

ENERGY OUTLOOK

VIRGINIA CENTER FOR COAL & ENERGY RESEARCH

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Gas Production in Virginia Challenges and Opportunities

Rapid changes are taking place in the Virginia gas business. Deregulation is causing energy businesses to rethink the variety of services they provide. Significant improvements in technology have made coalbed methane extraction more attractive financially, and corporate exploration has led to major increases in the estimated proven gas reserves within the Commonwealth. Gas production is up in Virginia; however, the number of new wells completed fluctuates widely from year to year. Interestingly, the amount of gas produced from coalbeds has increased well beyond conventional gas, and now accounts for close to 65 % of total gas production in Virginia. Changes in Virginia are a reflection of the swift metamorphosis currently affecting energy industries nationwide, including the natural gas industry.

Deregulation

A direct consequence of deregulation of the electrical utilities is a re-evaluation of the "one-business" company, whether it be coal mining, railroads, gas production or generation of electricity. Certainly, we have coal companies that also produce gas commercially, a natural consequence of the historical development of methane drainage technology. We also have electrical utilities that own coal mines.

In addition, however, gas transportation and marketing practices continue to respond to the deregulation of the early 1990s. Gas transportation firms are joining with electric utilities, an indication of fundamental industry changes. For example, Duke Power, a North Carolina electric utility and a Virginia coal purchaser, recently merged with PanEnergy, a gas pipeline firm. The resulting company is now known as Duke Energy, and strives to become a fully integrated energy supplier.

As the future unfolds, analysts expect that expanded applications of information technology will allow both electric and gas marketing firms to move towards demand-based pricing at the retail level, while becoming full-service suppliers of gas, electric power, and energy conservation services. Deregulation may play a role in these changes, encouraging entrepreneurial development of "energy companies" that will provide a total package, from the production of raw fuels to the delivery of electrical energy to the consumer. Such developments would have significant consequences in the

ways in which energy is changed from one form to another and marketed in the United States, with potentially large effects on Virginia.

While deregulation of the power industry is causing strategies to be re-appraised by everyone in the energy business, there is little doubt that coal will persist, for the foreseeable future, as the major source of fuel for American power utilities (*Energy Outlook*, May 1997). Even assuming the primacy of coal power production, however, new opportunities are emerging for gas. Although there is currently adequate production capacity to provide for base-load electrical demand over the next few years (with regional variations), a number of regions will increasingly require additional peak-load capabilities. The efficiency of gas turbines at smaller power stations provides an opportunity for increased sales of gas. On an even more local basis, gas engine/generator sets are a well-established technology and could provide a valuable source of electrical power in and around the coalfields. The Australians are currently discovering anew the benefits of such installations ("Converting methane to utility energy at Australian coal mines," *Mining Engineering*, SME, July 1997, p. 49).

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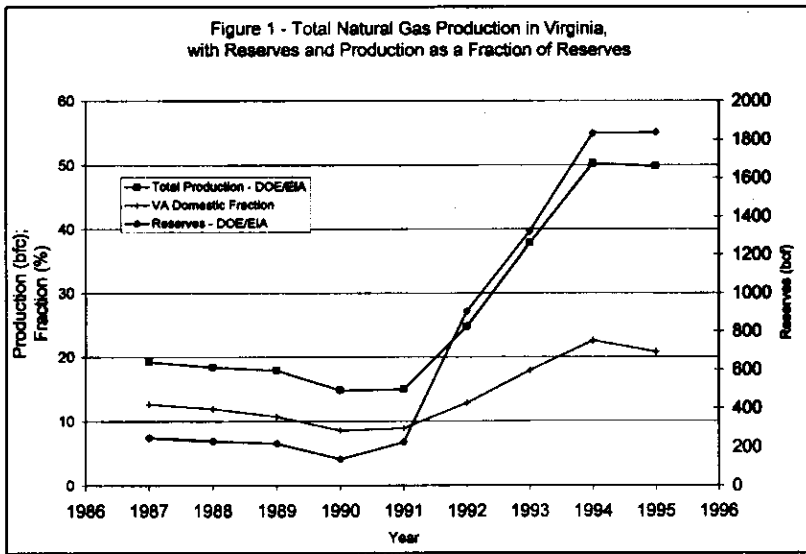
GAS PRODUCTION STATISTICS 6

Virginia



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construction of smaller power stations in the coalfields along with additional transmission lines. There are strongly held, and differing, views on whether this is a viable alternative to importing electrical power into Virginia via the proposed and controversial new 765 kV line. Certainly, each alternative will have an environmental cost, and such decisions will have a large impact on future prospects for the economy of Southwest Virginia.

