

SECTION 3 - NATURAL GAS

Natural Gas in Virginia

- The major uses for natural gas are for residential and commercial space heating, water heating, and cooking, and industrial process heating and chemical feedstock, transportation, and electric power generation.
- Natural gas was first produced in Scott County in 1931. Presently, natural gas is produced in Buchanan, Dickenson, Russell, Lee, Scott, Tazewell, and Wise Counties. Coal bed methane (CBM) is also produced in Buchanan, Dickenson, Russell, Tazewell, and Wise Counties. Virginia natural gas and CBM wells have produced 1.63 trillion cubic feet of gas since 1950.
- In 2010, a total of 18 companies operated gas wells that included 5,617 CBM wells, 1,838 conventional wells, and 15 wells producing both conventional natural gas and CBM. These 7,470 wells produced 147.3 billion cubic feet (BCF) of natural gas. Buchanan County accounted for the largest share of production, about 54 percent of the total.



Natural Gas Consumption

The major uses for natural gas are for residential and commercial space heating, water heating and cooking, and industrial process heating and chemical feedstock, transportation, and electric power generation.

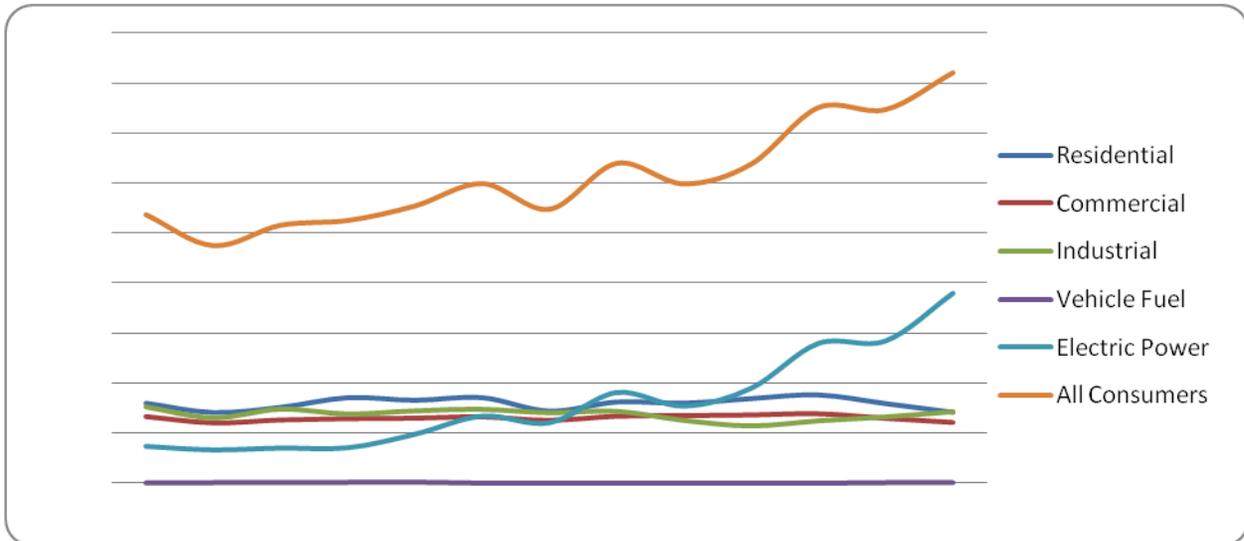
- In 2012, Virginia consumers used 392.3 (BCF) of natural gas. An additional 17.8 BCF was consumed in the operation of pipelines, primarily in compressors, and in well, field, and lease operations, such drilling operations, heaters, dehydrators, and field compressors.¹
- Natural gas use increased 56 percent over the last decade. Growth was primarily attributable an increase in to new customers and use of natural gas for electric generation.
- The growth pattern changed for commercial and industrial, primarily attributable to the economic downturn. Electric power consumption increased due to fuel-on-fuel competition, and residential demand dropped by nearly 6 ½ percent from 2007 and 2008 due to warmer than normal winter weather.

