

# **Economic Impacts of Virginia's Natural Gas Industries**

Carl E. Zipper  
Leonard Gilroy

**Virginia Center for Coal and Energy Research**  
Virginia Polytechnic Institute and State University  
Blacksburg, Virginia 24061-0411  
(703) 231-5038

**REPORT NO. 95-2**  
*September 1995*



# Economic Impacts of Virginia's Natural Gas Industries

## TABLE OF CONTENTS

<b>Executive Summary</b> .....	1
<b>Economic Impacts Considered</b> .....	2
<b>Project Methods</b> .....	2
<b>Direct Economic Impacts</b> .....	3
<b>Total Impact Estimates</b> .....	10
<b>Summary of Results</b> .....	15
<b>Acknowledgments</b> .....	15
<b>References</b> .....	15

## LIST OF TABLES

1.	Composite Estimates of Economic Data for Virginia's Gas- and Oil-Producing Firms (1993) .....	5
2.	Economic Data for Interstate Pipeline Operations in Virginia (1993) .....	8
3.	Economic Data for Virginia Natural Gas Distributors (1993) .....	8
4.	Statewide Economic Impact Calculations (1993) .....	11

## LIST OF FIGURES

1.	Virginia natural gas production .....	6
2.	Estimated distribution of Virginia interstate pipeline transport gas volumes among destinations .....	7
3.	Estimated disposition of revenues received by Virginia natural gas distributors .....	9
4.	1993 revenues, capital investment, and state and local tax payments by major natural gas industry segments .....	12
5.	Comparison of 1993 Virginia natural gas production volume to statewide gas sales .....	12
6.	Estimated distribution of jobs supported by Virginia's natural gas industries .....	13
7.	Estimated distribution of wages and salaries supported by Virginia's natural gas industries .....	14

# **Economic Impacts of Virginia's Natural Gas Industries**

Virginia Center for Coal and Energy Research  
Virginia Polytechnic Institute and State University  
Blacksburg, Virginia 24061-0411  
*September 1995*

## **Executive Summary**

This study estimates the contributions of the natural gas industries to Virginia's economy. Activities covered by this study include the production of natural gas and associated products from wells in southwestern Virginia, gas transportation, and the distribution of natural gas to consumers throughout Virginia.

The economic impacts of Virginia's natural gas industries considered by this study include direct, indirect, and induced effects. Direct effects include employment, payroll expenditures, and state and local tax expenditures by Virginia's natural gas industries; baseline data from published sources and an industry survey were used to estimate direct effects.

A measure of direct effects, however, does not capture the full extent of the gas industries' economic impact. A portion of the revenues received by these industries is spent in Virginia communities to purchase goods and services. In addition, wages and salaries received by natural gas industry employees, and by employees of supporting industries, support economic activity within the state. The business activities supported by industry and employee expenditures are called indirect and induced effects. Economic multipliers were applied to baseline data to estimate the indirect and induced economic effects resulting from the production, transportation, and distribution of natural gas in Virginia.

In 1993, Virginia's natural gas industries employed over 3,000 people who earned more than \$140 million in wages and salaries. In addition, over \$80 million of industry revenues supported state and local governments as taxes and other payments. However, the industries' total economic impacts went well beyond these figures. Total in-state economic impacts of Virginia's natural gas industries - including direct, indirect and induced effects - during 1993 are estimated at over \$1.5 billion in total economic activity, 12,000 jobs, and \$350 million in payroll income.

# Economic Impacts of Virginia's Natural Gas Industries

Virginia's natural gas industries are integral to the Commonwealth's economy. Although natural gas supports the lifestyles enjoyed by many Virginia citizens, the natural gas industries' economic contributions have remained out of the public eye. Few Virginia citizens recognize the Commonwealth's status as a gas producer, and even fewer are aware that Virginia's gas production is increasing rapidly. Similarly, few Virginians know of the economic activity associated with transportation and distribution of gas fuels in the Commonwealth.

The availability of natural gas fuels is integral to the quality of modern life. In contrast to the networks which distribute other commonly used energy sources, the infrastructure which carries natural gas to homes, businesses, and public facilities remains virtually unnoticed.

This report documents the economic contributions of the natural gas industry to the Commonwealth of Virginia.

## Economic Impacts Considered

The major types of economic impacts considered in conducting this study are described below.

- *Direct* economic impacts are those which occur as a direct result of industry activity. These include employment in the natural gas industries, wages paid by these industries to their employees, and the economic value of the products and services which those industries provide.

- *Indirect and induced* economic impacts include "spinoff" effects of industry activities. Indirect effects include the effects of purchases by an industry from local suppliers, while induced effects include economic impacts of expenditures by households receiving income from the natural gas industries.

- *Total* impacts are considered to be the sum of direct, indirect, and induced effects.

The study considered only *backward linkages* of Virginia's natural gas industries; these include the effects of natural gas industry purchases and tax payments, and expenditures by industry employees. Those impacts which economists describe as *forward linkages* - the value created when other businesses and individuals use natural gas fuels - are not included in this analysis.

