

Crossroads

ECONOMIC TRENDS IN THE DESERT SOUTHWEST

Unconventional Natural Gas Drives New Mexico Rig Count

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Oil and natural gas in New Mexico are found in two important producing regions: the San Juan Basin in the northwest and the Permian Basin in the southeast. Although oil seeps were evident and small quantities of oil were reported in water wells of the San Juan Basin as early as the 1880s, commercial quantities of oil were not discovered in New Mexico until the Hogback pool near Farmington in 1922. This discovery set off a search for oil throughout the state's northwest quadrant.

Oil in southeast New Mexico began with Rupert Ricker's return from World War I, his decision to lease land from the University of Texas and, in 1921, to spud in Santa Rita No. 1 (named for the patron saint of hopeless causes). His Big Lake field in Texas turned the Permian Basin into one of the world's great oil plays. By 1924, oil exploration had spread westward to the vicinity of Artesia and Hobbs and the state's four southeastern counties became a major producing region of the Permian Basin.

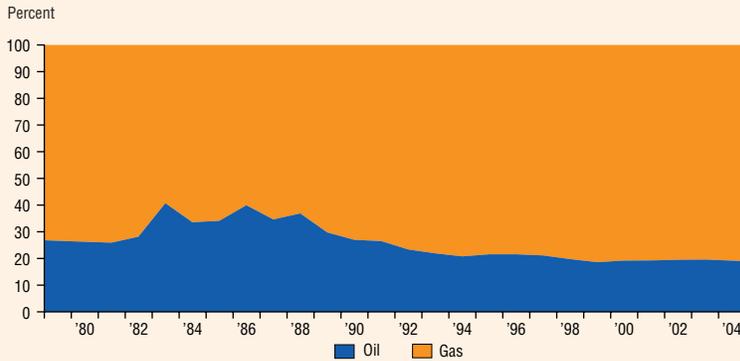
Early energy exploration in New Mexico was almost completely driven by oil. But markets and transportation for natural gas developed rapidly after World War II. A pipeline built by the El Paso Natural Gas Co. in 1950 was important in connecting the isolated and gas-prone San Juan Basin to California. Another pipeline quickly followed to Washington and Oregon.

Today the tail has grown to wag the dog. Chart 1 shows that based on energy content, natural gas has ruled the modern era of hydrocarbons in New Mexico. Oil's share of production peaked at just over 40 percent in 1983; it has fallen to 19 percent today. The favorable trend for gas is being rein-

Cyclical Differences Emerge in Border City Economies

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Chart 1
Share of Oil and Natural Gas Production in New Mexico



NOTE: Based on gas valued at oil-equivalents in terms of energy content.
SOURCES: New Mexico Institute of Mining and Technology; GO-TECH, octane.nmt.edu; author's calculations.

forced yet again by the development of unconventional, or continuous, gas reserves in the state. No more is production limited to domes or anticlinal structural traps of conventional gas; today's fields are uniformly spread over vast areas of coal, shale or impermeable limestone or sandstone. As New Mexico's rig count reaches some of its highest levels since 1986 (*Chart 2*), unconventional gas drives the search for hydrocarbons.

Important Industry

Oil and natural gas exploration and production make up an important industry in New Mexico. The industry directly em-

plloys 12,200 wage and salary workers in the state, a number that has jumped 10.2 percent in the last 12 months. These are well-paid jobs; New Mexico's natural resource and mining jobs pay 24.9 percent more than those in construction, 44.7 percent more than manufacturing and 56.6 percent more than finance.

Oil and natural gas are important to the state's finances as well. In 2000, for example, the oil and gas industry paid \$165.1 million to the state government in severance taxes, \$169.5 million in emergency school taxes, and \$34.6 million in conservation, equipment and other taxes. The combined \$369.2 million was

10.9 percent of state government revenues. In addition are various gross receipt, ad valorem and corporate taxes paid either to the state or other levels of government.

Table 1 shows how New Mexico ranks among various states and regions in oil and natural gas reserves. It is No. 5 in oil reserves, behind the federal offshore, Texas, Alaska and California. It is No. 4 in natural gas reserves, behind Texas, the federal offshore and Wyoming. The eastern part of the state—home to the Permian Basin—has 98.7 percent of the state's oil reserves, while the San Juan Basin in the west has 80 percent of the state's natural gas reserves.

