

# BEYOND ENERGY TRANSITION

## Emerald Operating Company Renewable Natural Gas and Renewable Hydrogen Generation

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*naturally replenishing, continuously produced, and biogenic*

- ***Imagine generating carbon-neutral, renewable biogenic natural gas (RNG) and renewable bio-hydrogen (H<sub>2</sub>) from coalbed underground aquifers, providing the clean fuels of the future.*** This is exactly what Emerald Operating Company (EOC) is achieving by merging biotechnology with existing infrastructure to create downhole “farms” that produce RNG and H<sub>2</sub>.
- Underground, microscopic organisms known as archaea inhabit coal surfaces and fractures, producing biogenic RNG and hydrogen. Coalbed aquifers offer an ideal environment for these organisms to flourish, providing a continuous supply of nutrient-laden groundwater. Additionally, coalbeds absorb carbon dioxide (CO<sub>2</sub>), a by-product of RNG and H<sub>2</sub> production. This CO<sub>2</sub> is adsorbed in the coalbed locking it away permanently, preventing it from reaching the atmosphere. Moreover, EOC’s patented borehole BioGem Tool™ ensures that methane does not escape into the atmosphere. ***This integrated process not only promotes the generation of carbon-neutral RNG and hydrogen but also facilitates carbon capture and reduces greenhouse gases.***

20 to 23  
Million Years  
ago

# GEOLOGICAL FORMATION OF COAL FOR GENERATING RENEWABLE NATURAL GAS & Bio-HYDROGEN

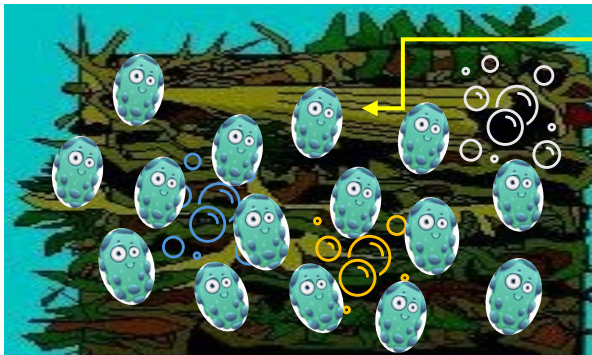
Present  
Day



Near  
Surface

## Peat Phase

Time



- Methanogens consume decaying vegetation, population thrives producing vast amounts of methane (CH<sub>4</sub>), CO<sub>2</sub>, Hydrogen (H<sub>2</sub>)

Deeper burial depth, temperature & pressure increasing

## Lignite Phase



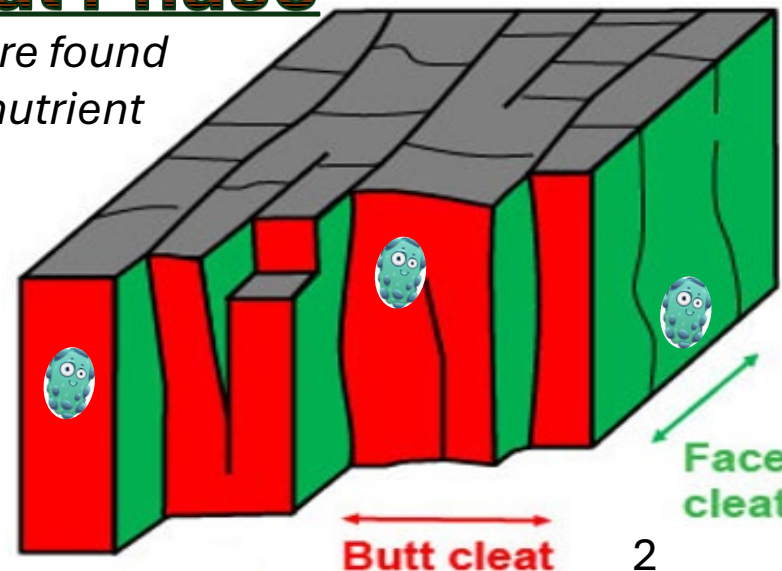
- Less nutrients for methanogens to thrive & generate CH<sub>4</sub>, CO<sub>2</sub>, & H<sub>2</sub> as the nutrients have been consumed & are beginning to harden into rock. CH<sub>4</sub> & CO<sub>2</sub> become adsorbed into the lignite molecular matrix; H<sub>2</sub> escapes to the atmosphere.