¹ EIA, Natural Gas Navigator. http://www.eia.doe.gov/dnav/ng/ng_cons_sum_dcu_SVA_a.htm. June 29, 2011

Table 3-1: Virginia's Natural Gas Consumption, 2000-2012 (million cubic feet)²

Year	All Consumers	Residential	Commercial	Industrial	Vehicle Fuel	Electric Power	Avg. Price per Mcf
2000	268770	79701	66098	76263	212	36700	\$8.78
2001	237853	70249	59809	65231	263	33118	\$10.66
2002	258202	75476	62699	73973	268	34936	\$8.49
2003	262970	85330	64004	69090	328	35256	\$10.66
2004	277434	82755	64518	72250	368	48784	\$11.59
2005	299746	85355	65838	73741	158	66951	\$13.50
2006	274175	71693	62352	70420	168	60321	\$14.33
2007	319913	80957	66444	71736	154	90573	\$13.71
2008	299364	79725	67006	62642	141	76983	\$14.50
2009	319134	84445	67709	57144	140	94829	\$12.07
2010	375421	88157	68911	62243	142	139755	\$11.14
2011	373444	79301	64282	66147	267	142284	\$11.21
2012	410108	70438	60217	71486	267	189848	\$10.60

Figure 3-1: Virginia's Natural Gas Consumption, 2000-2012 (million cubic feet)³



² Ibid.

³ Ibid.

- Natural gas consumption in Virginia is likely to grow over the next ten years.
 - Dominion has included construction of six new natural gas-fired generation plants through 2020, in its 2013 Integrated Resource Plan.
 - Non-utility producers may also construct new natural gas-fired plants to serve Dominion and other electricity markets.
 - Additional retail consumers will hook up to natural gas distribution systems as Virginia's population grows.
 - Transportation uses may increase demand for natural gas. Transportation may create new markets for Virginia natural gas if the number of refueling facilities is expanded.
 - Virginia fleets have nearly 1000 CNG vehicles on the road. Nearly all of them are located in the Hampton Roads, Richmond, and Northern Virginia areas.
 - Virginia's largest CNG fleets are operated by the U.S. Navy, VA Department of General Services, and the Washington Metro Area Transit Authority.

Natural Gas Production

- Virginia's 21 natural gas exploration and production companies produced 147.3 BCF of natural gas from 7,400 wells in 2013.^{4 5}
 - This amount is equal to 39 percent of the natural gas consumed in Virginia in 2010⁶.
 - CNX Gas Company LLC produced 86 BCF of natural gas or 58 percent of total state production in 2010. The second highest producer, EQT Production Company, produced 47 BCF of natural gas, equaling 32 percent of total State production.
 - Virginia produces both conventional natural gas and coal bed methane in the Central Appalachian Basin, which covers the State's western panhandle. Conventional gas is produced from Devonian (354 to 417 million years old) shales and Mississippian (323 to 354 million years old) limestones and sandstones of the Appalachian Basin, in the Appalachian Plateau Province. CBM is produced from coal seams in the Norton, Lee (New River), and Pocahontas Formations of Pennsylvanian Age (290 to 323 million years old) in the same physiographic region.
 - Most of Virginia's natural gas production comes from coal bed methane fields, two of which are among the 100 largest natural gas fields in the United States.⁷
 - Virginia currently has 33 landfills that are capturing, converting, and using landfill gas (LFG) as an energy source. Twenty-five of these landfills are generating electricity and have a combined capacity of 94.5 megawatts. Three LFG projects

⁴ Virginia Department of Mines, Minerals and Energy, 2030 Gas and Oil Production

⁵ EIA, "Virginia-Data", <http://www.eia.gov/state/state-energy-profiles-data.cfm?sid=VA#Reserves>, June 29, 2011.

⁶ EIA, "Natural Gas-Natural Gas Consumption by End Use http://www.eia.gov/dnav/ng/ng_cons_sum_a_EPG0_VC0_mmcf_a.htm, June 29, 2011, Virginia Department of Mines, Minerals and Energy, 2010 Gas and Oil Production Summary by County

⁷ EIA, "Virginia-Analysis", <http://www.eia.gov/state/state-energy-profiles-analysis.cfm?sid=VA>, June 29, 2011

are under construction and 38 landfills are either candidates or potential sites for projects. LFG projects are operational, under construction or planned in 54 counties from Eastern Shore to Southwest Virginia.⁸