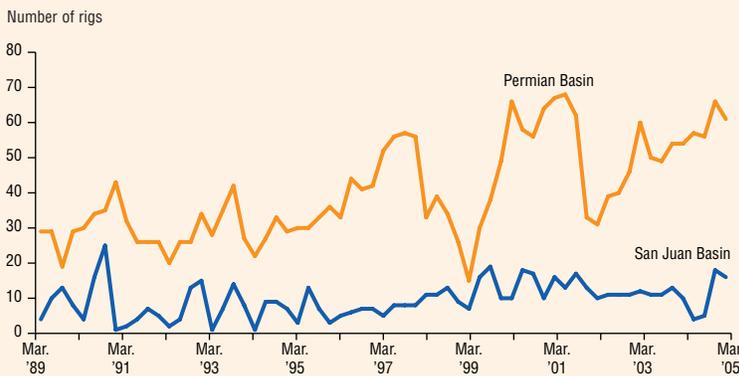
Oil and gas production follows the pattern set by reserves. In 2004, 95.7 percent of the state's oil production and 35.7 percent of natural gas came from the Permian Basin, with the San Juan Basin serving as a virtual mirror image in providing the rest. These shares have held steady for 20 years.

What has changed rapidly since 1984, however, has been the role of oil versus natural gas. Between 1984 and 2004, New Mexico oil production grew 46.2 percent, while natural gas grew 292.3 percent. This shift to natural gas reflects its abundance, low price and desirability as a clean fuel, especially for electricity production. In April 1988, 35.1 percent of working rigs in the United States were drilling for natural gas. In April 1994, that share was 55 percent and by April 2004, 86.2 percent. Chart 3 illustrates the rapid growth of gas production in both the San Juan and Permian basins.

Unconventional Gas

Geologists call it continuous gas, but it is also called unconventional gas or even weird gas. Whatever you choose to call it,

Chart 2
Number of Rigs Working in New Mexico, 1989–2005



SOURCES: Smith Tool Activity Tracking System, www.smith.com/stats/new; author's calculations.

Table 1
Oil and Natural Gas Reserves by State and Region, 2003

Oil	Millions of barrels	Natural gas	Billion cubic feet
Federal offshore	5,120	Texas	48,717
Texas	4,583	Federal offshore	23,033
Alaska	4,446	Wyoming	22,716
California	3,542	New Mexico	18,226
New Mexico	677	East	3,661
East	668	West	14,565
West	9	Colorado	15,839
United States	21,891	United States	197,145

SOURCES: Energy Information Administration, *U.S. Crude Oil, Natural Gas, and Natural Gas Liquids Reserves 2003 Annual Report*, November 2004.

you must give it due respect for its growing importance. The Department of Energy reports the share of unconventional gas doubled from 17 percent of Lower 48 natural gas supplies in 1990 to 35 percent in 2003. By 2025 it is projected to be 44 percent—matching the role of conventional gas—with the remaining 12 percent of domestic supplies imported.

Unconventional gas is methane or another light hydrocarbon similar to that found in the conventional anticlinal trap, but it is stored in the earth and produced differently.¹ It is stored uniformly in a formation that extends over a wide area but is trapped in a rock formation that requires additional resources to free it. New technologies have been developed to drill and complete and stimulate these wells.

Tight gas is trapped in an unusually impermeable sandstone or limestone formation. The problem is to get the low-permeability formation to release sufficient gas to flow in economic amounts to the well bore. Hydraulic fracturing was first developed in the 1940s and applied to tight formations in the 1970s. Water is injected under high pressure, cracking the formation and opening fissures

that boost gas production by a factor of 10 or more. New Mexico's San Juan Basin was the first western gas basin to produce gas from tight sandstone formations.

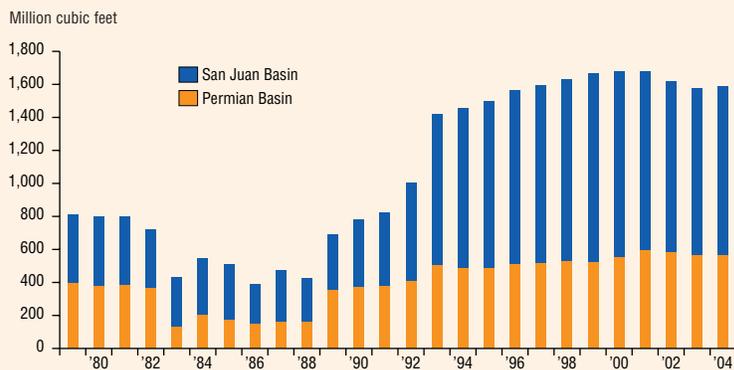
The San Juan Basin is also known as the initial proving ground for coal-bed methane. Coal-bed methane is a by-product of the formation of coal from plant material, not a result of the high temperatures and pressures that turn organic material to conventional natural gas found in structural traps. The coal-bed gas reserves remain trapped in the coal seams as long as the water table lies above it. To release the gas, a well is drilled and water is pumped out to lower the water table and release the gas to flow

to the well bore. As the water table falls, the well produces less water and more gas over time. Coal-bed methane accounts for about 45 percent of the San Juan Basin's annual gas production.