## Coal Phase

- The only nutrients available to the methanogens are found in the fresh water of the coals; the coals become nutrient poor. Methanogenic population is diminished.

Field tests in buried coals by Luca (2009) & Emerald (2019, 2022) demonstrate that when adding certain nutrients to the coals, the methanogenic population thrives, and new CH<sub>4</sub>, CO<sub>2</sub>, & H<sub>2</sub> are generated with CO<sub>2</sub> being adsorbed & sequestered in subsurface coals.

100's to  
1,000's of  
feet  
below  
surface

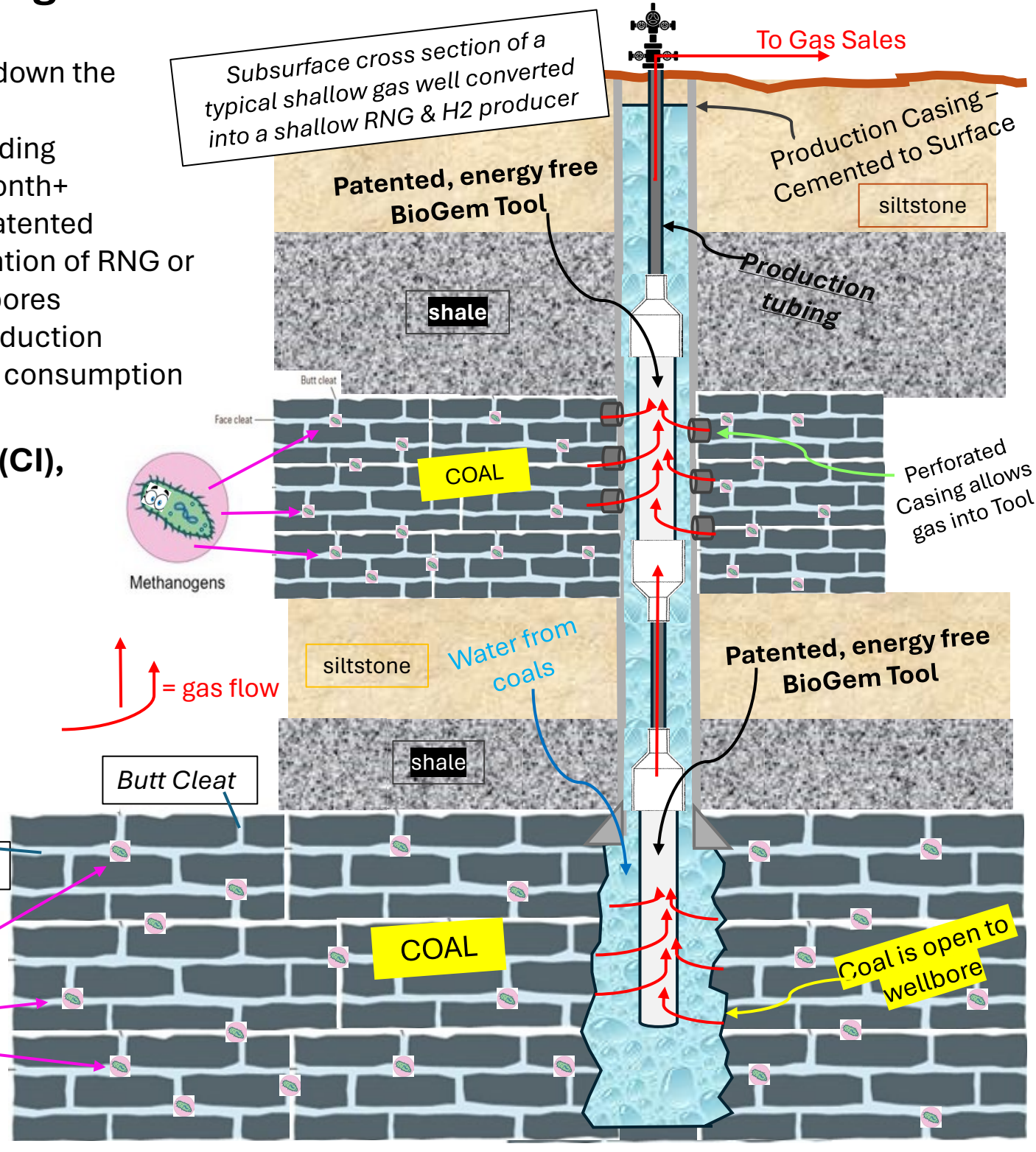


# Downhole 'Farming' of RNG and/or H2 in Natural Gas Wells

- Nutrients are applied/circulated down the wellbore into the coal seams
- Nutrients are left to incubate, feeding methanogens for a week+ to a month+
- Wells are re-equipped with the patented BioGem Tool™, facilitating separation of RNG or H2 from groundwater in the wellbores
- Separated RNG or H2 flow up production tubing, moving it to sales or local consumption