## Project Methods

The research took place in two major phases.

First, information on the direct impacts of Virginia's natural gas industry was gathered from a variety of sources. Primary among these were:

- The Virginia Department of Mines, Minerals and Energy's "1993 Gas and Oil Report," which reports oil- and gas-production data.
- Various publications of the U.S. Energy Information Administration (EIA).
- Information filed by commercial gas-distribution firms with the Federal Energy Regulatory Commission (FERC) and the Virginia State Corporation Commission (FERC Form II).
- Information provided by Virginia natural gas firms through responses to a mail survey conducted to gather data for this research, and through telephone discussions.

Secondly, the information was compiled and analyzed using the IMPLAN input-output model (Minnesota IMPLAN), the 1992 IMPLAN Virginia data set, and data gathered during the first study phase. For those industry sectors which are essential to this study, we altered IMPLAN's input assumptions so as to accurately reflect the baseline conditions represented by data collected during this study. The resulting multipliers were used to convert *direct* economic impacts, as documented from the above sources, to *total* impacts, which include direct, indirect, and induced effects.

The study is based on calendar year 1993.

## **Direct Economic Impacts**

For the purpose of this study, we considered Virginia's natural gas industry to consist of three primary sectors: producers, pipeline transporters, and distributors. Several firms operate in more than one sector.

### **Producers**

Natural gas production is a major industry in far southwestern Virginia. The major gas-producing counties are Buchanan, Dickenson, and Wise. In 1993, natural gas was also produced in the counties of Russell, Scott, and Tazewell, while a small amount of crude oil was produced in Lee County. Crude oil was also produced as a byproduct of conventional gas extraction in other counties. For the purposes of this report, the economic impacts of crude-oil production are included within the natural gas industry's economic impacts.

Two major technologies are utilized for natural gas extraction: conventional extraction and coalbed-methane extraction. Conventional gas drilling taps deep gas reservoirs. The average depth of conventional gas wells drilled in 1993 exceeded 5,000 feet (VDMME).

Coalbed-methane wells extract methane gas from coal seams. If not extracted in advance of mining, methane gas is released during mining. High methane-gas contents in some coal seams can cause dangerous mining conditions. Therefore, some coalbed-methane wells are drilled to remove gas from coal seams in advance of mining, creating less-dangerous mining conditions as

well as extracting a marketable product.

Thirty-seven billion cubic feet of gas were produced in southwestern Virginia in 1993 (VDMME). Fifty-four percent of this production was coalbed methane, while the remainder was conventional product (Figure 1). In 1993, Virginia ranked twenty-first among the nation's gas-producing states (U.S. EIA). Virginia's production was equivalent to approximately 17 percent of consumption. Virginia's gas (and oil) production was valued in the marketplace at approximately \$85 million (Table 1).

Total Virginia employment in the natural gas- (and oil-) producing industry is difficult to determine. First of all, several of Virginia's major gas-producing firms are primarily engaged in other businesses (including coal mining). Because Virginia Employment Commission (VEC) data classify workers according to their employer's primary business, VEC data do not accurately represent the full extent of Virginia's gas-producing industry employment. Secondly, a number of Virginia's producers operate from offices located out-of-state. Therefore, relationships between production volumes and employment that are typical of other states cannot be used to estimate employment by the Virginia industry.

The employment figure of Table 1 is an estimate based on a firm-by-firm telephone survey and extended discussions with several producers. A listing of Virginia gas producers provided by the Virginia Division of Gas and Oil provided the basis for the telephone survey. We were unable to reach all producers. The gas-production employment estimate of Table 1 is meant to represent workers based in the state of Virginia who are active in operating Virginia's gas-production capacity. The figure is meant to represent production-company employees and employees of contractors who are engaged in activities directly related to production.

Production wages and salaries are estimated based upon per-employee averages which were calculated from the VEC data (Table 1) and from information provided by several gas-production firms. Service industry employment and wage figures (Table 1) are taken from VEC data reports. Our discussions with Virginia producers indicate that the number of workers contracted by southwestern Virginia gas operations exceed the VEC figures. One reason for this discrepancy is that some firms whose primary business is not gas-related also contract services to gas producers.

Tax-payment and-capital spending estimates are based upon mail-survey results and telephone discussions. Information on gas production, footage drilled, and gathering-line construction contained in the 1993 VDMME Gas and Oil Report were used as a basis for extrapolating information obtained from those Virginia firms that provided detailed data to a total industry basis.

Although Virginia's natural gas production is confined to the southwestern counties, natural gas production also supports employees elsewhere in the state. The producer telephone survey resulted in contacts with several in-state firms which have no active (or very minimal) production in Virginia, but do maintain offices in Virginia to administer major gas holdings in other eastern states. These employees' wage and salary income estimates are based on data from VEC; all of these offices are located east of the Blue Ridge.

