Assessment of U.S. Coal Supply Markets

An Overview of Recent Reports by the National Coal Council on Factors Affecting the Future of Coal Supply

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American Public Power Association
Engineering & Operations Technical Conference
April 1st, 2019 – Colorado Springs, Colorado
The National Coal Council provides advice and recommendations to the Secretary of Energy on general policy matters relating to coal and the coal industry.

Members
Appointed by Secretary of Energy
Limited to 150 members representing a broad spectrum of coal interests
Body of Work

Reports

~ 35 reports prepared by NCC members at no cost to DOE
Extensive Range of Report Topics:

Carbon Management
Clean Coal Technologies
Coal & Coal Technology Exports
Coal Conversion
Utility Deregulation
Climate & Clean Air Regulations
Enhancing Coal’s Image
Building New Coal Plants

Industrial Coal Use
CCUS for EOR
Value of Existing Coal Fleet
Advancing CCS Technologies
Policy Parity for CCS
CO₂ Utilization
**Power Reset: Existing Coal Fleet**
**Advancing U.S. Coal Exports**
Formal request April 7, 2018 charging National Coal Council to:

... assess “opportunities to optimize the existing U.S. coal-fueled power plant fleet to ensure a reliable and resilient electricity system.”

Key question to address:

“What actions can be taken to optimize the U.S. coal-fueled power plant fleet so it can continue to provide reliable, resilient, affordable power as part of a diverse electric generation mix, and what unique benefits does coal provide?”
• What We Considered
  – Coal’s Unique Role in the U.S. Energy Portfolio
  – Outlook for Coal Generation
  – Measures to Optimize Diversity & Resiliency
Today’s Coal Fleet

Start-up Year & New Generating Capacity

U.S. Coal Fleet Age in 2017
Coal Retirement
Contributing Factors

• Shale Gale: natural gas prices - $7/MMBtu (2003-2008) vs. $3.20/MMBtu (2012-2016)
• Intermittent Renewable Energy Subsidies: 2010-2016 IRE’s share of subsidies increased from 42% to 45%; coal subsidies increased from 2% to 8%.
• Environmental Regulations: MATS, CWA, NSR, CCR, ELG.
• State Energy Policies: RPS, EERS.
• Technology R&D Support: No existing fleet funding for nearly 10 years.
• Societal Pressures: Divestitures, anti-coal advocacy, coal infrastructure opposition, coal project financing proscriptions
Outlook for Coal Generation

Coal Retirement Projections by 2030
Various Sources, 2017-18

Coal Generating Capacity in U.S., GW

- EIA AEO 2018 reference case
- Navigant
- NETL Report, 2018
- Rhodium Group "Taking Stock 2018"
- EIA AEO 2018 high oil and gas case
- MAKE Consulting / Wood MacKenzie
- IHS Markit

*2017 Coal Capacity of 254 GW is from EIA Data
Power Reset

Optimizing the Existing Coal Fleet to Ensure a Reliable and Resilient Power Grid

ASSESS | SUPPORT | REFORM | RENEW
• **ASSESS | SUPPORT | REFORM | RENEW**
  – Establish a uniform definition of grid resilience.
  – Assess the fuel security of ISOs/RTOs.
  – Establish quantitative metrics against which to evaluate grid resilience.
  – Evaluate the experience of other nations regarding the value of firm, dispatchable power and challenges associated with intermittent renewable energy deployment.
Coal’s Unique Role
Reliable & Resilient

- A diverse generation portfolio is critical to maintaining a reliable and resilient grid.
- Coal excels in:
  - Fuel security/assurance
  - Resource availability
  - Price stability
  - Dispatchability