Figure 3-2: Appalachian Basin Coal Bed Methane Formations

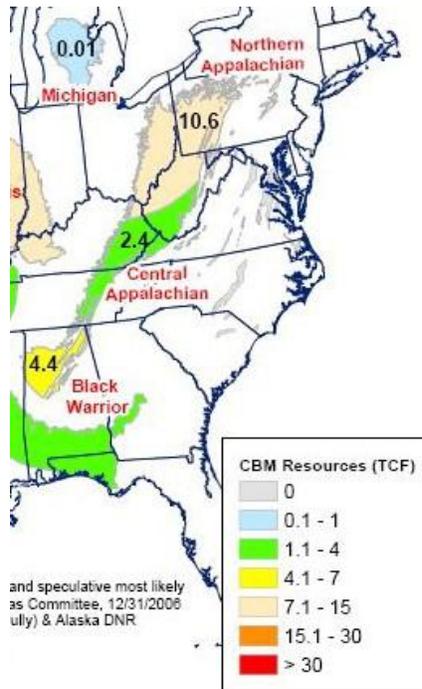
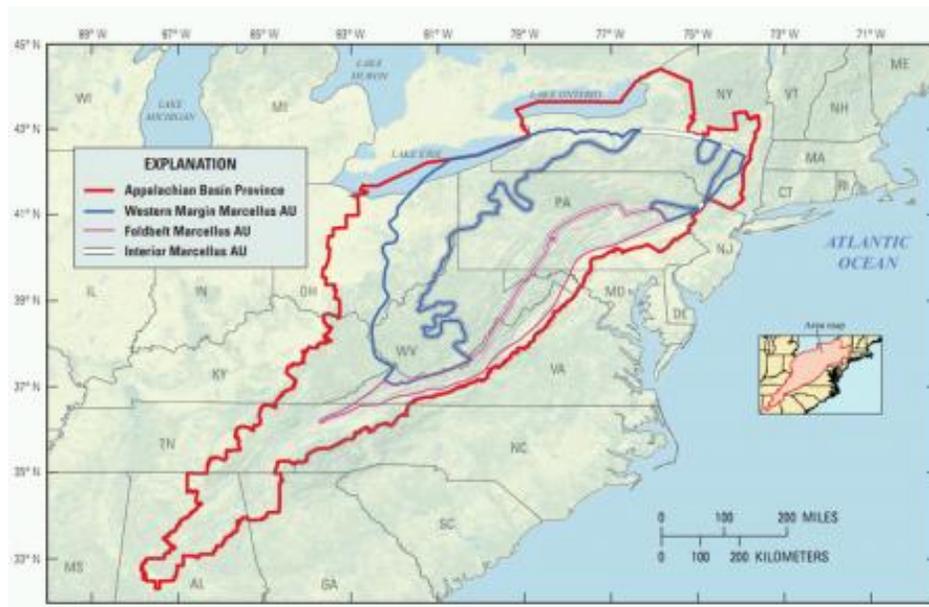


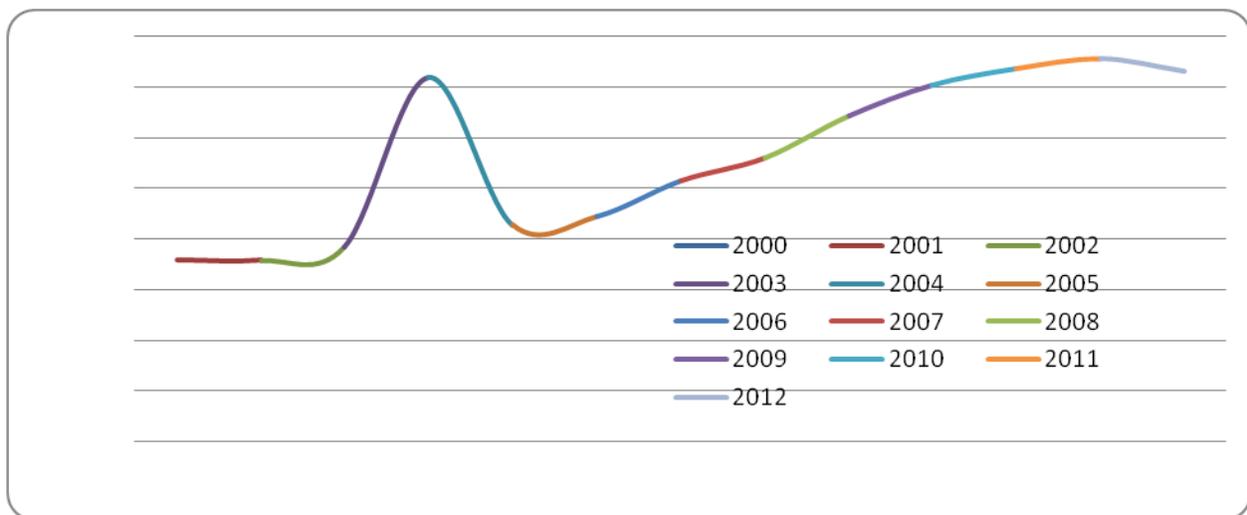
Figure 3-3: Appalachian Basin Natural Gas Shale Formations



⁸ EPA, Landfill Methane Outreach Program; <http://www.epa.gov/lmop/index.html>

- In 2010, a record total of 147.3 BCF of natural gas was produced in Virginia, with an estimated value of \$659 million. This value is based on the average wellhead price reported by the U.S. Energy Information Administration (EIA) of \$4.48 per thousand cubic feet (MCF). According to the EIA, Virginia ranked 17th in the nation among all states that produced natural gas in 2010. CBM accounted for roughly 82 percent of the total production (about 121 BCF) and conventional gas accounted for about 18 percent (about 26 BCF).
- Gas production has experienced an upward trend since 1980, and has increased 104 percent from 1999 (72 BCF) to 2010 (147 BCF). The increase was related to growth in CBM production, which reached a record level in 2010. Most of the increased production occurred in Buchanan County, where gas production increased from 42 BCF in 1999 to 78.6 BCF in 2010.