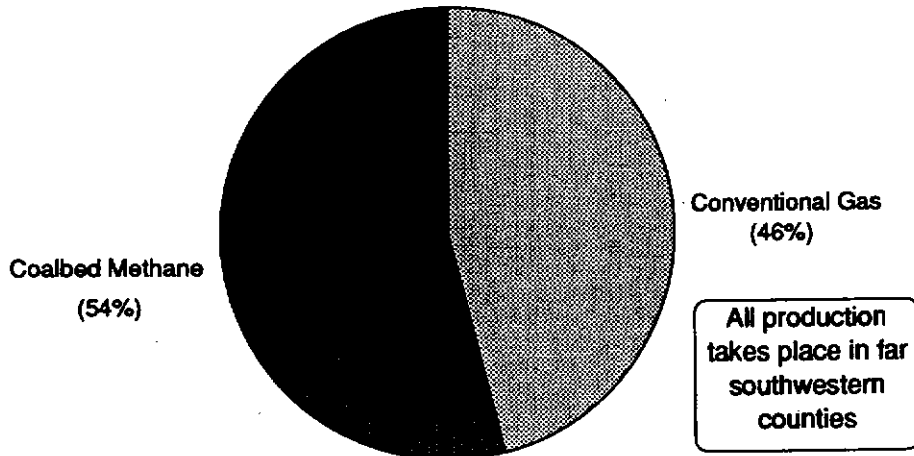


**Table 1. Composite Estimates of Economic Data for  
Virginia's Gas- and Oil-Producing Firms (1993)**

IN SOUTHWEST VIRGINIA:		Information Source
<b>Production Volumes:</b>		
Conventional Gas	17 bcf	VDMME
Coalbed Methane	20 bcf	"
Total	37 bcf	"
Average Wellhead Price	2.29 per mcf	"
Crude Oil Produced	12,120 bbl	"
Average Wellhead Price	16.21 per bbl	"
Gas Production Revenue	84.8 \$ million	Calculated
Oil Production Revenue	196 \$ thousand	"
Total Revenue - Oil and Gas	85.0 \$ million	"
<b>Gas Producers</b>		
Employment	33	VEC
Payroll	1.5 \$ million	"
<b>Gas Production</b>		
Employment	125	Estimated
Payroll	5 \$ million	by VCCER
<b>Service Firms</b>		
Employment	118	VEC
Payroll	3.9 \$ million	"
Taxes Paid (State and Local)	3.8 \$ million	Estimated by VCCER
<b>Capital Investment</b>		
Exploration, Development	34 \$ million	"
Gathering Systems	6 \$ million	"
<b>ELSEWHERE IN STATE:</b>		
<b>Gas Producers (1)</b>		
Employment	100	Estimated
Payroll	8 \$ million	by VCCER
<b>Service Firms</b>		
Employment	99	VEC
Payroll	29 \$ million	VEC

(1) Production firms with minimal in-state production, which also maintain administrative offices in the state.

**Figure 1. 1994 Virginia natural gas production**



**Total Production: 37 billion cubic feet (\$85 million value)**

12,000 barrels crude oil also produced

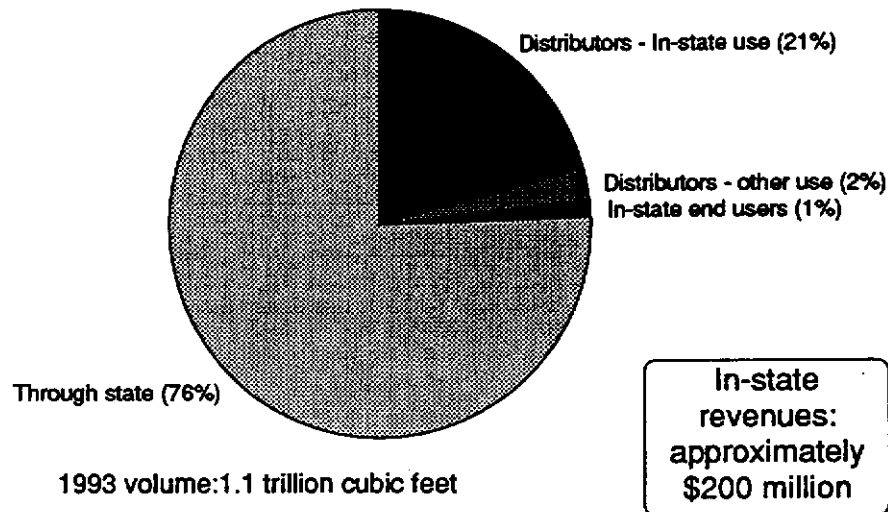
### **Interstate Pipelines**

Four interstate pipeline firms operate gas-transportation facilities in Virginia. The pipeline-transportation network maintained by these firms moves gas to Virginia distributors and industrial end-use customers, and it is used to transport gas through the state to out-of-state destinations. Some of Virginia's production is fed into pipelines within the state, and some is moved north and west to pipelines in Kentucky. The volume of gas moved into Virginia's pipelines by Virginia producers is quite small, relative to the total amount of gas handled by the state's gas-transportation system.