<table>
<thead>
<tr>
<th>Qualitative Comparison of Grid Reliability and Resilience Attributes by Fuel Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Attribute</td>
</tr>
<tr>
<td>Dispatchability</td>
</tr>
<tr>
<td>Inertia</td>
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<tr>
<td>Frequency Response</td>
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<tr>
<td>Contingency Reserves</td>
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<tr>
<td>Reactive Power</td>
</tr>
<tr>
<td>Ramp Capability</td>
</tr>
<tr>
<td>Black Start</td>
</tr>
<tr>
<td>Resource Availability</td>
</tr>
<tr>
<td>On-Site Fuel Supply</td>
</tr>
<tr>
<td>Reduced Exposure to Single Point of Disruption</td>
</tr>
</tbody>
</table>
Intermittent electricity is electrical energy that is not continuously available due to external factors that cannot be controlled, produced by electricity generating sources that vary in their conditions on a fairly short time scale. Sources of intermittent electricity include solar power, wind power, tidal power, and wave power. Because of this varying electrical generation these sources are considered non-dispatchable, meaning that their electrical output cannot be used at any given time to meet societies fluctuating electricity demands.

The costs of backstopping intermittent energy sources:

- Lower net generation
- Lower capacity factor
- Less revenue
- Lower efficiency
- Reduced plant life
Coal’s Unique Role Economics

Household Electricity Prices, 2017, $/kWh

Non-residential Electricity Prices

Residential Electricity Rates

Non-residential Electricity Prices, 2017, $/kWh
Recommendation
SUPPORT

• ASSESS | SUPPORT | REFORM | RENEW

– Provide appropriate economic and regulatory incentives to stem the tide of plant retirements.
– Establish an environment that values and compensates diversity.
– Support mechanisms to immediately compensate the U.S. coal fleet for the essential services it provides.
ASSESS | SUPPORT | REFORM | RENEW

- **Policy**: NSR, PURPA, CCR, ELG, CO2 storage on federal lands, engage on the Affordable Clean Energy plan

- **Market**: FERC capacity reform initiatives, ISO/RTO price formation, standards for essential reliability services, fuel security and resilience assessments

- **Taxes**: O&M expenses for coal plants, 45Q support, 48Q
Optimize Diversity & Resiliency
Policy & Tax Considerations

- New Source Review
- Tax Credits
  - O&M Tax Credit
  - 45Q Implementation
  - 48A Investment Tax Credit
- Land Use Policies on CCUS
- PURPA Reform
- Coal Combustion Residuals
- Effluent Limitation Guideline
Optimize Diversity & Resiliency Market Considerations

U.S. ISOs & RTOs

- Federal Energy Regulatory Commission Action
  - Price Formation
  - Essential Reliability Services
  - Capacity Market Reforms
  - Forward Resiliency Market
  - Demand Response Compensation Reform
Recommendation
RENEW

• ASSESS | SUPPORT | REFORM | RENEW

– Support the development and deployment of advanced coal technologies that enhance the competitiveness, efficiency and environmental performance of the existing coal fleet
– Promote education and awareness about the water-energy nexus
– Promote initiatives to enhance transparency about the inherent costs and benefits associated with all U.S. energy resources
Optimize Diversity & Resiliency Technology Considerations

- Opportunities exist to streamline, re-evaluate and **amend regulatory and legislative measures** to enable the U.S. existing coal fleet to operate more efficiently and effectively.
- Wholesale **electricity market reform** is needed to equitably value resilience as well reliability attributes.
- Many **technology options** are available to improve the competitiveness of the existing U.S. coal fleet.

