POLICY facts

U.S. DEPARTMENT OF ENERGY
OFFICE OF FOSSIL ENERGY
NATIONAL ENERGY TECHNOLOGY LABORATORY

**Strategic Center for Natural Gas**

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# MULTI-SEAM WELL COMPLETION TECHNOLOGY: IMPLICATIONS FOR POWDER RIVER BASIN COALBED METHANE PRODUCTION

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## STRATEGIC CENTER FOR NATURAL GAS WEBSITE

www.netl.doe.gov/scng

## CUSTOMER SERVICE

800-553-7681

## Background

The Powder River Basin coalbed methane (CBM) play is located in northeastern Wyoming and southeastern Montana. Covering 12,000 mi$^2$, the CBM play encompasses parts of seven counties in the two states and targets natural gas locked in Tertiary-age Fort Union Formation coals (Figure 1). Depths for the play range from 300 ft to over 3,000 ft and include a series of distinct coal seams, such as the Anderson, Wyodak and Big George.

Over the past five years, CBM development has increased dramatically in the basin. As of March 2003, nearly 1 billion cubic feet (Bcf) per day of natural gas and 1.6 million (MM) barrels of water were being produced from about 11,000 wells (Figures 2 and 3). Another 3,000+ wells are drilled but await utility and gathering line hookups, water discharge permits, etc. Thus far, development has generally targeted the shallow, thick, easy-to-reach coal seams along the eastern edge of the basin. However, with depletion of geologically more favorable areas, development has moved (is moving) toward the deeper and somewhat thinner coals in the central and northern portions of the basin. In these areas, currently used single-seam well completion technology (Figure 4) may no longer prove adequate.