Volumes of gas moved through Virginia's natural-gas pipeline network were estimated from two sources. The volumes moved to in-state commercial distributors for transfer to in-state users were compiled from the distributors' FERC filings. Because municipal distributors are not required to file operating data with the FERC, municipal distributor estimates are based on responses to our mail survey. The remaining information on volume was estimated based on U.S. EIA (1995), which contains profiles of the major gas-transportation firms including the four which serve Virginia. The predominant activity of Virginia's major pipelines is the movement of gas through the state (Figure 2).

The quantity of gas moved to in-state distributors for uses "other" than transfer to in-state consumers was estimated as a residual: We subtracted our estimate of the distributors' purchases for transfer to in-state consumers from the total volume shipped to Virginia distributors, as recorded by U.S. EIA (1995). This quantity represents gas purchased by distributors from

**Figure 2: Estimated distribution of Virginia interstate pipeline transport gas volumes among destinations**



Virginia pipelines for sale to non-Virginia consumers (several distributors serve customer bases which span state lines), as recorded by the EIA. Our estimate of gas transfers to Virginia distributors for in-state sale (Table 2) is slightly higher than the estimated volumes sold to in-state consumers (Table 3) to account for distribution system losses.

Pipeline employment, and wage and salary payments by pipeline firms, are figures provided by the Virginia Employment Commission for Standard Industrial Classification (SIC) occupational code 4922 ("Natural Gas Transmission"). In-state pipeline revenue was estimated at \$0.20 per mcf handled. Because we were unable to obtain information on natural gas pipeline industry cost structures, we estimated this figure by comparing the average 1993 wellhead price in Louisiana (EIA, 1994) to gas-purchase prices listed on the FERC forms by Virginia distributors. The difference was assumed to represent pipeline-transportation revenues. We then estimated in-state revenues by prorating the total transportation revenue estimate to Virginia and non-Virginia transportation segments on a mileage basis. The result was an estimate of \$0.29 per mcf. Because this method is so indirect, we used \$0.20 per mcf as a conservative estimate of the pipeline transporters' average in-state revenues. We also used this figure to estimate revenues received from through-state transport volumes.

Capital-spending and tax-payment estimates are based on the mail-survey responses. Three of the four major pipeline firms serving Virginia provided estimates. The aggregate estimates of Table 2 were developed by calculating average ratios to the total gas volume handled by the three respondents, and applying these ratios to the total volume handled by the state's gas pipeline network.

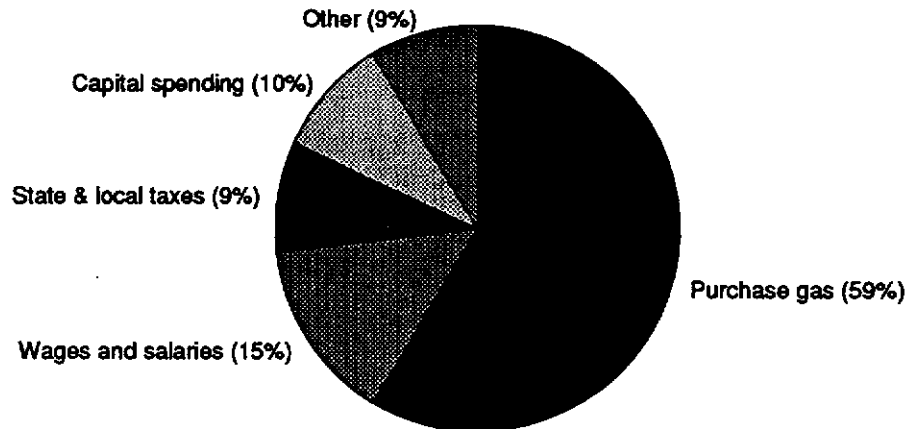
**Table 2. Economic Data for Interstate Pipeline Operations  
in Virginia (1993)**

Volume of Gas Transported:		
To Distributors for In-State Use	225	bcf
To Distributors - Other Use	26	bcf
To In-State End Users	14	bcf
To Out-of-State Destinations	818	bcf
Total	1,082	bcf
Revenues Generated:		
Moving Gas to Distributors for In-State Use	45	\$ million
Moving Gas to Distributors - Other Use	5	\$ million
Moving Gas to In-State End Users	3	\$ million
Moving Gas through Virginia to Out-of-State Destinations	164	\$ million
Total	211	\$ million
Employees	316	
Payroll	14	\$ million
State and local tax payments	6	\$ million
Capital spending	27	\$ million

**Table 3. Economic Data for Virginia Natural Gas  
Distributors (1993)**

Volume of Gas Handled	205	bcf
Total Revenues	834	\$ million
Disposition of Revenues		
Cost of Gas Purchased	488	\$ million
Payroll	122	\$ million
State and Local Tax Payments	73	\$ million
Capital Spending	79	\$ million
Other	71	\$ million
Employees	2,929	

**Figure 3. Estimated disposition of revenues received by Virginia natural gas distributors**



1993 Revenues: \$800 billion

### **Distributors**

Virginia residents are served by three municipal and eight non-municipal natural gas distribution firms. Representatives of all but one of these firms responded to the mail-survey information request. Non-municipal gas-distribution firms are regulated as utilities by the Virginia State Corporation Commission.

