FUEL PRICE FORECASTING WITH A FOCUS ON COAL

APRIL 25, 2017
About Energy Ventures Analysis, Inc. (EVA)

EVA, Inc. is a management consulting firm for the U.S. energy industry and is focused on economic, financial and risk analysis for the electric power, coal, natural gas, petroleum, and renewable, and emissions sectors.

Since 1981, EVA has been publishing supply, demand and price forecasts as part of its FUELCAST subscription service for these energy sectors.

EVA performs various analyses for an array of clients that include:
- power utilities,
- fuel producers,
- fuel transporters,
- commodity traders,
- regulators, and
- financial institutions.
**Demand**

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- Power sector dominates demand for US coal
- Exports are an attractive market but only when US dollar is weaker than it is today
# Production

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<td><strong>735.8</strong></td>
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• **Takeaways**
  
  • Electricity demand growth has disappeared
  
  • Coal was the swing fuel in 2012, 2015 and 2016 because of low gas prices.
  
  • Growth in renewables will eat into baseload generation (coal or gas)
• In the last decade, coal prices have become quite volatile.
• Impact on consumers is muted due to contract portfolios
Integrated Forecasting Is Required Due To Relationship Between Fuels

- Forecast of prices must reflect supply/demand balances in each market (e.g., power, industrial, export, etc.)
- Forecasts often require iterations to reflect the demand/supply response to different price levels.
Short- and Long-Term Price Forecasts

• Long-Term forecasts typically reflect Short-Term price outlooks for the first few years and Long-Term outlooks for the balance of period. Both Short- and Long-Term Forecasts are influenced by market fundamentals (i.e., supply and demand).

• In addition, Short-Term forecasts are influenced by:
  • Relevant market developments
  • Weather
  • Stockpile levels
  • Forward price curves
SHORT-TERM COAL PRICE FORECASTING
Relevant Coal Market Developments

- China partially reverses production cuts
- More coal plant retirements are underway
- Atypically warm winter
- Credit markets reopen for coal companies easing potential coal supply constraints
- Cyclone Debbie
- Trump gets elected
Winter Was 2nd Warmest On Record Since 1986

Weather: HDD deviation from the normal*

- Colder (Dec-Feb)
- Warmer (Dec-Feb)

* Normal: 30 Year Avg. HDD (1986-2016) Dec-Feb


2017 – 2nd warmest

Energy Ventures Analysis, Inc.
Winter Weather Is Key For Coal Burn As High Gas Storage Level Keeps Pricing Pressure In The Near Term

- **Weather: HDD deviation from the normal**
  - Colder (Dec-Feb)
  - Warmer (Dec-Feb)

- **Gas Storage level (BCF)**
  - Year-2014
  - Year-2015
  - Year-2017
  - Year-2016

- **Henry Hub Gas price ($/MMBtu)**
  - Year-2014
  - Year-2015
  - Year-2016
  - Year-2017

* Normal: 30 Year Avg. HDD (1986-2016) Dec-Feb
Higher Gas Prices In Late 2016 Lead To An Increase In Coal Burn And Reduction In Stocks
Coal Gained Market Share As Henry Hub Gas Crossed $3.50/MMBtu In December 2016

Coal vs Gas share of Generation (%)

36% coal

27% gas

Henry Hub price (right)

Energy Ventures Analysis, Inc.
Near-Term Coal Plant Retirements

Coal Plant Retirements (MW)
2016-2019 based on announcements

2017 Announced retirements

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<th>Retirement decision</th>
<th>Economic</th>
<th>MATS</th>
<th>Haze Rule</th>
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<td>X</td>
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| 2016 - 2019 Total   | 7,795    | 3,544| 1,550     | 1,018| 1,145| 538 |

Energy Ventures Analysis, Inc.
Coal Burn Forecasts By Region Are A Function Of Forecast Coal Generation By Plant

![Coal Burn Chart]

**Coal Burn (mmt)**

Electric Power Sector

- PRB
- ILLB
- NAPP
- CAPP
- SAPP
- Rockies
- Lignite/other

- **2014**: 407
- **2015**: 358
- **2016**: 322
- **2017**: 376
- **2018**: 360
- **2019**: 334
- **2020**: 326
Other markets for coal affect pricing. China curtailed domestic production increasing import demand. As a result, met coal prices jumped. After falling, cyclone Debbie struck and prices jumped again.
# Summary Of EVA Q1 2017 Short-Term Coal Supply And Demand Forecast

