# PHMSA Public Meeting

## H2 Panel Presentation

December 2022

TALLGRASS
Leading Energy Solutions

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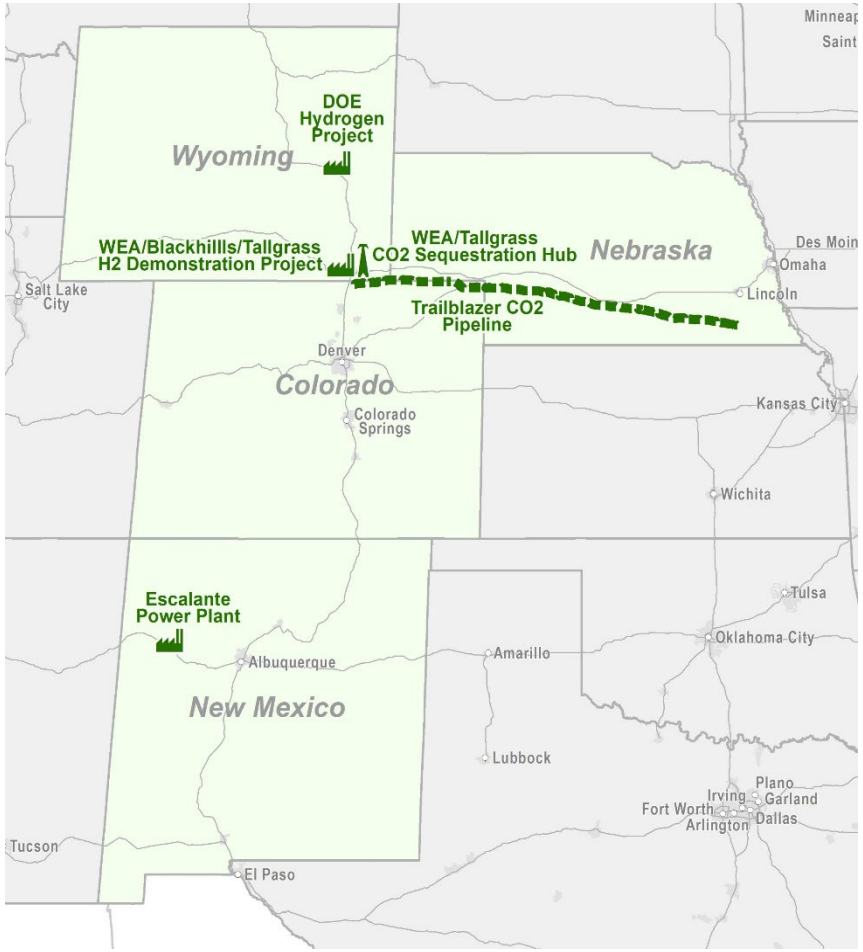
# Low Carbon, Hydrogen and CCUS Initiatives

**Decarbonized hydrogen businesses, multiple $CO_2$ projects and infrastructure development**




## HYDROGEN

- **DOE $H_2$ project (U.S. DOE grant)**
  - Initial engineering of a $CO_2$ capture unit on a 220MMSCFD $H_2$ ATR in partnership with Haldor Topsoe, BASF, Technip, University of Wyoming
- **Escalante Hydrogen**
  - Conversion of a 265MW coal power plant to 100% $H_2$ firing including new $H_2$ production with 95% $CO_2$ capture and sequestration
- **Black Hills Cheyenne**
  - Demonstration of $H_2$ combustion in a commercial NGCC with WEA, Black Hills (owner), GE and Black & Veatch