### Coal Power Plant Efficiency Audit Results

<table>
<thead>
<tr>
<th>Project Name</th>
<th>Capital Cost</th>
<th>B/C Ratio</th>
<th>B/C Ratio Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>Circulating Water Pump Refurbishment</td>
<td>Low</td>
<td>High</td>
<td>1</td>
</tr>
<tr>
<td>Sootblowing Steam Source</td>
<td>Low</td>
<td>High</td>
<td>2</td>
</tr>
<tr>
<td>Coal Mill Inerting Source</td>
<td>Low</td>
<td>High</td>
<td>3</td>
</tr>
<tr>
<td>Add Condensate Polishing</td>
<td>Medium</td>
<td>High</td>
<td>4</td>
</tr>
<tr>
<td>HP/IP/LP Turbine Upgrade</td>
<td>High</td>
<td>High</td>
<td>5</td>
</tr>
<tr>
<td>Coal Mills Replacement</td>
<td>High</td>
<td>High</td>
<td>6</td>
</tr>
<tr>
<td>Boiler Feed Pump Refurbishment</td>
<td>Low</td>
<td>Moderate</td>
<td>7</td>
</tr>
<tr>
<td>Helper Cooling Tower Replacement &amp; Pumps</td>
<td>Medium</td>
<td>Moderate</td>
<td>8</td>
</tr>
<tr>
<td>Replace Flame Scanners</td>
<td>Low</td>
<td>Moderate</td>
<td>9</td>
</tr>
<tr>
<td>VFD's for Forced Draft Fans</td>
<td>Medium</td>
<td>Low</td>
<td>11</td>
</tr>
<tr>
<td>Air Heater Overhaul</td>
<td>Medium</td>
<td>Low</td>
<td>10</td>
</tr>
<tr>
<td>Replace Air Preheat Coils</td>
<td>Low</td>
<td>Low</td>
<td>12</td>
</tr>
<tr>
<td>VFD's for Induced Draft Fans</td>
<td>Medium</td>
<td>Low</td>
<td>13</td>
</tr>
<tr>
<td>Alternate Air Heater Overhaul</td>
<td>Medium</td>
<td>Low</td>
<td>14</td>
</tr>
<tr>
<td>Alternate Air Preheat Coils Modification</td>
<td>Medium</td>
<td>Low</td>
<td>15</td>
</tr>
</tbody>
</table>
Coal Exports Report
Secretary’s Request

Formal Request
“... develop a white paper assessing opportunities to advance U.S. coal exports.”

Key Questions to Address
• What market, infrastructure and policy measures could be undertaken to increase export opportunities for U.S. coal?
• What global market dynamics present opportunities for increased U.S. coal exports?
• How can U.S. coal capitalize on its advantages and become more competitive in international markets?
• What institutional and regulatory constraints are limiting the advancement of U.S. coal exports?
What We Considered

• U.S. Coal Export Landscape
  – Export Regions
  – Transportation – Rail, Waterways, Ports
  – Prime Markets for U.S. Coal

• Competitive Assessment
  – Global Supply & Demand
  – U.S. vis-à-vis Other Suppliers
  – Policy Effects on Global Coal Trade

• Barriers to U.S. Coal Exports
  – Production/Supply
  – Transportation & Shipping
  – Institutional & Regulatory
Key Findings

Competitive Assessment

- Global coal trade is a robust and growing market; worldwide coal trade has more than doubled since 2000.
- Europe continues to be a principal market for U.S. eastern met coals; burgeoning demand in Asia represents a significant market opportunity for both eastern and western U.S. thermal coal.
- Global coal trade markets are volatile – influenced by economic growth/decline, weather, currency rates, energy policies, trade regulations/agreements and geopolitics.
## Advantages and Challenges of U.S. Thermal Coal versus Competitive Supply by Country