Figure 3-4: Natural Gas Withdrawals in Virginia, 2000-2012⁹



- Natural gas produced in Virginia is collected in gathering pipeline systems. These systems include low pressure pipelines from wells, to compression facilities where the gas is cleaned and compressed. After being compressed, the gas is fed into the interstate pipeline network where it is delivered to customers.
- Natural gas produced in Virginia is sold in Southwestern Virginia and other interstate markets because there is limited pipeline capacity to deliver gas from Southwestern Virginia to the Central and Eastern Virginia markets.
- The capacity to deliver Virginia-produced natural gas to the Northern, Central, and Hampton Roads regions



⁹ VEPT Virginia Total Historic Gas Production. http://www.energy.vt.edu/vept/naturalgas/historic_production.asp, June 29, 2011

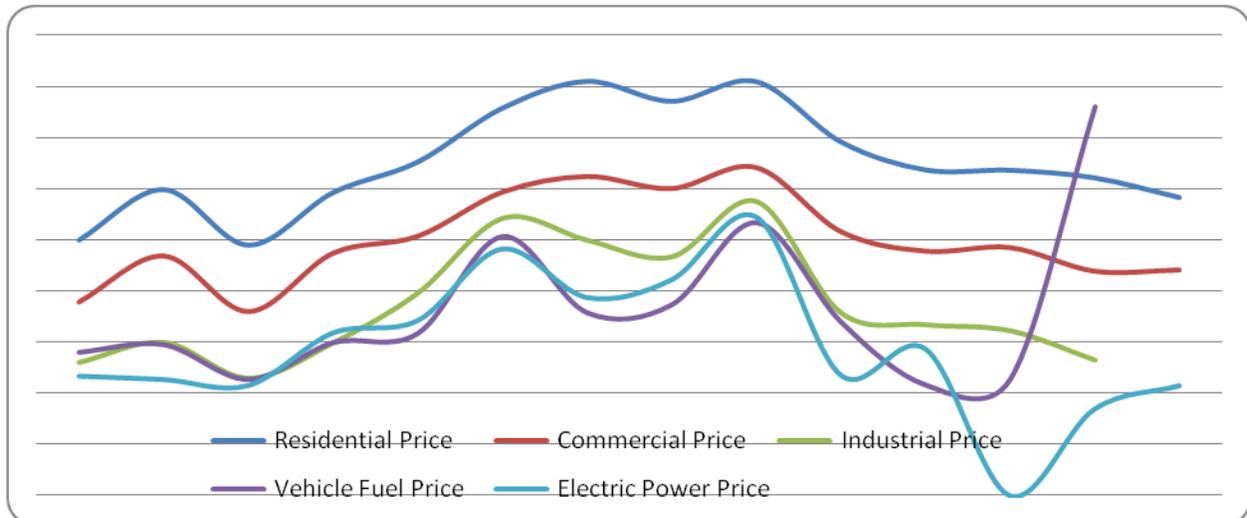
of Virginia increased with the connection of the Spectra Patriot Pipeline to the Transco interstate pipeline.

- The EIA projects natural gas prices at Henry Hub will increase annually, over the next decade, increasing from \$3.74/per MCF in 2014 to \$5.23 in 2025.¹⁰

Natural Gas Prices

- Virginia’s residential consumers paid on average \$11.65/thousand cubic feet (MCF) in 2013. Commercial customers paid on average \$8.82/MCF in 2013, and industrial consumers paid on average \$5.29/MCF in 2012.¹¹
- Since 2009, these prices reflect a 15.7 percent decrease for residential consumers, a 14 percent decrease for commercial consumers, and a 25.9 percent decrease for industrial consumers.

Figure 3-5: Average Natural Gas Price by Sector¹²



- Natural gas prices in Virginia have traditionally been higher than in areas that are closer to natural gas production. The higher price is attributable to the need to transport the natural gas long distances to Virginia.
- In 2013, abundant supply and low prices characterized natural gas markets. Prolific production from East Texas, Mid-Continent, Marcellus, and Utica Shales contributed to stabilize prices.

