Clean Coal Technology
&
Carbon Regulation Impacts to Coal and Fossil Fuel Industry

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Overview

• Global Perspective – Energy and Environment → Sustainability
• Clean Coal Technology – “CCUS”
  – CO₂ capture
  – Geologic research
  – EOR and transformative potential

• Regulatory Landscape for Power Industry
  – New coal-fired plants - NSPS
  – Existing coal-fired plants
  – Fossil fuel CO₂ future and EOR

• North Dakota and Critical Leadership for Transformation
Global Perspective

• World’s Energy Demand Will Increase 100% by 2050 per the International Energy Agency (IEA)

• Growth Will be Driven By
  – Aspiration to eliminate energy poverty – 1.4B people
  – Unconventional industrial and consumer demand

• Energy Security is the Driving Force

• All of the Above must be the Energy Strategy

• By 2050, 85% of World’s Energy will be Fossil Fuel
• What is CCUS? and Why is the “U” So Critical for Fossil Fuels Global Adoption and Sustainability?

• CO₂ Capture Technologies
  – Demonstration plants and current projects
  – 2nd generation technology by 2020 > $40-60/ton CO₂*
  – Transformative technology by 2030 > $10-20/ton CO₂*

• Geologic Research
  – Regional carbon sequestration partnerships in US
  – Global interest
  – CCUS is the answer – 100+ years of potential

*DOE targets per CCUS R&D Roadmap
Regulatory Landscape

• New Source Performance Standards – NSPS

• Existing Coal and Fossil Plants on Horizon

• CO₂ Research and EPA Regulations – Class VI

• CO₂ EOR and Class II

Regulations Must Support Both Energy and Environment Sustainability and Facilitate Market Realization and Deployment for Impact
• The more we understand, the more oil and potential we see

• Currently, only a 3 – 10% recovery factor

• Small improvements in recovery could yield over a billion barrels of oil

• **Will CO₂ be a game changer in the Bakken?**
  – For business
  – For the environment
Bakken Optimization Program
- Site logistics
- Waste Management
- Hydrocarbon Utilization
- Water Management
- Process Optimization and Systems Analysis

Bakken CO₂ Enhanced Oil Recovery and Storage Project
- Resource Maximization
- Innovative Reservoir Characterization
- Fracture Characterization and Modeling
• Significant Non-Bakken ND Fields/Pools Await CO$_2$ EOR

• Nearly 130 million tons of CO$_2$ needed for the top 22 candidate fields in ND
How Many More Bakkens?

- Cardium Shales, AB: 660 MMbo
- Exshaw Shales, MT: 30 MMbo
- Bakken Shales, SK: 30 MMbo
- Bakken Shale, ND, MT: 12,000 MMbo
- Waltman Shales, WY: 11 MMbo
- Niobrara Shales, CO: 240 MMbo
- Atoka-Cherokee Shales, CO: 146 MMbo
- Mancos Shale, NM: 75 MMbo
- Barnett Shale, TX: 70 MMbo
- Eagle Ford Shale, TX: 3350 MMbo
- Antelope Shale, CA: 700 MMbo
- Monterey Shale, CA: 17.5 MMbo
• Bakken CO₂ Demand for ND – A 30,000 Feet View

• Based on the following:
  – Traditional evaluation techniques
  – ND Industrial Commission original oil in place estimates
  – 4% incremental recovery
  – Net utilization of 5 and 8 mcf/bbl

• 2 to 3.2 billion tons of CO₂ needed

• ND currently produces ~33 million tons of CO₂/year