July 21, 2021

WEA Annual Review

WYOMING ENERGY AUTHORITY

Dr. Glen Murrell

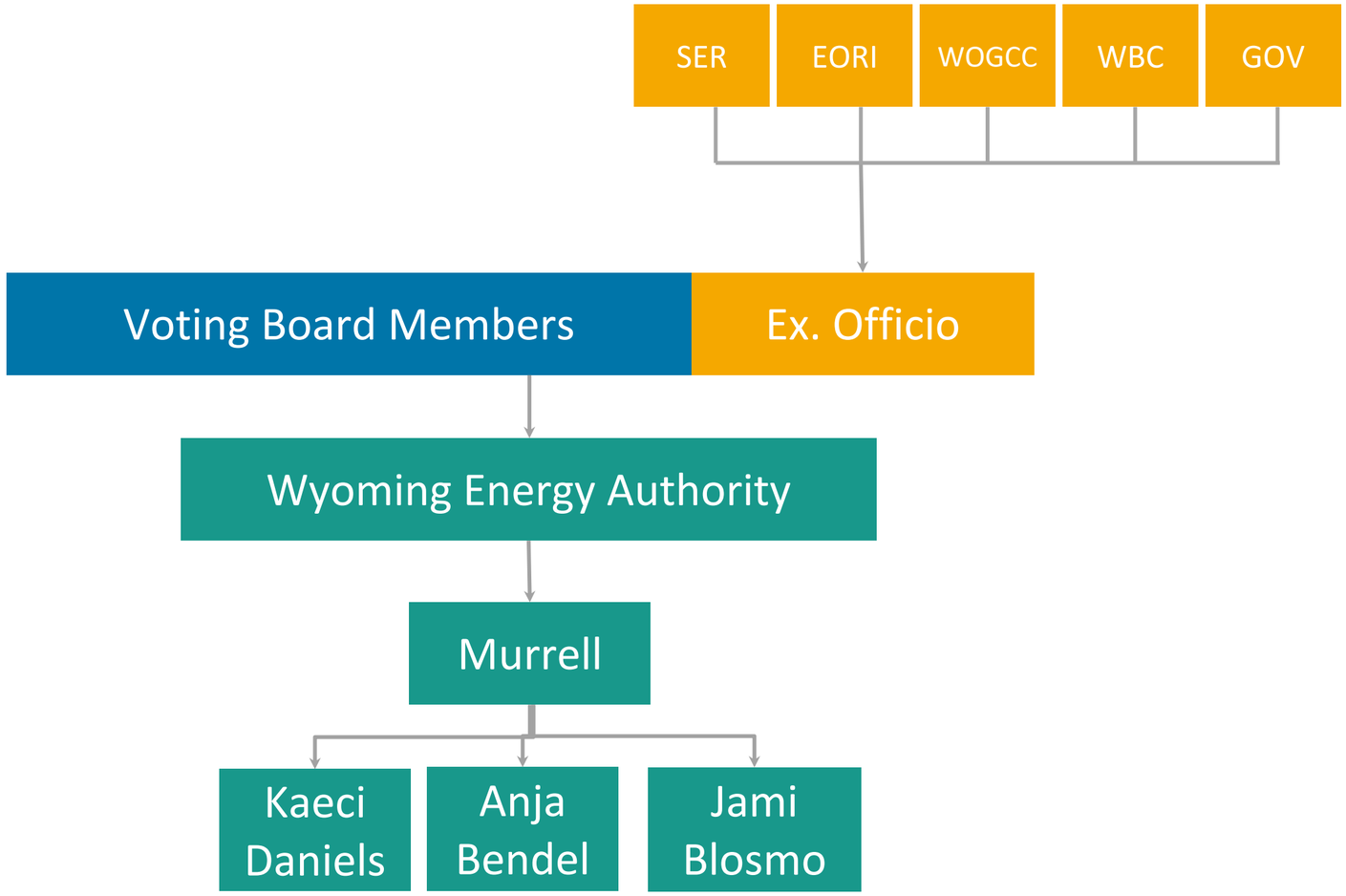
WEA

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.



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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

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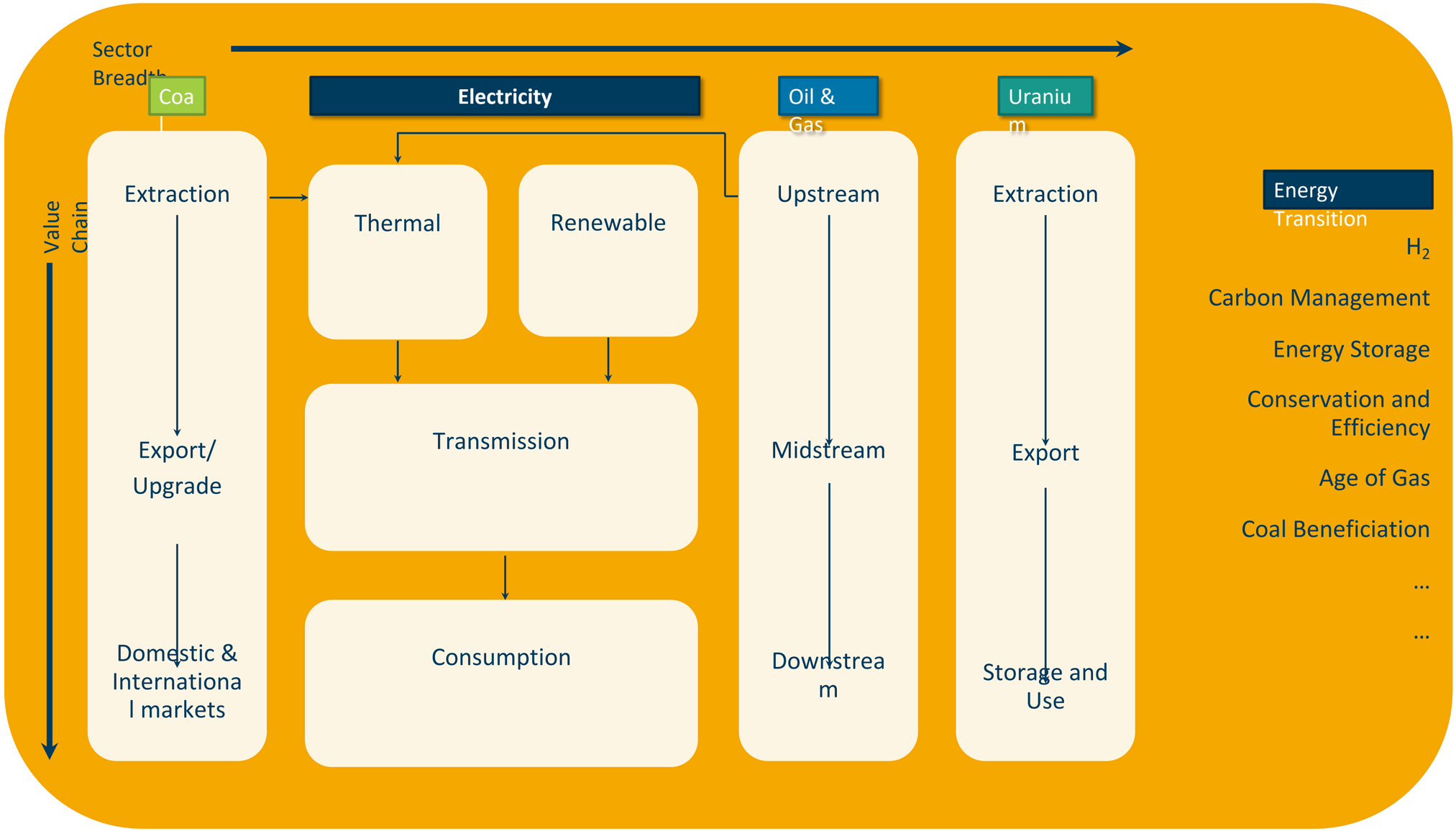
Scope