Average annual natural gas prices have remained relatively low over the past several years as a result of the availability of abundant domestic resources and the application of improved production technologies.

¹⁰ EIA, Annual Energy Outlook 2010. Natural Gas Supply, Disposition, and Prices, http://www.eia.doe.gov/oiaf/aeo/excel/aeotab_13.xls. May 16, 2010

¹¹ EIA, "Natural Gas – Natural Gas Prices", http://www.eia.gov/dnav/ng/ng_pri_sum_a_EPG0_PRS_DMcf_a.htm June 27, 2014

¹² Ibid.

Supply

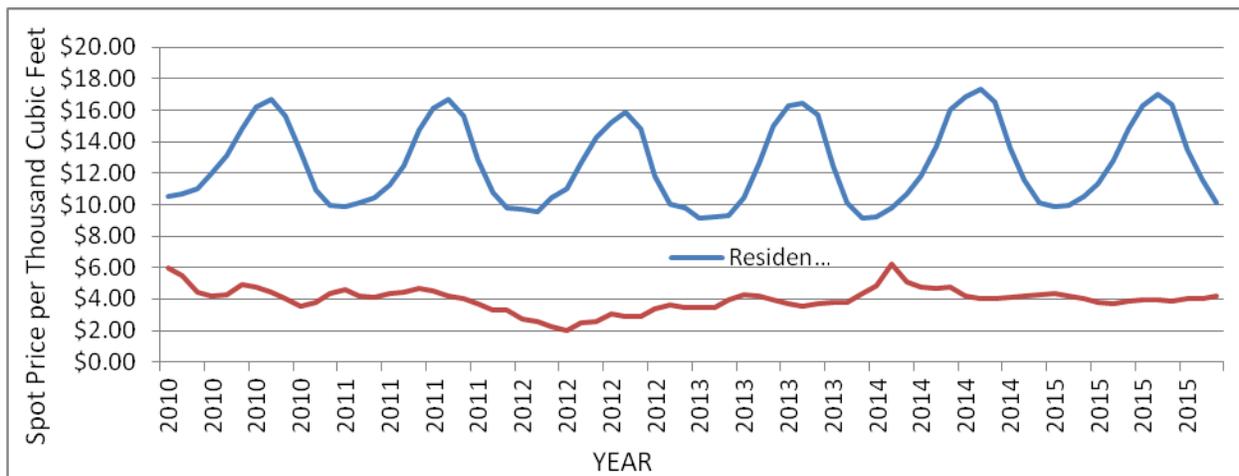
In 2013, marketed production of natural gas in the U.S. reached 25.6 trillion cubic feet (TCF), its highest recorded annual total.

Production of natural gas from shale and tight sand formations continued to increase. These production increases were the result of more efficient, cost-effective drilling techniques, notably in the production of natural gas from shale formations.

Additionally, shale gas has been the primary source of recent growth in technically recoverable natural gas resources in the United States. For example, the Marcellus Shale Formation encompasses 104,000 square miles, ranging in depth from 4,000 to 8,000 feet, and is estimated to contain more than 410 trillion cubic feet of natural gas.

The evolution of fracking and horizontal drilling technology has led directly to a proliferation of wells drilled in the Marcellus Shale. The Energy Information Administration (EIA) estimates that by 2035, 24 percent of total natural gas production will come from shale formations like the Marcellus. The bulk of Marcellus drilling activity has occurred in Pennsylvania, Ohio, and West Virginia. One gas company is expressing interest in drilling one exploratory Marcellus well in Rockingham County, and leasing is taking place in Rockingham and other counties. Another potential area of development is in the Taylorsville Basin Shale which extends through several counties including Caroline, King George, Westmoreland, King and Queen, King William, and others.

Figure 3-6: EIA Natural Gas Price History, 2010 to August 2014, and Projection for 2015