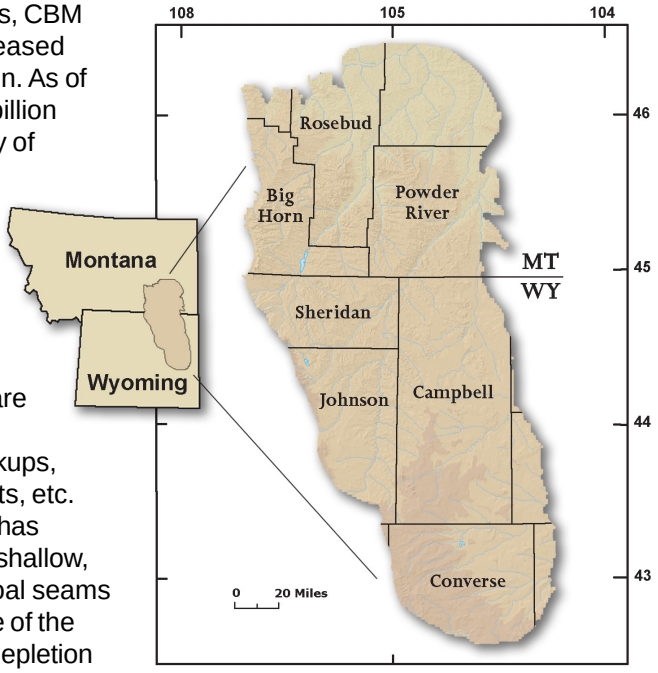



*Figure 1. Location of Powder River Basin - Northern Rocky Mountain Region.*

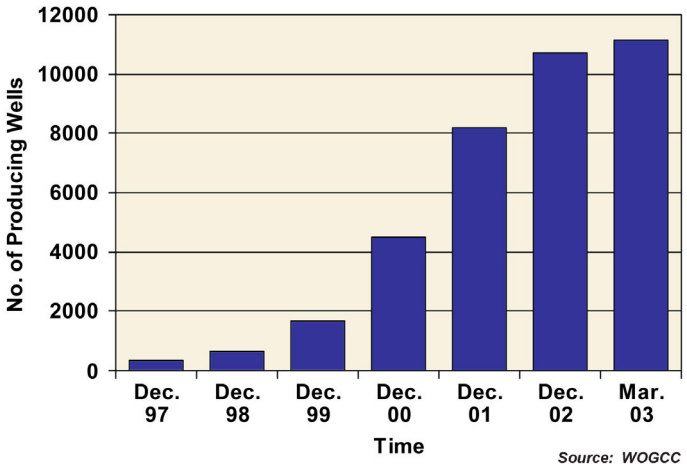



*Figure 2. Producing Wells (CBM) in the Powder River Basin.*

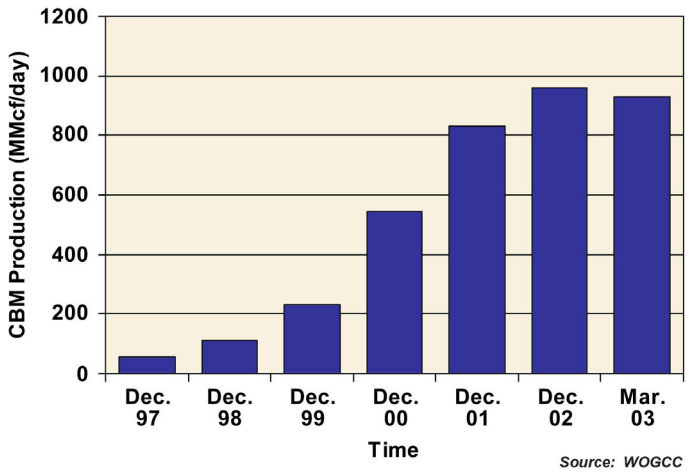
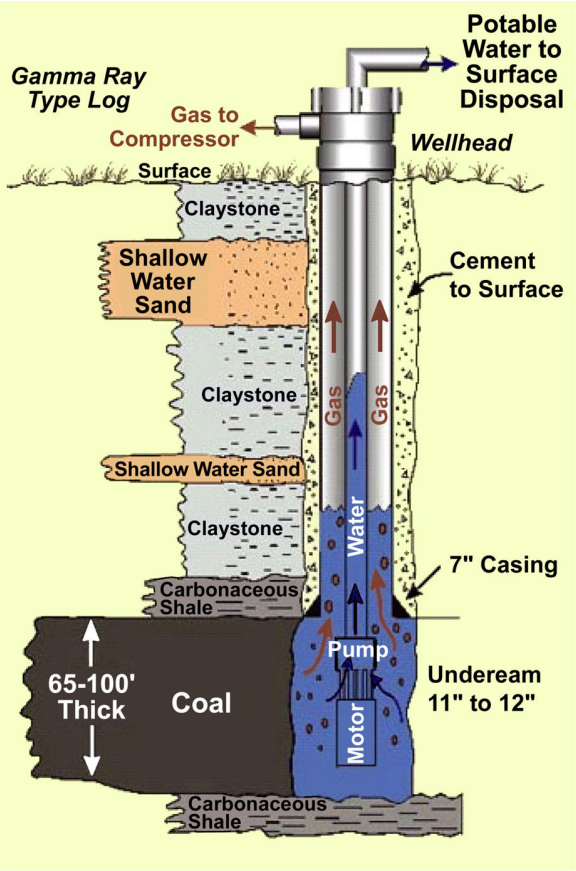



*Figure 3. Powder River Basin CBM Production.*

CBM operators in the Powder River Basin have long recognized the potential utility of multi-seam completions (MSC). Several operators have highlighted areas where such technology would be advantageous or vital for further development. A handful of operators have tried MSC. Unfortunately, because of the unique geological and reservoir properties of Powder River Basin coals — shallow, underpressured, low-rank (low strength) coals surrounded by water-bearing aquifers — the application of MSC technology has been largely unsuccessful.