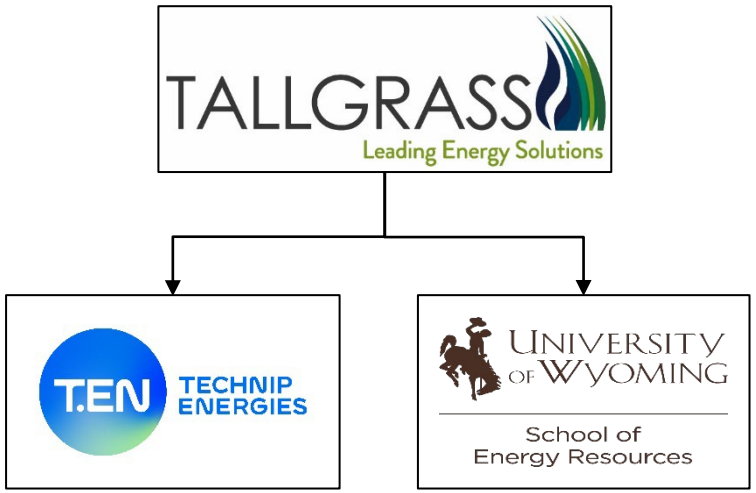
## $CO_2$

- **Trailblazer $CO_2$ pipeline**
  - Conversion of ~390 miles of a 36” pipeline from natural gas to $CO_2$ to access to 10 MTPY+ $CO_2$ within 50 miles of Trailblazer
- **Eastern Wyoming $CO_2$ sequestration hub**
  - Developing a 5-10 MTPY sequestration hub, including characterization well drilling and class VI permit application. Wyoming Energy Authority partially funding characterization well

# DOE $H_2$ project (U.S. DOE grant)

## Project Objectives

- Initial design of a commercial scale carbon capture system (CCS) that could be installed and fully integrated with a 220 MMSCFD blue hydrogen ($H_2$) facility (Blue $H_2$ Plant) utilizing auto-thermal reforming (ATR) technology
- Identify potential utilization pathways for $CO_2$ and $H_2$
- Determine LCOH and cost of carbon capture




## Success Criteria

- Development of an initial engineering study for a commercial-scale, CCUS system that separates, and stores more than 100,000 tonne/year net $CO_2$ with 95% purity from an industrial plant producing hydrogen from natural gas
- $CO_2$ capture efficiency of 90+%
- Total $CO_2$ captured above 100,000 tonne/year with 99% plant utilization
- $H_2$ purity is 99.97 mol%, CO and $CO_2$ is less than 10 ppm, final $H_2$ product is free of other impurities, and will be delivered at or above 360 psia
- $CO_2$ delivery pressure at 2,215 psia
- $CO_2$ purity is greater than 95 mol%

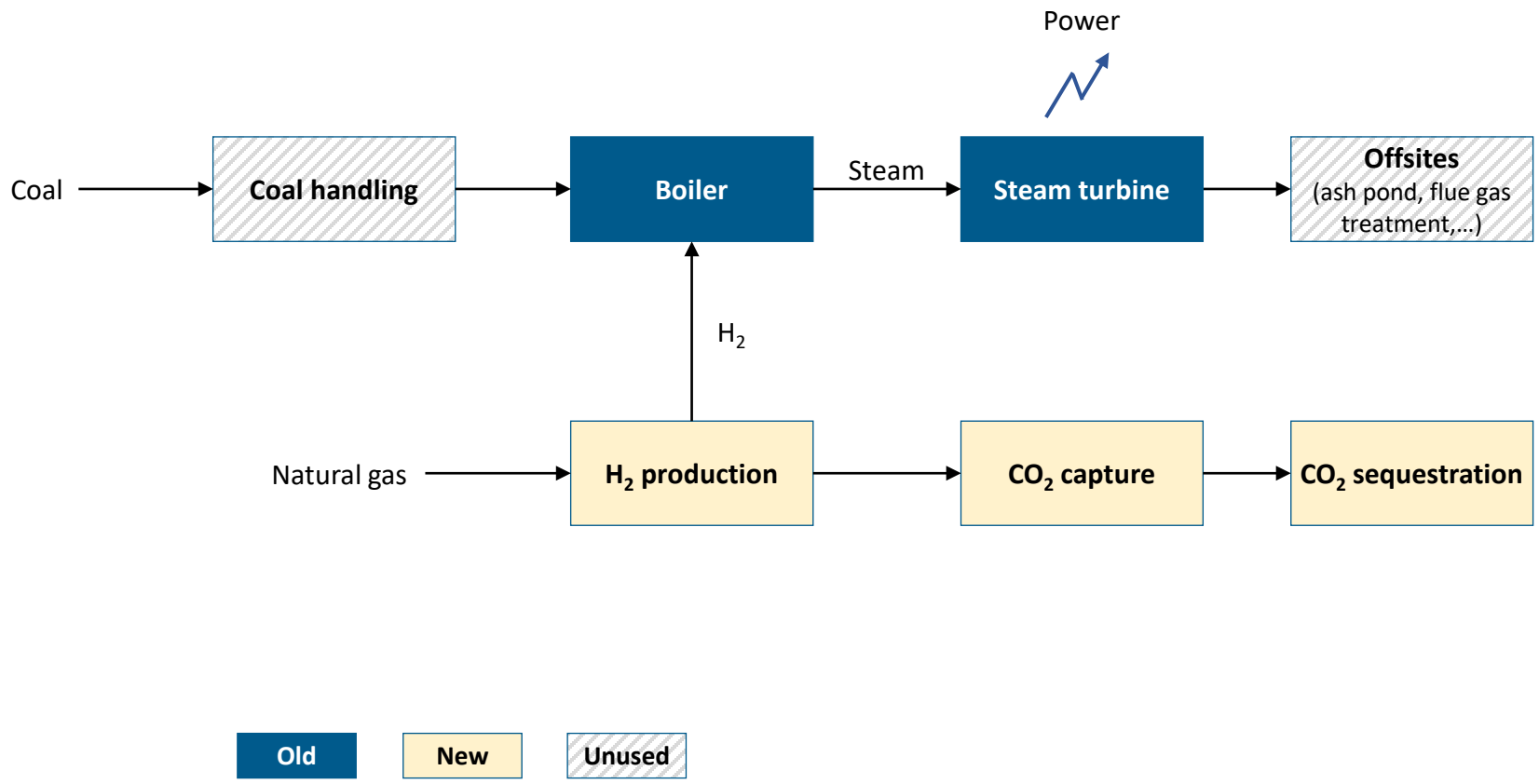
# Escalante: Clean Hydrogen & Decarbonized Power