In order for expanded natural gas production to be viable, it will also be necessary for the industry to access new markets. Virginia's producers seem to have several factors going against them in this area. For years, we have experienced a limited ability to move gas from the southwest Virginia production areas to major markets located to the north and east. Several factors are involved:

Technology Issues

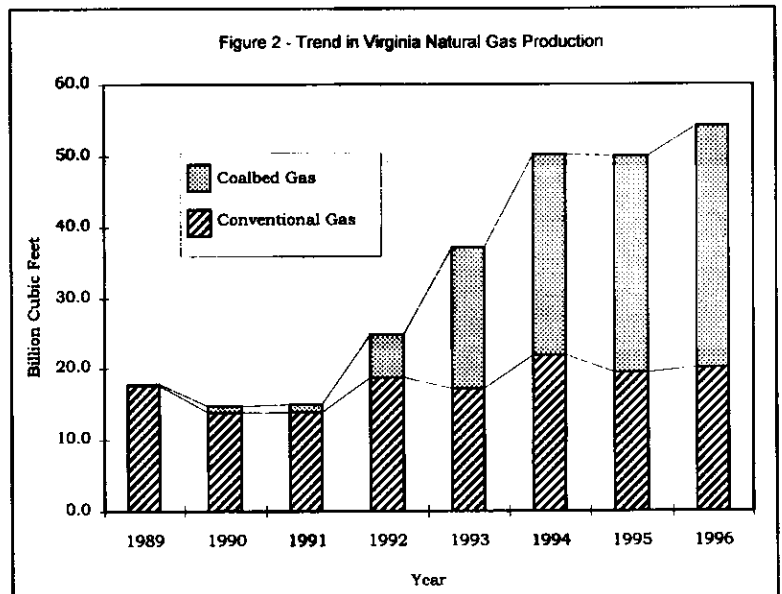
The technologies for extracting methane from the strata around mine workings have improved significantly over the years.

Developed initially to improve mine safety, methane drainage now also serves to provide a clean gaseous fuel, while reducing methane emissions into the atmosphere in ventilating air exhausted from underground coal mines. According to the Environmental Protection Agency (*Coal Mine Profits and Environmental Protection, 1995*) methane is eleven times more detrimental than carbon dioxide in terms of "greenhouse" effects, making this reduction of emissions highly desirable. In addition, new exploration and drilling technologies have expanded the abilities of gas-producing firms to find and extract gas, especially in offshore areas.

Unfortunately, we have an immense resource of methane in Virginia coal seams that are too thin, or of such poor quality, that they are unlikely ever to be mined (see *Energy Outlook, June 1996*). We continue to be unable to extract more than a fraction of this gas, so tightly is it bound up in the coal material. Research continues on this problem and should lead to improved productivity, but we do need a new technology breakthrough in this area. In addition to the technological difficulties, the tax incentives for coalbed methane exploration are now behind us. Consequently, as is usually the case with mineral exploration, the potential rewards are high, but so is the risk to be borne by investors.

Furthermore, there remain problems to be addressed by Virginia producers. Even if we produce additional gas, how do we transmit the energy to the customers? If energy is to be exported from the region, it will require either investment in new pipelines or

- Limitations on the ability of local producers to move gas from production areas to major gas pipelines leading to the Atlantic coast and northeastern markets
- Difficulties in dealing with the major pipelines due to the relatively small quantities of gas involved
- While gas markets pay premium prices for supplies that can be made available during periods of peak demand, Virginia's gas—both conventional and coalbed methane—tends to become available at a relatively steady rate, and no local, large-scale gas storage facilities are available for use by Virginia producers.



