

# Unconventional Natural Gas Resources on U.S. Federal Lands

U.S. Geological Survey Fact Sheet

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## Introduction

This Fact Sheet provides a summary of estimates made in two detailed reports (Crovelli and Schmoker, 1997; Crovelli and Nuccio, 1997) of technically recoverable natural gas resources for continuous-type (unconventional) plays on Federal Lands of the conterminous United States.

For the purposes of this study, Federal Lands are considered to be surface lands or subsurface mineral rights owned or managed by Federal agencies, or in cooperation with State or private interests. Indian and Native lands are excluded, even where administered in trust by the United States.

The resource estimates summarized here can be regarded as subsets of the continuous-type play assessment of the U.S. Geological Survey (USGS) 1995 National Assessment of United States oil and gas resources (Gautier and others, 1995; U.S. Geological Survey National Oil and Gas Resource Assessment Team, 1995). In this National Assessment, the USGS assessed 34 continuous-type gas plays in sandstones, shales, and chinks, and 39 such plays in coals (coalbed gas).

## Geologic Nature of Continuous-Type Accumulations

A continuous-type accumulation, whether reservoir in sandstones, shales, coals, or chinks, is one that is not significantly affected by hydrodynamic or hydrostatic influences. Such a continuous-type accumulation does not owe its existence to the buoyancy of gas or oil in water, and therefore cannot be described or assessed in terms of discrete accumulations delineated by downip water contacts.

The identification of a continuous-type accumulation is based on its geologic setting and does not incorporate the somewhat ephemeral criteria often associated with "unconventional" accumulations, such as a specified low API gravity or reservoir permeability ("tight"), special regulatory status, or need for unusual engineering techniques. Common geologic characteristics of continuous-type accumulations in sandstones, shales, or chinks include occurrence downip from water-saturated rocks, lack of obvious trap and seal, large areal extent, low matrix permeability, abnormal pressure (high or low), and close association with source rocks. Coalbed-gas accumulations display additional unique characteristics: (1) large amounts of gas are generated from coal by both thermogenic and biogenic processes, (2) coals serve as both the source and reservoir for gas, (3) much of the methane in a coal reservoir is sorbed onto the surface of coal particles and thus is not in a gaseous state, and (4) large volumes of water must usually be produced from coalbed-gas wells (and properly disposed of) during early stages of production to reduce reservoir pressure and initiate gas flow.

USGS estimates of technically recoverable coalbed gas, and of gas from continuous-type accumulations in sandstones, shales, and chinks in the U.S. as a whole (excluding Alaska and all Federal waters) are 49 trillion cubic feet (TCF) and 308 TCF, respectively (Gautier and others, 1995). Over the past decade, U.S. gas production from continuous-type accumulations has become significant. In 1994, unconventional gas resources accounted for 3.6 TCF or about 20 percent of U.S. gas production. Of that total, coalbed-gas production contributed 858 billion cubic feet, most of which came from the San Juan Basin of Colorado and New Mexico, and the Black Warrior Basin of Alabama.

## Technically Recoverable Continuous-Type Natural Gas Resources in Sandstones, Shales, Chinks, and Coals on Federal Lands

Federal Lands percentages by area were estimated for the 34 assessed continuous-type gas plays in sandstones, shales, and chinks, and the 39 assessed coalbed-gas plays. The key assessment assumption was that the Federal Lands percentage of each play represents the percentage of the continuous-type gas resource on Federal Lands.

The UNCLE (unconventional energy) assessment system developed by the USGS (Crovelli and Balay, 1995) was used to calculate estimates of technically recoverable natural gas resources in those parts of the continuous-type plays on Federal Lands. The UNCLE system incorporates an analytic probabilistic methodology for assessing unconventional petroleum resources. The resource estimates calculated at the play level were aggregated using a scheme displayed in Crovelli and Schmoker (1997) and Crovelli and Nuccio (1997) to obtain province-level estimates, and the regional and national estimates shown in table 1 (sandstones, shales, and chinks) and table 2 (coals). The region and province boundaries used by the USGS are shown in figure 1. (The tables list only regions where Federal Lands are judged to contain unconventional natural gas resources.)

