ENERGY OUTLOOK

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Where Will We Get Our Power in the 21st Century?

Unlike many other commodities available to consumers throughout the twentieth century, electricity has yet to go out of style. In the past hundred years, electrical power has held its own as a commodity in high demand. And why not? It is convenient, versatile, easy to transmit, and relatively inexpensive. Moreover, Appalachian Electric Power (AEP) expects overall power demand in its Virginia service area to grow at an average rate of 2.1 percent per year during the period of 1995 to 2005. This is a reflection of an increasing population, provisionally estimated to rise at a rate of about 0.5% per year over the 1990-2000 period for the region (according to the Virginia Employment Commission), and of the ever rising popularity of electricity, a trend which shows no signs of slowing down.

The increase in electricity consumption for the complete United States for the decade of 1985 to 1995 is shown on the figure on page 2, together with the contributions of the sources of energy from which the electrical power was generated. The growth in power demand has been such that all of the base sources also increased during this period - but for most of these sources, there looms a unique set of constraints. The rise in nuclear power, for example, was a consequence of newly-constructed nuclear power stations coming on line. However, there have been no new nuclear stations ordered in the United States since 1978, nor are there likely to be in the near future; hence, we can expect the contribution of nuclear power to decrease, although it retains significant promise for the longer term. Meanwhile, despite its increasing utilization, the employment of oil for power generation is constrained by cost and by our dependence on politically insecure overseas sources. The increasing availability of natural gas in the United States (Energy Outlook, Vol.XVI, No.1, Spring 1996), coupled with high efficiency for smaller generating sets, may lead to the increased use of this fuel, but this will most likely be limited to localized power generation. In addition, the potential for large new hydro-electric schemes in the United States is limited, both by the lack of further suitable water systems and by environmental considerations (although, again, there may be an increase in the use of this resource to meet smaller, local need). Other renewable forms of energy have contributed very little to the nation's electrical power base over the past decade. While research into renewable energy will (and should) continue, it is likely that this will play no more than a minor role in the total energy market in the foreseeable future.

This leaves coal as the dominant resource that has fed the nation's increasing demand for electricity. Domestic coal utilization has increased by about a third over the past decade. This increase is likely to continue, as well, while the future for coal utilization in the United States over the coming decades will be dominated by two major issues. First, there will be the country's ongoing need

In this issue

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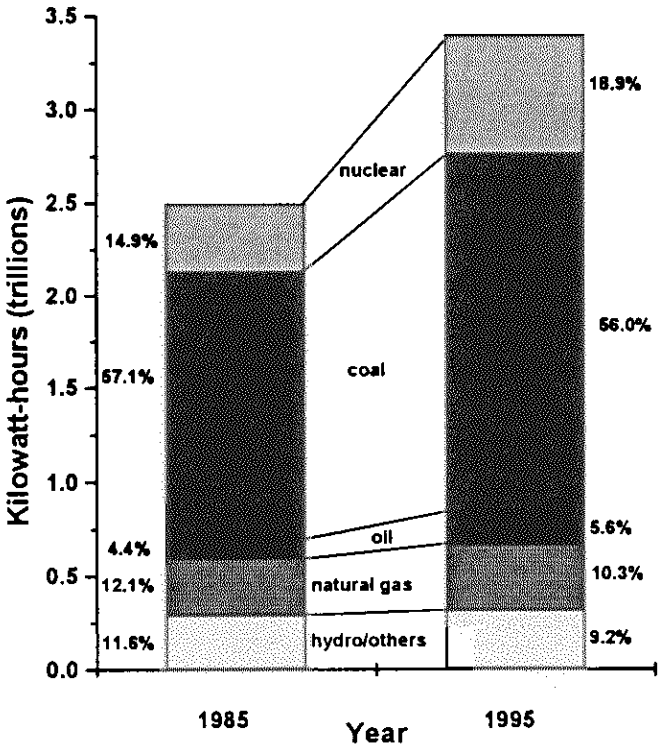
for a source of energy that is low-cost, readily available, and secure. Second, environmental standards governing the mining and utilization of coal will become increasingly rigorous. Both of these matters have been investigated in detail by a committee of the National Research Council in a study undertaken at the request of the U.S. Department of Energy; this study highlights the directions that DOE should consider in revising its strategic plan for coal.

