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Coalbed Methane Development: The Costs and Benefits of an Emerging Energy Resource

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ABSTRACT

Coalbed methane has rapidly become an important source of natural gas, particularly in the Intermountain West. The rapidity of its development has resulted in significant pressure on communities to deal with its environmental consequences. Coalbed methane production often results in large quantities of water that are released as byproducts of production; in some cases, the water may inundate sensitive arid ecosystems, worsen surface water quality, and diminish underground water supplies. Noise, dust, and increased traffic; impairment of visibility and conflicts with recreation and other land use; impacts on wildlife and ecosystems; and other consequences of development have generated opposition in many communities. Particularly vexing has been development on split estates, where surface owners do not own the mineral rights underneath their property and are required to cooperate with development that may disrupt the use and control of their land. This article examines the problems associated with coalbed methane development and offers a variety of suggestions for how conflicts could be reduced and how development could proceed in ways that are ecologically sustainable.

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INTRODUCTION

Coalbed methane (CBM) is a form of natural gas that is produced by drilling into coal seams, reducing the pressure that traps methane on the surfaces of coal molecules, and pumping the methane into natural gas distribution systems. Classified as an unconventional source of natural gas, CBM is of growing importance as a domestic source of natural gas at a time when demand is rapidly increasing and output from some conventional sources has peaked. Since natural gas is the cleanest burning fossil fuel and virtually all of the gas used in the United States is supplied either domestically or from Canada, it contributes to national energy security.

While CBM development has provided important economic benefits to many communities in the West, it has nevertheless been quite controversial. CBM development may result in significant impacts on communities and their environment, property values, and lifestyle. Although such impacts also occur with other forms of energy extraction, a unique challenge posed by CBM development is the speed with which impacts occur.

In comparison with the development of conventional gas, drilling costs are quite low and some wells can be drilled within a matter of days. Parties are forced to deal with issues of produced water, conflicts between landowners and those who lease mineral rights, impacts of development on communities, demands for governmental and regulatory services, and other issues in a very compact time frame.

In many areas, lawsuits over the adequacy of the analyses of expected environmental impacts, the regulation of development by local governments, and conflicts between surface owners and gas companies have resulted in conflict, delays, uncertainty, and acrimony. Counties have sued state oil and gas regulatory bodies over who has responsibility for regulating the impacts of CBM development. Companies have sued counties over zoning and land use plans that restrict their ability to develop resources, community groups have sued federal and state agencies for inadequately assessing environmental impacts, and landowners regularly voice concern about impacts on water quality. These conflicts show no signs of dissipating. Much of the conflict is rooted in widely discussed changes in the population of the West as recreational and preservationist interests increasingly clash with traditional extractive industries.

Environmental impacts associated with CBM development include the construction of roads, drill pads, water disposal sites, and related facilities; noise from pumps, compressors, and traffic that disturb residents and wildlife; air pollution; disruption of areas that were previously isolated from development or valued for undisturbed vistas

and solitude; and impacts on water quality and supplies. Given the importance of clean water in the arid West, no environmental issue has been more contentious or critical to the future of CBM development than that of the impacts on local water. There is great disagreement among community groups, state agencies, and energy companies over how much water is produced through CBM development. There is also concern over what happens to the produced water and what impacts it has on water quality, local ecosystems, and water supplies, as well as concern over the best uses for the produced water. As valuable as CBM is in the local economies of the West and in the production of domestic energy supplies, even more critical is the protection of the West's water supplies. The sooner water issues can be addressed, the sooner development can proceed in an orderly fashion with a minimum of lawsuits, conflicts, and acrimony.

I. AN OVERVIEW OF COALBED METHANE DEVELOPMENT

What Is CBM?

Coalbed methane is a form of natural gas that is trapped within coal seams. CBM was first discovered during coalmining operations when fires or explosions of methane gas threatened miners. To reduce the risk of explosions, methane has been vented during mining operations. Some companies began capturing CBM as a valuable resource, and, as attention was focused on methane as a potent greenhouse gas, CBM production was pursued as a way to help reduce the threat of climate change.

Coalbed gas is primarily made up of methane (typically 95 percent), with varying amounts of carbon dioxide.[1] Coalbeds are both the source of the gas that is generated and the storage reservoir once it is produced.[2] Coalbeds have a tremendous amount of surface area and can hold massive quantities of methane. Since coalbeds have large internal surfaces, they can store six to seven times more gas than the equivalent volume of rock in a conventional gas reservoir.

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1. U.S. GEOLOGICAL SURVEY, ENERGY RESOURCE SURVEYS PROGRAM, COALBED METHANE—AN UNTAPPED ENERGY RESOURCE AND AN ENVIRONMENTAL CONCERN, USGS Fact Sheet FS-019-97 (1997), *available at* http://energy.usgs.gov/factsheets/Coalbed/coalmeth.html (last updated Jan. 17, 1997).

2. For a useful overview of coalbed methane, see KARL LANG, COALBED METHANE TRENDS (PTTC Technology Connections, 2000), *available at* http://www.pttc.org/tech_sum/statev6no2.htm (last visited May 29, 2003).

CBM is produced either through chemical reaction or bacterial action.[3] Chemical action occurs over time as heat and pressure are applied to coal in a sedimentary basin. The gas in higher rank coals is produced as heat and pressure transform organic material in the coal; gas in low rank coals results from the decomposition of organic matter by bacteria.[4]

Bacteria that obtain nutrition from coal produce methane as a byproduct.[5] Most of the CBM is stored within the molecular structure of the coal. Gas molecules adhere to the surface of the coal, and some gas is stored in the fractures or cleats of the coal or dissolved in the water trapped in the fractures. Methane attaches to the surface areas of coal and throughout fractures and is held in place by water pressure. These cleats and fractures are typically saturated with water, and the coal must be dewatered (usually pumped out) before the gas will flow.[6] Most coals contain methane, but it cannot be economically extracted unless there are open fractures that provide the pathway for the desorbed gas to flow to the well. When the water is released, the gas flows through the fractures into a well bore or migrates to the surface.[7]

As the fracture system produces water, the adsorptive capacity of the coals is exceeded, pressure falls, and the gas trapped in the coal matrix begins to desorb and move to the empty spaces in the fracture system. The gas remains stored in nearby non-coal reservoirs until it is extracted.[8] Drilling dewaters the coal and accelerates the desorption process. Drilling initially produces mostly water; gas production eventually increases and water production declines. Some wells do not produce any water and begin producing gas immediately, depending on the nature of the fracture system. Once the gas is released, it is free of

3. Catherine Cullicott et al., *Coalbed Methane in the San Juan Basin of Colorado and New Mexico, in* COALBED METHANE DEVELOPMENT IN THE INTERMOUNTAIN WEST 51, 53 (Natural Resources Law Center, University of Colorado School of Law CD-ROM, July 2002).

4. Others suggest that "[a]t similar depths and pressures, coal beds contain from 2 to 4 times the amount of gas contained in a conventional gas reservoir." J.E. McElhiney et al., *Reservoir Engineering Aspects of Coalbed Methane, in* AAPG STUDIES IN GEOLOGY SERIES NO. 38: HYDROCARBONS FROM COAL 361, 361 (1993).

5. *The Orderly Development of Coalbed Methane Resources from Public Lands: Oversight Hearing before the House Subcomm. on Energy and Mineral Res., Comm. on Res.*, 107th Cong. 7 (2001) (Statement of Dr. Gene Whitney, Supervisory Geologist, U.S. Geological Society).

6. D. Keith Murray, *Coalbed Methane Reservoir Evaluation and Completion Technology, in* ATLAS OF MAJOR ROCKY MOUNTAIN GAS RESERVOIRS 188 (James Magruder Robertson et al. eds., 1993).

7. Vito Nuccio, *Geological Overview of Coalbed Methane*, Presentation at the U.S. Geological Survey CBM Field Conference (May 9-10, 2001) (on file with the Univ. of New Mexico School of Law Library).

8. Murray, *supra* note 6, at 188.

sulfur and usually it is of sufficient quality to be directly pumped into pipelines.[9]

Some coals cannot be developed because they cannot be dewatered economically. Other coalbeds may be too deep to feasibly drill to release the gas. CBM wells are typically no more than 5000 feet in depth,[10] although some deeper wells have been drilled to extract the gas. The deeper the coalbed, the less water is present but the more saline it becomes.[11] The volume of gas typically increases with coal rank, with the depth at which the coalbed is located, and with the reservoir pressure.[12] Basins that contain 500–600 standard cubic feet (SCF) of methane per ton are considered to be "very favorable for commercial coalbed gas production," as long as there is sufficient reservoir permeability and rate of desorption. Some coals have generated more than 8000 SCF of methane per ton of coal.[13] The most productive coalbeds are highly permeable, saturated with gas, and fractured.[14]

In the United States, CBM has been produced in commercial quantities since 1981.[15] CBM development grew rapidly from a few dozen wells in the 1980s to nearly 6000 wells producing 1.5 billion cubic feet (Bcf) by 1992. Despite the elimination of the tax credit for new wells after that time, production skyrocketed The Gas Research Technology Institute reported in 2000 that 14,000 wells produced 1.5 trillion cubic feet (Tcf) of gas, representing seven percent of the total gas production in the United States.[16] In 1989, the United States produced 91 Bcf of coalbed methane.[17] Ten years later, the total gas produced had grown to nearly 1.3 Tcf.[18] Figures for CBM production in the state of Colorado illustrate the rapid growth of development in the state. In 1990, CBM wells in the state produced 27 Bcf of methane. By 1995, they produced 240 Bcf, and their output steadily increased throughout the rest of the decade,

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9. *Id.*

10. *See* Rebecca Clarren, *How Well Do You Know Your Wells?*, HIGH COUNTRY NEWS, Sept. 25, 2000, at 9.

11. *Id.*

12. *Id.*

13. Murray, *supra* note 6, at 188.

14. Permeability is measured in units called a Darcy. Powder River coal, for example, often has a permeability of greater than one Darcy, which means the coalbeds are quite productive and the gas is relatively easy to extract. Lance Cook, *The Geology and Production Characteristics of the Powder River and Other CBM Basins in Wyoming, in* COALBED METHANE DEVELOPMENT IN THE INTERMOUNTAIN WEST 245, 248 (Natural Resources Law Center, University of Colorado School of Law CD-ROM, July 2002).

15. Richard A. Schraufnagel, *Coalbed Methane Production, in* AAPG STUDIES IN GEOLOGY SERIES NO. 38: HYDROCARBONS FROM COAL 341 (1993).

16. Peggy Williams, *Western Coalbed Methane*, OIL & GAS INVESTOR, Nov. 2001, at 34.

17. Nuccio, *supra* note 7.

18. *Id.*

reaching 417 Bcf in 2000.[19] Figure 1[20] charts the growth in CBM development in the United States in recent years. Development of CBM resources has been concentrated in the West, the South, and, to a lesser extent, the Midwest. The map in Figure 2[21] identifies the major CBM plays or basins in the United States, along with estimates of the volume of resources in each area.