**Escalante supports New Mexico's hydrogen hub development and decarbonization efforts**

- Tallgrass is evaluating large-scale clean energy production in northwest New Mexico and the repurposing of the Escalante power plant to use clean hydrogen as a fuel
- >95% of $CO_2$ from hydrogen production captured and permanently sequestered
  - $CO_2$ would not be used for enhanced oil recovery
- Escalante will provide:
  - **Clean Power:** ~265 MW of very low greenhouse gas, dispatchable power
  - **Economic Development:** 60+ permanent jobs in the local community and 500+ construction jobs
  - **Clean Hydrogen:** A foundation for further development of clean hydrogen

# Conversion of Power Plant Boiler to $H_2$ Fuel

- New $H_2$ Generating Facility with Carbon Capture and Sequestration



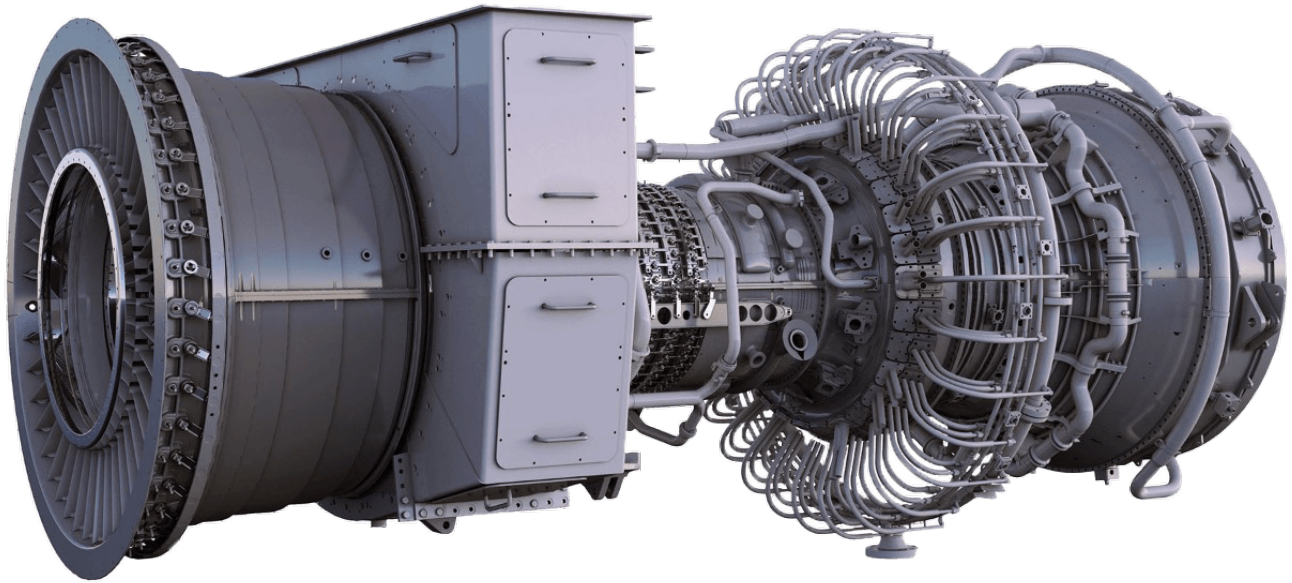

**Key Facts**

- Location: Prewitt, NM
- Owner/Operator – Tri-State Generation & Transmission Assoc.
- Capacity 265MW
- Commissioned in 1984
- Retired August 31, 2020

# Escalante's Role and Benefits

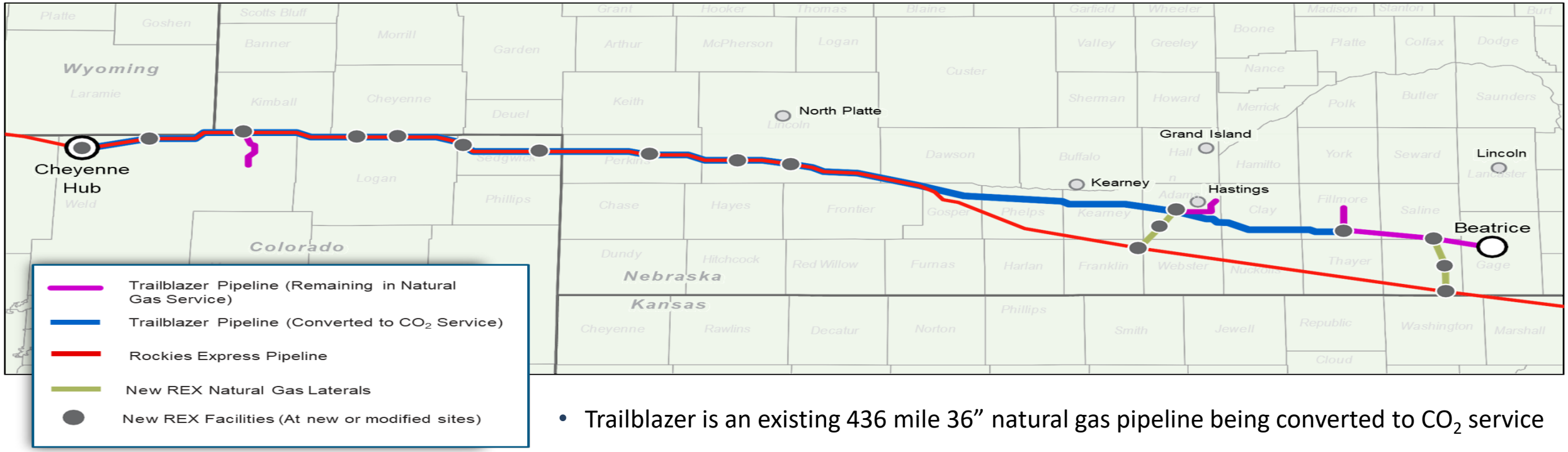
| | Issue | Escalante's Capacities & Benefits |
|---|---|---|
| **Reliability** | The changing resource mix means utilities increasingly need decarbonized ***capacity at different and variable times*** | • Escalante will be capable of **being dispatched at any time** and provide decarbonized power when renewables are not producing<br>  • Up to 265MW of capacity available 24x7 at a carbon level far lower than coal or natural gas fired plants<br>  • Performance comparable to natural gas generation but with very low $CO_2$ emissions |
| **Affordability** | Preserving ***affordability will be a growing challenge*** without new resources that can provide capacity around the clock | • Escalante will be a **less expensive source of capacity** than solar as renewable growth continues and lower cost than "green hydrogen" based resources<br>• Escalante will also be less expensive than lithium-ion batteries as a source of long-duration clean power |
| **Decarbonization** | New resources should be ***very low or zero carbon*** in support of state decarbonization objectives | • **Greater than 95% carbon capture in the production of hydrogen**<br>• Certainty of fuel supply since the source is not intermittent like renewables, including "green hydrogen" |