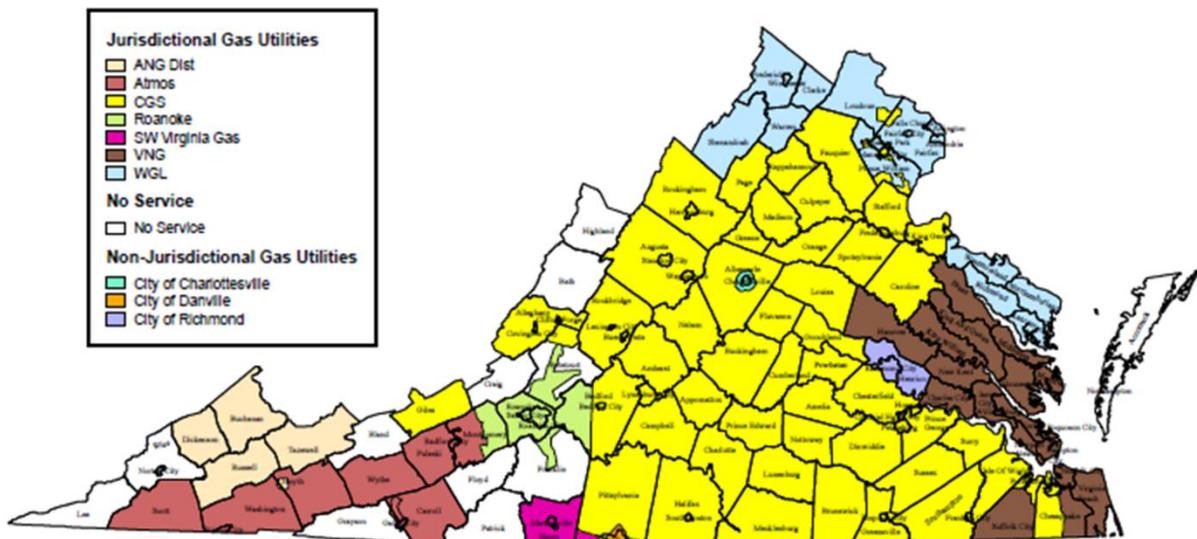


INFRASTRUCTURE

Virginia's Natural Gas Providers

- Natural gas transmission companies move natural gas from production areas to population centers through transmission pipelines. Local Distribution Companies (LDCs), which are utilities regulated by the SCC, distribute the gas to end users.
- A total of ten natural gas LDCs serve Virginia customers in assigned territories; seven are investor owned LDCs, and the remaining three are municipal LDCs.
 - Virginia's investor-owned LDCs are Columbia Gas of Virginia, Washington Gas, Virginia Natural Gas, Roanoke Gas, Atmos Energy, Appalachian Natural Gas Distribution Company, and Southwestern Virginia Gas Company.
 - The municipals are in the Cities of Richmond, Charlottesville, and Danville.
- LDCs primarily sell gas to the residential and commercial markets. Large natural gas users can contract directly for natural gas purchases under Federal Energy Regulatory Commission (FERC) rules. In 2012, Virginia gas users were 92.2 percent residential, 7.7 percent commercial, and 0.1 percent industrial.¹³
- The LDCs serve approximately 37 percent of U.S. households and 90,000 commercial natural gas customers.
- The LDCs operate approximately 20,000 miles of distribution pipelines, nationally.

Figure 3-7: Service Areas of Virginia Natural Gas Distribution Companies¹⁴



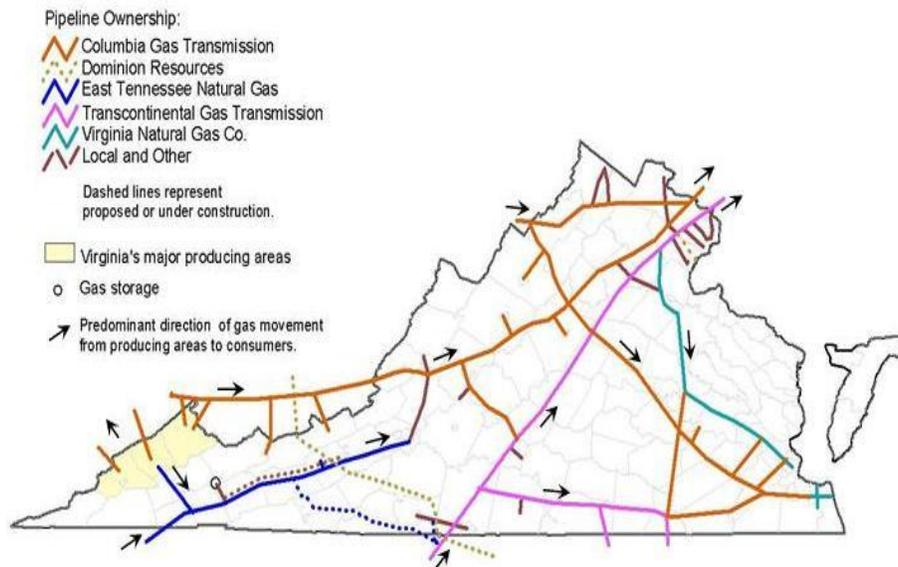
¹³ EIA: http://www.eia.gov/naturalgas/annual/pdf/table_016.pdf

¹⁴ Virginia State Corporation Commission, <http://www.scc.virginia.gov/pue/gas/map.aspx>. June 23, 2010