Volumes of gas handled, and revenues received, by the non-municipal distributors were estimated from FERC Form 2 filings. Volume and revenue figures for the municipal distributors were based on the mail-survey responses. The volume and revenue figures of Table 3 were compiled by totaling individual distributor figures. In a few cases, distributors' accounting years did not correspond to our study's calendar-year-1993 basis, so we used data from the closest available fiscal year. Nearly 60 percent of the revenues received by Virginia distributors are used to pay for gas purchases (including transportation, Figure 3).

Distributor employment and wage and salary payment estimates are based on figures provided by the Virginia Employment Commission. The VEC figures which provide the basis of these estimates are totals of SIC category 4924 ("Natural Gas Distribution") and SIC category 4923 ("Gas Transmission and Distribution"). SIC 4923 listed only five workers, so inclusion of the SIC 4923 total within the Table 3 employment and payroll totals did not introduce a major inaccuracy. Because the VEC data do not fully reflect the employment and wage payments by municipal distributors, information from the mail survey was used to complete these estimates.

State and local tax payments for the non-municipal firms are taken from FERC Form 2 filings. "Payments in lieu of taxes" to local governing bodies by municipal distributors, as reported in the mail survey, are also included in the Table 3 estimate. The state and local tax payment figures of

Table 3 include only those taxes paid directly by the individual firms; they do not include indirect tax payments such as sales' taxes levied on supply purchases. Capital spending estimates are based on the mail-survey responses.

### Summary

Estimated revenues, capital spending, and state and local tax payments by the three major gas industry segments are represented in Figure 4. The producers represented in Figure 3 include only southwestern Virginia production.

The ratio of capital spending to total revenue is quite high for southwestern Virginia's gas producers (nearly 50 percent), as these firms continue to make significant investments in expanding gas production capacity. Because the state and local tax payment figures of Table 1 and Figure 3 do not include sales taxes paid when purchasing equipment and supplies from local businesses, state and local tax payments by gas producers are probably underestimated.

Distributors pay a relatively high proportion of total revenues as state and local tax payments: close to 9 percent, for the sector as a whole. The total amount of gas produced in southwestern Virginia in 1993 was equal to about 18 percent of statewide gas consumption (Figure 5).

### Total Impact Estimates

Economic impacts are estimated in Table 4. Three separate sets of impacts are estimated: Total output, employment, and personal income. Table 4 shows how "multipliers" from the IMPLAN input-output model are applied to direct-impact figures in deriving total impact estimates. We used a 1992 Virginia data set to derive the IMPLAN multipliers. Revenue/employment multipliers were adjusted to reflect a 2.9 percent 1992-93 inflation factor.

In addition to estimating the impacts of each industry segment's primary activity, the economic impact calculations of Table 4 also consider state and local tax payments and capital investment expenditures. These factors are handled as separate calculations because the standard multipliers do not represent taxation and capital-investment effects. Because tax payments and investment can vary widely among firms in the same industry for a given year, they are calculated separately.

Total impact estimates are calculated for each major industry segment by summing the "direct, indirect, and induced" totals for industry revenues, capital spending, and tax payments. Revenues passed between industry segments (direct expenditures on capital investment and taxes) are subtracted from the direct, indirect, and induced totals so as to avoid double-counting.

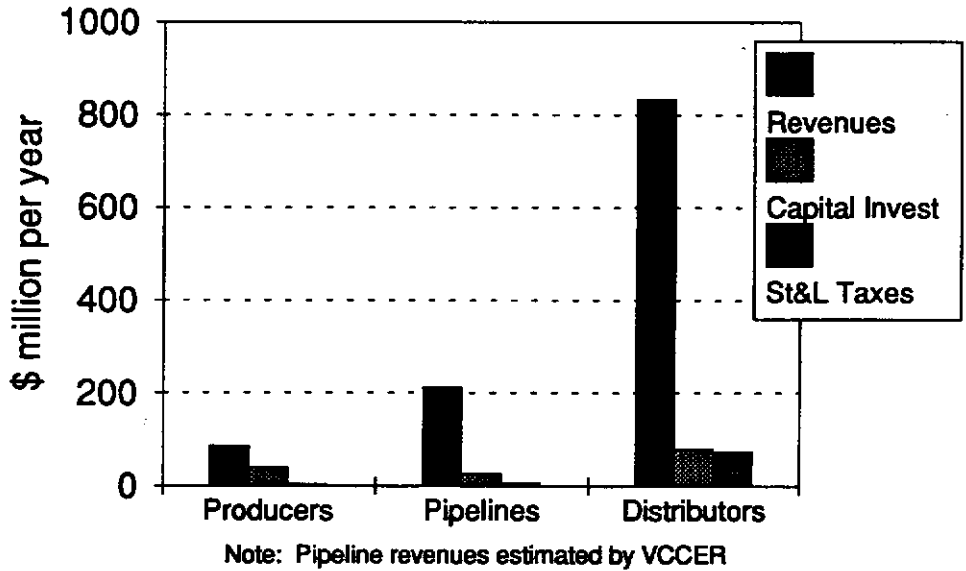
**Table 4. Statewide Economic Impact Calculations (1993)**

