Coal Industry Update

THE PATH FORWARD FOR COAL
Janet Gellici, National Coal Council
U.S. Association for Energy Economics/National Capital Area Chapter
Washington, DC – September 23, 2016
The National Coal Council provides advice and recommendations to the Secretary of Energy on general policy matters relating to coal and the coal industry.

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National Coal Council

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- Clean Coal Technologies
- Coal & Coal Technology Exports
- Coal Conversion
- Utility Deregulation
- Climate & Clean Air Regulations
- Building New Coal Power Plants
- Industrial Coal Use
- CCUS for EOR
- Value of Existing Coal Fleet
- Fossil Forward: CCS Technologies
- Policy Parity for CCS
- CO₂ Building Blocks: CO₂ Utilization
Presentation Overview

- U.S. Coal Sector Current Status
- Trending in Energy
- The Path Forward
U.S. Coal Sector Status

- Multiple Disruptive Forces
  - Market Demand
  - Competitive Markets
  - Technology
  - Policy

Source: EIA AEO 2016

Figure ES-1. Net electricity generation from coal, natural gas, and renewables in the AEO2016 Reference case, 2013-40
Market Demand Factors

Figure MT-27. U.S. gross domestic product growth and electricity demand growth rates, 1950–2040
percent, three-year moving average

Source: BMI Research

Source: EIA AEO 2016

Recent Pickup To Ease Over Long Term
China - Thermal Coal Imports (tonnes, LHS) And Growth (y-o-y, RHS)
Competitive Market Factors

Figure MT-41. Natural gas consumption by sector in the Reference case, 1990–2040

Figure MT-46. U.S. dry natural gas production by source in the Reference case, 1990–2040

Source: EIA AEO 2016
“Technologies such as wind and solar energy generation and energy efficient light bulbs are near the end of the innovation trajectory and are ready for deployment, he said, “but we are only at the beginning of that trajectory for a whole bunch of other technologies including large-scale storage, carbon capture ...”  Secretary Moniz, Sept. 19, 2016
Policy Factors

Figure MT-28. Net electricity generation by fuel in the Reference case, 2000–2040

Source: EIA AEO 2016

Figure MT-29. Net electricity generation by fuel in the No CPP case, 2000–2040
Current Status – Decline in Coal Consumption

Source: EIA AEO 2016

Figure MT-40. Coal consumption (quadrillion Btu) and sulfur dioxide emissions (million short tons) in the Reference and No CPP cases, 2005–40

Source: EIA Electricity Monthly 7-26-16
Current Status – Decline in Coal Production

Source: EIA AEO 2016
Current Status – U.S. Rail Impacts

*Canada - Figures for Canada include the U.S. operations of Canadian railroads...*
Current Status – Coal Mining Employment

42% Decline in Coal Mining Employees Since 2012

Source: BLS and Zero Hedge.
Current Status – Market Cap U.S. Coal Companies
Current Status – No New Coal Plants

Source: EIA AEO 2016
GE Wants to Bring More Life to Coal
After playing down fuel’s future, group chases rising demand in India and Southeast Asia

Wall Street Journal – August 17, 2016
Trending in Energy

- Integration of Fossil Energy
- “Expanding the Tent”

Common & Distinct Challenges of Carbon Capture for Coal & Natural Gas

Source: U.S. Department of Energy
Trending in Energy

- Technology Innovation Push
- International Partnerships

MISSION INNOVATION
Accelerating the Clean Energy Revolution

U.S.-CHINA CLEAN ENERGY RESEARCH CENTER

The world needs widely available energy that is reliable, affordable and does not produce carbon.
A diverse portfolio of energy resources is critical to U.S. energy and national security. A diverse energy system has the inherent benefits of being more robust and resilient in comparison to a system that is heavily dependent on a limited set of energy resources. A system that is diverse helps insulate the economy from certain risks, including price volatility and risks from supply disruptions that can affect the availability of particular energy resources or infrastructure.

U.S. Department of Energy – August 2016
Carbon Capture, Utilization, and Storage: Climate Change, Economic Competitiveness, and Energy Security
Trending in Energy

- Consensus on Need for CCUS
- Recognition of Need for Policy Parity for CCS

“There is a growing consensus among industry, the environmental community and governments that future carbon dioxide (CO₂) emission reduction goals cannot be met by renewable energy sources alone and that carbon capture, utilization and storage (CCUS) technologies for all fossil fuels will have to be deployed to achieve climate objectives in the U.S. and globally.”