... plus, non-energy extractives, like Trona, Bentonite, precious metals....

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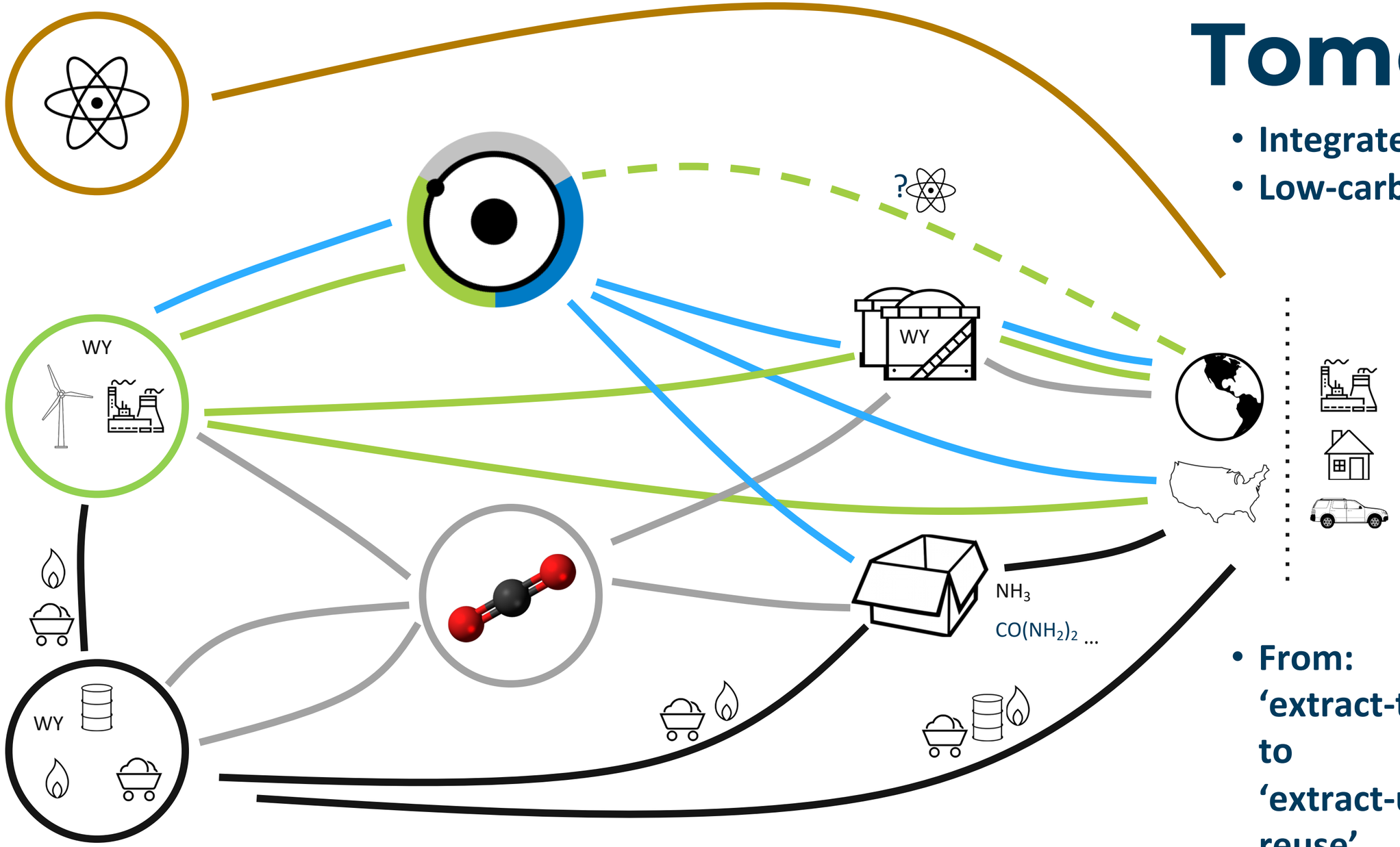
Tomorrow?