The resulting report, published by the National Academy Press, makes interesting reading for anyone concerned with energy production ("Coal, Energy for the Future," National Academy Press, Washington D.C., 1995 TP 326.U6N385). In it, the committee reviews the markets for coal, the major uses of coal, the availability of competing energy sources, coal utilization technologies, and the current and probable future environmental legislation affecting coal use. A significant conclusion is that, worldwide, the growth in coal utilization will be even more rapid than has been seen in the United States. Increasing populations and economic development in the Asian nations, notably China, will ensure this growth. Coal is not resource-limited. It accounts for over 94 percent of the proven fossil fuel reserves in the United States. In practice, this is reduced very considerably by the practical issues of geology, mining economics and environmental constraints. While the older-worked coalfields will see a decline in output (Energy Outlook, Vol. XVI, No. 3, Fall 1996), the national coal reserve base remains high.

Of the approximately one-billion tons of coal that are mined in the U.S. annually, some 10 percent is exported. It is of interest to note that there is no great increase in the export market on the horizon; while prospects may improve for increased sales to western Europe, prices will remain relatively low due to highly productive extraction techniques in South America and our western states.

As indicated by the figure, nuclear power is coal's closet competitor. However, memories of Chernobyl and Three Mile Island - coupled with fears of nuclear proliferation and ongoing political wrangling over the disposal of nuclear waste - suggest that there will be little, if any, new capacity from nuclear power stations in the United States in the next two to three decades. Furthermore, there is a sufficient general baseload capacity (with regional variations) to indicate that the demand for large new coal-fired stations will remain low until about 2010, when the retirement of older stations, the need for reduced emissions, and an increased baseload will combine to necessitate the construction of large new stations. Smaller power stations will be constructed for peak loads in the meantime, some of which may favor gas-fired units.

Energy Sources for Electrical Generation in the United States



But in what form will the nation's coal be utilized? Probably it will continue to be most useful in its natural state. Outside of South Africa, the production of liquid and gaseous fuels from coal is small. The reasons for this include the processing costs, environmental difficulties, and the availability of low-priced petroleum and natural gas. This situation is projected to remain in a similar state for the next fifteen years. After that, technological developments in coal science and environmental control, coupled with increasing prices and the decreasing availability of oil, will make liquid/gas fuel extraction from coal more attractive.

The National Research Council report makes projections for three time periods. Until 2005, the utilization of coal will remain much as it is at the present time - primarily for power generation, but with improving environmental safeguards. In the mid-term, estimated as the period from 2006 to 2020, electrical power generation will still provide the primary market for coal in the United States, with an increased baseload, high-efficiency generators and reduced emissions. During this time, higher oil prices will encourage renewed research into the production

of liquid/gas fuels from coal. From 2020 to 2040, coal is projected to provide an increasing contribution to our supply of liquid and gas fuels, although coal-fired power stations will remain significant in output and will have stringent controls on emissions. Also during these coming decades, alternative (renewable) sources of energy will become more viable, while the safety and waste problems associated with nuclear power may at last be resolved.

Where will our electrical power come from in the 21st century? Technologies evolve so rapidly that it is hard to imagine what the world will be like even twenty years from the present. We can be almost certain, however, that we will still want and need electricity, and more of it than ever before. The bottom line is that the future of coal is assured well into the next century.

VIRGINIA ENERGY STATISTICS

As a new feature of the *Energy Outlook*, statistics relating to the production of electricity, coal and natural gas in the Commonwealth of Virginia will now be regularly featured for informational purposes.

Any comments pertaining to these statistics, or regarding statistics that you would like to see in future issues, should be addressed to Ian Loomis, VCCER, 109 Femoyer Hall, Virginia Tech, Blacksburg, VA 24061-0411 (Telephone 540/231-8108).