## Energy free, low Carbon Index (CI), patented production tool

- BioGem Tool™ is powered by the differential pressure that exists between the hydrostatic head of water in the wellbore & the lower pressure maintained inside the production tubing
- Tool can be used to produce Renewable Natural Gas or Hydrogen or both
- BioGem Tools can be attached in series hundreds of feet long or punctuated by lengths of tubing, as needed

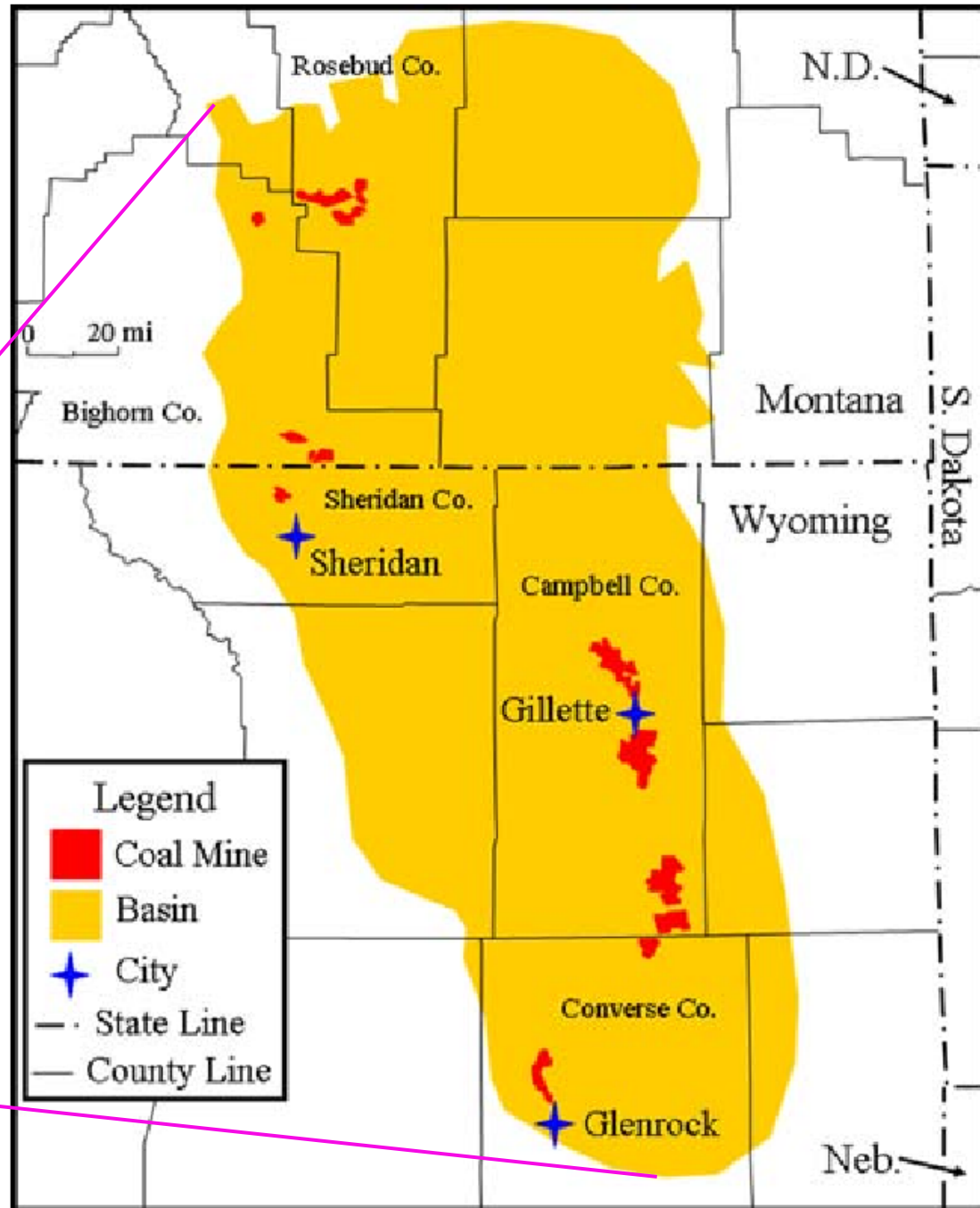
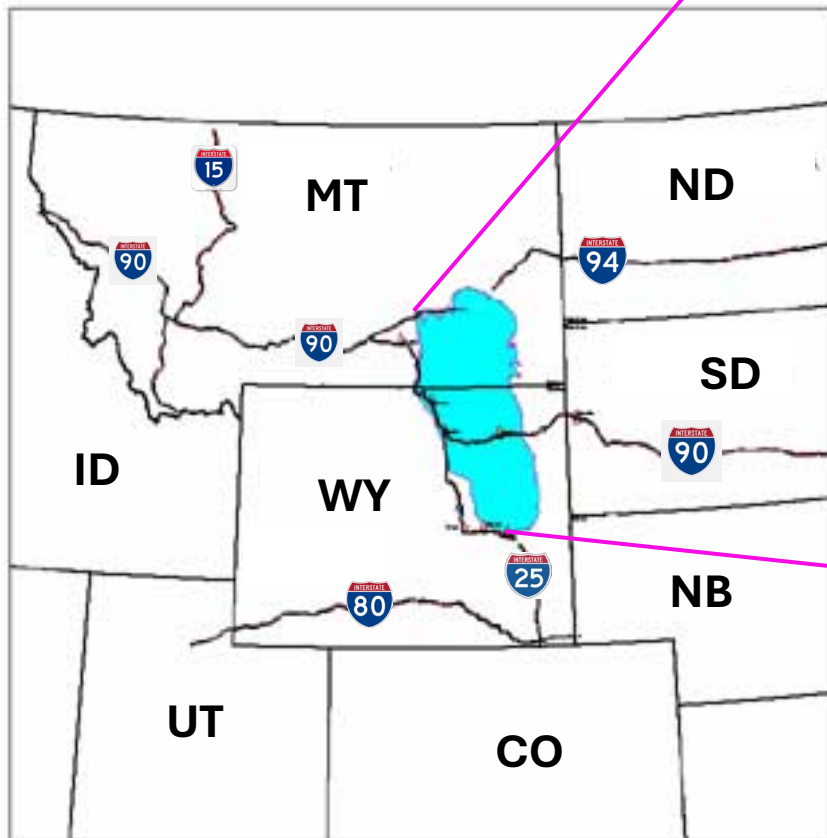