(Courtesy of L. Cook)

*Figure 4. Typical Single-Seam Well Completion (Open Hole).*

## Task Description

At the request of the Department, Advanced Resources International, Inc. (ARI) undertook an analysis designed to evaluate the potential impacts of MSC technology for coalbed methane development in the Powder River Basin. The study was a natural outgrowth of an earlier DOE analysis, which evaluated the economic impacts of produced water management alternatives on CBM development in the basin.* Objectives of the MSC study include:

- Estimate how much additional CBM resource would become accessible and technically recoverable — compared to the current practice of drilling one well to drain a single coal seam
- Determine whether there are economic benefits associated with MSC technology utilization (assuming its widespread, successful application) and if so, quantify the gains
- Briefly examine why past attempts by Powder River Basin CBM operators to use MSC technology have been relatively unsuccessful

* Powder River Basin Coalbed Methane Development and Produced Water Management Study (November 2002), DOE/NETL-2003/1184

- Provide the underpinnings to a decision whether a MSC technology development and/or demonstration effort is warranted by the Department

## Summary of Findings

The Powder River Basin has numerous sequences of "thin" coal seams that extend over major areas of the basin, particularly along the northern portion of the basin and in Montana. Whenever these thin (<20 ft thick) coals and the natural gas contained therein are considered in the context of recoverable resources, the volume of technically recoverable natural gas significantly increases (Figure 5). More importantly, development/adaptation and widespread application of MSC technology is expected to significantly improve the economics of CBM development in the Powder River Basin.

The revised outlook for coalbed methane in the Powder River Basin is as follows:*

- The gas in-place, including both thick coals and thin (< 20 ft) coal seams, is estimated at 75 trillion cubic feet (Tcf)

- The technically recoverable coalbed methane resource is estimated at 50 Tcf

- The economically recoverable CBM resource is estimated to range from 24 to 38 Tcf (assumes $3.50/Mcf at Henry Hub and two basis differentials)

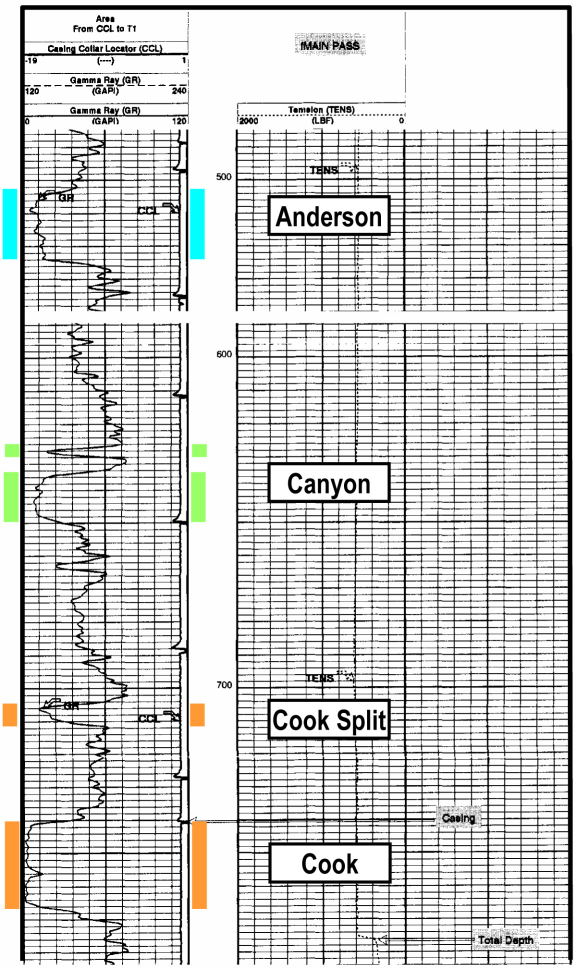
  - In both scenarios, the volume of economically recoverable CBM increases by 21 Tcf (versus resource development via single seam well completion methods)

- Federal and state revenues would significantly increase (Figure 6)

  - Royalty payments are estimated to increase by $3.6 billion

  - Tax (severance and ad valorem) receipts are estimated to increase by $4.1 billion

- MSC technology seems essential for developing the CBM resource in Montana and on Indian lands — areas that contain an abundance of natural gas in thin coal seams




Source: Advanced Resources International

*Figure 5. Log Section Showing the Presence of Multiple Coals in a Relatively Short Interval.*