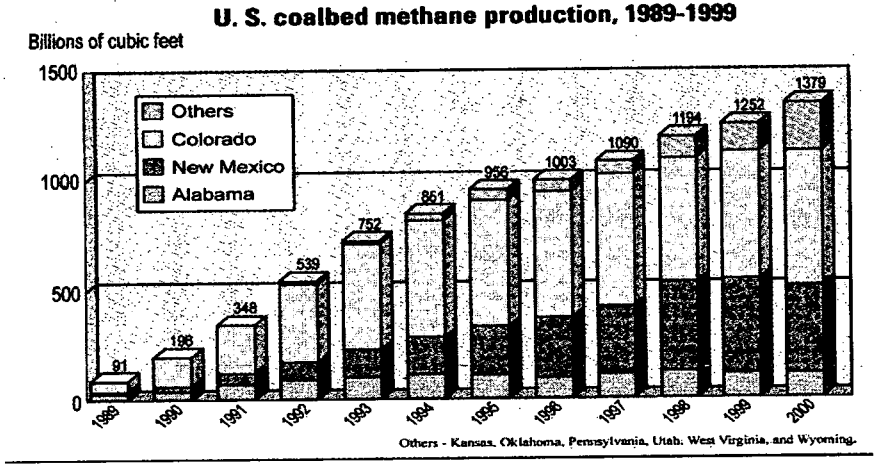


Figure 1

19. Meeting with Richard Griebling, Colorado Oil and Gas Conservation Commission, Natural Resources Law Center, Boulder, Co., Nov. 27, 2001.

20. John R. Dyni, AAPG EXPLORER 41 (Nov. 2002).

21. Walter B. Ayers, Jr., *Coalbed gas systems, resources, and production, and a review of contrasting cases from the San Juan and Powder River Basins*, 86 AAPG BULLETIN 1855 (Nov. 2002).

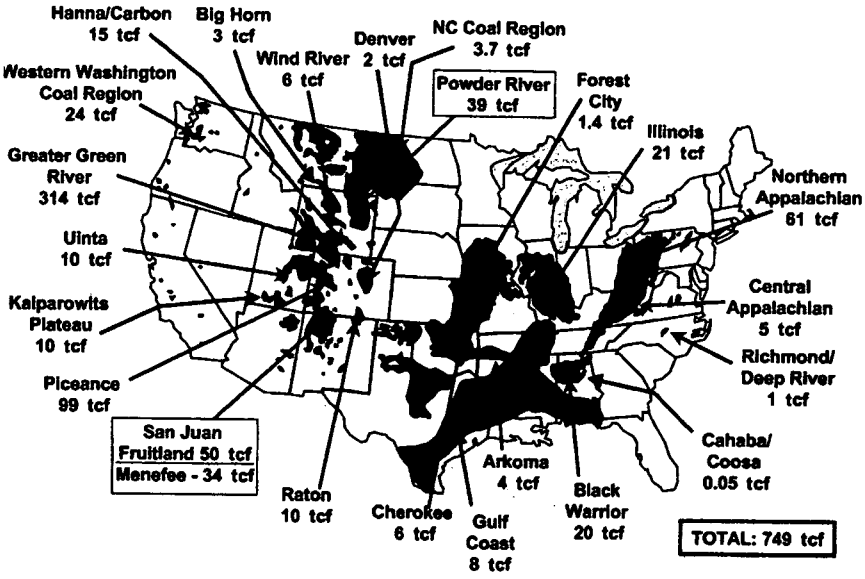


Figure 2

How Does CBM Compare with Other Forms of Natural Gas?

Methane is the major component of natural gas, and CBM can be used in the same way as conventional gas. Conventional gas is formed in shale and limestone formations; pressure and temperature combine to transform organic matter into hydrocarbons. The gas migrates upward until trapped by a geologic fault or fold and rests in this reservoir rock until it is discovered, drilled, and extracted. The location and extent of conventional gas typically requires exploratory drilling since the location of reservoirs is not apparent from the surface.[22] Since CBM wells are typically shallow (less than 4000 feet) and on land, well costs are low to moderate in comparison with conventional natural gas.[23]

In conventional wells, gas production peaks early and then declines over time and water production eventually increases, the opposite of CBM extraction.[24] Figure 3[25] depicts the stages in production

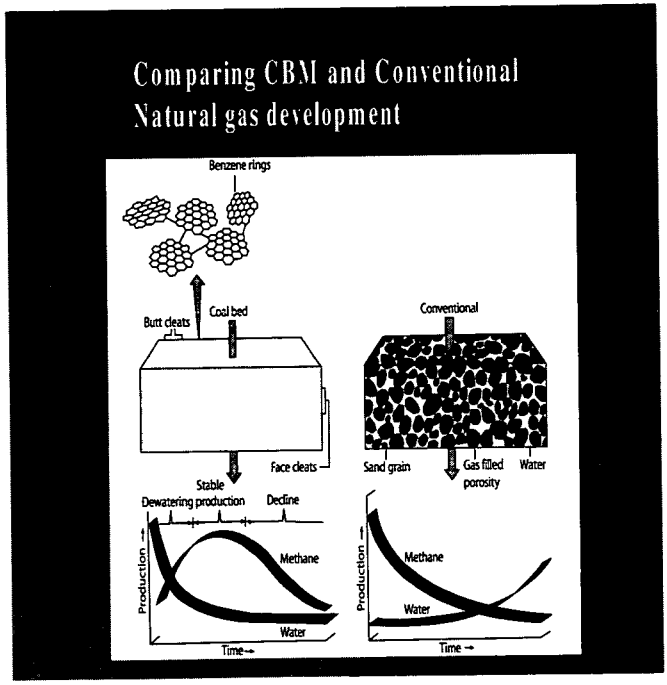
22. For more on how CBM compares with other forms of natural gas, see generally Cullicott et al., *supra* note 3.

23. Vello A. Kuuskraa & Charles M. Boyer, II, *Economic and Parametric Analysis of Coalbed Methane, in* AAPG STUDIES IN GEOLOGY SERIES NO. 38: HYDROCARBONS FROM COAL 373, 373-74 (1993).

24. *Id.*

of both kinds of wells.[26] For CBM wells, large quantities of water are produced during the initial phase, and then water volume declines as the pressure of the reservoir falls (see Figure 3). The actual shape of the production curve is a function of extraction techniques and varies considerably by reservoir. In some basins, peak gas production occurs in three or more years. The length of time required to produce peak gas production increases in low permeability reservoirs and increased well density.[27] Since CBM wells generally produce gas at lower rates than conventional gas wells, the cost of water disposal in CBM development is significant relative to that of conventional development.[28]

Figure 3



25. William T. Brown, *Developing CBM in the Powder River Basin in* COALBED METHANE DEVELOPMENT IN THE INTERMOUNTAIN WEST 272, 275 (Natural Resources Law Center, University of Colorado School of Law CD-ROM, July 2002).

26. Kuuskraa & Boyer, *supra* note 23.

27. Schraufnagel, *supra* note 15, at 342-43.

28. *See id.*

CBM is sometimes compared with another unconventional gas—"tight" gas, which is found at much deeper depths and in low permeability sandstone.[29] In order to release gas from tight Cretaceous sands, a technique known as hydraulic fracturing is used. Hydraulic fracturing involves the injection of a fluid into a rock formation to cause a crack or fissure to form.[30] Fracturing is also used in some CBM plays to increase production.

Recent Legal Developments

Legal disputes have ensued over ownership of coalmine and coalbed methane. In *Amoco Production Company v. Southern Ute Indian Tribe*,[31] the Supreme Court ruled that CBM is not included in the meaning of coal; CBM is part of the gas estate, not the coal estate. The Court indicated that coal companies could vent the gas while mining, but the right to vent the gas does not imply ownership of it. The ruling is not binding on state law and private contracts. Oil and gas rights, including CBM rights, are generally more senior than coal mining rights, and CBM companies may seek injunctions to ensure mining operations do not adversely affect methane extraction. In some cases, coal companies have bought out CBM leases so mining can continue unobstructed. In other cases, the companies complain that CBM owners who buy up gas rights and then sell them at above market prices are holding up the company's operations unfairly.[32]

In 1980, Congress enacted a tax credit to encourage domestic production from unconventional sources, including CBM. Referred to as the Section 29 tax credit (section 29 of the 1980 Crude Oil Windfall Profit Tax Act[33]), the provision has two limits: the gas must be sold to an unrelated party and the credit only applies to wells placed in service before December 31, 1992. The tax credit, worth $3 per barrel of oil or Btu equivalent, expired on December 31, 2000, and the tax credit was modified and extended in both the House and Senate energy bills that the two chambers passed in 2001 and 2002.[34] The bills died at the end of

29. Andrew Kelly, *Rockies Seen as Key to U.S. Natural Gas Growth*, PLANET ARK, *at* http://www.planetark.org/dailynewsstory.cfm/newsid/12997/newsDate/26-Oct-2001/story.htm (Oct. 25, 2001).

30. *Id.*

31. 526 U.S. 865 (1999).

32. John Watts, *Keynote Address*, *in* COALBED METHANE DEVELOPMENT IN THE INTERMOUNTAIN WEST 112, 113 (Natural Resources Law Center, University of Colorado School of Law CD-ROM, July 2002).

33. 26 U.S.C. 4986.

34. H.R. 4, 107th Cong. (2002); S. 517, 107th Cong. (2002).

the 107th Congress and are expected to be reintroduced during the 108th Congress.

II. THE IMPORTANCE OF COALBED METHANE AS A SOURCE OF ENERGY

What Role Do Natural Gas and CBM Play in U.S. Energy Production?

"Oil and natural gas are the dominant fuels in the U.S. economy, providing 62 percent of the nation's energy."[35] Natural gas provides 24 percent of the energy used in the United States and 27 percent of total domestic production.[36] The United States produces 85 percent of the gas it uses and imports the rest from Canada. Natural gas is used to produce 16 percent of the electricity generated in the United States, and the fastest growing use of natural gas is for the production of electricity.[37] Natural gas is also used for space and water heating, cooking, fueling industrial processes, fueling vehicles, and other purposes. It is particularly valuable because natural gas is the cleanest burning fossil fuel.

Natural gas prices have fluctuated considerably in recent years, affecting incentives to explore for new reserves. Prices were stable throughout the late 1980s and 1990s, and low prices in 1998 and 1999 resulted in cutbacks in exploration. In 2000, prices quadrupled, reaching an all time high of $9.98 per million BTUs in December 2000; exploratory activity expanded accordingly.[38] When prices fell in 2001 and 2002, drilling activity rapidly declined.

Natural gas, including CBM, and other domestically produced energy sources play a major role in the Bush administration's energy policy. The administration's National Energy Policy, issued in May 2001, emphasized expanding U.S. sources of fossil fuels. The report includes 105 specific recommendations, including 42 suggestions for policies to promote conservation, efficiency, and renewable energy sources and 35 that deal with expanding supplies of fossil fuels. The report, however, clearly emphasizes and gives priority to expanding the supply of traditional energy sources by opening new lands for exploration, streamlining the permitting process, easing regulatory requirements, and enlarging the nation's energy infrastructure. The report summarizes the energy challenge this way:

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35. NATIONAL ENERGY POLICY DEVELOPMENT GROUP, NATIONAL ENERGY POLICY: RELIABLE, AFFORDABLE, AND ENVIRONMENTALLY SOUND ENERGY FOR AMERICA'S FUTURE 5-3 (May 2001), *available at* http://www.whitehouse.gov/energy/.

36. *Id.* at 1-7.

37. *Id.*

38. *Id.* at 5-18, 5-19.b.