	Output (\$ million)	Employ- ment (jobs)	Personal Income (\$ million)	Implan Sector
<b>SW Va Production:</b>				
Revenues/Jobs/Income	85	125	5	# 38 -
Revenue Multiplier	1.51	3.57	2.41	Oil and Gas
Direct, Indirect, Induced	128	446	12	Production
Investment/Jobs/Income (1)	41	200	7	See
Multiplier	1.55	2.25	1.83	Note
Direct, Indirect, Induced	63	450	13	(2)
State and Local Taxes	3.8			# 512
Revenue Multipliers	2.04	23.40	0.57	State and Local
Direct, Indirect, Induced	8	89	2	Gov't Services
Direct, Indirect, Induced (3)	147	984	27	
<b>Administrative Offices:</b>				
Employees/Income		100	8	# 508
Multipliers (4)	0.23	2.97	1.55	Management &
Direct, Indirect, Induced	23	297	12	Consulting Services
<b>Pipelines and Distribution:</b>				
Revenues/Jobs/Income	1,000	3,245	136	# 444
Multipliers	1.37	2.26	1.71	Natural Gas
Direct, Indirect, Induced	1,371	7,336	232	Distribution (5)
Capital Investment	107			# 50
Revenue Multipliers	1.89	18.72	0.46	New Utility
Direct, Indirect, and Induced	202	1,996	49	Structures
State and Local Taxes	80			# 512
Multipliers	2.04	23.40	0.57	State and Local
Direct, Indirect, Induced	162	1,863	46	Gov't Services
Distribution + Pipelines Total	1,549	11,194	326	
<b>Total Estimated Impacts</b>	<b>1,719</b>	<b>12,475</b>	<b>365</b>	

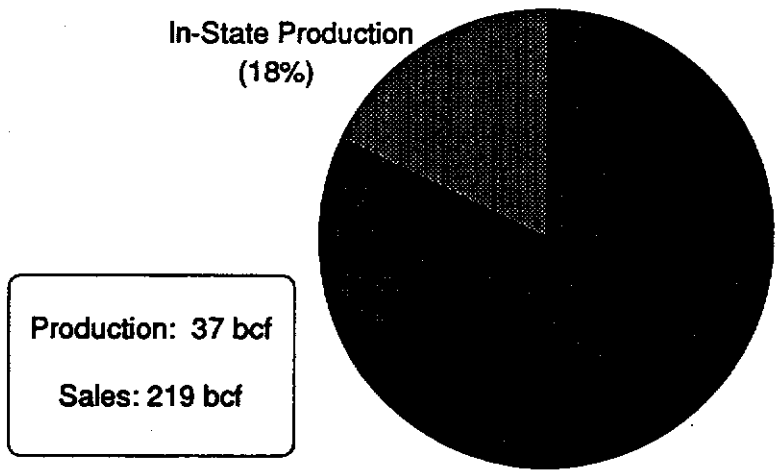
**Notes:**

- (1) Direct employment and payroll figures based on information received from industry through mail and telephone surveys; rough estimates.
- (2) # 57 (Maintenance and Repair of Oil and Gas Wells) and # 50 (New Utility Structures) blended to construct hybrid multiplier.
- (3) All "total output" economic activity may not remain in state (see text).
- (4) Output multiplier applied to direct estimate.
- (5) Defined to include both "Natural Gas Transmission" and "Natural Gas Distribution" industry segments.