# LOCATION

## Powder River Basin

The Powder River Basin (PRB) is in northeastern Wyoming & southeastern Montana, covering approximately 20,000 square miles. Coal mines in this basin supply over 40% of our nation's coal, primarily utilized for electrical generation.

Subsurface PRB coalbed aquifers can easily satisfy our country's need for clean energy. These coal aquifers are sufficient to provide RNG and hydrogen continuously in huge to unlimited quantities.



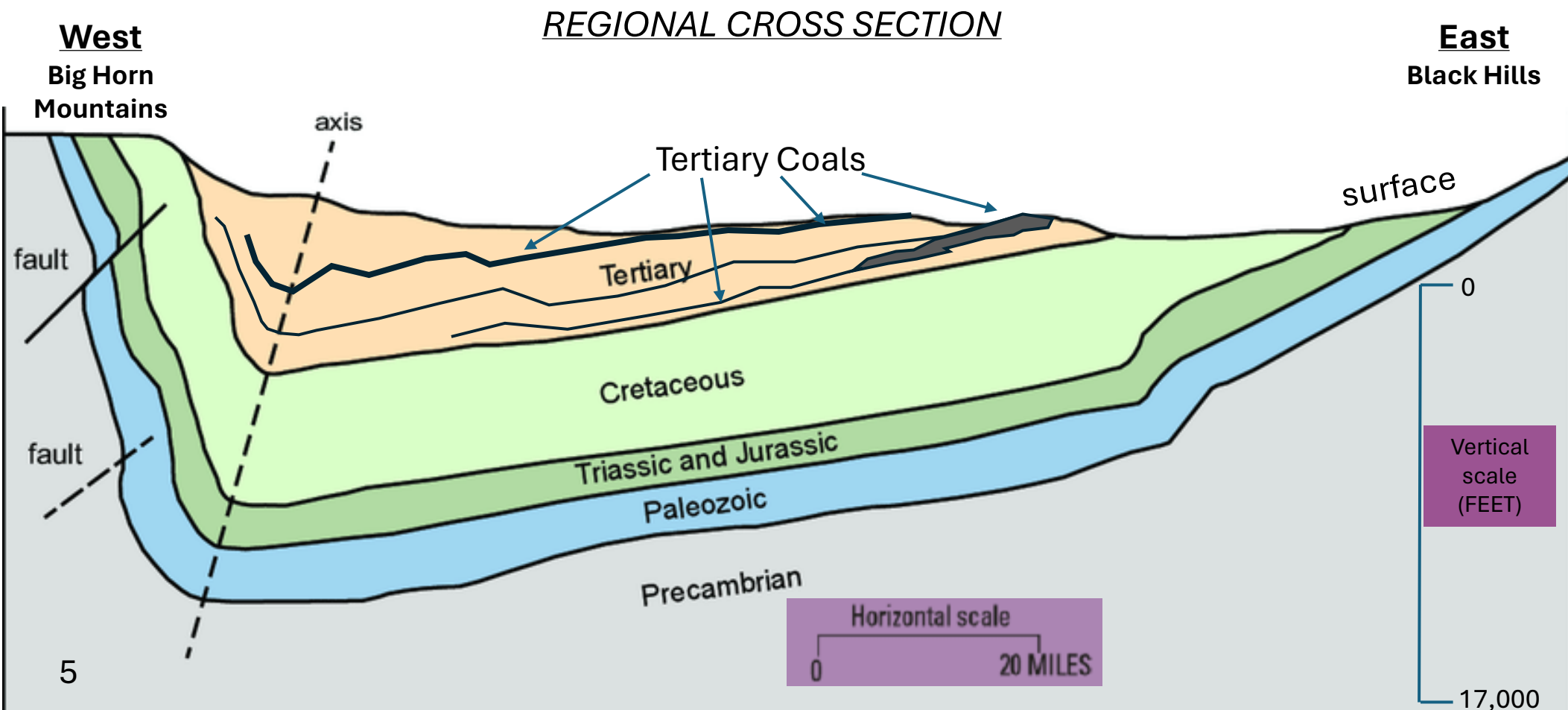
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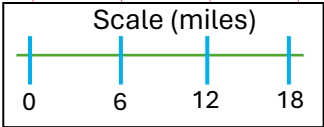
# Underground Coal Occurrence

Subsurface rock formations in the Powder River Basin dip from east to west at about 115' per mile, exhibiting an asymmetrical basin axis to the west. Targeted coals are Tertiary in age, approximately 20 to 23 million years old. Coals at a depth of 500 to 2,000 feet are targets for EOC's RNG/H<sub>2</sub> farming process. Perspective coals for RNG/H<sub>2</sub> generation exist over an extensive area of 5,500+ square miles of the northern PRB.



# Size of the Opportunity

Sheridan

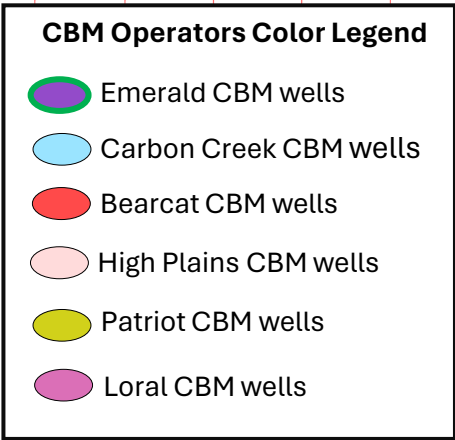


Buffalo



Gillette

Wright



\*WOGCC = Wyoming Oil & Gas Conservation Commission

As of late 2022, over 5,900 idle/orphaned coalbed methane wells exist throughout the northern PRB region. Most operators filed bankruptcy, and therefore abandoned their wells to the State of Wyoming. The WOGCC\* oversees these abandoned wells, available for acquisition. Other operators listed below have ~200 additional wells that likely will become available.

These wellbores are associated with extensive gas gathering systems & production facilities, all available for acquisition at a fraction of the cost, compared to what it would be to construct.

These assets can be evaluated and hand-picked to fit the EOC approach to farming RNG and bio-Hydrogen.

Emerald Operating Co./ BioGem Inc.

Denver, Colorado/Gillette, Wyoming

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