- Integrated energy economy
- Low-carbon intensity



- From: ‘extract-transport-consume’, to ‘extract-upgrade-store-reuse’

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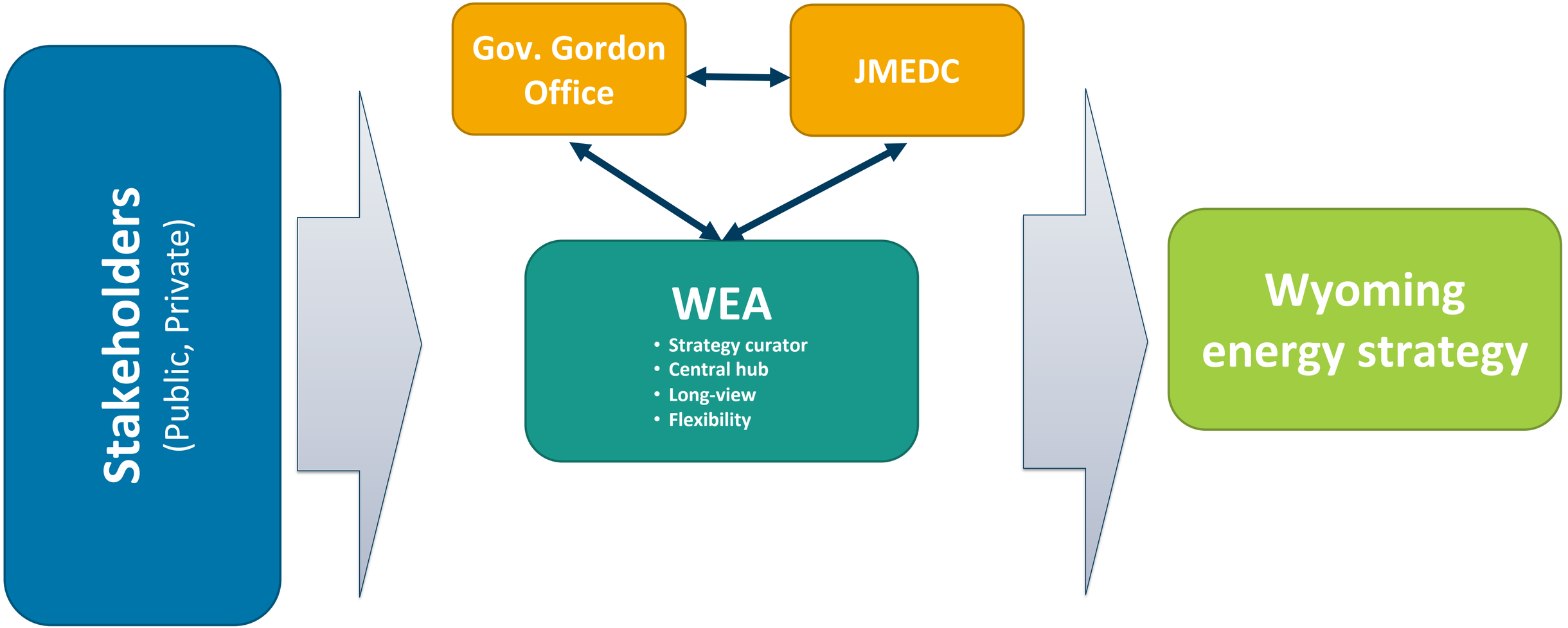
Wyoming Energy Strategy

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



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Wyoming Energy Strategy

Phase 0
- Fact finding and problem definition

July, 2020 thru' Oct, 2020

Phase 1
- Aspirations and vision setting
- Stakeholder Engagement
- Initiatives

Nov, 2020 thru' May, 2020

Today

Phase 2
- Quantification and Abatement modelling
- Communication

June, 2021 thru' Sept, 2021

Phase 3
- Enablement

Oct, 2021 and on

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Wyoming Energy

- *7,717 trillBTU (~$14.5B in product value) in 2018*
- *3rd largest producer in USA. If Wyoming were a country it would be ~13th largest, and roughly equivalent to Norway, Kazakhstan or the U.A.E.*
- *Coal @ $12t is cheaper than dirt: 40lb of top soil is $1.78 (~7.5X value)*
- *Oil @ $35bbl is cheaper than water: 1 Gallon of water is ~$1 (~$42 bbl)*
  - *Constituent product value (e.g. gasoline, diesel, jet fuel,…) is ~$80bbl*
- *Gas @ $2Mcf is cheaper than air: 80 cf tank refill ~$5 (~30X value)*
- *Electricity @ 10c/KWh is simply darn cheap: $1 worth of electricity could boil a kettle of water 50 times*

ABUNDANCE = CHOICE

…and people are choosing low-emissions energy

…and their Governments are responding

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Our North Star

EM**POWERING** OUR NATION WITH A NET-ZERO ENERGY MIX

“….today, I challenge you to join me in making Wyoming net negative in CO_2 emissions. We have to take the lead, and not look back….. ,

As we actively and thoughtfully collaborate with industry environmental groups, entrepreneurs, local communities, and others to produce our way to net negative carbon emissions, literally. Not by regulating away our past, ***but by innovating our way to the future.”***