# Black Hills Cheyenne



- **Description**
  - Demonstration of H2 combustion in a commercial NGCC with WEA, Black Hills (owner), GE and Black & Veatch
  - Black Hills Energy is lead on the project
  - Tallgrass will provide technical expertise for blue hydrogen production
- **Phase I**
  - Front-End Engineering Design (FEED) for a blue hydrogen gas production facility with carbon capture,
  - Conceptual engineering assessment of equipment modifications to GE LM6000 combustion turbines to accommodate a blend of hydrogen and natural gas, and
  - Hydrogen fuel demonstration using one of Black Hills Energy's GE LM6000 turbines. For the hydrogen demonstration, the company and GE will test the performance of the turbine modifications using varying amounts of hydrogen blended with natural gas. The hydrogen will be supplied from tanker trucks.

# Trailblazer Pipeline Conversion




- Trailblazer is an existing 436 mile 36" natural gas pipeline being converted to $CO_2$ service
- Capacity to transport more than 10 million tons of gaseous $CO_2$ per year
- Clear path toward abandonment
- Access to significant sequestration capacity
- Leveraging existing Tallgrass operating experience and field personnel

# Hydrogen Pipelines

- **Regulated under Part 192**
  - Hydrogen is a flammable gas as defined in 192.3
  - Includes natural gas pipelines with hydrogen blends and pure hydrogen pipelines
  - Does not contain specific guidance on hydrogen
  - The gas factor used for hydrogen in the PIR calculation for HCA determination is not mentioned
    - 0.69 is typical for natural gas.
      - ASME B31.8S is referenced for other gases, but B31.8S does not mention hydrogen
    - 0.47 is used in ASME B31.12

- **ASME B31.12 - Hydrogen Piping and Pipelines**
  - Similar to B31.4 and B31.8, but specific to hydrogen pipelines
  - Not referenced in Part 192
  - Applicable for pipelines containing more than 10% hydrogen
  - Addresses design, construction, and operation
  - Includes guidance on design factors which are typically lower than in natural gas service
    - Option A (Prescriptive Design Method) - 0.5 design factor for Class 1-3 and 0.4 for Class 4
    - Option B (Performance-Based Design Method) – 0.72 for Class 1, 0.6 for Class 2, 0.5 for Class 3, and 0.4 for Class 4
  - Includes a separate material performance factor ($H_f$) that can further decrease the design pressure for pipe >X52

# Hydrogen Pipelines – Build New or Convert

- **New Pipelines**
  - Gives the operator complete control over all aspects of the design and construction of the asset
- **Pipeline Conversions**
  - The repurposing of existing pipelines makes sense in some cases
    - New pipelines are challenging to permit and the process can be lengthy
    - Provides opportunities for under-utilized pipelines
    - Less environmental impact
  - Steps for Conversion
    - PHMSA Pipeline Safety: Guidance for Pipeline Flow Reversals, Product Changes and Conversion to Service
    - ASME B31.12 also addresses conversions in section PL-3.21 - Steel Pipeline Service Conversions
- **What makes a good candidate for conversion?**
  - Every pipeline is unique and needs to be evaluated based on its unique characteristics
  - A pressure derate will probably be required if following ASME B31.12 to operate at no more than 50% SMYS
  - Vintage pipelines (pre-1970)
    - Typically lower yield pipe which does not require the material performance factor ($H_f$) derate
    - Need to be aware of historical issues associated with vintage pipe (weld seam, low toughness, hard spots, poor coating, SCC, etc)
      - Consider the potential for hydrogen embrittlement and impact on these issues associated with historical pipe
  - Modern pipelines
    - Avoids historical issues associated with vintage pipelines
    - However, modern pipe is typically higher yield which might require a further derate due to the material performance factor ($H_f$)

# Thank You