Production

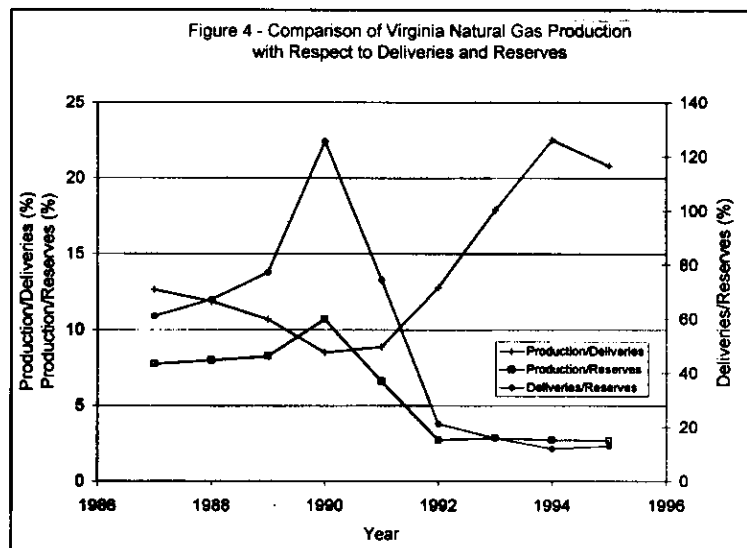
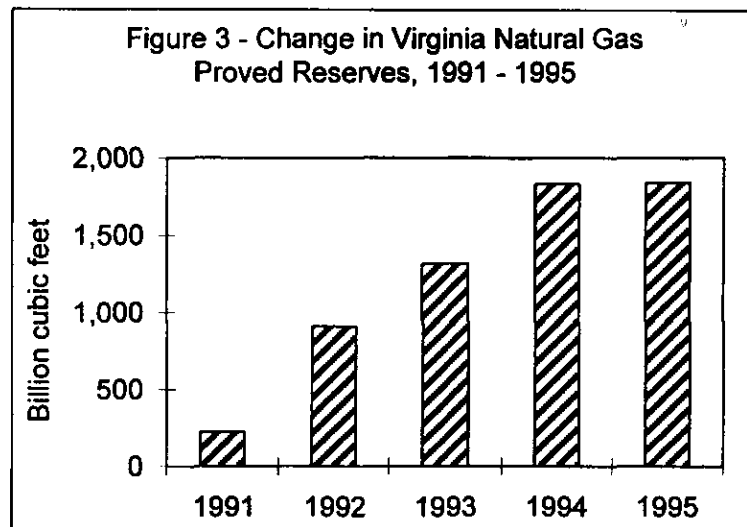
Until 1989, the production of natural gas in Virginia was essentially from "conventional" sources. Since that time output from coalbed sources has grown from practically nil to nearly 65% of Virginia natural gas production. Based on 1996 data (Div. of Gas and Oil, *Virginia Gas Report*), the coalbed gas wells of Virginia out-produce conventional wells by more than a factor of two over all.

The role of coalbed reservoirs as a viable source of natural gas in Virginia is illustrated in the drastic rise in total reserves following a low point in 1990 (Figure 1). Following the trend of reserves, the total production of natural gas in Virginia increased steeply beginning in 1991. Figure 2 illustrates that the vast majority of the increase in gas production since 1991 has come from coalbed sources. The delivery of natural gas to consumers in Virginia has increased just over 50% in the last 10 years. In the same period of time, Virginia production has increased by about 180%.

Exploration expenses borne by Virginia's gas producers over the past several years have yielded major benefits. The industry's exploration and production activities have made it a major economic force in southwestern Virginia, especially in the coal producing counties where the majority of gas production is located. During the early 1990s—when many new wells were being developed—the industry supported close to 1000 jobs (see VCCER Report 95-02), with most located in Virginia's coal-producing counties, where they helped to offset the economic impacts of declining coal production.

Exploration efforts have resulted in a significant increase in the cumulative estimate of Virginia's proven gas reserves (Figure 3).