## US Coal Supply (mmt)

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<th>2018</th>
<th>2019</th>
<th>2020</th>
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<td>Powder River Basin</td>
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<td>362.3</td>
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<td>51.6</td>
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<td><strong>U.S. Production</strong></td>
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<td><strong>824.4</strong></td>
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<td><strong>806.1</strong></td>
<td><strong>797.6</strong></td>
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<td>Import, PC, Waste</td>
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<td>20.5</td>
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<td><strong>Total Supply</strong></td>
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<td><strong>849.6</strong></td>
<td><strong>827.5</strong></td>
<td><strong>820.4</strong></td>
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-Producer stock & unaccounted: (12.0) 1.2 1.2 1.2 1.2

## US Coal Demand (mmt)

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<th>2018</th>
<th>2019</th>
<th>2020</th>
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<td>Electric Burn</td>
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<td>Stockpile Change</td>
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<td>(37.0)</td>
<td>(12.0)</td>
<td>-</td>
<td>-</td>
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<td>Electric Receipts</td>
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<td>711.7</td>
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<td>699.1</td>
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<tr>
<td>Coke Ovens</td>
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<td>16.9</td>
<td>16.6</td>
<td>16.6</td>
<td>16.5</td>
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<td>Comm./Indust.</td>
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<td>31.9</td>
<td>31.5</td>
<td>31.1</td>
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<tr>
<td><strong>Domestic Receipts</strong></td>
<td><strong>696.0</strong></td>
<td><strong>761.3</strong></td>
<td><strong>772.1</strong></td>
<td><strong>752.3</strong></td>
<td><strong>746.6</strong></td>
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<td>Export Metallurgical</td>
<td>40.5</td>
<td>48.0</td>
<td>45.3</td>
<td>42.7</td>
<td>40.0</td>
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<tr>
<td>Export Steam</td>
<td>25.0</td>
<td>33.6</td>
<td>30.9</td>
<td>31.3</td>
<td>32.6</td>
</tr>
<tr>
<td><strong>Total Exports</strong></td>
<td><strong>65.5</strong></td>
<td><strong>81.6</strong></td>
<td><strong>76.3</strong></td>
<td><strong>73.9</strong></td>
<td><strong>72.6</strong></td>
</tr>
<tr>
<td><strong>Total Demand</strong></td>
<td><strong>761.5</strong></td>
<td><strong>842.9</strong></td>
<td><strong>848.4</strong></td>
<td><strong>826.2</strong></td>
<td><strong>819.2</strong></td>
</tr>
</tbody>
</table>

1 Includes Import, PC, WC

Energy Ventures Analysis, Inc.
Short-Term Coal Price Forecast Is Influenced But Not Determined By Forward Price Curves

MORE COAL PLANT RETIREMENTS ARE UNDERWAY
• Trump rescinded Stream Protection Rule (Feb 16)
• Trump nominee Scott Pruitt confirmed as EPA Administrator (Feb 17)
• Broad “Energy Independence Executive Order” with extra focus on Clean Power Plan (March 28)
• DOJ Motion to Hold ELG Compliance in Abeyance (March 28)
• Withdrawal of Federal Plan for CPP Compliance published in Federal Register (April 3)
• EPA motion for continuance of oral arguments to give the appropriate officials adequate time to fully review the 2015 ozone NAAQS. (April 7)
• Administrative Stay by the EPA of the Effluent Limitation Guidelines (April 12)
• Department of Energy initiated 60 day study on impact of renewable energy mandates and subsidies on baseload generation. (April 14)
Long-Term Integrated Price Forecasting for the Power Sector

**Emissions/Renewables**
- Capacity Retirement Forecast
  - Forecast Retirements
  - Forecast Retrosfits
  - Capital Cost of Required Controls

**Renewable Forecasting Model**
- Renewable Capacity
- Renewable Generation
- State Renewable Portfolio
- Standards & Net Accounts
- Fuels includes: wind, solar, geothermal, biomass, municipal solid waste, landfill gas

**Emissions Price Forecast**
- Emissions Allowance Prices
- Balance by Utility Owner
- Annual Emission Profiles
- Allowances Market Liquidity

**Gas**
- Basis Differential Forecast
  - Differentials for 75+ Pricing Hubs
  - Pipeline Infrastructure

**Gas Supply Model**
- Henry Hub Price Forecast
- Production by Play
- Conventional vs. Unconventional Production
- Advances in Drilling Technology
- Imports & Exports