> Even with improved efficiency, the United States will need more energy supply....The shortfall between projected energy supply and demand in 2020 is nearly 50 percent. That shortfall can be made up in only three ways: import more energy; improve energy efficiency even more than expected; and increase domestic energy supply.[39]

The Bush national energy plan argues that, in the near term, an increase in natural gas production will come from "unconventional sources" in the Rocky Mountain and other regions, and the plan includes a number of recommendations that affect natural gas and CBM development.

- The plan calls on federal agencies to promote enhanced recovery of oil and gas from existing wells, encourage oil and gas technology through public-private partnerships, reduce impediments to federal oil and gas leases, and reduce royalties and create other financial incentives to encourage environmentally sound offshore oil and gas development.

- The plan recommends additional oil and gas development in the National Petroleum Reserve in Alaska and the opening of an area (called section 1002) in the Arctic National Wildlife Refuge for exploration.

- The plan calls for streamlining the regulatory process, providing "greater regulatory certainty" for power plant operators, and reducing the time and cost involved in licensing hydroelectric power plants.

- The plan urges the continued development of clean coal technology through a permanent extension of the research and development tax credit and investing $2 billion in research and development over ten years.

- The plan suggests the President issue an executive order to "rationalize permitting for energy production in an environmentally sound manner" and federal agencies "expedite permits and other federal actions necessary for energy-related project approvals."[40]

- The plan suggests the Department of the Interior reassess decisions it has made to withdraw certain lands from

39. *Id.* at 5-3.
40. *Id.* at 3-13.

> energy exploration and development, and to simplify its leasing policy so that more oil and natural gas are produced, including in the Outer Continental Shelf.
>
> • The plan urges Congress to resolve the legal status of eleven million acres of BLM lands and 1.8 million acres managed by the U.S. Fish and Wildlife Service that have been designated by the agencies as wilderness study areas and to determine which lands could be opened up to energy development.[41]

The average household uses about 50,000 cubic feet of natural gas each year.[42] One trillion cubic feet (Tcf) of natural gas is enough to meet residential needs for about 75 days. The balance of the natural gas used each year fuels electricity production and industrial and commercial operations. Demand for natural gas is currently 22.8 Tcf and growing at about one Tcf per year.[43] The U.S. Department of Energy (DOE), which provides the basis for the national energy policy projections, suggests that natural gas use will increase from 22.8 to 34.7 Tcf between the years 2000 and 2020;[44] another estimate suggests consumption will climb to 32–36 Tcf by 2015.[45] Others project an even more rapid increase in consumption. Many executives of natural gas companies believe that by 2007 the market for gas will reach 30 Tcf.[46] The United States will likely increase its dependence on imports of natural gas in order to meet growing demand.[47] North America uses about one-third of the natural gas consumed globally each day but only contains about two percent of total world reserves.[48]

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41. Unless otherwise noted, the preceding bullet points are from *id.* at Appendix One.

42. Cullicott et al., *supra* note 3, at 57.

43. *Id.*

44. National Petroleum Council, *Natural Gas: Meeting the Challenges of the Nation's Growing Natural Gas Demand* 1 (Draft Report, Dec. 15, 1999), *available at* http://www.fe.doe.gov/oil_gas/npc/gasstudy/npc_gas.pdf. *See also* ENERGY INFORMATION ADMINISTRATION (EIA), ANNUAL ENERGY OUTLOOK 2001 84 (Dec. 2000).

45. ENERGY INFORMATION ADMINISTRATION (EIA), ANNUAL ENERGY OUTLOOK 2001, 84 (2000).

46. Mark Hand, *The Golden Age: How Long Will It Last?*, PUB. UTIL. FORT., Mar. 1, 2002, at 12.

47. ENERGY INFORMATION ADMINISTRATION (EIA), *supra* note 45, at 83.

48. Matt Daily, *US Seen Turning Abroad to Feed Natgas Appetite*, WORLD ENV'T NEWS, Feb. 14, 2003, *available at* http://www.planetark.org/avantgo/dailynewsstory.cfm?newsid=19832.

What Does CBM Contribute to National Energy Supplies and Local Economies?

CBM accounts for seven percent of total natural gas production and eight percent of gas reserves in the United States.[49] CBM from the intermountain states has played a significant role in meeting U.S. demand for natural gas, and that role is expected to grow larger. Eighty percent of the total CBM production in the United States has come from the San Juan Basin in New Mexico.[50] There is little agreement over the size of the natural gas resources remaining in the interior West. According to one estimate, Colorado, New Mexico, Utah, and Wyoming contain, 42 Tcf of economically recoverable CBM.[51] That amount represents about one-third of the estimated 145 Tcf of recoverable CBM in the United States.[52] In December 2002, the U.S. Geological Survey estimated that the San Juan Basin of Colorado and New Mexico contained 24 Tcf of CBM reserves and the Powder River Basin of Wyoming 14 Tcf.[53] Reserves typically refer to gas that is technologically recoverable; resources represent reserves plus additional gas that is not recoverable under current economic and technological conditions. In 2001, the Gas Technology Institute estimated 535 Tcf of total (not necessarily economically recoverable) CBM resources in the Rocky Mountain basins.[54] Given the exploding demand for natural gas, there will be pressure to find and develop as much of the region's gas as possible.

The San Juan basin in southern Colorado/northern New Mexico has been the major source of CBM for the nation. Development began in 1988 and rapidly expanded throughout the next decade. Production has now leveled off and companies are trying to maintain output by more intensive development. The Powder River Basin in northwest Wyoming is the area of CBM production that is growing the most rapidly. The first CBM well was drilled in 1986; by 1997, 460 wells were drilled; by 2000,

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49. Matthew R. Silverman, *Coalbed Methane in the Rocky Mountain Region: Yesterday, Today and Tomorrow, in* COALBED METHANE DEVELOPMENT IN THE INTERMOUNTAIN WEST 125, at 125 (Natural Resources Law Center, University of Colorado School of Law CD-ROM, July 2002).

50. *Id.* at 128.

51. *Id.* at 132.

52. Murray, *supra* note 6, at 165.

53. Christopher Doering, *Coalbed Methane Reserves Increase in Rocky Mountains*, Planet Ark, *available at* http://www.planetark.org/avantgo/dailynewsstory.cfm?newsid=19114 (Dec. 18, 2002).

54. Walter B. Ayers, Jr., *Coalbed gas systems, resources, and production, and a review of contrasting cases from the San Juan and Powder River Basins, in* AAPG BULL. NO. 86 at 1853, 1855 (Nov. 2002).

4502 wells had been drilled.[55] Production similarly exploded from 14 Bcf in 1997 to 151 Bcf by 2000.[56] CBM resources are also being developed in the Uinta Basin in eastern Utah, the Raton Basin in south-central Colorado, and the Piceance Basin in northwest Colorado, and major expansions of coalbed development are expected in Montana, the Green River basin in Wyoming, and perhaps other areas in the West.

CBM development has also become a valuable industry in the Rocky Mountain states, contributing revenue to state governments, counties, and businesses. For example, Wyoming's 1999 state budget deficit was nearly $200 million; when oil and gas prices rose in 2000 and CBM and other energy development expanded, its budget experienced a $700 million surplus.[57] CBM development was worth more than $26 million in state revenues in 2001.[58] Wyoming began putting five percent of its mineral revenues into a trust fund as a hedge against an economic downturn, and the fund contained $1.8 billion in February of 2003.[59] LaPlata County, Colorado, received 43 percent of its property tax revenues (12 percent of its total revenue) from CBM industries.[60] New Mexico receives nearly six percent of its total general fund revenues from natural gas taxes.[61] In 2000, the federal government received $211 million in CBM royalties from federal leases in New Mexico's portion of the San Juan basin alone.[62] The Southern Ute Tribe's net worth grew from $39 million in 1989 to $1.2 billion in 2002 in large part due to CBM development.[63]

55. Don Likwartz, *A Review of CBM Development in the Powder River and Other Wyoming Basins*, *in* COALBED METHANE DEVELOPMENT IN THE INTERMOUNTAIN WEST 251, 254 (Natural Resources Law Center, University of Colorado School of Law CD-ROM, July 2002).

56. *Id.* at 255.

57. Hal Clifford, *Wyoming's Powder Keg*, HIGH COUNTRY NEWS, Nov. 5, 2001, *available at* http://www.hcn.org/servlets/hcn.PrintableArticle?article_id=10823.

58. *Id.*

59. T.R. Reid, *No State Income Tax and $1.8 billion Socked Away*, WASH. POST, Feb. 6, 2003, *available at* www.washingtonpost.com/ac2/wp-dyn/A31815-2003Feb5?langujage=printer.

60. Cullicott et al., *supra* note 3, at 68.

61. *Id.* at 69.

62. *Id.* at 68.

63. Bob Zahradnik, *CBM Development on the Southern Ute Reservation*, *in* COALBED METHANE DEVELOPMENT IN THE INTERMOUNTAIN WEST 228, 231 (Natural Resources Law Center, University of Colorado School of Law CD-ROM, July 2002).

III. ENVIRONMENTAL IMPACTS AND CONTROVERSIES SURROUNDING CBM DEVELOPMENT

Impact on Global Warming

Natural gas is an essential bridge to renewable, ecologically sustainable energy use. In particular, CBM development promises significant environmental benefits, particularly in reducing the threat of global climate change. Methane is one of the most significant greenhouse gases and is more than 20 times as potent as the equivalent volume of carbon dioxide in trapping radiated energy and contributing to the threat of disruptive climate change; however, it produces half as much carbon dioxide per unit of energy as coal.[64] One-third of the methane released into the atmosphere is related to energy production and transportation.[65]

Fugitive methane emissions occur during the production of natural gas and emissions are expected to increase as natural gas production expands, even though the average rate of emissions per unit of production is declining. Coal-related methane emissions are expected to decline as technologies for the recovery of vented methane improve. Expanded CBM development could actually result in decreased methane releases if methane that would be otherwise vented through coal mining is captured through coalmine methane recovery, carefully transported to ensure minimal loss, and then used to produce energy.

CBM production could also reduce greenhouse gas concentrations in the atmosphere by serving as a sink for carbon dioxide.[66] The "adsorption of CO_2 molecules by coal enhances the desorption of methane" and thus enhances its production. Carbon dioxide injected into coal seams for secondary recovery of methane drawn from power plant waste streams, for example, is consequently not released into the atmosphere where it otherwise would act as a greenhouse gas.[67] Collecting methane also reduces a serious risk to coal mine safety.

Environmental Impacts of Development

A wide range of environmental problems associated with development clouds the future of CBM. The construction and operation

64. John M. Reilly et al., *Multi-gas Contributors to Global Climate Change* 14 (Feb. 2003), *available at* http://www.pewclimate.org/projects/multi_gas.pdf.

65. EIA, *supra* note 45, at 98.

66. LANG, *supra* note 2.

67. *Id.*

of access roads, drill pads, pipelines, power lines, and transmission stations produce noise, dust, air pollution, and water pollution that adversely affect humans and wildlife. Development places burdens on communities' social services, roads, and other infrastructure. In some ways, CBM is no different from other forms of economic activity that require communities to absorb increased traffic, noise, air pollution, demands on housing and public services, and other consequences of growth. Like other forms of energy development in the West, CBM projects clash with expectations that many residents have for solitude and recreation.

