Wyoming CarbonSAFE is focused on investigating the **feasibility** of practical, secure, **permanent**, **geologic storage** of carbon dioxide **(CO_2)** emissions from coal-based electricity generation facilities near Dry Fork Station Gillette, Wyoming….*

Things we are looking for…..

- ✓ Is there sufficient volume in the subsurface to store commercial quantities of CO_2?
- ✓ Can the CO_2 be injected safely? Stored permanently?
- ✓ What are the risks/costs/policy?

[1] Commercial quantities = 50 million tons over 25 years (i.e. 2 million tons per year)

https://www.youtube.com/watch?v=UoYnC4h7_Dg&feature=youtu.be



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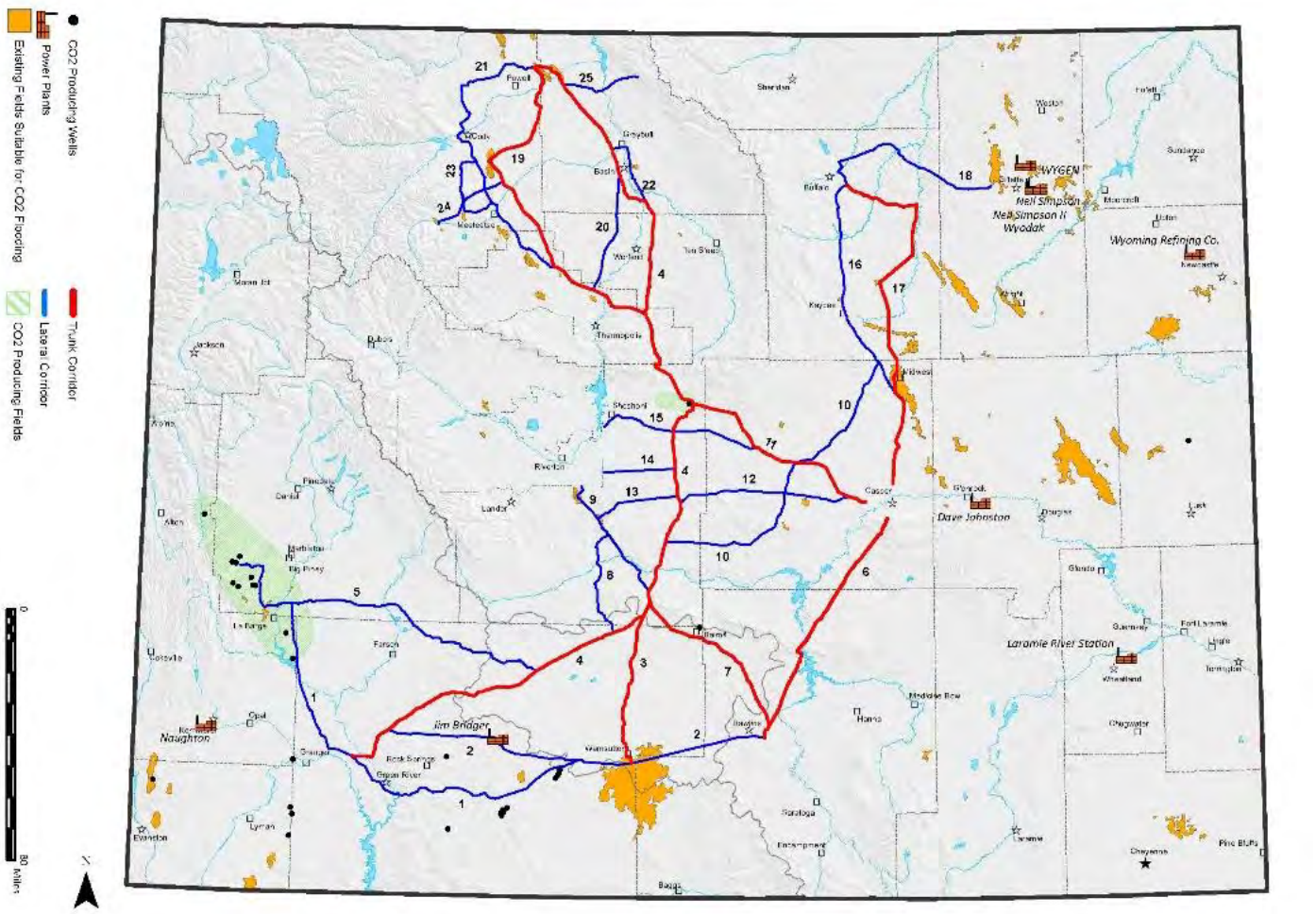
Wyoming Pipeline Initiative



- Goal is to facilitate development with a coordinated planning approach
- Connect sources of CO2 with compatible Oil fields and sequestration prospects
- Trunk and lateral corridors
- Multiple products, not just CO2 pipelines
- Also considers broadband infrastructure

Status

- WPCI notice of intent - November 2019
- Draft EIS - April 2020
- Final EIS - October 2020
- Record of final decision expected January 2021
- What next? Pre-requisite work on Class VI wells?

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