New Elk Coal Company – Coal Mining In an Established Gas Field

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Outline

• Background
• Obstacles to employing a comprehensive development plan
• Can co-development of resources lead to sustainable energy development?
• Mutually undesirable impacts on coal and gas production
• Conclusions
Raton Basin geology

• Two gassy coal packages – Late Cretaceous and Paleocene
  • Raton Formation
  • Vermejo Formation
New Elk Mine

- Formerly the Allen Mine opened in 1951 to supply metallurgical coking coal to an iron and steel production facility in Pueblo, CO
- Produced from the Raton Formation
- The Allen Mine closed in the early 1980s and was allowed to partially flood
- Nearby Golden Eagle Mine (formerly the Maxwell Mine) is gassy
  - Metallurgical/steam coal produced from Maxwell seam
  - Longwall mine which closed December 1995 when its production was 1.5 million tons
  - Methane recovery project in 1997 from abandoned mine vent shafts, existing methane drainage boreholes and gob vent boreholes
    - 1.5 mmcf/d recovered in 1997
New Elk Mine assets

New Elk Coal Company

- Assets: property ownership, coal leases and water rights
  - Property rights include temporarily idled New Elk underground coal mine (formerly Allen Mine)
  - Other surface assets: coal prep plant, coal storage silos, mine facility buildings, surface conveyors, electrical substations, mine waste disposal areas, coal storage areas, ventilation air shafts, belt conveyor and track slopes and approximately 13 miles of railroad right-of-way
- Was fully permitted in 2012 but ceased business in 2015

Photo credit: Cline Mining Corporation
New Elk Mine location and historical setting
Raton Basin CBM

Raton and Vermejo Formations

- Basin is rich in CBM and conventional natural gas
- Commercial CBM production began 1982
- Third largest CBM producing basin in the US
- Raton coal - 193 cubic feet/ton
- Vermejo coal - 492 cubic feet/ton
- Estimated methane resources are 38.7 trillion cubic feet
- Both formations produce economically important quantities of coal, gas and water
- By 2008 more than 3,800 wells produced 800 billion cubic feet
Raton Basin CBM and water production peak and decline

**Explanation**
- **Raton Basin Gas Production**
- **Forecasted Gas Production**
- **Raton Basin Water Production**
- **Forecasted Water Production**

Cumulative through 06-2013
- 1,445,149,573 bbls
- 60,696,282,066 m³

Cumulative through 06-2013
- 1,334,907,864 mcf
- 37,804,590,708 m³

**Gas EUR**
- 2,169,388,634 mcf
- 61,437,086,115 m³

**Water EUR**
- 1,711,773,533 bbls
- 60,083,251,008 m³

**NOTE:** Estimated 2013 production by two as data available through 06-2013.
Co-development of resources

- Since closing of Allen Mine at least 737 CBM wells have been drilled in the mining area
  - 254 of those wells had been drilled in the New Elk Mine’s leasehold
- New Elk Coal Company’s plans for reopening the mine must consider the possible effects from the existing CBM wells penetrating the mineable coal seams
Obstacles to employing a comprehensive development plan
Obstacles to co-development

• Ownership Issues
  – Minerals and gas primacy
  – Surface access—sometimes difficult or impossible due to urbanization or environmental restrictions on sensitive wildlife habitat

• Technical Issues
  – Influence of CBM wells on mine design
    • Size of barrier pillars necessary to protect integrity of CBM wells
  – Timing and coordination of development
Ownership considerations for comprehensive development

- Lack of policy – no mandated coordination efforts
- Primacy issues between coal mining and CBM/gas production
- Primacy determined by language in mineral leasing contracts
Safety considerations for comprehensive development

• Validation of cement bond integrity of CBM wells that penetrate the coal mine footprint
• Mine could face unplanned abandonment costs for CBM wells completed within the mineable coal seams
Cross-Section through coal mine
A closer view of casing integrity and bonding to the borehole
Can co-development of resources lead to sustainable energy development?