- Gov. Gordon, State of the State address, March, 2, 2021

Strategic Opportunities

Heritage Projects

CCUS deployment + decarbonized products

Hydrogen + H_2 products

Demand creation

– *old and new markets*

Electrification

Storage & transmission

Value-added electricity

- *Green data centers, crypto mining, Renewables based Direct Air Capture (DAC)*

Retail evolution – *EV, conservation/efficiency*

Repurposed Infrastructure

Energy Evolution

Advanced nuclear tech

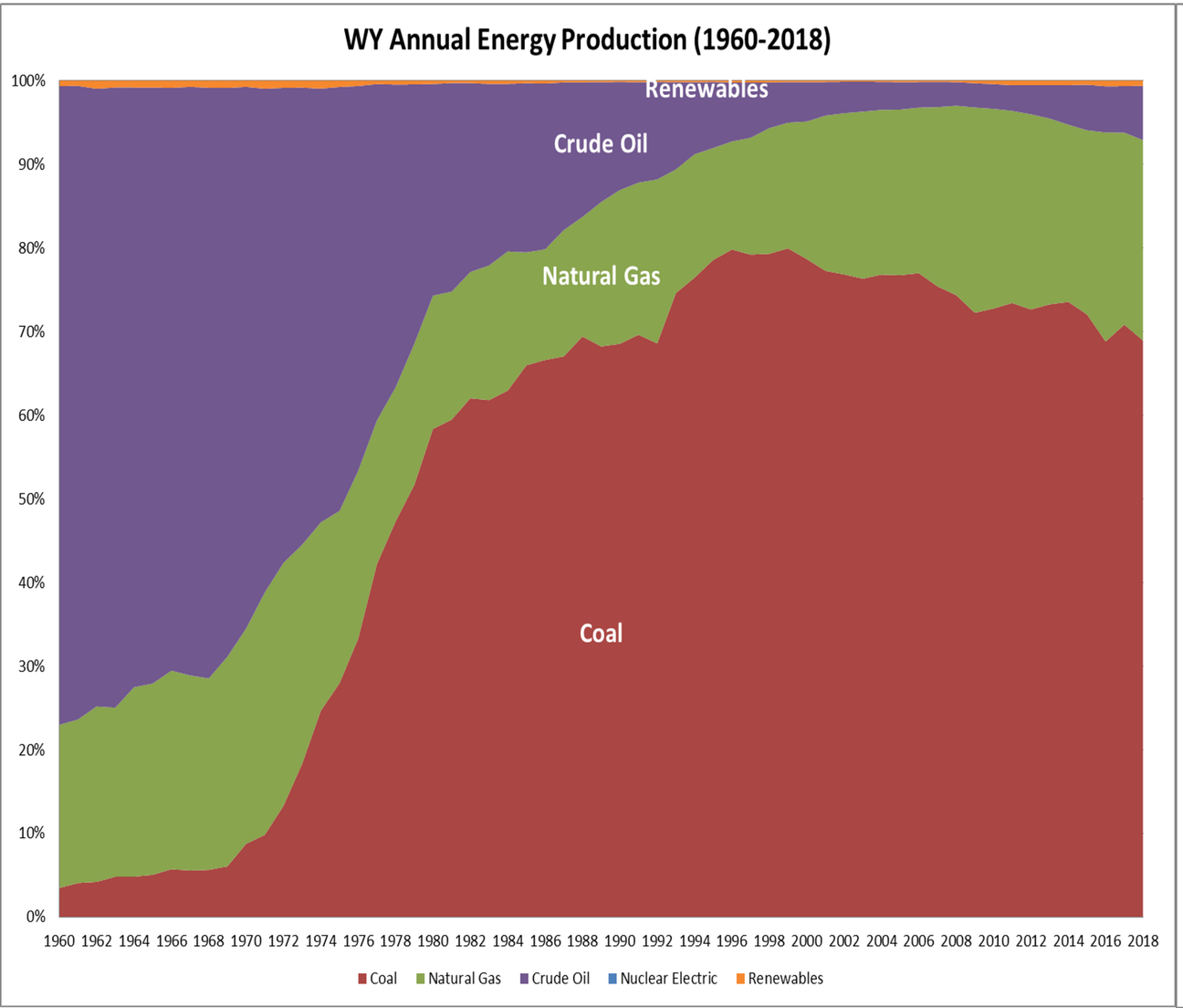
– *SMR, Thorium salt*

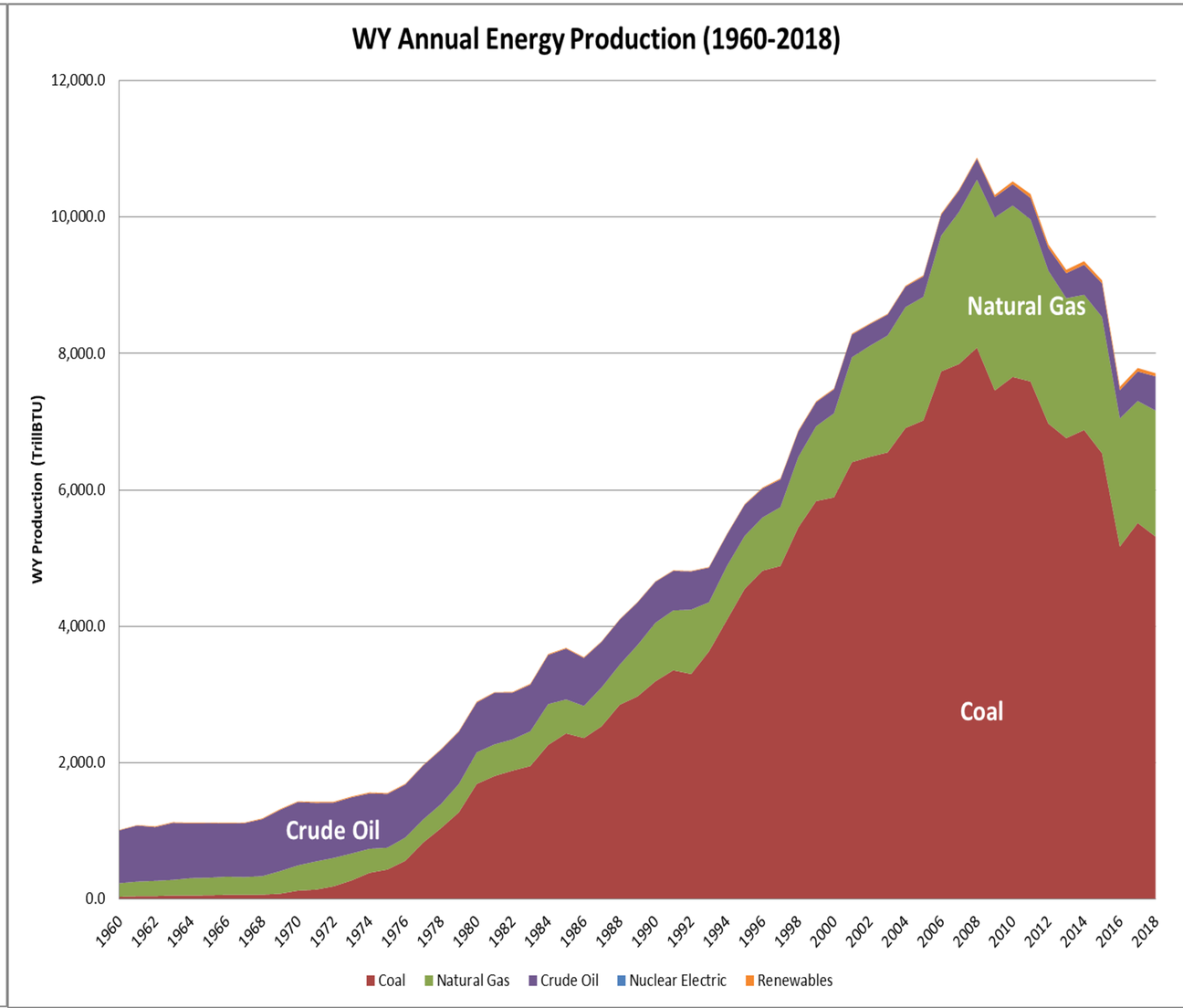
REE and CM

Carbon engineering

Non-linear value chains

The Challenge

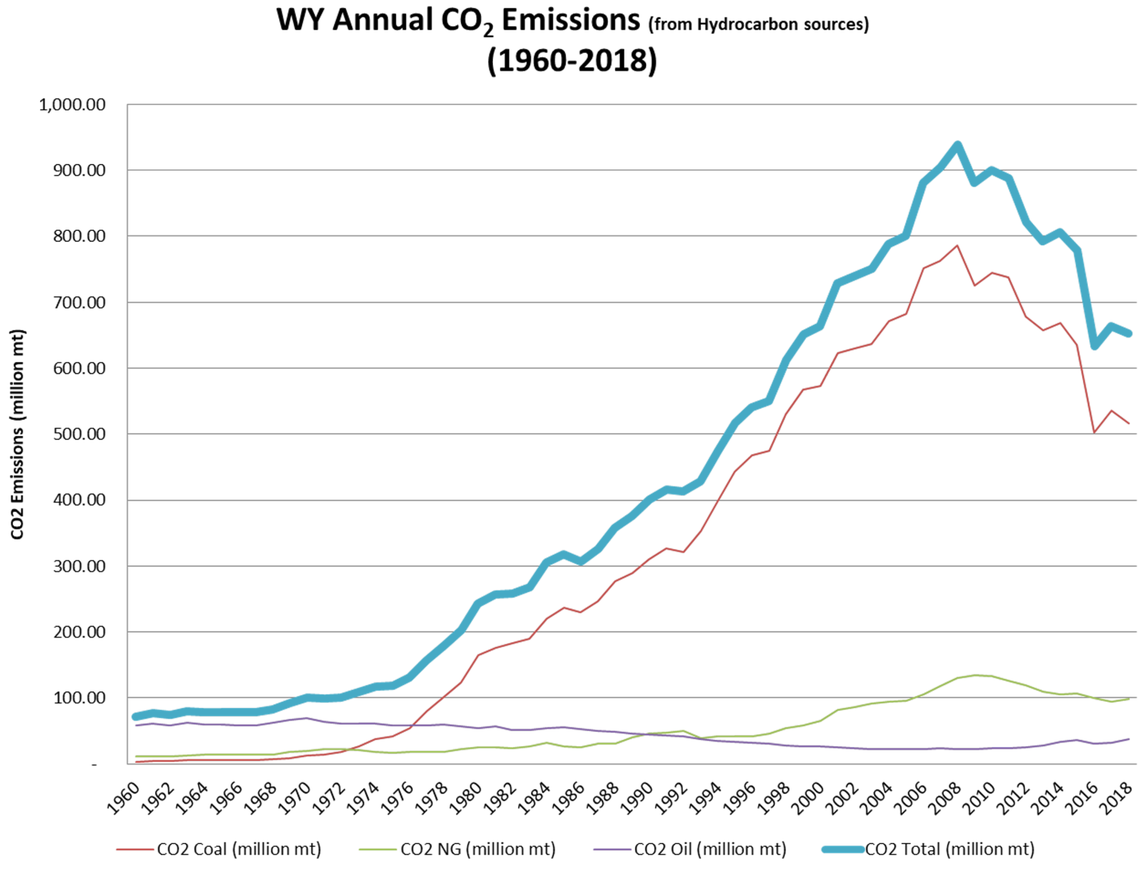


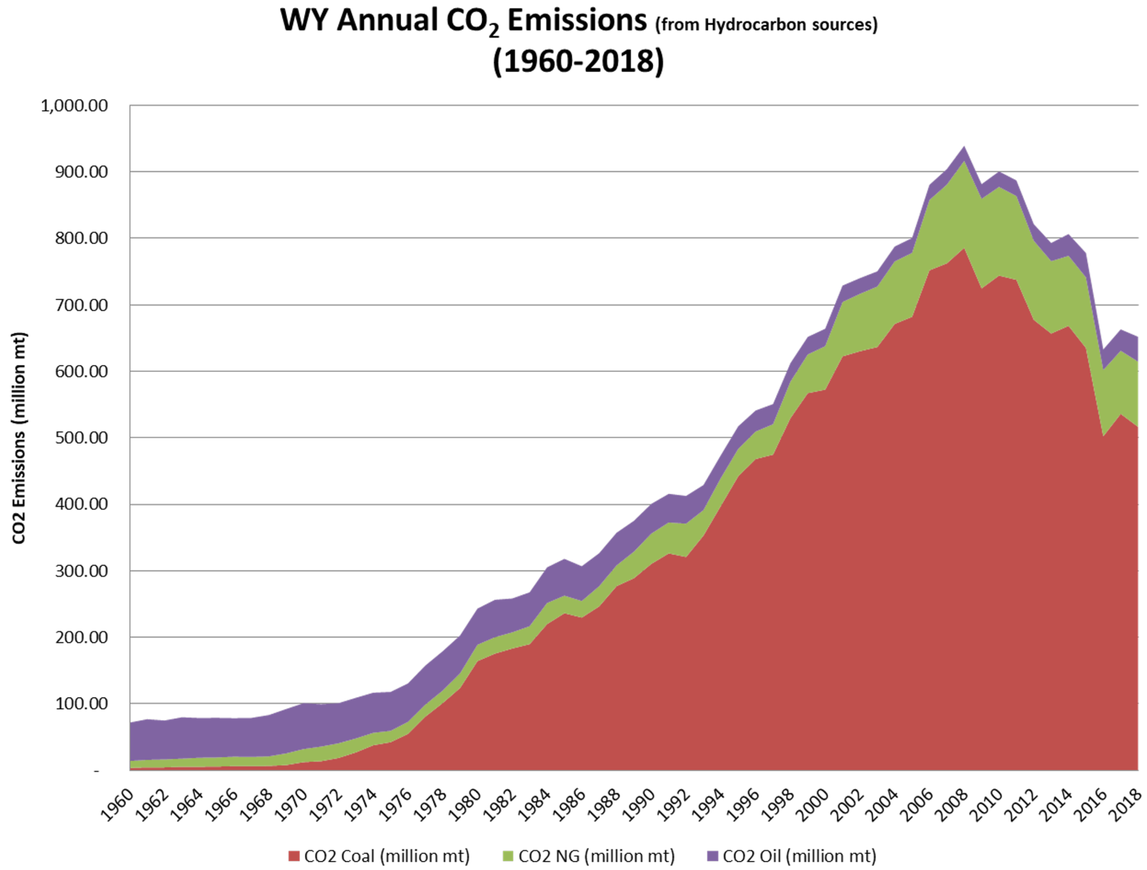


The Challenge

mt = metric ton

- WY's full 'scope 3' emissions are dominated by our exported hydrocarbon commodities. Internal CO_2 footprint probably ~60 mill. mt/yr (mostly due to electricity generation). 