Average Price of Gas for United States and Virginia, by Consumer, with 1995 Deliveries and Market Value in Virginia

	1995 - $ per thousand cubic feet[1]		1995 Deliveries (million cubic feet)[2]	1995 Market Value (Millions of Dollars)
	U.S. Average	Virginia	Virginia	Virginia
Well head[3]	1.55	1.72		
City Gate	2.78	2.92		
Residential	6.06	7.18	68,712	493.4
Commercial	5.05	5.08	56,991	289.1
Industrial	2.71	3.35	97,499	326.6
Electric Utility	2.02	2.67	16,414	43.8
		1995 Totals for Virginia:	239,616	1152.9

[1] - Department of Energy , Energy Information Agency, *Natural Gas Monthly*, Publication DOE/EIA-0130(97/02), pp. 49-63.

[2] - op. cit. pp. 29 - 44.

[3] - Department of Energy , Energy Information Agency, *Natural Gas Annual 1995*, Publication DOE/EIA-0131(95), p. 17.

Total Gas Deliveries in Virginia for 1995, with Virginia Production, by Conventional and Coalbed Sources

	(million cubic feet)	(million cubic feet)
Total Gas Deliveries (1995)[3]		239,616[1]
Virginia Production		49,867
Conventional	*19,511 (39%)*[2]	
Coalbed Methane	*30,356 (61%)*[2]	
Net Gas Imported		197,331

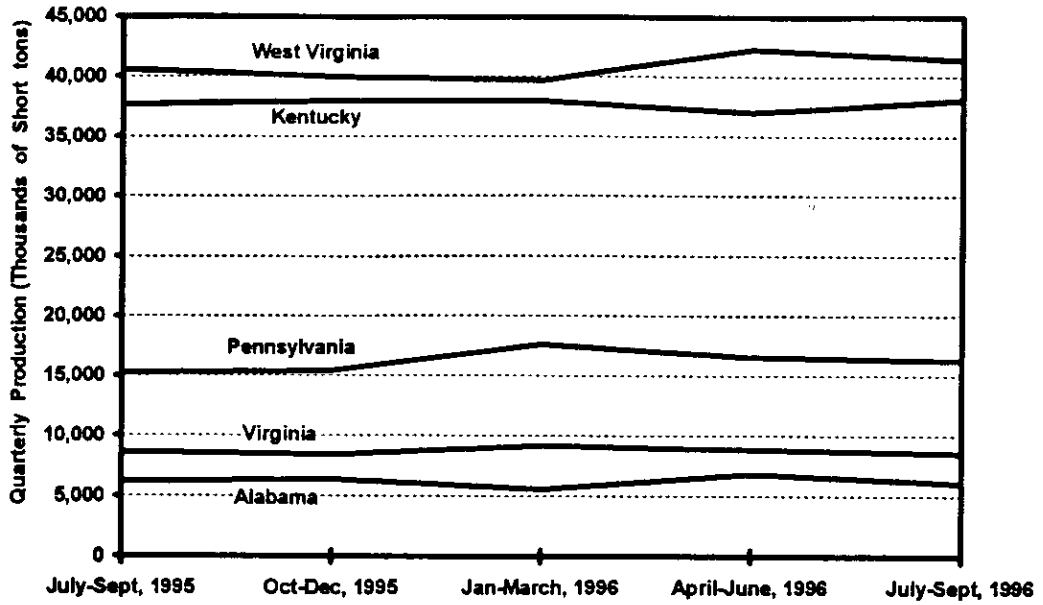
[1] - Department of Energy, Energy Information Agency, *Natural Gas Monthly*, Publication DOE/EIA-0130(97/02), p. 45-48.

[2] - Department of Mines, Minerals and Energy, Division of Gas and Oil, Commonwealth of Virginia, *1995 Gas and Oil Report*, June 1996, p. 11-Rpt-95.