***. . . development/adaptation and widespread application of MSC technology is expected to significantly improve the economics of CBM development in the Powder River Basin.***

* Assumes widespread, successful application of MSC technology

## RELEVANT PARTIES

Federal Agencies
State and County Governments
Operators and Producers
Service Industry
Environmental Advocates
Royalty Owners
Native Americans

## RELATED LINKS

**Bureau of Land Management Buffalo Field Office**
http://www.wy.blm.gov/bfo/

**Bureau of Land Management Miles City Field Office**
http://www.mt.blm.gov/mcfo/

**Montana Board of Oil and Gas Conservation**
http://bogc.dnrc.state.mt.us/

**Montana Bureau of Mines and Geology**
http://www.mbmg.mtech.edu/

**Montana DEQ**
http://www.deq.state.mt.us/coalbedmethane/index.asp

**US EPA – Region 8**
http://www.epa.gov/region08/water/wastewater/wastewater.html

**Wyoming DEQ**
http://deq.state.wy.us

**Wyoming Oil and Gas Conservation Commission**
http://wogcc.state.wy.us

**Wyoming State Geological Survey**
http://www.wsgsweb.uwyo.edu/

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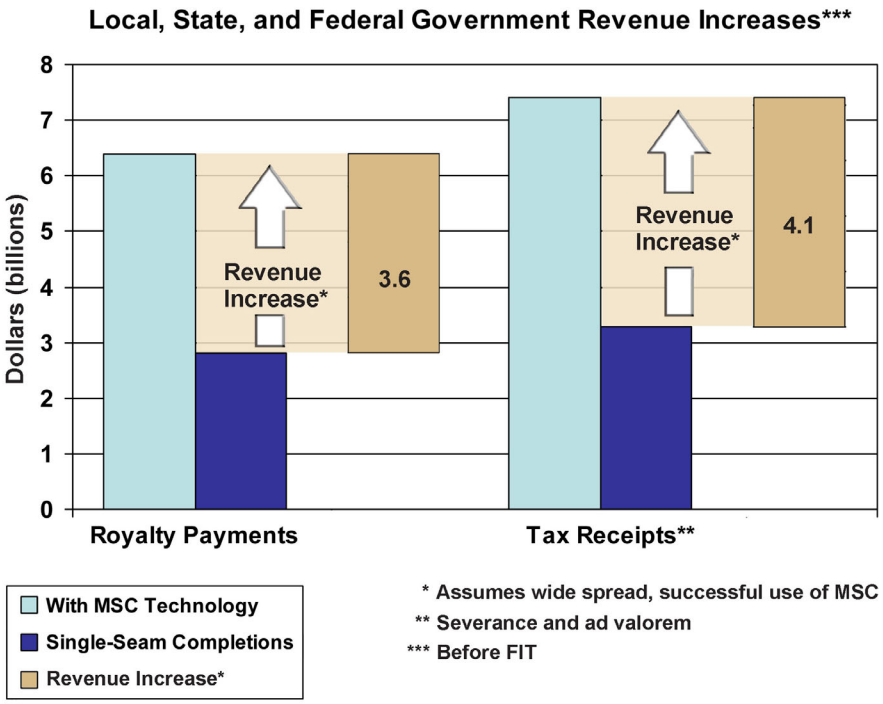


*Figure 6. Potential Economic Benefits Associated with MSC.*

These results clearly illustrate that MSC technology can help improve the outlook for CBM in the Powder River Basin — by increasing reserves-per-well thus decreasing unit costs. The full report can be accessed by clicking on the following link

Multi-Seam Well Completion Technology: Implications for Powder River Basin Coalbed Methane Production

The report and further information on this topic can also be obtained from the NETL website at www.netl.doe.gov.

The Department recognizes that in addition to technology, other actions, e.g., improved market access, are required to optimally develop this major natural gas resource. As such, DOE remains committed to working with other federal and state agencies, and though public-private partnerships to facilitate responsible development of domestic sources of clean-burning natural gas.