90% is emitted ***outside*** of Wyoming borders.
- Peaked in 2008 (940 mill. mt/yr), corresponding to peak in coal production. Has since declined 30% to **650 million mt in 2018**





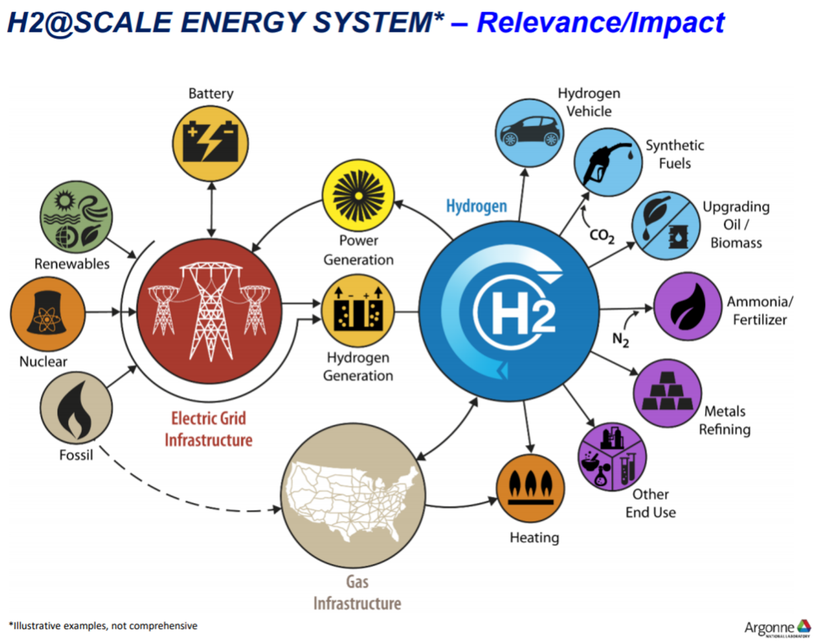
Key Initiatives

Wyoming Hydrogen

- SER Center Of Excellence
- WEA cost-share study

Sequestration as a Service

- Pre-permit Class VI wells
- Public/Private commercialization of CCUS
- Stewardship