Although not the focus of this Fact Sheet, a summary of estimates of technically recoverable crude oil resources for the continuous-type oil plays in sandstones, shales, and chinks on Federal Lands is given in the following table:

Area	Crude oil (billion barrels)		
	Mean	F95	F5
Region 2—	0	0	0
Region 3—	0.27	0.11	0.51
Region 4—	0.04	0.02	0.06
Region 6—	0.01	0.01	0.02
Region 8—	0	0	0
<b>Nation</b>	<b>0.32</b>	<b>0.15</b>	<b>0.57</b>



Drilling for coalbed gas in the Wind River Basin, Wyoming. Original slide by R.C. Johnson



## Conclusions

Continuous-type (unconventional) gas accumulations are presently, and will continue to be, important sources of "clean" energy for the United States. USGS assessments suggest that the natural gas resource in continuous-type accumulations under Federal stewardship is large enough and of sufficient public interest to warrant careful study and thoughtful management.

The following points summarize our investigations:

Mean estimates for technically recoverable natural gas in continuous-type (unconventional) accumulations on Federal Lands (excluding Alaska) total 143 TCF. Of this total, 127 TCF of gas resides in sandstones, shales, and chinks, and 16 TCF of gas resides in coals.

A gas volume of 143 TCF is significant in terms of U.S. usage. For perspective, annual U.S. gas consumption in recent years has averaged roughly 22 TCF. In terms of energy, 143 TCF of gas is equivalent to about 24 billion barrels of oil.

Assuming a value of \$2.00/thousand cubic feet of gas for purposes of illustration, the estimated gas resource on Federal Lands of 143 TCF (continuous-type accumulations only) has a potential worth of hundreds of billions of dollars.

Some 133 TCF of gas (of the total estimate of 143 TCF) is located in the Western U.S.—the Colorado Plateau, Great Basin, and Rocky Mountains—where the percentage of Federal land ownership is significant, and the potential for conflict over land usage is high.

## References

- Crovelli, R.A., and Balay, R.H., 1995, Probabilistic methodology and computer programs for assessment of unconventional oil and gas resources, in Gautier, D.L., Dolton, G.L., Takahashi, K.I., and Varnes, K.L., eds., 1995 National Assessment of United States oil and gas resources—Results, methodology, and supporting data: U.S. Geological Survey Digital Data Series DDS-30 [CD-ROM].
- Crovelli, R.A., and Nuccio, V.F., 1997, Estimates of technically recoverable natural gas resources for continuous-type (unconventional) plays in coal beds on Federal Lands of the conterminous United States: U.S. Geological Survey Open-File Report 97-491, 115 p.
- Crovelli, R.A., and Schmoker, J.W., 1997, Estimates of technically recoverable petroleum resources for continuous-type (unconventional) plays in sandstones, shales, and chinks on Federal Lands of the conterminous United States: U.S. Geological Survey Open-File Report 97-490, 210 p.
- Gautier, D.L., Dolton, G.L., Takahashi, K.I., and Varnes, K.L., eds., 1995, 1995 National Assessment of United States oil and gas resources—Results, methodology, and supporting data: U.S. Geological Survey Digital Data Series DDS-30 [CD-ROM].
- U.S. Geological Survey National Oil and Gas Resource Assessment Team, 1995, 1995 National Assessment of United States oil and gas resources: U.S. Geological Survey Circular 1118, 20 p.

**Table 1.** Estimates of technically recoverable natural gas resources for continuous-type (unconventional) plays in sandstones, shales, and chinks on Federal Lands of the conterminous United States for the regions and Nation.