A unique challenge posed by CBM development is the speed with which change is occurring. In the Powder River Basin, for example, drilling of a well from start to finish only takes from three to six days.[68] As a result, parties are forced to deal with issues of produced water, conflicts between landowners and those who lease subsurface mineral rights, impacts of development on communities, demands for governmental and regulatory services, and other issues in a very compact time frame. Impact fees, property taxes, royalties, and other financial resources can help communities cope with growth, but the consequences of growth may come much faster than the eventual flow of funds. Local governments bear the brunt of dealing with the consequences of growth but may lack the resources and authority to address them effectively. Depending on state law, local governments may or may not benefit directly from royalties or severance taxes derived from development.

Despite some progress in bringing energy companies and landowners together to resolve differences and despite some cases where county governments, federal agencies, residents, and CBM developers work in harmony, conflicts and pressures will likely continue as the density of development increases and new lands are opened to drilling. In some areas, parties may be able to strike a balance between energy extraction and grazing and between water used for energy production and for other purposes. In other areas, such as wilderness study and roadless areas, development may be precluded by commitments to preservationist values. Among the most controversial issues surrounding CBM development are (1) the impact on water quality and quantity and its impacts on assessment of CBM development, (2) the impact on land owners, (3) conflicts between different levels of government, and (4) the conflict between CBM development and preservation of roadless areas and wild lands.

68. Likwartz, *supra* note 55, at 252.

How Does CBM Development Affect Adjacent Water Quality and Quantity?

The dewatering process associated with the development of CBM results in a high volume of water discharged at the land surface. Ranchers may use high quality discharged water to irrigate crops or water stock, as is the case in many areas in the Powder River Basin. Water that is not useable for irrigation or watering stock may be re-injected into underground regions.[69] Given the scarcity of water in the West, virtually any production of water that is not put to beneficial use or that might affect water quality or water supply and rights is controversial. As a result, the development of CBM sometimes pits energy developers against ranchers and other water users. The impact of CBM development on underground water supplies and the disposal of produced water are two of the most critical challenges confronting CBM development.

Impacts on underground water supplies

One of the major complaints of local residents in regard to CBM development is the threat of water contamination. In the San Juan basin, for example, some residents have reported that their drinking water has been contaminated by methane or by hydraulic fracturing.[70] Others have complained that drilling reduces the water levels of residents' and ranchers' wells as aquifer rock is fractured and water escapes.[71] British Petroleum (BP) Amoco purchased four homes and leveled them as part of the settlement of a lawsuit after owners charged the company with responsibility for methane in their basements and water wells.[72] Some residents emphasize that, while drilling is not directly responsible for the natural seepage of hydrogen sulfide into rivers, it may amplify the natural seepage. These same residents point to signs along the Animas River, a popular kayaking and river running area, that warn of harmful levels of hydrogen sulfide seeping from the ground into the water.[73]

The impact of CBM drilling on local water supplies has been very contentious in the Raton Basin. Residents of Cokedale, in Las Animas County, protested CBM drilling of 100 wells that produce 24

69. *Id.* at 254-56.

70. Gwen Lachelt, *Impacts of CBM Development on Communities, in* COALBED METHANE DEVELOPMENT IN THE INTERMOUNTAIN WEST 236 (Natural Resources Law Center, University of Colorado School of Law CD-ROM, July 2002).

71. Interview with Catherine Cullicott, ECOS Consulting (Feb. 27, 2002).

72. Judy Pasternak, *Coal-bed Methane Puts Basic Needs of Water, Energy at Odds*, L.A. TIMES, Mar. 27, 2001, *available at* http://www.ogap.org/resources/latimes_cbm.htm.

73. *Id.*

million gallons of waste water a month, because they feared the water will contaminate the shallow wells that residents depend on; this dispute resulted in lawsuits and counter suits.[74] The issue of water contamination is critical. CBM contamination of drinking water is being studied by the U.S. Environmental Protection Agency. If study results conclude that contamination has occurred, it will be difficult for development to continue until more detailed studies are completed.[75]

Discharges into the Tongue and Powder Rivers have been particularly contentious. In this region, the CBM-produced water is generally of sufficiently high quality for drinking and watering stock, but the water is not as good as in the Tongue River, so no discharge permits can be issued.[76] In other areas, the water can be discharged into the Belle Fouche and Cheyenne Rivers and Caballo Creek.[77] While the water is suitable for cattle, there are insufficient cattle to use the produced water. Surface disposal is a challenge as it may result in erosion when discharged into drainages or may inundate vegetation. Even though water quality is good, salts may concentrate during evaporation and harm soils.[78]

Critics of CBM development argue that the amount of water withdrawn in Wyoming as a result of CBM production will greatly lower aquifer levels. They warn that by 2010, surface discharge of produced water could reach one billion gallons a day. Data from coalmine permits and plans suggest that it will take 800–1500 years following reclamation to recharge the coal aquifer and, despite the differences between coal mining and CBM extraction, CBM development poses the same kind of threat to the region's long-term water supply.[79] The draft environmental impact statement for the next round of development in the Powder River Basin suggests that the drawdown of the Fort Union Coal Aquifer under all alternatives will be from 300–1200 feet and 10–250 feet for the Deep Wasatch Sands. For the Shallow Wasatch Sands, drawdown projections range from 1–50 feet in areas of thin cover and -1 to -50 feet in areas of impoundments and creeks receiving produced water. Peak drawdown will likely occur between 2006 and 2009, and the aquifers will, according

74. Stuart Steers, *Look Out Below!*, DENVER WESTWORD, Nov. 12, 1998, *available at* http://www.westword.com/issues/1998-11-12/feature.html/1/index.html.

75. Interview with Adam Keller, La Plata County Planning Office (Feb. 28, 2002).

76. Mike Day, *CBM Water Management: Challenges, Solutions, and Opportunities, in* COALBED METHANE DEVELOPMENT IN THE INTERMOUNTAIN WEST 257, 258 (Natural Rsources Law Center, University of Colorado School of Law CD-ROM, July 2002).

77. Williams, *supra* note 16, at 43.

78. Todd Wilkinson, *Wyoming Weighs the Price of Prosperity*, CHRISTIAN SCI. MONITOR, Nov. 13, 2000, at 2.

79. Thomas F. Darin & Amy W. Beattie, *Debunking the Natural Gas "Clean Energy" Myth: Coalbed Methane in Wyoming's Powder River Basin*, 31 ENVTL. L. REP. 10,566, 10,575-76 (2001).

to the draft environmental impact statement (DEIS), recover to within 95 percent "over the next hundred years or so."[80]

Industry representatives disagree with the idea that CBM development significantly impacts water quality and quantity, although they acknowledge that there have been occasional problems. According to one BP official, "different companies have different standards," but there has been improvement over the years in the impacts on water quality.[81] CBM wells are two to three thousand feet deep, while drinking water wells are only 200-400 feet deep. CBM well bores are encased in steel and cement 50 feet below the lowest water table to ensure no contamination of aquifers occurs. When BP began drilling one well in each 160-acre plot, company officials tested water quality near the new wells before and after drilling commenced. Since biogenically-produced methane is found at shallower depths and thermogenic gas at deeper levels, companies can conduct isotopic analyses that fingerprint the gas and allow analysts to trace its origins and learn whether the methane is a result of natural migration or a result of drilling. The Colorado Oil and Gas Commission requires additional testing if methane is found in domestic drinking water wells, and significant levels of methane were found in 12 percent of those wells. [82] Phillips Petroleum suggests that water produced near the Cheyenne River in Wyoming quickly infiltrates into the ground and recharges shallow aquifers.[83]

Given the aridity of the West, dealing with the impact of CBM development on water is a tremendous challenge. While there is considerable uncertainty concerning the impact of CBM development on water quality, some residents are convinced that development at least exacerbates the natural seepage of methane into drinking water sources if not directly contaminating aquifers, and because of these concerns they resist any action that threatens the water on which their lives depend. The impact of CBM development on water is ultimately a question of fairness. The benefits of development largely accrue to developers, while the risks of loss of water fall on the surface owners whose water sources are threatened. This is, of course, not always the case. Some surface owners also own mineral rights and benefit from production. Some

80. U.S. DEP'T OF THE INTERIOR, BUREAU OF LAND MANAGEMENT, WYOMING STATE OFFICE, DRAFT ENVIRONMENTAL IMPACT STATEMENT AND DRAFT PLANNING AMENDMENT FOR THE POWDER RIVER BASIN OIL AND GAS PROJECT 4-12 (Jan. 2002).

81. Dave Brown, *CBM Development and Water Issues, in* COALBED METHANE DEVELOPMENT IN THE INTERMOUNTAIN WEST 222 (Natural Resources Law Center, University of Colorado School of Law CD-ROM, July 2002).

82. *Id.* at 227.

83. Steve de Albuquerque, *An Overview of CBM Exploration and Production, in* COALBED METHANE DEVELOPMENT IN THE INTERMOUNTAIN WEST 117, 125 (Natural Resources Law Center, University of Colorado School of Law CD-ROM, July 2002).

surface owners are able to use produced water for cattle and other purposes. But the mismatch between benefits and burdens contributes to the controversy surrounding CBM projects.

Disposal of produced water

The amount of water produced from each CBM well varies tremendously within CBM basins as well as across the different basins. Calculations based on U.S. Geological Survey data suggest the following average water production per day per well:[84]

Average Water Production

	Gallons/Well/Day
Powder River	16,800
Raton	11,172
San Juan	1,050
Uinta	9,030

In Wyoming, there were 110 wells producing 6.5 mcf of gas/day and 949,637 gallons of water in 1994; by 2001, there were 5446 wells producing 642 mcf of gas/day and 61,141,720 gallons of water/day.[85] In the Colorado portion of the San Juan Basin, approximately 1200 wells have produced nearly 36 billion gallons of water to date.[86] In the Wyoming portion of the Powder River Basin, it is estimated that in the next 15 years, approximately 51,000 wells will have produced over 1.4 trillion gallons of water.[87]

The quality of produced water varies considerably across and even within basins, depending on the depth of the methane, geology, and environment of the deposition.[88] In general, the deeper the coalbed, the less the volume of water in the fractures, but the more saline it

84. Based on data provided in Michael J. Day & Arthur P. O'Hayre, *Management of Produced Water in Coalbed Methane Operations, in* ROCKY MTN. MIN. L. FOUND., CONF. ON COALBED METHANE at 12A-9 (Nov. 14-15, 2002).

85. Cook, *supra* note 14, at 250.

86. Colo. Oil and Gas Conservation Comm'n, *Statistic, at* http://oil-gas.state.co.us/statistic.html (on file with author).

87. U.S. DEP'T OF THE INTERIOR, BUREAU OF LAND MANAGEMENT, 1 DRAFT ENVIRONMENTAL IMPACT STATEMENT AND DRAFT PLANNING AMENDMENT FOR THE POWDER RIVER BASIN OIL AND GAS PROJECT 2-24 (2002).