This 4-year, 8-fold increase occurred as the proven gas reserves nationwide remained at a relatively constant level. Note also that gas reserves in Virginia increased more than 12 times from 1990 to 1995. Despite increased reserves and gas production in Virginia, the fraction of gas delivered that was also produced in Virginia (domestic fraction) is just over 20 %, although this value is slightly more than 2½ times the domestic fraction in 1990 (Figure 4).



Two other interesting indices are also illustrated in Figure 4. These are the ratio of production to reserves and deliveries to reserves. In both of these cases, reserves are in the year indicated. Following the upswing in domestic gas production associated with coalbed sources in 1990, both the production and the delivery to reserves ratios fell dramatically. Currently the production to reserves ratio is about 35 % of the 1987 value. The deliveries to reserves ratio is only 21 % of the 1987 value.

While production and reserves are multiplying, there is a growing consolidation of the Virginia gas industry as a smaller number of producers become responsible for a growing percentage of total production (Figure 5).

In spite of record production increases, the state's gas industry remains a very small player nationally. Virginia's 1996 gas production (approximately 54 billion cubic feet) represented only about ¼

of 1 % of the nation's total. Unlike coal, U.S. gas production tends to be geographically concentrated. In 1996, the top three producing states, Texas, Louisiana, and Oklahoma, were responsible for 68 % of the nation's 19.5 trillion cubic feet (tcf) production total. About 4 tcf, or about 20 % of the nation's production, came from offshore wells in the Gulf of Mexico.

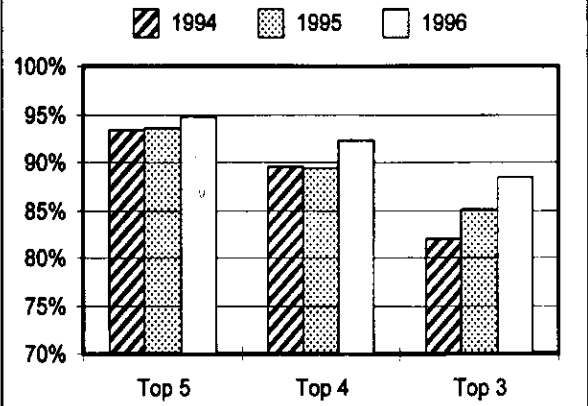
The Future

Consider for a moment what would happen if Virginia produced 7¼% of present reserves again on an annual basis, as in 1987, rather than the current level of about 2½%. What would this mean in revenue from sales of Virginia natural gas? For starters, the domestic fraction would increase from 20% to 62%. That is, total production would increase from the 54.3 billion cubic feet (bfc) of 1996, to about 168 bfc. In terms of revenue generated, this would mean approximately \$195 million at a rate of \$1.72 per 1000 cubic feet, paid at the wellhead. Delivered at consumer prices, the additional revenue to Virginia suppliers could be as much as \$547 million, based on 1995 prices and consumer distribution.*

How will Virginia gas producers fare in the emerging energy economy? Time alone will tell. On the one hand, the changes affecting the industry may result in increased opportunities for small-scale players, such as Virginia gas producers. On the other hand, the region's small production capacity may cause it to be unattractive to the increasingly large energy transportation and marketing firms spawned during this era of deregulation and improved information technology.

*Residential 28.7% at \$7.18 per 1,000 cubic feet; Commercial 23.8% at \$5.08; Industrial 40.7% at \$3.35; and Electric Utility 6.8% at \$2.67

Figure 5 - Increasing Concentration of Virginia Gas Production Among Top Producing Companies, 1994 - 1996



1997

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- Company Name
- Company Contact
- Company Address
- Telephone Number
- Mine Name
- Mine Type
- Activity Status, 1/1/96
- Production, 1995
- Production, 1996
- Number of Employees
- Number of Days Worked
- Number of Hours Worked
- Tons/Man Hour
- Wages
- County
- Seams Worked
- Seam Heights
- Equipment Used
- Coal Owners