Workshop on Best Practices in Coal Mine Methane Capture and Utilization
Bogotá Colombia 24-25 July 2018
Sustainable energy development

Requires balancing potentially competing factors:

- Environmental Protection
- Energy Security
- Energy for Quality of Life
Sustainable energy

- What are some considerations?
  - Environmental Protection
    - What happens to produced water? Can it be conserved?
    - Are fugitive emissions of methane controlled and used.
  - Energy for Quality of Life
    - All sustainable development goals depend on energy, modern life depends on clean and abundant energy
    - Energy demand is growing and regional needs are substantial
    - Provides sustained job availability
    - Safe working environment
  - Energy Security
    - Provides alternative sources of energy as a bulwark against geopolitical events
    - Coal and natural gas (methane) are primary energy fuels that can be used together or separately to generate electricity, can be transported for off-site use, and are chemical feedstocks
Environmental considerations for comprehensive development

Las Animas County, Colorado is Home to Approximately 600 Farms and Ranches

Location Map of Water Disposal Facilities from Mining and Gas Production
Sustainable development of resources

- What is the value of each of the resources – how do they compare?
- What are the benefits of CBM production in those mineable coal seams – pre-mine drainage?
- What options were considered in the study?
  - Plug and temporarily abandon wells completed in mineable coal seams and later recomplete as gob vent boreholes
  - Leave wells intact with sufficient barrier pillars and continue to mine coal as the mine plan allows
  - Purchase CBM wells and mine through them
Economic considerations for comprehensive development in USA

Average Price of U.S. Steam and Metallurgical Coal Exports, 2011 - 17

Average Henry Hub Price of U.S. Natural Gas, 2011 – Q1 2018

- Average export and sales prices for coal and gas respectively from 2011 to early 2018
- Since the peak of coal prices in 2011, there has been a steady decline in price
- Natural gas prices continue to fluctuate, but overall have declined
Annual average sales price for coal and natural gas on heat content basis
Value of CBM wells based on estimated ultimate recovery
Mutually undesirable impacts on coal and gas production
Technical considerations for comprehensive development

- MSHA regulations for the size of barrier pillars were determined by Oil & Gas Industry
  - 300’ radius pillar surrounding well
- Mine has a right to petition for an alternative program as long as the safety of miners is protected
- Successful instances in the Appalachian Basin
Undesirable impacts

• Gas production may or may not be interrupted and coal mining may experience undesirable impacts from CBM production
  – Having to work around barrier pillars
  – Cement bond may not be sufficient in some cases to protect from gas migration into mine workings
  – Do the present regulations address the real issues?
    • Are the regulations for barrier pillars adequate for mining?
    • Present policies do not accommodate various geologic and coal/gas production and mining issues across energy resource rich sedimentary basins
Plan view of 3D model runs

First Run: 100 x 100 ft mine out of gas producing coal seam

Sixth Run: 500 x 500 ft mine out of gas producing coal seam
Full model at end of simulation
Results of mining encroachment on gas producing coal seam

Single well gas production rate vs time over 5 years

Single well cumulative gas production over 5 years
Conclusions

- Raton Basin in Southeast Colorado has been locale for profitable coal mining and gas (conventional and CBM) extraction for many years. Water has been co-produced and may become the most precious commodity, but presently does not have a market value. Long term impacts on the agricultural community should be reassessed.

- Co-development of resource extraction poses challenges that are surmountable. Coordination is desirable, but not required among entities that control mineral rights in most countries. This should change.

- Lack of coordination efforts between coal and gas developers can lead to unplanned costs and may lead to unexpected hazards. This should be incorporated into principles-based policy and regulations.

- Benefits to planned co-development could lead to fewer production interruptions for miners and gas producers and should be coordinated to enhance efforts to reduce greenhouse gas emissions. Use and value of water resources should also be considered during planning.
Gracias!

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