Natural Gas Transmission

- Natural gas consumed in Virginia is transported by four primary interstate pipelines:
 - Transco Pipe Line provides access to supply sources from Texas, the Gulf of Mexico, and other southern locations.
 - East Tennessee Gas Pipeline provides access to supply sources from Virginia and other Appalachian natural gas production areas, from Texas and other southern locations via the Tennessee Gas Pipeline system.
 - Columbia Gas Transmission provides access to supply sources from Appalachian Marcellus and Utica Shales, and Texas, the Gulf of Mexico, and other southern locations via the Columbia Gulf Transmission system.
- Dominion Transmission provides access to supply sources from Appalachian Marcellus and Utica Shale production, and LNG imports through the Cove Point Liquefied Natural Gas (LNG) import facility in Maryland.
- There are approximately 2,950 miles of natural gas transmission pipelines in Virginia.

Figure 3-8: Major Natural Gas Transmission Pipelines in Virginia¹⁵



¹⁵ Modified from VEPT, Major Natural Gas Pipelines. http://www.energy.vt.edu/vept/naturalgas/NG_pipelines.asp. June 28, 2011

Table 3-2: Principal Natural Gas Pipeline Companies Serving Virginia

Pipeline Name	Principal Supply Source(s)
<i>Interstate & Importing Pipelines</i>	
Columbia Gas Transmission Company	Appalachian, Marcellus, and Utica Shales, and upstream sources from Columbia Gulf Transmission
Dominion Cove Point LNG LP	Upstream sources from Columbia Gas Transmission, Dominion Transmission, Transco Gas Pipe Line and LNG imports
Dominion Transmission Corporation	Appalachian, Marcellus and Utica Shales
East Tennessee Natural Gas Company	Appalachian and upstream sources from Tennessee Gas
NORA Gas Transmission Company	Appalachian
Transcontinental Gas Pipeline Company	Texas, the Gulf of Mexico, and other southern supply sources
<i>Intrastate Pipelines**</i>	
Virginia Natural Gas Company	Upstream sources from Dominion Transmission

- Natural gas companies have added new pipeline capacity across the state in recent years, including:
 - Virginia Natural Gas' HRX pipeline that provides a third pipeline water crossing in Hampton Roads¹⁶
 - Spectra's East Tennessee Line to Southside Virginia and North Carolina¹⁷
 - Spectra's Jewell Ridge Pipeline to deliver natural gas from Southwest Virginia's gas production areas to the East Tennessee line and Saltville natural gas storage facility¹⁸

Natural Gas Storage

- Virginia is home to two underground natural gas storage facilities, the Spectra salt cavern storage facility in Saltville and the Early Grove underground storage field in Scott and Washington Counties.¹⁹
- Other underground natural gas storage services are located in various areas and the market area available to Virginia utilities and consumers throughout the interstate pipeline system. Dominion is one of the largest operators of these underground natural gas storage facilities in the United States.

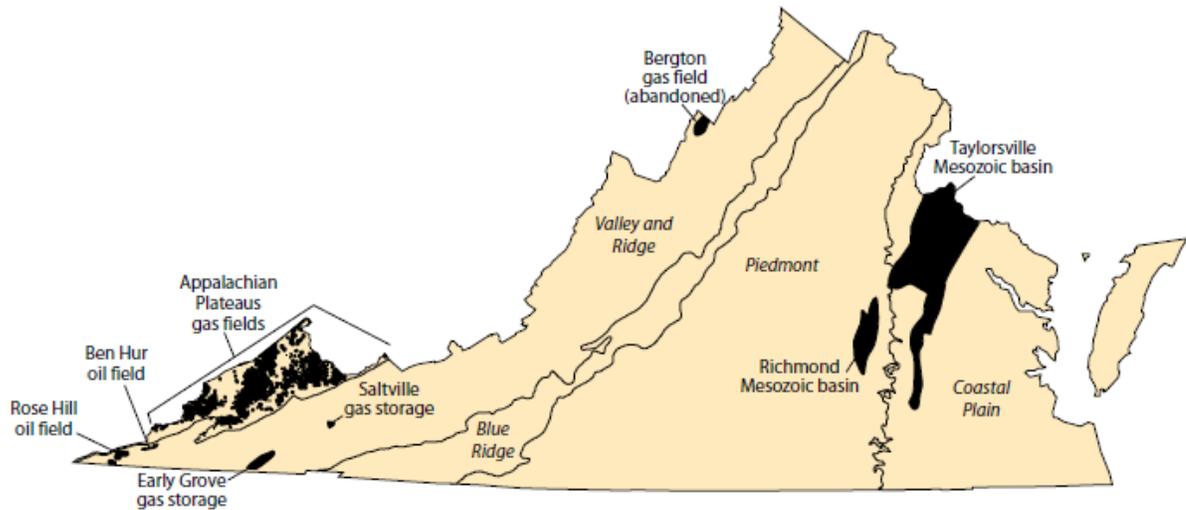
¹⁶ Virginia Natural Gas, "Hampton Roads Crossing Pipeline"
<http://www.virginianaturalgas.com/Universal/AboutUs/InOurCommunity/HamptonRoadsCrossingPipeline.aspx>, June 29, 2011