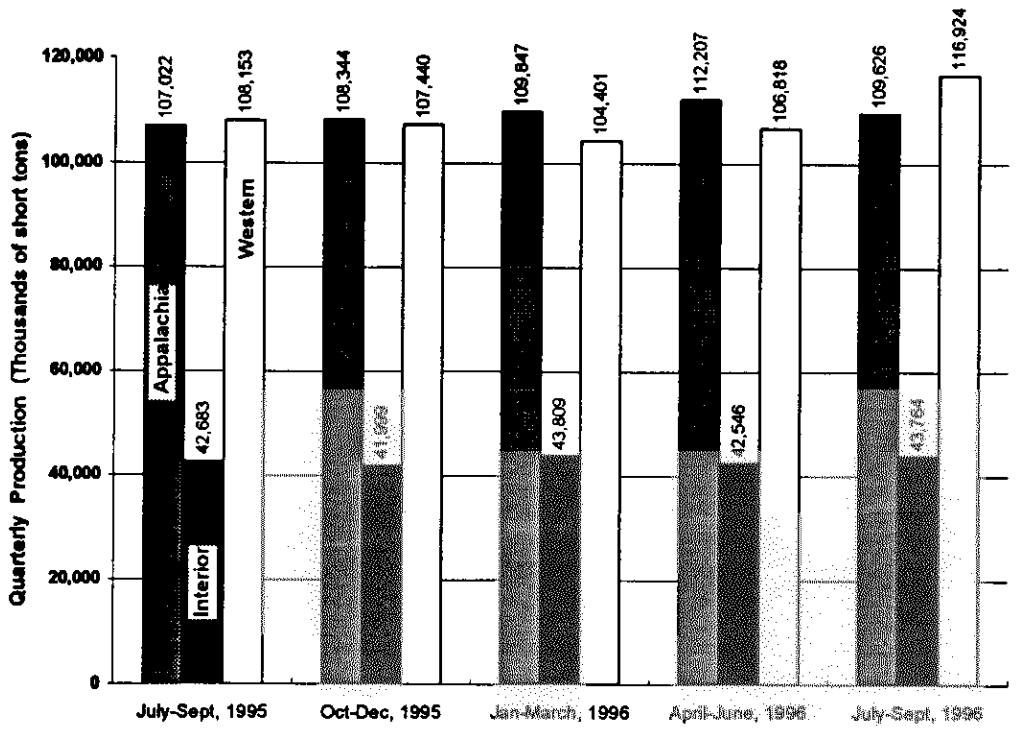
[3] - Total Gas Deliveries does not include 7,582 MMcf used as lease and pipeline fuel.