**Figure 4. 1993 revenues, capital investment, and state and local tax payments by major natural gas industry segments**

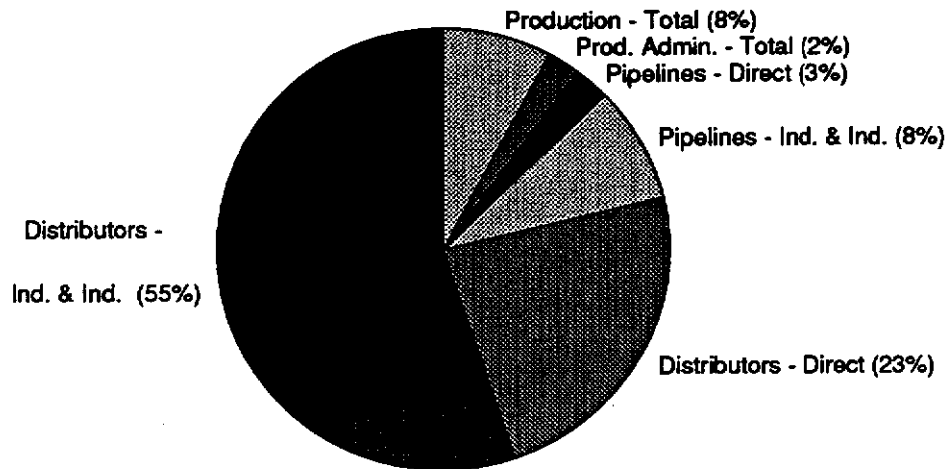


**Figure 5. Comparison of 1993 Virginia natural gas production volume to statewide gas sales**





**Figure 6. Estimated distribution of jobs supported by Virginia's natural gas industries**



Total number of jobs supported: Approximately 12,000

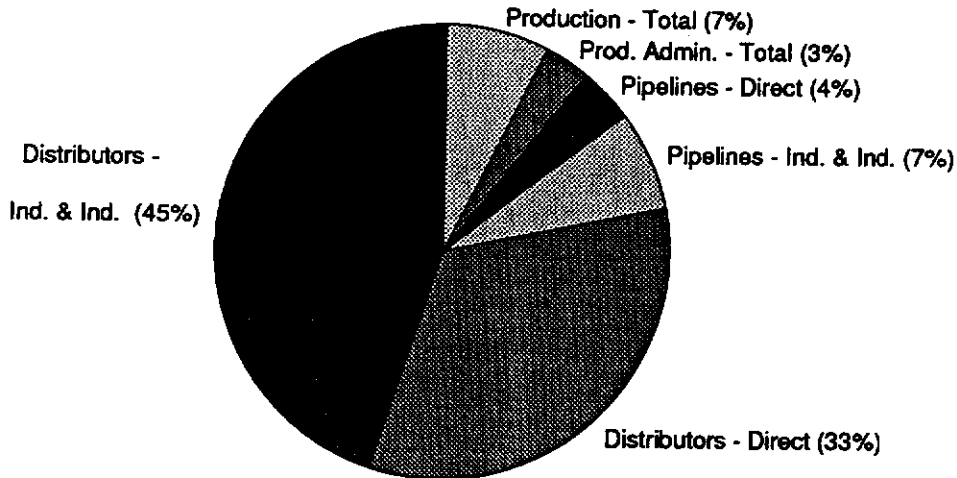
### **Southwestern Virginia Gas Production**

Estimating the economic impacts of natural gas production proved problematic because of difficulties in obtaining accurate in-state employment and payroll figures. As discussed above, the direct employment and payroll figures used in Table 4 are meant to represent only Virginia-based workers. We believe the figures which represent production-based direct employment and payroll impacts are relatively accurate, but are less certain about the capital-investment impacts. Our discussions indicate that most Virginia well-drilling and associated activity is conducted by contract firms, and some of these firms and their employees are based out-of-state.

Multipliers derived from the IMPLAN model were applied to the direct impact estimates of Table 4 so as to estimate total economic impacts. The capital-investment multipliers were constructed by combining IMPLAN sectors 50 (New Utility Structures) and 57 (Oil and Gas Well Maintenance and Repair), using the ratio of gathering-line construction to other development expenses as a basis for proportions. The number of workers engaged in development (capital investment), and associated direct payroll income, during 1993 is an estimate based on telephone discussions with several firms. This rough estimate is intended to represent only Virginia-based workers.

These figures indicate that, in 1993, Virginia's natural gas-producing industry supported close to 1,000 jobs, and was responsible for over \$25 million in payroll income, within the state. Most of this economic activity took place within the gas-producing counties. Figures 6 and 7 indicate southwestern Virginia production to be responsible for nearly 10 percent of the jobs and wages supported by the gas industries, statewide. The production-output total figure of Table 4 (\$147 billion) represents economic activity in Virginia and in other states adjacent to its gas-producing areas; the majority of this economic activity occurs within Virginia. The employment and personal-income figures represent only in-state totals.

**Figure 7. Estimated distribution of wages and salaries supported by Virginia's natural gas industries**



Total personal income supported:  
approximately \$350 million annually

### **Administrative Offices**

These figures apply to eastern U.S. gas producers who maintain major administrative offices but no substantial production in Virginia. All of these offices are located east of the Blue Ridge. IMPLAN multipliers were applied to the employment and payroll figures of Table 1 to estimate the economic impacts of these operations in the state. The results are an estimate of approximately 300 jobs and \$12 million in personal income, 2-to-3 percent of the natural gas industry's statewide impacts. VEC data show that these are high-wage occupations.

### **Pipelines and Distributors**

These impacts are estimated on a combined basis because IMPLAN considers them to be a single sector. The revenue-output figure of Table 4 represents the combined activity of the pipelines and distributors. The amount of distribution revenues transferred by distributors to pipelines to pay for transportation of gas provided to in-state consumers (\$45 million) has been subtracted from the total revenue sum because these funds are handled by both pipelines and distributors.