88. The major elements of CBM water include total dissolved solids (salts); pH and temperature; major cations—Na, K, Mg, Ca; major anions—Cl, SO^4, HCO^3; trace elements—Fe, Mn, Ba, Cr, As, Se, Hg; and organics—hydrocarbons, additives. C.A. Rice & T.T. Bartos, *Nature and Characteristics of Water Co-Produced with Coalbed Methane with Emphasis on the Powder River Basin* (presentation at the U.S. Geological Survey Coalbed Methane Field Conference, May 9–10, 2001).

becomes.[89] In the San Juan basin, for example, water quality can vary from 20,000 ppm TDS in the southern portion of the basin to 500 ppm (potable) near the outcrops.[90] In contrast, water produced in Wyoming is largely usable for a variety of purposes. The quality of produced water varies across the Powder River. In general, water quality is highest in the southeast and diminishes to the West and North, where total dissolved solids increase.[91]

A U.S. Geological Survey (USGS) study concluded that total dissolved solids (TDS) range from 370 to 1940 mg/L, with a mean of 840 mg/l; the national drinking water standard for potable water is 500 mg/l. TDS levels in sample wells increase to the north and west.[92]

Options for managing produced water include the following (costs generally increase as one moves down the list):[93]

- Traditional surface discharge: water is allowed to travel downstream and be absorbed or evaporate as it moves;
- Irrigation: water is released to agricultural areas;
- Treatment: water is treated to improve quality;
- Containment within reservoirs: water is piped to a surface impoundment where it is absorbed or evaporates or may be used to water cattle;
- Atomization: water evaporates more quickly than normal through the use of misters placed in surface impoundments.
- Shallow injection or aquifer recharge: water is pumped into freshwater aquifers;
- Deep injection: salty water is typically re-injected.[94]

Because of differences in water quality, CBM-produced water is dealt with differently across the major basins:[95]

89. Nuccio, *supra* note 7.

90. U.S. DEP'T OF THE INTERIOR, BUREAU OF LAND MANAGEMENT, *supra* note 80, at 3-65.

91. Mike Day, *CBM Water Management: Challenges, Solutions, and Opportunities, in* COALBED METHANE DEVELOPMENT IN THE INTERMOUNTAIN WEST 257, 262 (Natural Resources Law Center, University of Colorado School of Law CD-ROM, July 2002).

92. C.A. Rice, M.S. Ellis, & J.H. Bullock, Jr., *Water Co-Produced with Coalbed Methane in the Powder River Basin, Wyoming: Preliminary Compositional Data*, U.S. Geological Survey Open File Report 00-372, at 5 (2000).

93. Rice & Bartos, *supra* note 88.

94. Williams, *supra* note 16.

95. de Albuquerque, *supra* note 83, at 125.

San Juan: 99.9 percent of produced water re-injected

Uinta: 97 percent re-injected, 3 percent evaporation

Powder River: 99.9 percent surface discharge

Raton:

Colorado: 70 percent surface, 28 percent re-injected
New Mexico: 100 percent injected

Water options within these broad categories also vary considerably, and more detailed information on what companies are currently doing with produced water is needed. Even if water quality is high, salts may concentrate during evaporation or may overwhelm the semi-arid environment, inundating vegetation and causing erosion.

In areas where water quality is good, such as some parts of the Raton Basin, CBM companies and land owners have negotiated agreements to provide produced water for stock. Company officials report that there is more demand for water than they can supply. Such examples are evidence that CBM development can occur in partnership with landowners in ways that profit both.[96] However, conflicts appear to be pervasive. Some Wyoming residents believe domestic and stock water wells are drying up or becoming contaminated and discharge of water is causing erosion and soil damage. Others have reported that domestic well caps have been blown off by gas pressure, methane has been found in their water wells, and they have seen companies continue to discharge water after they have received notices of violations.[97]

Stock reservoirs have been created, and while some ranchers have welcomed the added water source, others do not since the land is taken out of production.[98] Ranchers are faced with soils damaged by the salts and metals remaining after evaporation, less grass is available for cattle, clay soils become hard pan, and dead cottonwood trees, dead grass, and weeds result from the discharge of produced water.[99] Water storage pits are another source of contention. Dehydrator/separator pits are required to be lined, but residents have complained that companies do not always comply with these requirements.[100]

96. Interview with Gerald Jacobs, Evergreen Gas, Denver, Co. (Nov. 15, 2002).

97. Nancy Sorenson & Jill Morrison, *CBM Development, Ranching, and Agriculture, in* COALBED METHANE DEVELOPMENT IN THE INTERMOUNTAIN WEST 285, 287 (Natural Resources Law Center, University of Colorado School of Law CD-ROM, July 2002); de Albuquerque, *supra* note 83.

98. Hal Clifford, *Drilling Method Pumps Up Floods of Conflict*, CHRISTIAN SCI. MONITOR, Jan. 3, 2002, *available at* http://csmonitor.com/2002/0103/p3s1-usgn.html.

99. Sorenson & Morrison, *supra* note 97, at 288.

100. Cullicott Interview, *supra* note 71.

How Does CBM Development Affect Landowners and Communities?

While much of the conflict between companies and landowners is rooted in water, other impacts of development have also generated problems. The construction of roads, drill pads, water disposal sites, and related facilities and the operation of these facilities may conflict with livestock operations and farming. Noise from pumps, compressors, and traffic may disturb residents and wildlife. Air pollution problems include health effects of fine particles and reduced visibility. CBM development has disrupted areas that were previously isolated from development or valued for undisturbed vistas and solitude.

Split estates and landowner-gas company conflicts

Much CBM development is occurring on split estates—areas where those who own the surface rights of land are not the same as those who own the subsurface mineral rights. Some surface owners have been able to negotiate payments with energy companies for damage to their lands or even a share of the proceeds from development. But conflicts have occurred when residents have purchased surface rights to settle in quiet, undeveloped rural settings or in residential areas and have not realized that those who own the subsurface rights must be given access to the land to develop those rights.[101] Landowners have been forced to allow drilling on lands they assumed would be used for grazing or hunting. This is not a problem unique to CBM, but the rapid pace and magnitude of development appears to have intensified conflicts.[102]

Split estates are rooted in laws that were enacted to promote the development of the West by opening lands to settlers but reserving mineral rights to the federal government. Most of the land disposition statutes enacted by Congress in the late nineteenth and early twentieth centuries reserved the mineral estate to the United States. The Stock-Raising Homestead Act of 1916, for example, reserved to the United States "all the coal and other minerals" under the federal lands sold to settlers.[103] The Taylor Grazing Act of 1934 similarly reserved "all minerals to the United States" for federal lands that were exchanged for

101. *See* Blaine Harden & Douglas Jehl, *Ranchers Bristle as Gas Wells Loom on the Range*, N.Y. TIMES, Dec. 29, 2002, *available at* www.nytimes.com/2002/12/29/national/29METH.html.

102. *Id.*

103. Dec. 29, 1916, ch. 9, 39 Stat. 862, repealed by Pub. L. No. 94-579, title VII, § 702, 90 Stat. 2787 (1976). *See* JAN G. LAITOS, NATURAL RESOURCES LAW 333 (2002).

private lands in order to consolidate Bureau of Land Management (BLM) grazing districts.[104]

Landowners argue that CBM development challenges their ability to manage their land in a sustainable fashion. They report that they were not given the option to not sign development agreements, that they were not notified when subsurface minerals were leased, that surface use agreements were not required, that eminent domain was used to install pipelines, and that communications towers have been installed without their permission. Landowners also report that there is a lack of planning for infrastructure needs, a failure to deal with threatened and endangered species, no planning to protect air quality, little information sharing with land owners regarding CBM development, and inadequate bonding, which has resulted in orphan wells.[105] For these residents, such oversights do not represent merely damage to their lands and the wasting of scarce and precious water; they also foster a sense of powerlessness and the violation of property rights. These residents feel powerless to protect their lands and ensure their sustainability.[106]

Local residents have complained about noise, particulate emissions from vehicles and traffic, wind-generated dust, emissions from compressors, reduced visibility, fragmentation of habitat by roads, noxious weeds, increased human damage to fragile ecosystems, loss of privacy, and diminished quality of life. Visibility on Native American reservations and protected federal lands is threatened, and CBM development appears to have contributed to the problem.[107] Fine particles affect visibility and also pose the greatest threat to human health. Fine particles have increased by 50 percent and average concentrations in the area average 12 micrograms/cubic meter.[108] Larger particles, measured as PM10, are less deadly but still pose a health threat for those with asthma and other respiratory diseases. Noise levels provoked one resident to fire 17 shots at a compressor. Others complained of companies leaving garbage behind and the loss of scenery, solitude, and wildlife.[109]

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104. June 28, 1934, ch. 865, 48 Stat. 1269. The Taylor Act was repealed in 1976. Pub. L. No. 94-579, title VII, § 705(a), 90 Stat. 2787 (1976). *See also* LAITOS, *supra* note 103, at 333.

105. Sorenson & Morrison, *supra* note 97, at 286; de Albuquerque, *supra* note 83, at 120.

106. Sorenson & Morrison, *supra* note 97, at 286.

107. Harden & Jehl, *supra* note 101.

108. The national ambient air quality standard for fine particulates is an annual average of no more than 15 micrograms/cubic meter; California has proposed a standard of 12 micrograms/cubic meter. Bob Yuhnke, *Air Quality and CBM Development, in* COALBED METHANE DEVELOPMENT IN THE INTERMOUNTAIN WEST 280, 282 (Natural Resources Law Center, University of Colorado School of Law CD-ROM, July 2002).

109. Sorenson & Morrison, *supra* note 97, at 288, 289.

Other land use conflicts pit preservationists against developers. Some roads are closed for the winter to protect wildlife habitat, but if CBM development occurs in the area, companies can get a waiver to use the road to access their sites.[110] Old growth Ponderosa pines are included in some roadless areas that companies would like to open for drilling, but these are treasured areas for preservationists.[111] Ranches, retirement homes, and roadless areas do not easily coexist with extensive energy development infrastructure. Some residents feel that the long-term goals of sustainability and community are threatened by short-term energy development. The anger and frustration felt by some local residents is palpable. They accuse companies of failing to comply with the law and arrogantly dismissing residents' complaints; these same frustrated residents lament the discounting by governments and by energy companies of the personal, anecdotal problems that local landowners report because they are not part of formal scientific studies.[112] In February 2003, a Sheridan, Wyoming, jury ordered Paxton Resources to pay one rancher about $811,000 for causing damages to his land in breach of a surface use and damage agreement.[113]

CBM development and impacts on communities

The socio-economic impacts of coalbed methane development are similar to those resulting from the development of conventional gas. Development produces new jobs, new income, and new revenues for governments from taxes and royalties. It also increases demand for new public services and housing and increases traffic, air pollution (from construction as well as traffic and other sources once construction is completed), noise, and congestion. As explained above, one key difference between CBM and conventional gas that has exacerbated tension is that drilling and construction typically proceeds much more quickly for CBM than for conventional gas. CBM wells may take a few days to drill and a few more to complete, whereas conventional wells may take 45 to 60 days to drill and complete. CBM development may rapidly transform a rural community into an energy production area with pipelines, compressors, and other facilities, while the transformation resulting from conventional gas development will likely proceed

110. Cullicott Interview, *supra* note 71.

111. *Id.*

112. *See generally* Mark Pearson, *Concluding Comments and Observations*, COALBED METHANE DEVELOPMENT IN THE INTERMOUNTAIN WEST 300 (Natural Resources Law Center, University of Colorado School of Law CD-ROM, July 2002).

