



*Because clean energy matters!*

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A smaller version of the CO2 STORE logo, with "CO2" in green and "STORE" in white inside a green box.

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# Executive Summary

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- We propose a technology that changes carbon dioxide (CO<sub>2</sub>) from a waste to a commodity, prevents CO<sub>2</sub> emissions to the atmosphere, and helps create thousands of green jobs across the nation.
- Owing to its high carbon content, coal is the dirtiest fossil fuel resource, accounting for over 40% of U.S. CO<sub>2</sub> emissions in 2008. However, coal is the largest electricity source, accounting for almost half of the nation's electricity generation and providing 60,000 jobs in 2009. The United States owns the largest coal reserve in the world, equivalent to a 245-year supply at current consumption rates. With coal inexpensive to mine and plentiful in supply, the United States cannot effectively address climate change without capturing and sequestering CO<sub>2</sub> emissions from coal.
- The major obstacle to implementing CO<sub>2</sub> Capture and Sequestration (CCS) today is its high cost. If there existed a dependable market for CO<sub>2</sub>, power plants would choose to capture and sequester CO<sub>2</sub> emissions instead of emitting CO<sub>2</sub> into the atmosphere. Currently, however, there is no dependable market for CO<sub>2</sub> from coal plants because many industries seeking to purchase large amounts of CO<sub>2</sub>, particularly enhanced oil recovery industries, have variable and localized demand that doesn't match supply (either spatially or in time). Our technology will address this mismatch between CO<sub>2</sub> supply and demand.
- We propose CO<sub>2</sub> Interim Storage, or briefly, CIS. CIS involves developing an interim storage network in areas where CO<sub>2</sub> is the missing link between potential producers (coal power plants) and potential consumers (enhanced oil recovery industries). CO<sub>2</sub> can be stored in underground reservoirs upon production and withdrawn when required to satisfy demand. This network will work similarly to the natural gas transmission and storage infrastructure. The sale of CO<sub>2</sub> to customers can offset infrastructure and pumping costs required to setup the storage network, and, in the long run, can help compensate for the sequestration cost of carbon. Altogether, the potential benefits of CIS include:
  - **Reducing CO<sub>2</sub> emissions from coal power plants by sequestering CO<sub>2</sub> in oil reservoirs.**
  - **Transforming CO<sub>2</sub> from a waste into a market commodity, thereby bridging the gap between CO<sub>2</sub> producers and consumers.**
  - **Building an integrated CO<sub>2</sub> network to facilitate the long-term deployment of CO<sub>2</sub> Capture and Sequestration.**
  - **Creating thousands of new “green jobs” in the construction of an interim storage network.**

**CO<sub>2</sub> STORE**

# THE PROBLEM

- Coal is the number-one electricity source in the US accounting for 45% of generation<sup>1</sup>



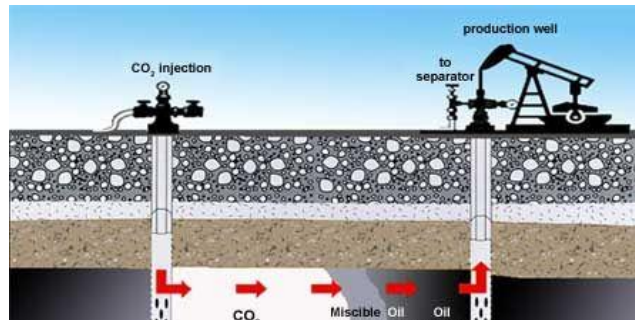
Coal is the dirtiest fossil fuel source, driving over 40% of US emissions of CO<sub>2</sub><sup>2</sup>

Excess in CO<sub>2</sub>



**No Link – Missed Opportunity !!!**

- Large amounts of CO<sub>2</sub> are needed for industrial processes, especially Enhanced Oil Recovery (EOR)