National Coal Council – August 2016
CO₂ Building Blocks: Assessing CO₂ Utilization Options

“In order to achieve CCS deployment at commercial scale, policy parity for CCS with other low carbon technologies and options is required.”

National Coal Council – January 2015
Fossil Forward – Revitalizing CCS: Bringing Scale & Speed to CCS Deployment
FOSSIL FORWARD
Revitalizing CCS
Bringing Scale and Speed to CCS Deployment

NCC Report - January 2015
Policy Parity for Carbon Capture and Storage Technologies
Dis-Parity CCS vis-a-vis Renewables

Global Clean Energy Investments 2004 - 2013

- **Renewables**
  - $1,929 Billion

- **Carbon Capture & Storage**
  - $20 Billion

Source: International Energy Agency.  *Includes technology development, projects, M&A.  Source: BNEF.
Renewables Receive 72% of Total Incentives
Coal Just 6%

- Fossil fuels produced 78.5% of U.S. energy; renewables 11.4%, nuclear 10.1% in 2013
- Renewable subsidies increased from ~15% in 2007 to 72% in 2013
- Funding for coal declined from 12.7% in 2007 to 6% in 2013

Source: Energy Information Administration, March 2015.
Policy & Financial Incentives Work
Capital and operating costs for projects with CCS are more expensive than conventional technologies, carrying greater commercial risk.
The Path Forward - Leveling the Playing Field

Financial Incentives
- Broaden to include incentives available to other clean energy sources

Regulatory Improvements
- Regulatory blueprint needed to remove barriers to construction and development of CCS projects

Research Development and Demonstration
- U.S. Dept. of Energy must be a catalyst for commercial scale demonstrations to start immediately

Communications and Collaboration
- U.S. Dept. of Energy must assure policymakers that fossil fuels will continue to be used & CCS is essential
The Path Forward – HELE Technologies

CO₂ Reduction Glidepath
Increasing Efficiency of Coal Plants by 1% Reduces CO₂ 2-3%

- Average Worldwide: 30%
  - 1,116g CO₂/kWh
- EU: About 38%
  - 881g CO₂/kWh
- State-of-the-art technology:
  - 45%
  - 743g CO₂/kWh
- Steam power plant: 700°C technology
  - About 50%
  - 669g CO₂/kWh
- CCS technology but efficiency loss 7-12% points
  - 90%

Source: VGB PowerTech 2013, World Coal Association.
“One of the greatest challenges we face and a potential game changer is how we can develop technologies for very, very, very large-scale utilization of CO$_2$.”

Secretary Moniz – House Testimony – September 15, 2016
**Technically Recoverable Domestic Oil and CO₂ Storage Capacity, State of Art and “Next Generation” CO₂-EOR Technology**

<table>
<thead>
<tr>
<th>Basin/Area</th>
<th>Technically Recoverable Oil (Billion Barrels)</th>
<th>Technical CO₂ Demand/Storage (Million Metric Tons)</th>
<th>SOA</th>
<th>“Next Generation”</th>
<th>SOA</th>
<th>“Next Generation”</th>
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<tbody>
<tr>
<td>1. Main Pay Zone CO₂-EOR</td>
<td></td>
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<tr>
<td>Lower-48 Onshore</td>
<td>55.6</td>
<td>105.5</td>
<td>22,270</td>
<td>33,050</td>
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<tr>
<td>Alaska</td>
<td>5.8</td>
<td>8.8</td>
<td>3,320</td>
<td>4,110</td>
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<td>Offshore GOM</td>
<td>23.5</td>
<td>52.9</td>
<td>12,640</td>
<td>15,060</td>
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<td>Sub-Total</td>
<td>84.9</td>
<td>167.2</td>
<td>38,230</td>
<td>52,220</td>
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<td>2. Residual Oil Zone CO₂-EOR</td>
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<td>ROZ Fairways*</td>
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<td>25.7</td>
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<td>Below Oil Fields</td>
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<td>Sub-Total</td>
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<td>n/a</td>
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<tr>
<td>Total</td>
<td>84.9</td>
<td>209.2</td>
<td>38,230</td>
<td>77,520</td>
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*Four County Permian Basin San Andres ROZ fairway.*