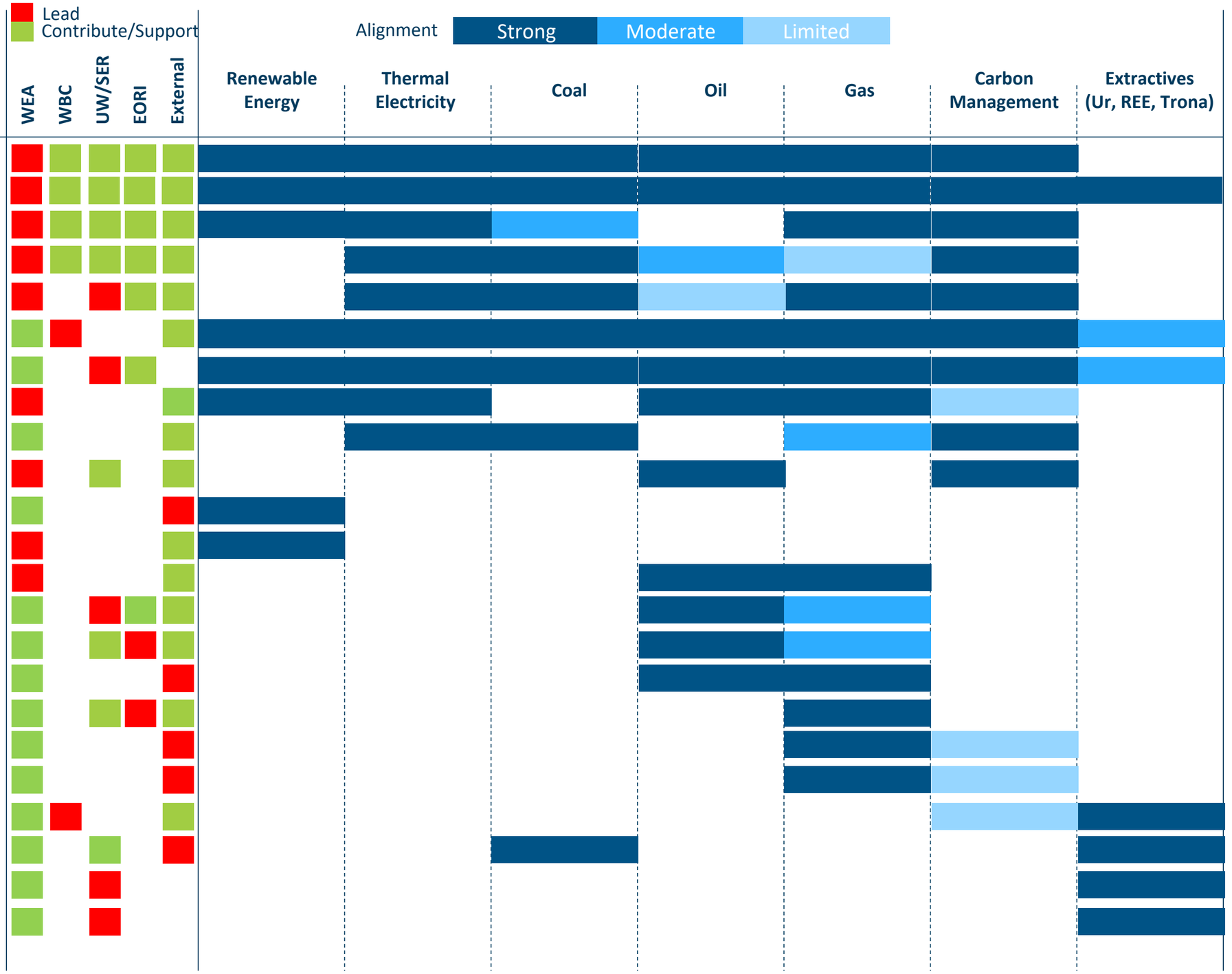
Why Sequestration?

- *Wyoming has an existing **CO_2 management infrastructure** already, which could be connected up to other CO2 pipeline systems*
- *Wyoming has abundant **reservoir storage capacity***
- *Wyoming has **Class VI primacy***
- *Wyoming established a strategic **pipeline corridor initiative***
- *It has a head start on many **policy** reqs.*
- *It benefits **ALL** CO2 emission sources including H2*
- *It would remove a great deal of uncertainty, liability and CAPEX from any emitters consideration*

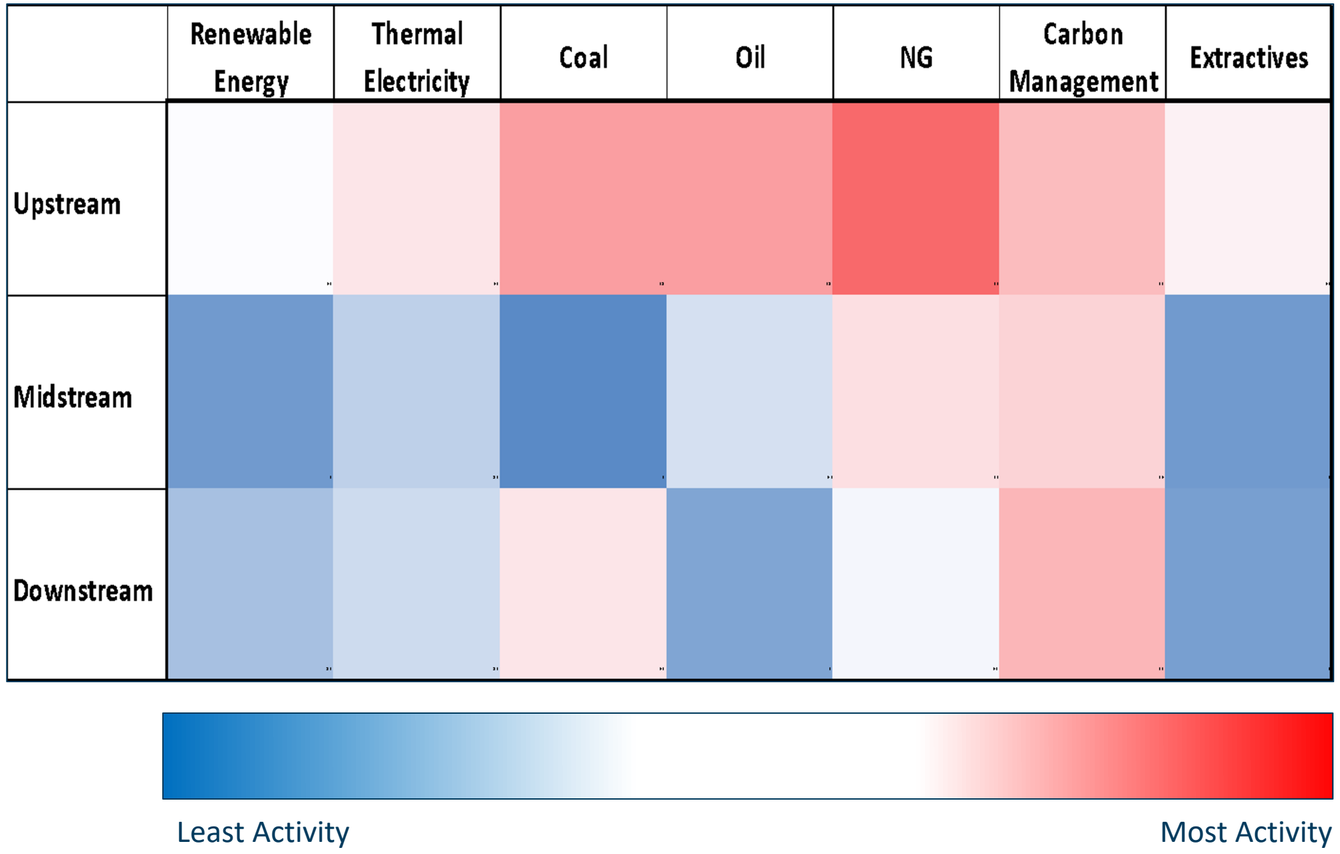
Why Hydrogen?