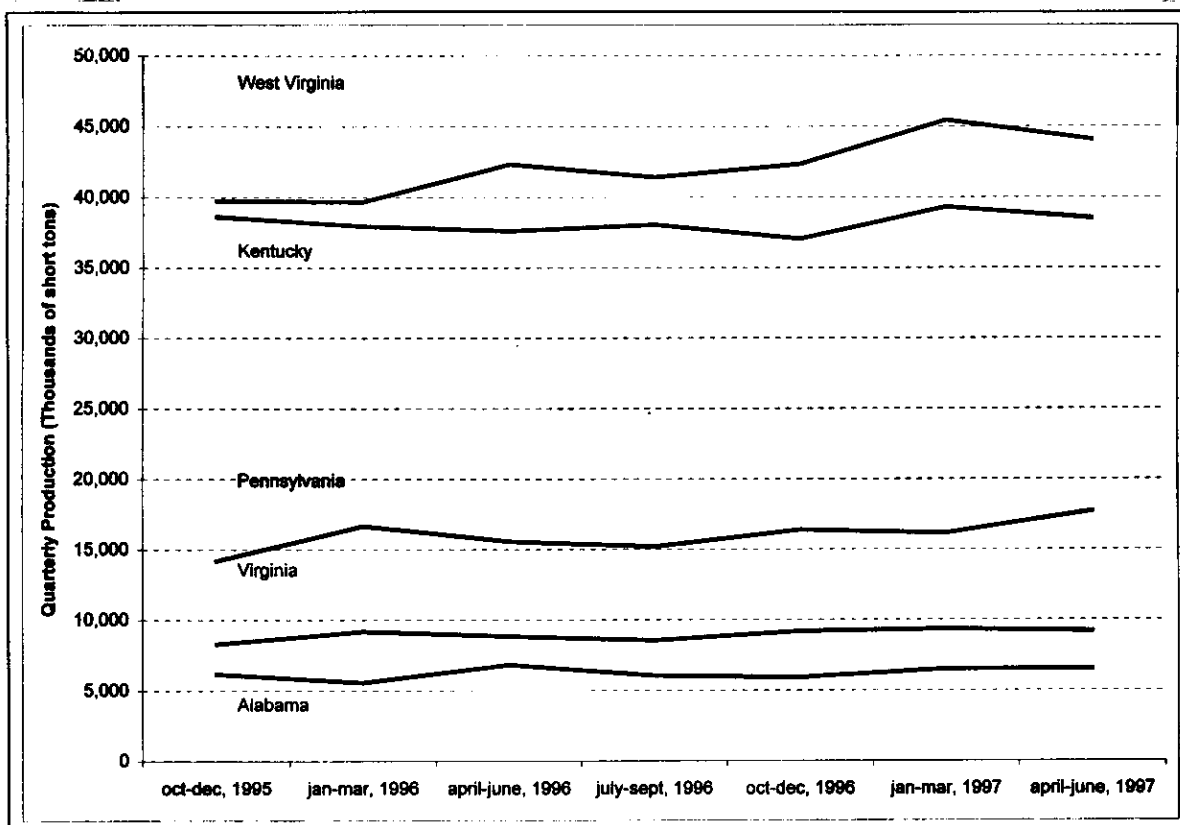
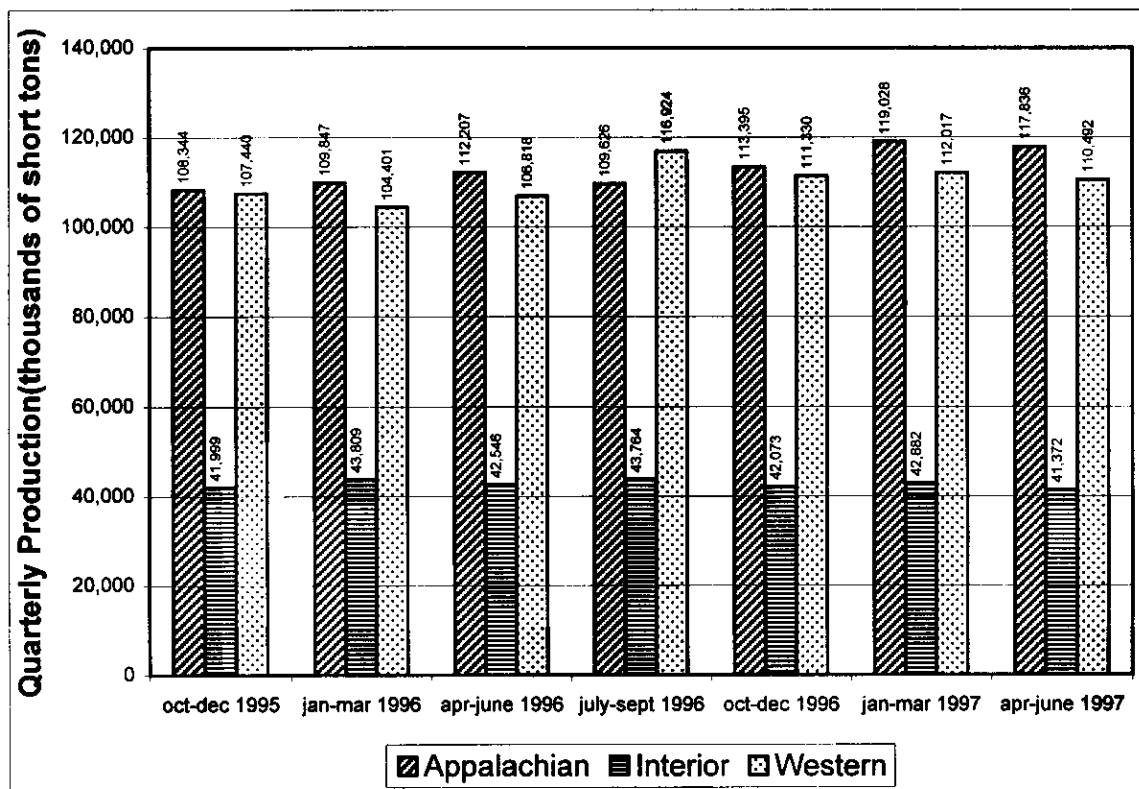
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Quarterly Coal Production