The third important form of unconventional gas is Devonian shale. Shale is a nonpermeable rock, a clay compacted by pressure. Free gas is stored in the rock pores or in natural fractures. As with other unconventional gas types, the gas is stored continuously, and hydraulic fracturing is used to make it flow freely. The San Juan Basin's Mancos and Lewis formations are important producers for this form of gas. The Lewis formation, for example, has become a secondary and shallower target on the way to deeper tight-sand formations. Although research and technology have been important in producing all forms of unconventional gas, shales are particularly challenging; there is no universal formula for success in freeing the gas from the formation.

Development of technologies to successfully exploit unconventional formations was the product of tax credits offered on wells drilled from 1979 to 1993. Throughout the 1990s, subsi-

Chart 3
Natural Gas Production in New Mexico, 1979–2004



SOURCES: New Mexico Institute of Mining and Technology; GO-TECH, octane.nmt.edu; author's calculations.

dies on production from these wells paid about \$1.05 per thousand cubic feet of unconventional gas delivered to market. The tax credits are now gone, but the technologies developed continue to lower the cost of delivering this gas, making it highly profitable at today's prices. Continuous gas wells typically have lower capital costs because they are shallower and use smaller rigs; in addition, there is little risk of a dry hole because the gas is uniformly spread over a wide area. The wells also tend to be long-lived. The small number of rigs needed to explore and develop the San Juan Basin (see Chart 2) is in large part a function of these no-miss, long-lived features of continuous gas.

The Permian Basin, although best known as an oil basin, has benefited from these technologies as well. For example, the Morrow sandstones became an important gas play in southeast New Mexico in the late 1990s. Interest runs high throughout the basin in effective stimulation of low-permeability carbonates and sandstones and effective production from regional shales. Despite the San Juan Basin's reputation for unconventional gas production, the Permian Basin in New Mexico has kept pace. From 1984 to 2004, northwest New Mexico saw gas production rise by 301 percent, but southeast New Mexico was right behind at 279 percent.

Outlook

The next 20 years of New Mexico oil and gas are secure, based on the state's existing and proven reserves. These reserves will, however, require further development. In the early 1990s, coal-bed methane dominated the activity in the San Juan Basin. Today, as coal-bed methane fields peak, we see activity swinging toward tight sands, with

shale as a secondary target. A recent study by the New Mexico Institute of Mining and Technology predicted 16,000 subsurface completions over the next 20 years in the San Juan Basin. The study concluded with a reminder of the challenge of balancing this development with land-use and environmental issues.

This reminder about environmental sensitivity is offered again by two recent controversies outside the traditional geography of New Mexico oil and gas. The Raton Basin, a 6 million-acre region that straddles the line between Colorado and New Mexico's Colfax County, is one such case. Development of 8 trillion to 12 trillion cubic feet of coal-bed methane reserves was slowed for many years by a lack of infrastructure. The first pipelines entered the area in 1994 and 1998. With the basin now about 50 percent developed, oil companies have just begun to move from southern Colorado and into northern New Mexico. This entails drilling in the Carson National Forest, and the permitting process has provoked doubts and opposition from environmentalists and outdoors enthusiasts. Opposition centers primarily on the creation of a web of inter-

linking roads through wilderness areas to connect hundreds of well pads.

Similar opposition has sprung up against drilling in the Otero Mesa region of the Chihuahuan Desert, west of Carlsbad and northeast of El Paso. According to environmentalists, this particular stretch of desert is home to unique grasslands, endangered wildlife and the largest untapped reservoir of drinking water left in New Mexico. The oil industry has found enough natural gas to justify development of the fields and a pipeline to market. The question—as always—is where to strike the balance between development for today's needs and conservation for the future.

—Robert W. Gilmer

Gilmer is a vice president of the Federal Reserve Bank of Dallas.

Notes

¹ Some definitions of unconventional natural gas resources include gas trapped below 15,000 feet, although drilling to these depths is no longer a technological challenge. Others include geopressured zones or methane hydrates that pose largely unmet technological challenges. We consider here only continuous gas in tight formations, coal-bed methane and Devonian shale.

The Maquiladora Industry: Future of the Electronics and Automotive Sectors

Grand Hotel Tijuana • Tijuana, Mexico • Thursday, August 11, 2005

This one-day workshop will bring together researchers working on issues related to the future of the maquiladora industry, with special attention to the electronics and automotive sectors.

The workshop is being organized by the El Paso Branch of the Federal Reserve Bank of Dallas through the Network of Border Economics (Red de la Economía Fronteriza) in collaboration with Colegio de la Frontera Norte (COLEF), Cámara Nacional de la Industria Electrónica de Telecomunicaciones e Informática (CANIETI), and San Diego State University.

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