- *Wyoming has the **greatest abundance of natural feedstock for Hydrogen production in the country.** (NG, Coal, Renewables)*
- *Its **geographical location** is favorable*
- *It has all the **ancillary export infrastructure** in place*
- *It has an existing substantial **CO_2 management infrastructure** already*
- *It has an existing **Hydrogen manufacturing** industry.*
- *It has a head start on many **policy** reqs.*
- *It aligns with the **Wyoming Energy Strategy** and other economic initiatives in the state – "All-of-the-above", "Net-Zero", "Value-added", "energy and economic diversification", "innovate to the future"*

Initiatives

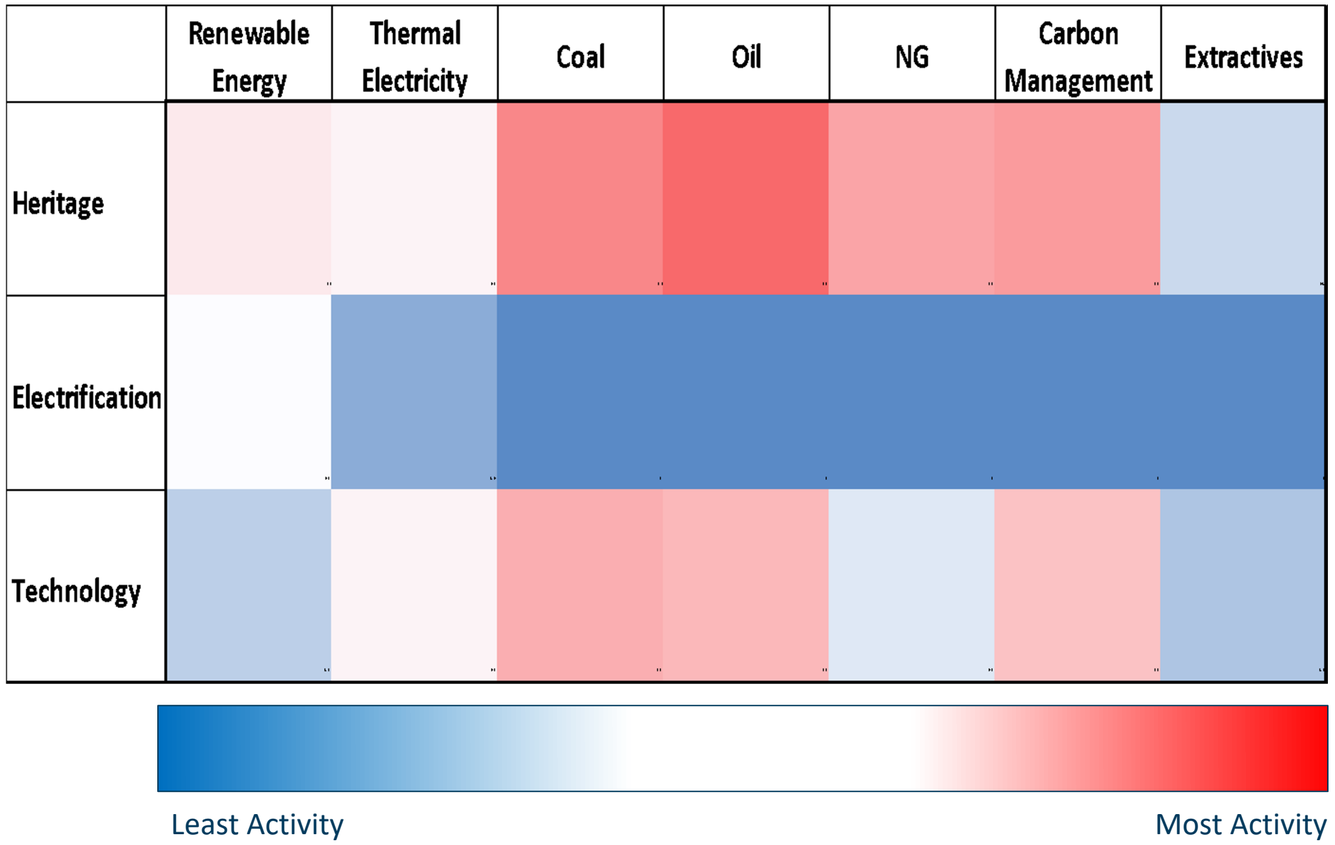


Portfolio Heatmap - Sector



- Good coverage across the upstream portions of the value-chain
- Most activity focused on the ‘big-3’
- Renewables least represented
- Carbon management value-chain attracts most activity

Portfolio Heatmap - Strategy



- Heritage aspects of Strategy most represented.
- Some work to do on Electrification.

CCUS Funding

HB0001H2023 Section 340. Carbon Capture, Utilization and Storage

- $10m appropriated from legislative stabilization reserve account.
- Subject to approval by the University of Wyoming energy resources council and the governor.
- Objective to match research grants and contracts related to carbon capture, utilization and storage, and advance commercial CCUS activities in Wyoming
- Request for Proposal (RFP) released this week. Will be open for 3 months
- We will extend (or re-open) solicitation period in order to accommodate forthcoming DOE FOAs or other co-funding opportunities, if they arise.

Areas of interest:

1. **Post-combustion** capture from thermal electricity generation systems (coal or natural gas- based) or other industrial processes.
2. **Pre-combustion** capture from thermal electricity generation systems or other industrial processes; including reformation, gasification, pyrolysis or other hydrocarbon conversion processes.
3. **Carbon removal** technologies and methods.
4. **Utilization** of captured CO_2, including novel enhanced oil recovery techniques , synfuels, and other carbon engineering approaches.
5. **Storage and sequestration** of captured CO_2, including the development of large regional CO_2 storage hubs
6. Carbon capture/removal **accreditation, offsets, standards, monetization, trading** and associated commodity attributes.

Stay Connected

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