**Average Price of Gas for United States and Virginia, by Consumer
With 1996 Deliveries and Market Value in Virginia**

| | 1996 - \$ per thousand cubic feet ¹ | | 1996 Deliveries (million cubic feet) ² | 1996 Market Value (millions of dollars) |
|------------------|--|----------|--|--|
| | U.S. Average | Virginia | Virginia | Virginia |
| Wellhead | N/A | N/A | | |
| City Gate | 3.34 | 3.89 | | |
| Residential | 6.29 | 7.94 | 76,818 | 609.9 |
| Commercial | 5.38 | 5.85 | 58,649 | 343.1 |
| Industrial | 3.35 | 4.24 | 84,864 | 359.8 |
| Electric Utility | 3.98 | 2.98 | 10,275 | 30.6 |
| | | | 1996 Totals for Virginia: | |
| | | | 230,606 | 1343.5 |

¹ Department of Energy, Energy Information Administration, Natural Gas Monthly, Publication DOE/EIA-0130(97/06) pp. 49 – 63.

² op. cit. pp. 29 – 44.

**Total Gas Deliveries in Virginia for 1996
With Virginia Production, by Conventional and Coalbed Sources**

| | (million cubic feet) | (million cubic feet) |
|--|---------------------------|----------------------|
| Total Gas Deliveries (1996) ³ | | 230,607 ¹ |
| Virginia Production | | 54,290 |
| <i>Conventional</i> | 20,137 (37%) ² | |
| <i>Coalbed Methane</i> | 34,154 (63%) ² | |
| Net Gas Imported | | 176,317 |

¹ Department of Energy, Energy Information Administration, Natural Gas Monthly, Publication DOE/EIA-0130(97/06), p. 46.

² Department of Mines, Minerals and Energy, Division of Gas and Oil, Commonwealth of Virginia, 1996 Gas and Oil Report, June 1997, p. 9.

³ Includes only gas deliveries; does not include gas used as lease and pipeline fuel. Quantity of lease and pipeline fuel for 1996 not available at this time.

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