Shortage in CO<sub>2</sub>

- CO<sub>2</sub> in market today comes from natural underground sources

**CO<sub>2</sub> STORE**

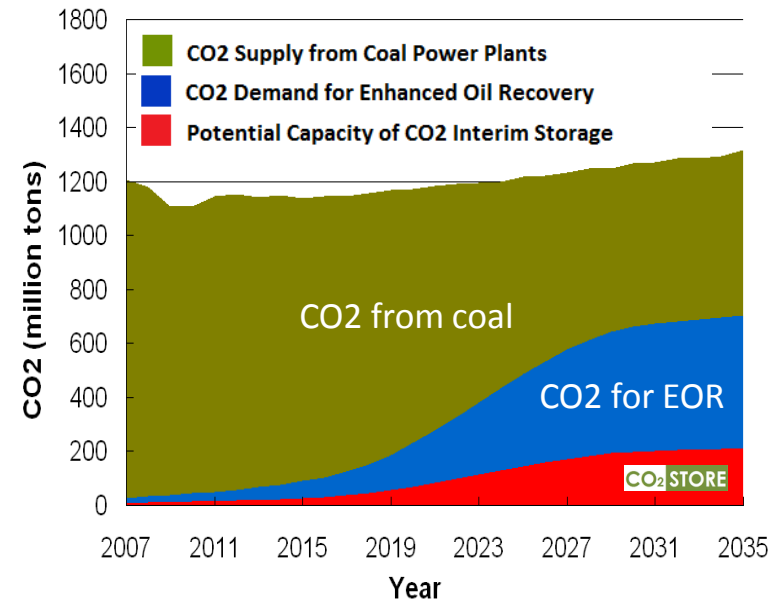
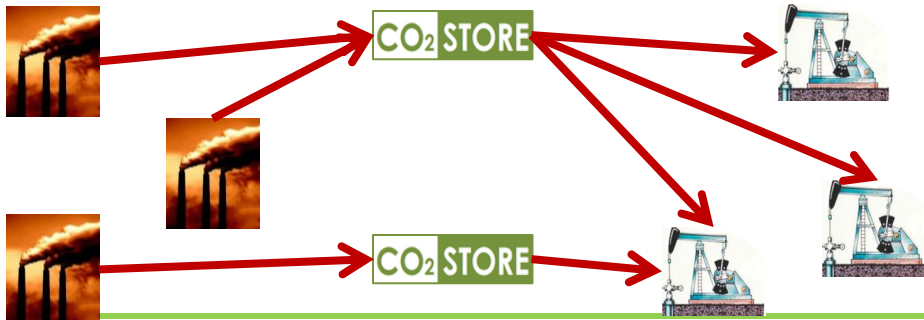
<sup>1</sup>EIA, Annual Energy Review 2009 (August 2010)

<sup>2</sup>EPA, Inventory of US Greenhouse Gas Emissions and Sinks, 1990-2008 (April 2010)

Pictures courtesy of theresilientearth.com and <http://www.geos.ed.ac.uk>

# THE SOLUTION: CO<sub>2</sub>STORE INTERIM STORAGE

- **Transform** CO<sub>2</sub> from waste to commodity
- **Bridge** the gap between main CO<sub>2</sub> producers (coal power plants) and consumers (oil recovery sites)
- **Reduce** CO<sub>2</sub> emissions from coal power plants by sequestering CO<sub>2</sub> in oil reservoirs
- **Build** an integrated CO<sub>2</sub> network
- **Incentivize** the long-term deployment of CO<sub>2</sub> Capture and Sequestration
- **Create** thousands of new “green jobs” in the construction of an interim storage network



- **Significant market potential**
  - 11.7-14.4 billions tons of CO<sub>2</sub> for EOR
  - 700 Mt/yr CO<sub>2</sub> for EOR in 2035

CO<sub>2</sub>STORE

# CO2STORE BUSINESS MODEL



- **CO2STORE** target market: US geographies with coal power plants, prioritizing first geographies with EOR sites
- **CO2STORE** operate as an independent 3rd party that builds, operates, and optimizes the performance of a CO2 network to balance supply and demand
  - Provide storage and market clearing for CO2 captured from coal power plant emissions
  - Sign supply agreements with coal power plants, which help offset capital and operating costs for carbon capture
  - Sell CO2 for Enhanced Oil Recovery sites upon demand

- **CO2STORE** achieves some returns under current regulations, and can offer a very attractive upside to investors if cap-and-trade or carbon legislation is passed