**Key Finding**

CO₂-EOR still represents the most immediate, highest value opportunity to utilize the greatest volume of anthropogenic CO₂.
CO₂ Markets as Incentives for CCUS

- U.S. law recognizes CO₂–EOR and other geologic storage technologies for compliance purposes.
- Non-geologic storage technologies may be used only if EPA determines they are as effective as geologic storage.
- U.S. climate goals and non-binding international climate goals require CCUS technology deployment at scale in the near future.
- CO₂ utilization in non-geologic contexts face the following hurdles:
  - Cost of capture
  - Insufficient scope of market/supply
  - Nearly all non-geologic CO₂ utilization technologies are not yet commercialized
  - Geographic/infrastructure considerations
  - Legal and regulatory considerations
Janet Gellici, CEO
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Recommendations for Leveling the Playing Field

Foundational Financial Structure: Contracts for Differences

- Establish a “contracts for differences” structure enabling greater competitiveness
- Allow developers to propose a menu of government incentives – e.g., CCPI grants to reduce capital, loan guarantees to reduce borrowing costs, tax credits to reduce cost of power over time
- Provide CFD structure for first 5-10 GW of projects with CCS on a competitive basis
- Use to create commercial demonstrations and large-scale pilot projects
Recommendations for Leveling the Playing Field

Financial Incentives

- **Limited Guaranteed Purchase Agreements**: Offer a limited number of pioneering CCS facilities to receive a guarantee that their output will be purchased in order to obtain financing.

- **Market Set Aside**: Establish a market set-aside to provide parity with state RES requirements.

- **Clean Energy Credits**: Allow CCS projects to receive credit under applicable programs for 100% of CO₂ emissions avoided.
Recommendations for Leveling the Playing Field

Financial Incentives

• **Tax Credits and Price Interventions**: In addition to guaranteed purchase agreements and the ability to attract financing, offer other support through:
  – Production Tax Credit
  – Revised CO₂ Injection Credit
  – Electricity Price Stabilization
  – CO₂ Price Stabilization

• **Tax-Preferred Bonds**: Provide financing with tax-preferred and tax exempt bonds under Section 54 or Section 142 of Internal Revenue Code
Recommendations for Leveling the Playing Field

Financial Incentives

• **Master Limited Partnerships**: Provide MLP structure for projects with CCS so qualifying income is taxed at the individual level.

• **Loan Guarantees**: Put in place a mechanism to pay the credit subsidy cost of loan guarantees similar to the Section 1705 program that helped renewables.
Recommendations for Leveling the Playing Field

Regulatory Improvements

• **Regulatory Blueprint**: U.S. Dept. of Energy must take the lead in developing a regulatory blueprint to identify and remove barriers to construction and development of CCS projects

• **Remove Injection Barriers**: Eliminate barriers in EPA’s Clean Power Plan and 111(b) rule to include beneficial reuse of CO₂ from regulated carbon capture facilities

• **New Source Review**: Eliminate uncertainty under NSR to encourage installation of CO₂ emission controls
Regulatory Improvements

• **Infrastructure Siting:** Federal policymakers should consider providing backstop federal eminent domain authority for siting and construction of CO₂ pipelines, similar to authority provided under the Natural Gas act for gas pipelines.

• **Storage Siting:** U.S. Dept. of Energy should identify at least one reservoir capable of storing at least 100 million tons of CO₂ at a cost of less than $10 per ton in each of the seven regions covered by the Regional Carbon Sequestration Partnership program.
Recommendations for Leveling the Playing Field

Research, Development and Demonstration

• Align RD&D Funding with Other Fuels:
  – Substantially increase RD&D budget
  – Fully fund CCS RD&D recommended in CURC-EPRI Roadmap
  – Fund an 80% federal cost share for early stage RD&D
  – Fund 100% federal cost share for large-scale pilots
  – Fund 50% cost share for commercial demonstrations
Communications and Collaboration

• **Initiate Projects Immediately**: In addition to initiating 5 to 10 gigawatts of U.S. projects, DOE should advance collaboration of 5 to 10 gigawatts of global demonstration projects in the next year, which will promote energy, environmental, and foreign policy objectives.

• **Vigorously Explain Reality**: DOE must assure U.S. and global policymakers and other stakeholders that fossil fuels will be used to an even greater extent today, and there is a resulting need for CCS.