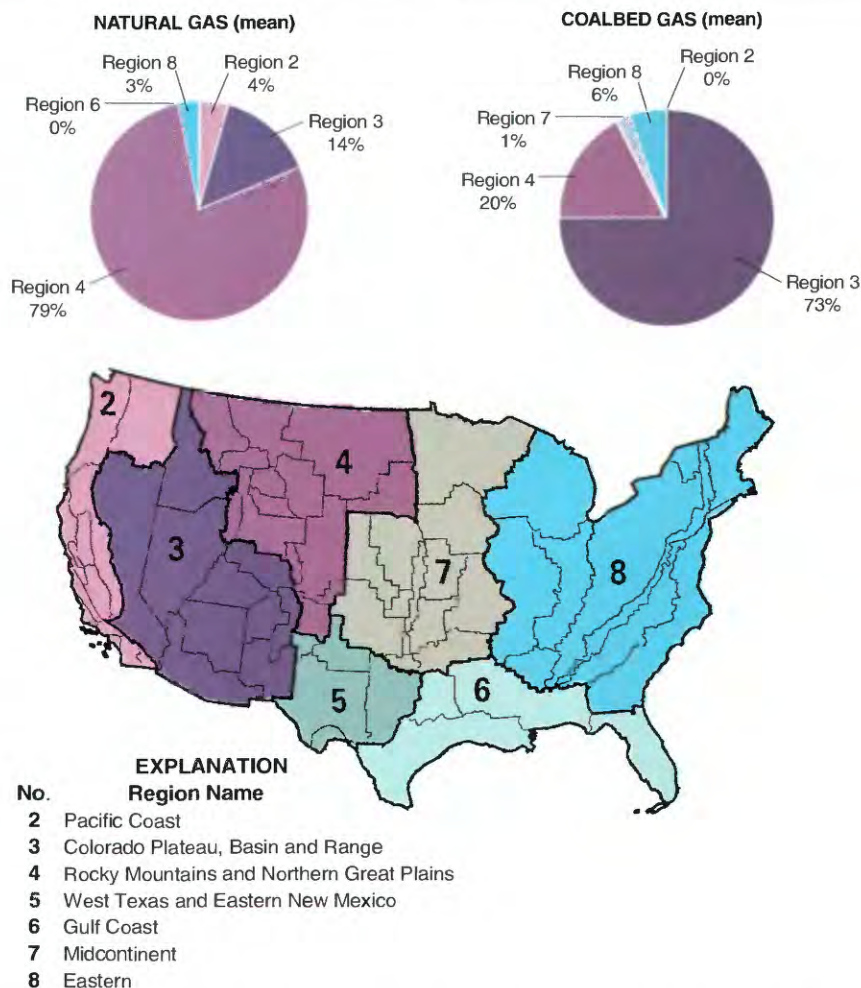
[Fractile values (F95, F5) are not additive. F95 represents a 19 in 20 chance and F5 represents a 1 in 20 chance of the occurrence of at least the amount tabulated. Natural gas includes both non-associated and associated-dissolved gas]

Area	Natural gas (trillion cubic feet)		
	Mean	F95	F5
Region 2—	4.88	1.12	12.4
Region 3—	18.31	12.35	25.82
Region 4—	100.06	49.08	175.58
Region 6—	0.18	0.12	0.27
Region 8—	3.64	1.94	6.15
<b>Nation</b>	<b>127.07</b>	<b>72.38</b>	<b>202.36</b>

**Table 2.** Estimates of technically recoverable natural gas resources for continuous-type (unconventional) plays in coals on Federal Lands of the conterminous United States for the regions and Nation.

[Fractile values (F95, F5) are not additive. F95 represents a 19 in 20 chance and F5 represents a 1 in 20 chance of the occurrence of at least the amount tabulated]

Area	Coalbed gas (trillion cubic feet)		
	Mean	F95	F5
Region 2—	0.06	0.02	0.1
Region 3—	11.69	9.6	14.04
Region 4—	3.2	1.39	6.04
Region 7—	0.23	0.16	0.31
Region 8—	0.9	0.66	1.19
<b>Nation</b>	<b>16.08</b>	<b>12.97</b>	<b>19.63</b>



**Figure 1.** Petroleum regions and provinces of the conterminous United States involved in this assessment. Heavy lines, region boundaries; lighter lines, province boundaries. (Modified from U.S. Geological Survey National Oil and Gas Resource Assessment Team, 1995.)

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