**Gas Demand Model**
- Gas Consumption by Sector
  - Industrial, Commercial, Residential, Electric Power and Transportation

**Power**
- Power Plant Tracking System
  - Announced Capacity Additions
  - Announced Capacity Retirements
  - Projected Retirements based on Market Insights

**AuroraXMP Dispatch Model**
- Electric Power Forecast by Fuel Type and Plant
  - Annually
  - Hourly
  - Hourly Wholesale Power Price
  - Hub
  - Market Zone
  - Additional Capacity Forecast
  - Capacity Price Forecast
  - Emissions by Unit
  - Reserve Margin Analysis
  - Fuel Consumption by Unit
  - Regional Transmission Analysis

**Coal Price Model**
- Coal Commodity Prices ($/ton) by:
  - Nominal and Real Dollars
  - Dollars per Short Ton or Metric Ton
  - FOB Rail, Barge, Mine
  - Coal Basins: NAPP, CAPP, ILLB, PRB, Rockies
  - Domestic and International

**Delivered Coal Price Model**
- Commodity Coal Price at Each Generator
- Transportation Cost to Each Generator
- Coal Consumption Percentage by Coal Basin at Each Generator
- Heating Value of Coal Consumed at Each Generator

**Coal Flows Model**
- Coal Supply and Demand
  - For Commercial, Industrial, Electric Power, and Metallurgical Sectors
  - By Coal Supply Region
  - Coal Stockpile Changes
  - Coal Export/Imports
  - Electric Power Receipts and Consumption

**Coal Burn Model**
- Coal Consumption Forecast
  - By Generation Unit
  - By Coal Region

**Oil & Petroleum Products**

**Oil Demand Model**
- Demand for Major Consuming Markets
- Subsidies, Substitution, and Efficiency Gains

**Oil Pricing Model**
- Global Oil Prices for Major Crude Types
- Domestic Petroleum Product Prices

**U.S. Transportation Model**
- U.S. LDV Fuel Consumption for All Fuel Types
- Evaluates Major Structural Drivers:
  - Fuel Efficiency
  - Vehicle Fleet
  - Behavioral Patterns

**Oil Supply Model**
- Output for Major Producing Countries
- OPEC vs. Non-OPEC Production
- Marginal barrel
- U.S. Five Major Shale/Tight Oil Plays
## Key Long-Term Assumptions For Coal Price Forecasting

### Demand
- Electricity demand growth
- Installed capacity
  - Renewables
  - Retirements (coal and nuclear of particular interest)
  - Additions
- Regulatory requirements
- Other domestic demand (industrial and met)
- Export
  - Type (Met and Thermal)
  - Export Terminal Capacity
  - Relative strength of the U.S. dollar
- Gas prices

### Supply
- Production capacity
- Production costs
- Mining regulations
- Reserve profiles
- Health of the coal industry
## Key Long-Term Assumptions For Natural Gas Price Forecasting

<table>
<thead>
<tr>
<th>Demand</th>
<th>Supply</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Residential/Commercial</td>
<td>• Shale expansion and technology</td>
</tr>
<tr>
<td>• Existing industrial</td>
<td>• Decline of off-shore production</td>
</tr>
<tr>
<td>• Power</td>
<td>• Decline of conventional production</td>
</tr>
<tr>
<td>• LNG exports</td>
<td>• Infrastructure status and improvements</td>
</tr>
<tr>
<td>• Pipeline exports to Mexico</td>
<td></td>
</tr>
<tr>
<td>• New industrial facilities</td>
<td></td>
</tr>
<tr>
<td>• Fleet conversions</td>
<td></td>
</tr>
</tbody>
</table>
Closing Thoughts On Long-Term Forecasts

- **Coal vs Gas Price Forecasts**
  - Coal is purchased typically through staggered multi-year contracts which mutes coal price volatility actually paid by generators.
  - Gas is purchased typically day ahead or same day which exposes generators to volatile pricing absent hedging. Gas price forecasts do not include hedging costs.
  - These factors are hard to consider but significant to dispatch analysis which determines plant performance.
  - IRP analyses do not appear to reflect these different profiles.

- **Stochastic versus Deterministic Modeling**
  - Stochastic modeling addresses some of the uncertainty in price forecasts through probability distributions of possible outcomes subject to constraints defined above.
  - Stochastic modeling does not replace the need for “designed scenario analysis” to capture either binary outcomes or specific scenarios that merit consideration.
QUESTIONS?

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412-421-2390