113. Associated Press, *Ranch Wins in Coalbed Methane Damage Trial*, BILLINGS GAZETTE, Feb. 9, 2003, *available at* www.billingsgazette.com/index.php?display=rednews/2003/02/09/build/wyoming/cbmwin.inc.

more slowly. As a result, CBM projects may place more strain on communities than conventional projects because of the speed of development.

Differences in conditions and expectations across and even within basins are critically important in determining the level of acceptance of CBM development by local residents. The San Juan, New Mexico, basin, for example, has been a major energy producer, and local communities have come to expect the benefits and costs of energy development. In these communities, where conventional gas development or coal mining has already occurred, new CBM projects often produce relatively little incremental impact. In contrast, the Colorado part of the San Juan basin has not been intensively developed, and many people moved into the area with expectations of solitude and recreation. The Durango area, for example, has become a recreational, residential, retirement community and expansion of CBM development in La Plata County clashes with strongly held expectations for the protection of roadless areas, vistas, and residential areas.[114]

Proposals to intensify drilling density have generated particular opposition in the affected communities.[115] One study of the impact of CBM development on land values in Colorado's LaPlata County found a 22 percent reduction in the market value of property with CBM wells. Properties adjacent to a gas well have seen a reduction in sales price of less than one percent. The study also predicted an increase in public safety risks from fires and accidents.[116] Tax policy differences between the two states may be another factor in accounting for differences in the acceptability of CBM development. In New Mexico, oil and gas taxes directly fund educational programs, and that connection helps strengthen support for drilling. In Colorado, oil and gas revenues are not so closely identified with funding for such programs.[117]

How Well Have Environmental Impacts of CBM Development Been Assessed?

CBM development on federal lands is governed by leases issued under both BLM Resource Management Plans and Forest Service Land and Resource Management Plans (LRMPs). BLM Land Use Plans or Resource Management Plans (RMPs) are developed in accordance with

114. *Id.*
115. *Id.*
116. Jim Greenhill, *Gas Wells Drop Property Values 22%*, DURANGO HERALD, Nov. 3, 2002, *available at* www.durangoherald.com/asp-bin/article_generation.asp?article_type=news&article_path=/news/news/021103_1.htm.
117. Interview with Adam Keller, Planning Office, La Plata County (Feb. 28, 2002).

section 202 of the Federal Land Policy and Management Act (FLPMA). LRMPs are issued pursuant to the National Forest Management Act (NFMA). Because CBM development has been so rapid and recent, most plans did not anticipate or discuss the impacts of this level of CBM development, if CBM development was discussed at all. The Federal Onshore Oil and Gas Leasing Reform Act (FOOGLRA) of 1987 requires competitive bids for leases on federal lands.[118] Standard lease terms include application of federal environmental laws and additional measures to minimize adverse impacts and can include special or supplemental stipulations. The National Environmental Policy Act (NEPA) applies to leasing decisions, although there is some debate as to whether environmental assessments or full environmental impact statements are required and federal courts have issued inconsistent opinions on the issue. BLM may provide NEPA analysis for leasing decisions in RMPs, but most RMPs did not anticipate the level of CBM development.[119]

Leasing disputes may play a major role in the Powder River Basin and perhaps other areas as well. In April 2002, the Interior Board of Land Appeals (IBLA) ruled, in response to a challenge by the Wyoming Outdoor and Powder River Basin Resource Councils of three CBM leases in the Powder River Basin issued by the BLM, that the agency had failed to perform adequate environmental reviews before issuing the leases.[120] The board found that two BLM studies on which the agency relied in making leasing decisions, a 1985 BLM resource management plan that did not consider CBM development impacts and a draft environmental impact statement on CBM development, were "insufficient to provide the requisite pre-leasing NEPA analysis for the sale parcels in question." While the decisions only applied to three leases, they appear to be similar to many more and the decision could bring to a halt thousands of CBM leases until the BLM can revise its environmental assessments. In addition to stopping existing leases, the decision puts into question whether the analysis the BLM is doing in anticipation of approving thousands of new leases would meet the board's criteria. The IBLA opinion concluded that

> not only does the record amply demonstrate that the magnitude of water production from CBM extraction in the

118. Pub. L. No. 100-203, 101 Stat. 1330-256 (1987).

119. The Forest Service engages in a two tier leasing analysis under FOOGLRA: analysis of all lands under its jurisdiction available for leasing and leasing decisions for specified lands. Standard Lease Terms (SLTs) give the lessee the right to use the leased land to explore, drill, extract, remove, and dispose of oil and gas deposits under the land. Additional measures may be added to mitigate adverse impacts to the surface. *Id.*

120. Wyoming Outdoor Council, et al., 156 IBLA 347 (Apr. 26, 2002).

> Powder River Basin creates unique problems and the CBM development and transportation present critical air quality issues not adequately addressed in the RMP/EIS, but BLM has also acknowledged the inadequacy of the RMP/EIS as far as the analysis of CBM issues is concerned.[121]

As a result, the BLM could not rely on that document to satisfy its obligations under NEPA.[122]

In January 2003, the IBLA issued a second opinion that rejected BLM's approval of BLM leases because of inadequate environmental reviews, particularly the failure to assess the impact of CBM development on water quality, soils, and vegetation.[123] These decisions may have major impacts on CBM development, depending on the results of further litigation, administrative appeals, and environmental assessments. The environmental impact statements the BLM has prepared for the next round of CBM leases (see below) assume the leases issued thus far are valid; however, if the challenges are ultimately upheld, the BLM may be forced to make changes in the new EISs.[124]

These new EISs, issued in final form in January 2003, have also been problematic. In May 2002, EPA officials in Region 8 gave the draft EISs the lowest possible ranking,[125] faulting the BLM for not examining options for preventing harm from the water, for differences between the Montana and Wyoming studies' analyses of the same water issues, for failing to resolve issues dividing the two states as well as the Northern Cheyenne and Crow tribes, and for inadequate assessment of the effect of development on air quality.[126] The EPA also found the Montana EIS "environmentally objectionable due to the lack of specifically identified, economically and technically feasible water-management practices that are adequate to assure attainment of water quality standards under the Clean Water Act" and was even more critical of the Wyoming EIS, suggesting that while the Montana document could be remedied, the

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121. *Id.* at 358

122. According to one report, reversal by the secretary is unlikely. *See* Ellen Nakashima, *Ruling Could Delay Wyo. Gas Exploration*, WASH. POST, May 1, 2002, at A23.

123. Mike Stark, *New Powder River EIS Ordered*, BILLINGS GAZETTE, Jan. 16, 2003, *available at* http://www.billingsgazette.com/index.php?id=1&display=rednews/2003/01/16/build/wyoming/eis-powderiver.inc.

124. Dustin Bleizeffer, *Lawsuits Readied for Hearings*, CASPER STAR-TRIB., Jan. 16, 2003, *available at* www.casperstartribune.net/articles/2003/01/02/news/wyoming/62b28b31e300a38d3e64.

125. Clair Johnson, *EPA Reaction to Methane Analysis Studied*, BILLINGS GAZETTE, May 5, 2002, *available at* http://www.billingsgazette.com/index.php?display=rednews/2002/05/02/build/local/82-methane.inc.

126. Dustin Bleizeffer, *Agencies Split on Methane Study*, BILLINGS GAZETTE, May 1, 2002, http://www.billingsgazette.com/index.php?id=1&display=rednews/2002/05/01/build/wyoming/methane.inc (last visited May 1, 2002).

Wyoming study may need to be scrapped, [127] The EPA also suggested that environmental safeguards could be devised so that the BLM could eventually approve new development.[128]

CBM development technologies that can reduce environmental impacts

The selection of production technologies can result in reduced environmental impacts. BP officials, for example, have argued that reducing visual and noise impacts of drilling and recovery has not been a priority for companies, since their operations are typically not located in inhabited areas.[129] They have begun to develop equipment and practices that reduce impacts. Technologies such as horizontal drilling allow development without disturbing sensitive areas. Other techniques allow for more recovery from one well pad, also decreasing environmental impacts. Companies can employ a pneumatic pump that operates without an engine, produces no noise, and is only about 10 to 15 feet tall (conventional pumps may be 30 to 40 feet tall). However, pneumatic pumps may not work well when large volumes of water are extracted in the process. An alternative is the progressive cavity pump, smaller than traditional pumps (only about seven feet tall) but requiring an engine. Other technologies include engines that can be equipped with a muffler much as in a motor vehicle. Technological improvements can reduce the size of well pads and the footprint of equipment.[130]

New technologies mitigate some of the negative effects of the CBM extraction process. Sound barriers, formed with insulation above and on the sides of engines, minimize noise pollution. Noise, traffic, and dust from operators driving to monitor production can be reduced through automated monitoring systems that can be solar powered. J.M. Huber officials operating in Wyoming, for example, have camouflaged wells from nearby residents by building a ridge of dirt and planting trees on the ridge. Companies have also replaced controllers on wells in order to reduce leaking methane and thereby reduce greenhouse gas emissions.[131] At least one company is developing a diagnostic device for assessing the concentration of CBM in a coal seam using a slender tube

127. Scott McMillion, *EIS on Coalbed Methane Drilling Blasted*, BOZEMAN CHRONICLE, May 2, 2002, *available at* http://newspapers.mywebpal.com/partners/311/public/newss295454.html.

128. Ellen Nakashima, *Wyo. Drilling Project Gets Failing Grade from EPA*, WASH. POST, May 17, 2002, at A27, *available at* http://www.washingtonpost.com/ac2/wp-dyn/A30380-2002May16?language=printer.

129. Shirena Trujillo, *New Rules for Wells Aimed to Address Landowners; Concerns*, DURANGO HERALD, Aug. 27, 2002, *available at* http://199.45.202.146/OILGAS/1news2988.htm.

130. *Id.*

131. *Id.*

with sensors that produce immediate data on coal conditions. If reservoir assessments can be improved, the likelihood that a company will pump out a large volume of groundwater and then discover that there is insufficient recoverable methane to make the process worthwhile will be decreased.[132]

How effectively has CBM development been regulated?

County regulation of CBM development, aimed at minimizing environmental impacts, clashes with state regulation and has generated political conflicts and litigation. In Colorado, some 11 counties and 15 municipalities have enacted rules governing CBM development, including moratoria by Delta and Gunnison counties on new drilling until problems and conflicts are ameliorated. County regulations may place limits on operations; require special use, building, and road permits; and require companies to paint production tanks and keep sites weed-free. Colorado's La Plata and Las Animas counties have enacted regulations that require consideration of noise levels, impacts on air and water quality, vibration and odor levels, fire protection, access requirements, visual impacts, and impacts to wildlife and public safety. Conflicts have occurred between the county and developers and between the county and state officials. Most of these county initiatives have been challenged in court, and lawsuits between state officials, county commissioners, environmental and community groups, and companies have been filed frequently.

La Plata County was the first to regulate CBM development and its regulations were challenged by gas companies as pre-empted by state or federal laws. The county first adopted regulations affecting CBM development in 1991. Industry challenged the regulations in court and the county's authority was upheld. It issued new regulations in 1995 providing that surface owners be able to determine, within a window specified by the Oil and Gas Conservation Commission (OGCC), the specific areas on their land where drilling could take place. The county was again sued, and this time the court struck down the regulations.[133] County officials have emphasized that their goal is to address the impacts of development on communities and not to block CBM production.[134] Of particular importance to county officials is the objective of equating the surface and mineral estates so landowners can help

132. Judith Kohler, *Energy Industry Ignoring Efficient, Cleaner Drilling Methods*, SALT LAKE TRIB., Oct. 14, 2001, at D4.