Coal Quarterly Production Statistics

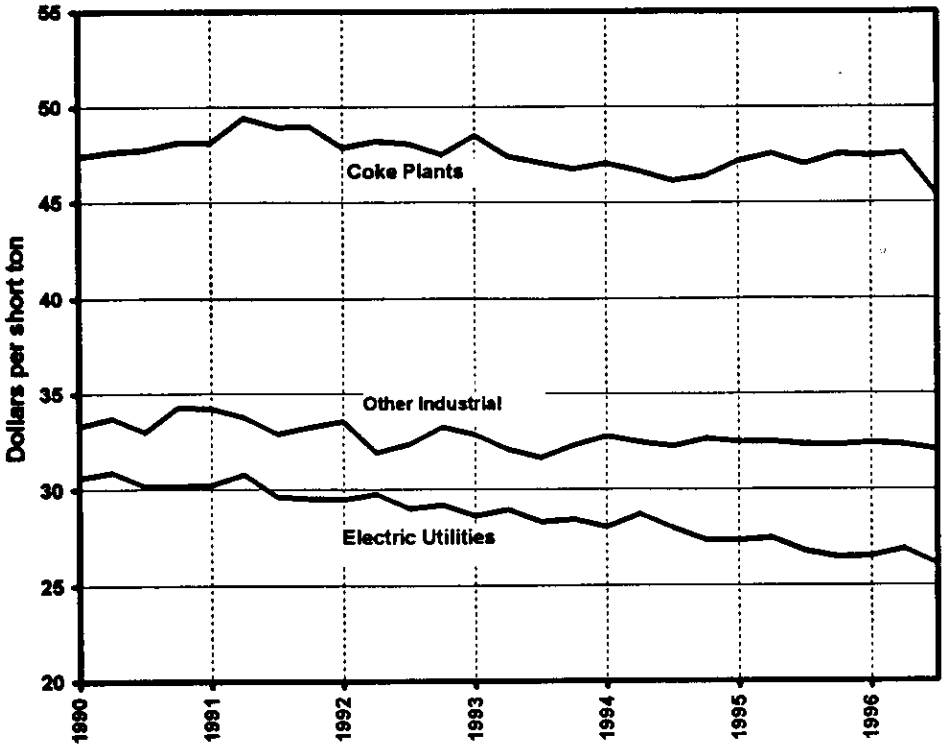
Appalachian



National



Average Price of U.S. Coal Receipts



Electric Utlity Generation
Share of Total (%)
for United States, Virginia, and Surrounding States

	Coal		Petroleum		Gas		Nuclear		Hydroelectric	
	1995[1]	1996[2]	1995[1]	1996[2]	1995[1]	1996[2]	1995[1]	1996[2]	1995[1]	1996[2]
US	**55.0**	**56.1**	**2.0**	**2.2**	**10.6**	**8.9**	**22.4**	**21.9**	**9.7**	**10.6**
VA	*46.2*	*48.8*	*2.3*	*1.2*	*3.8*	*2.1*	*47.7*	*47.0*	*0.3*	*0.9*
WV	99.2	99.1	0.3	0.2	0.1	-	-	-	0.5	0.6
KY	95.6	95.4	0.2	0.1	0.1	0.2	-	-	3.9	4.3
OH	87.1	89.9	0.2	0.2	0.4	0.1	12.2	9.5	0.2	0.3
TN	70.4	63.3	0.3	0.3	0.2	0.1	19.2	25.4	9.9	10.6
MD	61.2	63.1	2.9	3.3	3.7	1.6	29.0	26.7	3.2	5.4
NC	57.1	62.9	0.2	0.2	0.3	0.2	38.1	32.4	4.3	4.3
PA	57.3	57.7	1.6	1.9	1.4	0.4	39.4	39.2	0.3	0.8

Source: Department of Energy , Energy Information Agency, *Electric Power Monthly, February 1997, with data for November 1996*, Publication DOE/EIA-0226(97/02), pp. 20-24.

[1] - 1995 data listed as final.

[2] - 1996 data listed as preliminary.

ENERGY SCOUT:
VCCER Report on Acid Rain Act Available

Economists have long argued that market-based, incentive approaches to pollution control would be less costly and more effective than the traditional, "command and control" regulatory approach. "Command and control" regulation is characterized by static emissions limits which do not take into account the costs of compliance by individual pollution sources. The U.S. Clean Air Act Amendments of 1990 (CAAA90) established a sulfur dioxide (SO_2) control program which aims to reduce acid rain while minimizing pollution control costs. Title IV of the CAAA90 established what has become known as the Acid Rain Program, which applies a flexible, market-based approach to achieve pollution abatement through the issuance of tradable SO_2 emissions permits (called "allowances").

Phase I of the CAAA90 program became operational in 1995. In a new VCCER research report, *The Clean Air Act Acid Rain Program: Implications for Virginia's Coal Producers* (Gilroy & Zipper, VCCER Report No. 97-01, May 1997) the results of an empirical assessment of electric utility compliance strategies during the program's first year of full implementation are provided, and these results analyzed with respect to their implications for producers of Virginia coal. Copies are $8.00 apiece; for more information, contact Lisa Blankenship, VCCER, 100 Holden Hall, Virginia Tech, Blacksburg, VA 24061-0411 (Telephone: 540/231-5038. E-mail: lisab@vt.edu).

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