<table>
<thead>
<tr>
<th>THERMAL COAL</th>
<th>vs. Australia</th>
<th>vs. Indonesia</th>
<th>vs. Russia</th>
<th>Colombia</th>
<th>South Africa</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mine cost</td>
<td>U.S. mine costs are higher</td>
<td>PRB mine costs are lower</td>
<td>U.S. mine costs are higher</td>
<td>U.S. mine costs are higher</td>
<td>U.S. mine costs are higher</td>
</tr>
<tr>
<td>Quality</td>
<td>U.S. sulfur levels are higher in the ILB and NAPP</td>
<td>Broadly similar characteristics (PRB)</td>
<td>Russia has very low sulfur coal</td>
<td>U.S. has higher energy content</td>
<td>U.S. has higher energy content</td>
</tr>
<tr>
<td>Infrastructure and logistics</td>
<td>U.S. rail costs are higher</td>
<td>Inland rail costs are higher in the U.S.</td>
<td>U.S. rail costs are lower</td>
<td>U.S. rail costs are higher</td>
<td>S Africa has rail capacity constraints</td>
</tr>
<tr>
<td>Ocean freight (OF)</td>
<td>U.S. has higher OF costs to Asian markets</td>
<td>U.S. has higher OF costs to Asian markets</td>
<td>U.S. OF is higher to Asia</td>
<td>U.S. usually has higher OF costs</td>
<td>U.S. has higher OF costs</td>
</tr>
<tr>
<td>Security and regularity of supply</td>
<td>U.S. seldom has labor strikes</td>
<td>Indonesia has fiscal instability</td>
<td>Russian winter can interrupt coal delivery</td>
<td>The U.S. has greater fiscal and regulatory stability</td>
<td>The U.S. has greater fiscal and regulatory stability; there is a threat of domestic market obligation in South Africa</td>
</tr>
<tr>
<td>Shipment uniformity</td>
<td>Broadly similar characteristics</td>
<td>U.S. has better quality control of shipments</td>
<td>U.S. has better quality control of shipments</td>
<td>Broadly similar - U.S. and Colombia both careful shippers that carefully manage contracts</td>
<td>Broadly similar - U.S. and South Africa both careful shippers that carefully manage contracts</td>
</tr>
</tbody>
</table>

U.S. can’t always load large vessels, although metallurgical coal consumers and producers usually favor Panamax vessels; dredging ports could be an equalizer, but at a cost.
Key Findings
Barriers to U.S. Exports

SUPPLY CONSIDERATIONS

• Mining regulations – existing and prospective – can affect the competitiveness of U.S. coal exports.

• Aspects of Federal mineral ownership governance can impede U.S. coal exports.
Key Findings
Barriers to U.S. Exports

TECHNOLOGICAL CONSIDERATIONS

• Technology improvements in coal mining and preparation could enhance the cost-competitiveness of U.S. coal in global markets.
Key Findings
Barriers to U.S. Exports

TRANSPORTATION & SHIPPING CONSIDERATIONS

U.S. coal export economics would improve with channel deepening to accommodate larger bulk carrier vessels, improved dredging and maintenance of the inland waterways, and expansion of export port capacity on the U.S. West Coast.
Coal in a New Carbon Age
## Global Coal Reserves

<table>
<thead>
<tr>
<th>Country</th>
<th>Million Tonnes</th>
<th>Share</th>
</tr>
</thead>
<tbody>
<tr>
<td>U.S</td>
<td>258,709</td>
<td>25.0%</td>
</tr>
<tr>
<td>Russia</td>
<td>160,364</td>
<td>15.5%</td>
</tr>
<tr>
<td>Australia</td>
<td>144,918</td>
<td>14.0%</td>
</tr>
<tr>
<td>China</td>
<td>139,919</td>
<td>13.5%</td>
</tr>
<tr>
<td>India</td>
<td>97,728</td>
<td>9.4%</td>
</tr>
<tr>
<td>Germany</td>
<td>36,100</td>
<td>3.5%</td>
</tr>
<tr>
<td>Ukraine</td>
<td>34,375</td>
<td>3.3%</td>
</tr>
<tr>
<td>Poland</td>
<td>25,811</td>
<td>2.5%</td>
</tr>
<tr>
<td>Kazakhstan</td>
<td>25,605</td>
<td>2.5%</td>
</tr>
<tr>
<td>Indonesia</td>
<td>22,598</td>
<td>2.2%</td>
</tr>
<tr>
<td>Other</td>
<td>88,885</td>
<td>8.6%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>1,035,012</strong></td>
<td><strong>100.0%</strong></td>
</tr>
</tbody>
</table>

Source: BP Statistical Review of World Energy, June 2017