133. Josh Joswick, *CBM Development from the County Perspective, in* COALBED METHANE DEVELOPMENT IN THE INTERMOUNTAIN WEST 233, 234-35 (Natural Resources Law Center, University of Colorado School of Law CD-ROM, July 2002).

134. *See generally id.*

shape the location and nature of extractive activities that affect their lands. These officials have proposed that companies be required to negotiate surface use agreements before drilling begins. Industry representatives argue that they already provide those agreements before drilling, while others claim that such requirements are too onerous and will drive industry out of the state.[135]

State-county conflicts over CBM development are also emerging in Montana. In August 2002, Gallatin County Commissioners, under authority of a county zoning ordinance, created an emergency zoning district for the Bozeman Pass area and imposed a one-year moratorium on CBM wells because of the likely impacts on environmental values.

Given the lack of water in many areas of the Rocky Mountain West, it is important to explore whether the existing water management uses are optimal. Companies and landowners may find fruitful opportunities to work together to capture produced water and, if quality permits, sell it to users. Existing water law can help ensure produced water is put to beneficial use, but the current legal framework does not create incentives for companies to do so.

State "conservation statutes" govern CBM development. These statutes created oil and gas commissions and boards and authorized them to (1) protect the opportunity of all owners to share in oil and gas production and (2) prevent waste of the resource. Their responsibilities have expanded to include the regulating of drilling, casing, plugging, and abandonment of wells. These laws do not provide legal requirements for protecting water supplies and, because of their emphasis on facilitating production of the energy resource, may even serve as a barrier to protecting the water if it conflicts with extracting the resource.

State statutes governing CBM development and produced water differ in terms of the standards they provide to oil and gas commissions in governing extraction and related activities. In Colorado, for example, the Commission is to encourage production and prevent and mitigate adverse environmental impacts. [136] CBM produced water is considered exploration and production waste and producers are not required to show a beneficial use of the water or to obtain a withdrawal permit. In Wyoming, the Commission is to regulate drilling so that it does not contaminate underground water or allow owners to pollute streams or unreasonably damage surface lands and to prevent waste and damage to crops and wildlife.[137] Producing water through CBM development is

135. Josh Joswick, LaPlata County Commissioner, presentation at the Oil and Gas Accountability Project, Energy Summit (Denver, CO, Apr. 6, 2002).

136. 1995 Colo. Sess. Laws 250; COLO. REV. STAT. § 34-60-106(2)(d) (1995).

137. WYO. STAT. ANN. § 30-5-104(d)(ii) (Michie 1979).

itself defined as a beneficial use in Wyoming and applications for withdrawal are granted as a matter of purpose.

Montana and Wyoming may also take different approaches in regulating produced water released into the Powder and Tongue Rivers. Wyoming uses a narrative standard for produced water; Montana is deciding whether to develop a numeric threshold. Montana farmers fear that produced water will be discharged into the Tongue, Powder, and Little Powder rivers and Rosebud Creek and will degrade irrigation water. The farmers in this area have worked with the Department of Environmental Quality to develop numeric standards. CBM companies fear high pollution levels will preclude them from discharging CBM water into the rivers and are pressing the state to adopt more flexible narrative standards.[138]

A key to future CBM development is resolution of the legal question of whether water produced during the CBM extraction process is defined as tributary or non-tributary water. That is whether the produced water is withdrawn from underground sources that contribute to water resources owned by others. If it is tributary water, the CBM development company and whoever uses it may be liable to the owner of the water and could be required to replace it. It would likely be expensive to prove that, in fact, CBM produced water is tributary.

The gas companies appear to be hoping no one raises the issue. As indicated above, the Colorado Oil and Gas Conservation Commission has defined the water as waste but has provided by regulation for incidental beneficial use of the water. If the water is nontributary, the surface owner must give permission for its withdrawal, which seems to be implicitly, if not explicitly, provided when drilling begins.

Companies appear to be operating under the presumption that CBM produced water is nontributary, but if a party could prove otherwise, companies would need to compensate water owners or owners could seek injunctions on CBM development to protect their water supply. Water law and the water well permitting process simply did not anticipate CBM development and the produced water problem. As a result, some of the produced water that could be put to beneficial use is wasted.

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138. Jennifer McKee, *Wyoming Balks at Methane Plan*, BILLINGS GAZETTE, Aug. 21, 2002, *available at* http://www.billingsgazette.com/index.php?display=rednews/2002/08/21/build/local/56-methane.inc; Editorial, *Coal-Bed Methane Regulations Needed Soon*, GREAT FALLS TRIB., Dec. 11, 2002, *available at* www.greatfallstribune.com/news/stories/20021211/opinion/550596.html.

IV. THE FUTURE OF CBM DEVELOPMENT

There are widely differing assessments of the impact of CBM development on western landscapes. Jim Baca, former director of the BLM and former mayor of Albuquerque, said, in a tour of western states sponsored by The Wilderness Society, that CBM development in the San Juan Basin "has absolutely destroyed whole landscapes there and quality of life for people."[139] Baca warned that the BLM lacks the resources or staff to deal with the greatly expanded workload due to CBM development, and, as a result, the agency is not inspecting wells in the San Juan area, water is not being properly contained, and wells are not being properly maintained. Baca suggested the agency will need a massive infusion of funds in order to adequately manage CBM.[140]

In contrast, Deputy Secretary of the Interior Steve Griles said in a March 2002 speech that energy development in Wyoming is a blueprint for the rest of the nation, "restoring the environment and...allowing us to have both a healthy, sound environment and the recovery of energy that fuels this great country and the economy we have."[141] Griles rejected criticism of coal and CBM development in particular as damaging to the environment, saying, "It's just not a fair representation...I looked at coalbed methane development here in and around Gillette. When it is done correct and right, the impact on the environment can be positive."[142] However, the level of protests at local meetings, the amount of litigation, and the angry debate conducted on the editorial pages of local newspapers suggest that the environmental consequences of CBM are serious and, in many places, are being inadequately addressed.

Ranchers, farmers, wilderness advocates, county commissioners, company executives, air and water quality regulators, oil and gas commissioners, governors, federal agency officials, and others differ in their diagnoses of the causes of the controversies that have swirled around CBM development and possible remedies. Like many other public land issues that are characterized by complex problems and a fragmented structure of governance in place to address them, CBM development needs new structures and processes to develop and implement solutions. There is strong support throughout the West for bringing together parties in ways that transcend traditional governmental jurisdictions to increase communication, generate

139. Clair Johnson, *Former BLM Director Lists Off Problems with Coalbed Methane*, BILLINGS GAZETTE, Mar. 9, 2002, *available at* http://www.billingsgazette.com/index.php?display=rednews/2002/03/29/build/local/78-baca.inc.

140. *Id.*

141. Dustin Bleizeffer, *Griles: Wyoming Key To Energy Plan*, GILLETTE STAR TRIB., Mar. 24, 2002, *available at* http:/www.wyonow.com/NEWS/WYONEWS/24WyomingEnergy.html.

142. *Id.*

innovative alternatives for solving problems, and build support for implementing solutions.

The Collaborative Process

Public participation in the CBM development process can provide an example of collaborative efforts that reduce conflicts, resolve problems, and ensure that energy production continues in a more sustainable fashion. Collaboration seeks to avoid the conflict, litigation, and problems that have plagued other planning processes and provide a forum for officials from different levels of government and overlapping jurisdictions to work together. Collaborative or consensus-based decision making suggests that decision makers recognize the importance of place-based decision making and a land ethic and will work to ensure the participation of all affected interests. Collaborative efforts must also integrate overlapping government jurisdictions, develop partnerships for designing and implementing solutions, learn from experience, engage in intelligent trial-and-error, and employ adaptive management techniques and approaches.

Proponents argue that successful collaborative processes involve a number of provisions: (1) involve the interests or stakeholders who are most affected by decisions, (2) empower local environmental protection groups to advocate for broad environmental values in local decisions, (3) ensure that all interests have adequate resources to represent their views and participate effectively, (4) allow agencies to facilitate participation among stakeholders and develop plans responsive to their concerns within the constraints of national laws and policies, (5) reduce conflict among stakeholders, (6) generate opportunities to find innovative and low cost solutions, and (7) promote partnerships between agencies and stakeholders that promote implementation and foster problem solving and learning by experience.[143]

Not everyone favors collaborative processes, since some interests may not be as influential in consensus-based settings as they are in legal or political forums where they have had considerable experience in highlighting differences and arguing persuasively for their positions. Collaborative efforts must take into account the concern by environmentalists, for example, that de-legitimizing conflict may weaken their power to advocate for uncompromising environmental protection

143. For a helpful overview and assessment of the functioning of consensus-based groups, see generally DOUGLAS S. KENNEY, ARGUING ABOUT CONSENSUS: EXAMINING THE CASE AGAINST WESTERN WATERSHED INITIATIVES AND OTHER COLLABORATIVE GROUPS ACTIVE IN NATURAL RESOURCE MANAGEMENT (Nat. Resources Law Center, Univ. of Colo. School of Law, 2000).

demands. Such efforts may increase the costs and time required to make decisions, and win-win solutions will not always be possible as natural resources become increasingly scarce and preservation values fundamentally collide with commodity interests.[144] Part of the evolution of natural resource policy making will be the development of new ways of bringing members of a community together to devise plans that will meet sustainability goals and will generate strong commitments to comply with the difficult choices to be made. While each landscape is different, lessons from one area can be shared with others. Open and inclusive processes that encourage broad participation, initiatives that capitalize on a sense of place and landscape, and agreements that clearly meet or exceed the protections required in natural resource laws are some of the keys to constructive collaboration.[145]

Toward a Solution: Workshops in Existing CBM Basins

Since the problems and conflicts surrounding CBM development differ considerably by basin, people in each basin are in the best position to work together to design and implement solutions. A series of workshops could provide a forum for those interested in CBM development in each basin to produce recommendations and guidelines to governments, companies, and residents concerning many of the most contentious issues surrounding CBM development. Such collaborative efforts seem to be most promising when they are characterized by clear and discrete tasks to be accomplished within a limited time frame, strong leadership and commitment by affected interests, and adequate resources to support the analyses required and ensure the participation of all interests. These workshops could draw upon the expansive materials already available, including environmental impact statements, reports, and studies as well as commission additional research that may be needed. Participants might include representatives from the BLM and other federal agencies, state oil and gas commissions and boards, state air and water quality agencies, county commissions and planning boards, other governmental bodies, as well as citizen and industry representatives. The agenda for these workshops could include the following issues; a separate workshop could be convened for each issue, or a workshop could take on two or three issues.

144. For a discussion of the challenges facing collaborative efforts and how they might be addressed, see JULIA M. WONDOLLECK & STEVEN L. YAFFEE, MAKING COLLABORATION WORK: LESSONS FROM INNOVATION IN NATURAL RESOURCE MANAGEMENT (2000).

145. BARB CESTERO, BEYOND THE HUNDREDTH MEETING: A FIELD GUIDE TO COLLABORATIVE CONSERVATION ON THE WEST'S PUBLIC LANDS (Sonoran Institute, 1999).