The pipeline and distribution industry segments, combined, are responsible for the majority portion of the Virginia gas industry's statewide impacts: over \$1.5 million in economic activity, over 10,000 jobs, and approximately \$300 million in personal income.

Figures 6 and 7 disaggregate the impacts of these two segments based upon their respective contributions to each component of the aggregated total. The pipelines are responsible for about 11 percent of total economic impacts, while the distributors are responsible for about three-fourths of that total.

## **Summary of Results**

The results of this analysis indicate that the total in-state economic impacts of Virginia's natural gas industries during 1993 included over \$1.5 billion in total economic activity, approximately 12,000 jobs, and approximately \$350 million in wage and salary payments.

The impacts discussed here should be considered as only a partial estimate. Forward linkages of natural gas fuels also have important economic effects. For example, many businesses choose to locate where natural gas fuel is available. The positive economic impacts of business location decisions, and other forward-linked activities, have not been considered.

## **Acknowledgments**

Thanks to Laura Hehner of Commonwealth Gas for her help and assistance throughout this project. Thanks to Barbara Hayek of the Virginia State Corporation Commission, and to Jackie Constantine of the Virginia Employment Commission, for their help in providing data maintained by their agencies. Thanks to representatives of Virginia's natural gas industries who completed the mail surveys, and who spent time speaking with us by phone, and to Johanna Jones, for her help in preparing this report.

This study was funded by the Virginia Oil and Gas Association.

## **References**

Minnesota Implan Group. 1993. Micro IMPLAN User's Guide. Stillwater, Minnesota.

U.S. Energy Information Administration (EIA). 1994. Natural Gas Annual. DOE/EIA 0131(93).

U.S. Energy Information Administration (EIA). 1995. Natural Gas Annual 1993 Supplement: Company Profiles. DOE/EIA-0131(93)/S.

Various firms. Federal Energy Regulatory Commission Form 2 Filings (commercial gas distributors).

Virginia Department of Mines, Minerals and Energy. 1994. Virginia Gas and Oil Report 1993. Division of Gas and Oil, Abingdon.

Virginia Employment Commission. 1993 employment data, prepared upon request.

## OTHER VCCER PUBLICATIONS

*The Virginia Center for Coal and Energy Research provides objective and factual information on energy issues of economic and environmental importance to the Commonwealth. Its mission is to conduct interdisciplinary research into coal and energy issues, and to disseminate information on energy and energy-related research conducted both within and outside of Virginia Polytechnic Institute and State University.*

*For information regarding prices and availability of the following and other VCCER publications, call the VCCER Publications Office, (540) 231-6506, or write to VCCER, 617 North Main Street, Blacksburg, Virginia 24060-0411.*

### Periodicals

#### ***Energy Outlook*, Quarterly.**

The mission of this quarterly, six-page newsletter is to disseminate coal- and energy-related news, information, and research results having a particular importance to the Commonwealth. With a current circulation of 3,600, ***Energy Outlook*** reports on research activities of VCCER staff, on research being conducted at Virginia Tech and other Virginia universities, on organizations within the state that focus on energy production, on legislation of special importance to the state's coal and energy industries, and on other energy-related topics. Four issues/year subscription.

#### ***1995 Virginia Coal*, July 1995.**

Updated annually, this guide is a complete directory and data reference source for all mines licensed during the Commonwealth for 1994. Mine listings for each operation include company and mine name, location and contact person, coal owner, seam worked, employees, production, productivity, and mining equipment used. Other information contained in ***Virginia Coal*** includes state production data, county coal summaries, coal analyses, natural-gas production data, rail information and Hampton Roads coal-export information and service directories. The most complete catalog of its kind available anywhere in the state.

### Research Reports

***In-State Economic Impacts of the Virginia Coal Industry and Potential Coal Production Declines.*** Carl Zipper. 30 p. May 1995.

***An Analysis of Household Water Supply Impacts by Underground Coal Mining in Virginia.*** Carl Zipper, William Balfour, John Randolph, and Richard Roth. 34 p. May 1994.

***Assessment of Virginia Coalfield Region Capability to Support an Electric Power Generation Industry.*** Carl E. Zipper, Thomas K. Henritze, and John Randolph. 50 p. January 1994.

***Virginia Coal: An Abridged History.*** Walter R. Hibbard; April 1990. 151 pp.

***Virginia Energy Patterns and Trends: Virginia Energy Profiles 1960-1990. [1991 Edition.]*** John Randolph. August 1991.

---

Virginia Tech does not discriminate against employees, students or applicants on the basis of race, color, sex, sexual orientation, disability, age, veteran status, national origin, religion, or political affiliation. Anyone having questions concerning discrimination should contact the Virginia Tech Equal Opportunity/Affirmative Action Office.

***Economic Impacts of Virginia's Natural Gas Industries*** is Virginia Tech publication no. VT/176/1095/150/961611.