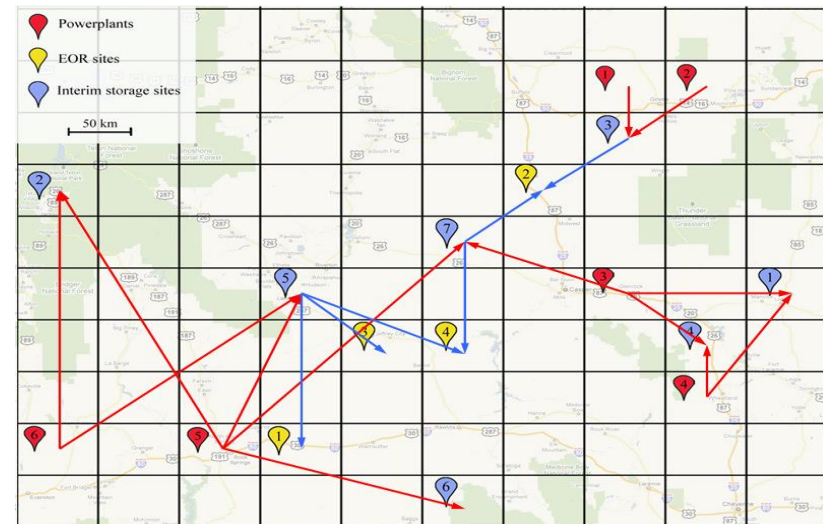
**CO<sub>2</sub> STORE**

# CO2STORE Competitive Advantage

- **Providing Technical Expertise**
  - Coal power plants lack the engineering talent to construct the CO2 network and manage underground storage sites
  - Individual EOR sites – being small and independent – lack the incentive to invest in a storage and delivery network
  - CO2STORE effectively utilize infrastructure investments across multiple power plants and EOR sites
- **Facilitating Collaboration in the Energy Sector**
  - Coordinate with multiple stakeholders in the coal and oil businesses
- **Creating Thousands of New Jobs**
  - 108,440 jobs in the similar natural gas distribution network (2009 figures)
  - 11,790 jobs in pipeline construction only
- **Implementing State-of-the-Art Research**
  - CO2STORE is based on 2 years of research, involving reservoir characterization, system optimization, and cost estimates

## Wyoming Pilot – Case Study

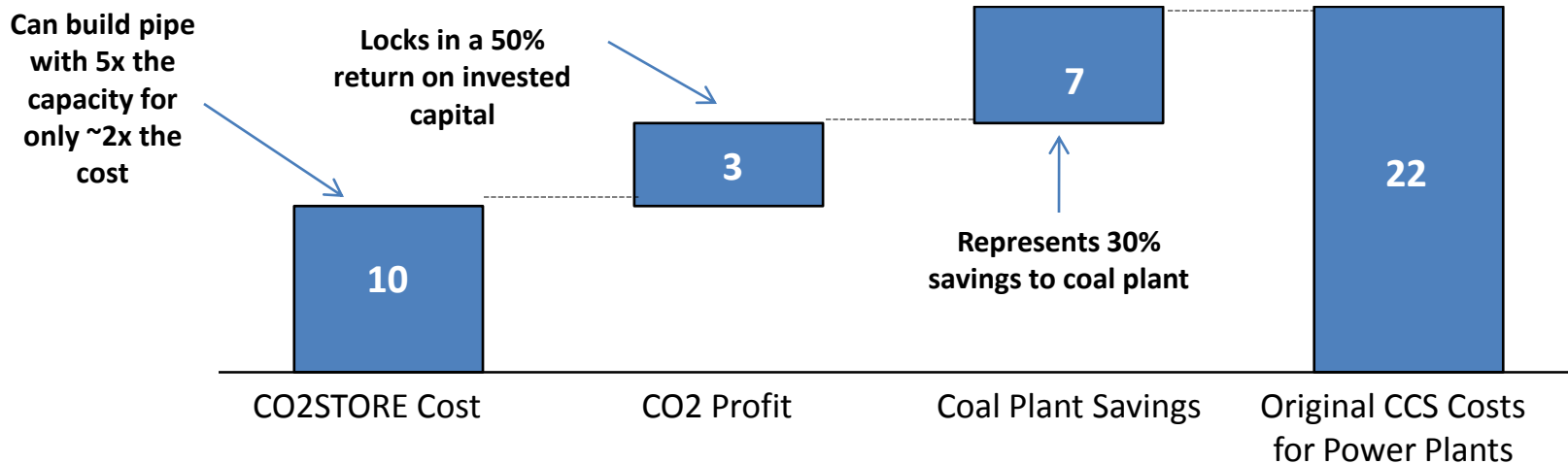
- 6 largest in-state coal power plants
- 4 Enhanced Oil Recovery sites
- 7 optimal CO2 storage sites
- Network Capacity: 41M tons CO2/yr



Results of Pilot Size Optimization - WY

# CO2STORE Economic Model

## Waterfall of CO2STORE Capital Costs (\$M)



## Value to Coal Plants

### Build out own storage

vs.

CO<sub>2</sub>STORE

- Pay \$22M+ in **capital costs** to build out interim storage
  - \$20M for 100km of 0.3m pipe<sup>1</sup>
  - \$2M for injection / monitors<sup>2</sup>
- Less likelihood of connecting to **EOR clients** given small network size

- **CO2STORE manages and pays for the entire process**
- **30% savings in capital costs**
- **Can offer revenue sharing**

1 = 100km assumed; uses midpoint of IPCC Special Report on CCS, Chp 4; assumes 0.3 and 0.6m diameter pipe

2 = assumes similar economies of scale with injection and monitoring



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