Balancing the rights and interests of surface and mineral owners

Stewardship, sustainability, and collaboration all require that those who own and live on the land play a major role in determining how development occurs. If landowners cannot help shape the surface impacts of CBM development then they will simply not be viable partners in ensuring the sustainability of the western landscape. Their participation in determining the location of pumps, compressors, pipelines, and roads need not be a threat to the ability of companies to extract the gas profitably, and there needs to be a balance between the needs of companies and land owners.

Established mineral law generally emphasizes the rights of those who hold leases to extract minerals, and companies could stand firm on this superiority issue. But harmonizing surface and mineral owner rights is an essential element of reducing the conflict surrounding CBM development, putting produced water to beneficial use wherever possible, and balancing resource extraction with other uses of the land. If companies and landowners view each other as partners in developing this valuable resource, they will be able to work out many disagreements. As indicated above, the Supreme Court of Colorado ruled in 1997 that the rights of mineral and surface owners must be exercised in a manner consistent with each other: "Both estates are mutually dominant and mutually servient because each is burdened with the rights of the other."[146] Other states could choose to embrace a similar view. Some suggestions for ways of improving cooperation and reducing conflict between surface owners and companies include:

- Require companies to consult with land owners and encourage surface owner agreements on split estate lands before issuing drilling permits and effectively enforce this requirement and monitor compliance
- Have the state provide an ombudsperson or expedited dispute resolution process to address problems with surface owner agreements;
- Enact state policies that create incentives for companies to work closely with landowners through royalty credits, awards and recognition, and other efforts;
- All parties should assess the need for legislative changes in oil and gas laws to better reflect the balance between landowner and mineral development rights.

146. Gerrity Oil & Gas Corp. v. Magness, 946 P.2d 913, 927 n.8 (Colo. 1997).

Ensuring that prices reflect the true cost of developing CBM resources

The costs of leases, royalty or severance taxes, exploration, extraction, and transportation are reflected in the price at which gas is sold. But other costs of development, including the surface land owner's financial, opportunity, aesthetic, and other costs of the development of CBM resources are often not represented in those prices. Prices that reflect the true costs of production are essential in ensuring markets that efficiently allocate resources. Competitive pressures between CBM and other sources of natural gas, and between natural gas and other energy sources, create powerful incentives to externalize costs. Governments play a critical role in ensuring that prices include more of the real costs of production. CBM workshops might explore several options for better internalizing the costs and benefits of CBM development:

- Companies to compensate split estate landowners for surface access, mitigation of impacts, damages, and loss of property values resulting from gas development with mineral lease revenues and royalties;

- States to require adequate reclamation bonding or create an escrow fund from lease and royalty revenues to ensure the implementation of reclamation agreements.

Improving the issuance and enforcement of permits

Enforcement of permit stipulations, relevant laws, and other legal requirements is important in recognizing the efforts of responsible companies and in creating clear incentives for compliance. Both industry and community representatives emphasize the need for effective enforcement. Effective enforcement helps ensure that all companies are required to incorporate the costs of balanced and environmentally sensitive development in the prices they charge and some firms are not able to undercut their competition by reducing environmental protections. Effective enforcement is a regular refrain of community groups who want to ensure that standards are applied consistently and fairly. Companies are similarly frustrated with delays in the permitting process. Ideas for improving permitting and enforcement efforts of federal and state agencies include the following:

- Secure additional funding for processing, issuing, and enforcing permits, through permit fees on applications as occurs in other environmental permitting (Clean Air Act operating permits, for example), royalty payments, and other sources;

- Ensure that companies not acting responsibly are identified and sanctioned for noncompliance with relevant laws and regulations.

- Create incentives for companies to comply with permit requirements through self-audits and other innovations that allow conscientious companies to demonstrate compliance and permit government agencies to focus enforcement resources on problem companies.

Balancing the interests of counties and states in regulating CBM development

Counties are at the front line of efforts to deal with the impacts of CBM development. They need the legal and financial resources to address those impacts and to be able to coordinate energy and other forms of economic development with zoning and other land use planning efforts. State laws give responsibility to oil and gas commissions to regulate resource extraction and typically emphasize efficient production of resources and minimization of waste and may not provide much guidance for how the impacts of extractive activities should be addressed. In some areas, county and state officials appear to be working together with minimal problems, while in a few areas, conflicts between state and county officials are a major issue.[147] State agencies should work with counties to develop clear statements of authority concerning the governance of CBM and develop ways of balancing the interests of different constituencies. Workshops could seek to devise guidelines for coordinating the efforts of county, state, and federal agencies that could address the following issues:

- Harmonizing the regulatory concerns of state oil and gas commissions, environmental quality agencies, and counties;

- Encouraging companies to work with counties in coordinating the development of CBM infrastructure to reduce the number and extent of facilities, contractual obligations and technological differences place limits on sharing infrastructure, but some reduction in impacts is likely;

147. As indicated earlier, state and county officials in Wyoming have worked together without major conflict; in contrast, some Colorado county commissioners have clashed repeatedly with state officials. *See* Cullicott et al., *supra* note 3; Diana Hulme, *Coalbed Methane Development in Wyoming's Powder River Basin, in* COALBED METHANE DEVELOPMENT IN THE INTERMOUNTAIN WEST 86 (Natural Resources Law Center, University of Colorado School of Law CD-ROM, July 2002).

- Discovering what state-county relationships have worked in particular areas and how successful models might be adapted elsewhere

Encouraging ecosystem- or watershed-level planning and coordination for CBM development

Each CBM basin poses a unique set of challenges in governing development, but one commonality is the complex and fragmented framework of governance. Specific regulatory authority is given to a variety of government agencies and those jurisdictions do not reflect the landscape shaped by development. A workshop involving all relevant agencies and citizen and industry representatives could bring participants together to produce guidelines to

- Create ecosystem or watershed planning efforts and regional air quality planning processes to ensure that CBM-related decisions are integrated with other land use and development decisions;

- Create forums to coordinate CBM permitting and other regulatory decisions to streamline the time required to make decisions, facilitate public participation in regulatory decisions, and increase communication among decision makers.

Protecting water quality and supply

There is clear consensus that water quality must be protected during CBM development but no consensus about the scope of the problem. As indicated above, governments can assuage concerns by more effective enforcement of permitting requirements for drilling and for disposal of water. A workshop could bring parties together to

- Formulate plans to produce accurate baselines for water quality and quantity;

- Review compliance with testing and monitoring requirements and regularly assess those requirements to see if they should be strengthened.

Ensuring the beneficial use of high-quality produced water

Water is such a valuable commodity that all parties involved in CBM development should renew their efforts to find ways to ensure that produced water is used beneficially. One of the most valuable uses of produced water is to recharge aquifers. Suggestions for workshops include the following:

- Clarify legal ownership of produced water;
- Develop guidelines and processes to ensure that surface owners are involved in decisions concerning the discharge of water onto their lands;
- Develop a research program to carefully trace what happens to produced water and what its impacts are on surface ecosystems and groundwater;
- Explore how water can be used to recharge aquifers.

Ensuring effective reclamation in permitting and bonding

Reclamation is not currently the most pressing CBM development-related issue, but the fear of inadequate future reclamation is undoubtedly a concern of those who seek to slow down CBM development. Given the relatively short life span of CBM wells, the adequacy of reclamation policies will soon be tested as fields mature. Reclamation is another area where a commitment to a developer/landowner partnership can reduce conflict and promote ecologically sustainable production. Some of the recommendations discussed above address reclamation, but because of the importance of ensuring that reclamation contributes to the sustainability and stewardship of lands in the West, a workshop could develop specific recommendations on how to

- Ensure surface owners are involved in reclamation planning through surface use agreements;
- Ensure adequate reclamation requirements are included in permits and adequate reclamation bonds are posted as part of the permitting process.

Limiting CBM development in ecologically sensitive areas

In most areas, CBM development and other land uses can be balanced. In a few areas, the choice is either to protect them as undeveloped or to allow some development. The vast majority of public lands are available for resource extraction, and lands where no development has yet occurred contain only a small fraction of total CBM reserves. Wilderness study areas, roadless areas, and other protected lands may contain valid leases and the rights and interests of leaseholders need to be preserved. Preserving the ecological integrity of these areas usually precludes the construction of new roads. One of the most difficult challenges for a CBM workshop would be to develop recommendations for placing limits on development, compensating

leaseholders fairly if they are not able to exercise their leases, and minimizing impacts of development affecting protected areas. A workshop could suggest

- Places such as roadless areas, wilderness study areas, and national monuments and wildlife reserves where development should not take place;
- How CBM development can take place with a minimum of environmental impact in or near these ecologically sensitive areas;
- How leaseholder rights can be protected in areas where it is determined that development should not occur;
- How the broad commitment to collaboration, communication, and conservation can ensure that development of new CBM resources is more carefully and systematically planned and adverse impacts minimized.
- How the BLM and other regulatory agencies can apply principles of adaptive management to planning and leasing actions affecting CBM so that development is balanced with protection of habitat, wildlife corridors, and other environmental values.

Addressing the broader policy debate

Mitigating the environmental problems associated with CBM development is a significant challenge facing states, communities, and companies, particularly in a dynamic market where natural gas prices change with the weather. Low natural gas prices give companies little opportunity to invest in activities that minimize environmental impacts. Decision makers within each basin need to solve immediate problems as well as develop ways to ensure ecologically sustainable energy production.

Demand for natural gas is increasing and will continue to do so. Satisfying that demand exclusively through increased production will make it very difficult to balance extraction with other values affected by development. The more efficient the use of natural gas and the more effective efforts to conserve its use, the less pressure there will be on increasing well density and developing new areas. In addition to conservation and efficiency in the use of natural gas, collecting methane that would otherwise escape in the process of mining prevents the waste of an important resource and reduces emissions of a very potent greenhouse gas. While conservation and efficiency efforts are not directly part of CBM development and may not be in the short-term

interest of gas companies, all parties should be interested in the sustainability of natural gas as a transition fuel until even cleaner, renewable energy sources are more widely developed. Ultimately, the question is how can methane extraction be balanced with conservation and efficiency efforts and the promotion of renewable resources in order to reduce pressures for development on sensitive lands, ranching and agriculture, and other values. Answers may differ in different communities. As communities assess the costs and benefits of CBM development as compared with other forms of energy production, they may find that renewable energy production provides a more economically sustainable and ecologically attractive future.

The importance of energy in the American economy and the foreign policy consequences of our reliance on imported oil raise important policy questions that have profound implications for the American West. Energy development often clashes with efforts to preserve undeveloped lands, protect ecosystems and wildlife habitat, and maintain recreational and aesthetic interests. Conflicts are inevitable as people throughout the West have greatly differing views about what should happen on public and private lands.

The rapid pace of CBM development has compressed and magnified these conflicts; this pace must be slowed down to allow for more detailed study of environmental impacts and greater public involvement in how development proceeds. Ecologically sustainable CBM development must incorporate requirements for developers such as preparing baseline data on water quality and other environmental conditions before development begins and conducting comprehensive environmental assessments before leases are granted. These measures are necessary to ensure that critical water sources and fragile ecosystems are preserved. Likewise, politically acceptable CBM development must incorporate careful planning to minimize impacts on landowners and communities, to ensure proof of adequate resources to finance eventual reclamation, and to effectively engage all stakeholders in negotiations and discussions.