¹⁷ Spectra Energy, "U.S. Transmission-East Tennessee Natural Gas"
<http://www.spectraenergy.com/Operations/US-Transmission/Pipeline-Assets/East-Tennessee-Natural-Gas/>, June 29 2011

¹⁸ Ibid.

¹⁹ Spectra Energy, "U.S. Transmission-Saltville Gas Storage", <http://www.spectraenergy.com/Operations/US-Transmission/Pipeline-Assets/Saltville-Gas-Storage/>, June 29, 2011

Figure 3-9: Underground Natural Gas Storage Facilities



- Virginia LDCs operate peak-shaving natural gas storage facilities near their local distribution networks.
 - These facilities include compressed natural gas tanks, liquefied natural gas tanks, propane storage tanks, and one underground propane storage cavern.
 - Companies store gas in these facilities when demand is low and inject gas into the pipeline system during times of peak demand.

FEDERAL AND STATE LAW AND REGULATIONS

Virginia's Natural Gas Utility Regulatory Structure

- Virginia's statutory scheme for the regulation of gas utilities provides that LDCs are required to offer service at just and reasonable rates, and have the opportunity to earn a maximum rate of return set through rate cases before the State Corporation Commission (SCC).
- Starting in 2000, LDCs were authorized to offer all customers direct access to natural gas suppliers, called retail supply choice.
 - Washington Gas Light Company and Columbia Gas of Virginia offer this choice to all customers.
 - In 2009, 8.4 percent of eligible residential customers and 23.3 percent of eligible commercial customers participated in choice programs.²⁰

²⁰ Ibid.

- LDCs have the opportunity to be governed by performance-based ratemaking (PBR) agreements that allow higher rates of return contingent upon the LDC meeting defined performance standards. Columbia Gas and Washington Gas have used SCC approved PBR plans.
- Natural gas LDCs are authorized to undertake Conservation and Ratemaking Efficiency (CARE) programs and if they do, to decouple earnings from the volume of gas sold. Rate decoupling is conditioned upon adoption of an SCC approved plan for promoting and investing in conservation and efficiency by the company's customers.
 - As of Summer 2014, Virginia Natural Gas and Columbia Gas have implemented CARE plans.
- Virginia enacted the Steps to Advance Virginia's Energy Plan (SAVE) program in 2010 to provide timely cost recovery for large-scale replacement of aging local distribution pipeline infrastructure.
- Virginia enacted legislation that seeks to create a regulatory framework for natural gas utilities to invest in upstream reserves, where those investments are reasonably expected to yield lower delivered cost of gas to customers, mitigate price volatility, or mitigate supply risk. This bill went into effect July 1, 2014.

Adequacy of Supply

- Natural gas production in the coalfield region should rise incrementally as producers continue to drill new coal bed methane and conventional shale wells in Southwest Virginia.
- Virginia's natural gas reserves were estimated in 2009 to be 3,091 BCF.²¹ Given current removal rates, this reserve would support production for about 22 years.
- Additional reserves and potential production are available in the Marcellus Shale areas west of the Shenandoah Valley and offshore.
- A growing amount of out of state supply is available from shale production areas in Pennsylvania, Ohio, West Virginia, and elsewhere.
- The federal Energy Information Administration predicts there should be adequate supplies from new domestic production for expanded uses of natural gas.²²
- Potential disruptions of natural gas production or interstate transmission pipelines are unforeseen but may occur and could possibly affect multiple states, including Virginia. States will need to work with the U.S. Department of Energy to coordinate responses to such possible supply disruptions.



²¹<http://www.eia.gov/state/state-energy-profiles-data.cfm?sid=VA>

²²EIA, Annual Energy Outlook, 2010. [http://www.eia.doe.gov/oiaf/aeo/pdf/0383\(2010\).pdf](http://www.eia.doe.gov/oiaf/aeo/pdf/0383(2010).pdf). May 16, 2010

Offshore Natural Gas

- There is an estimated 1.66 TCF of natural gas reserves in federal waters in the Virginia administrative boundary areas offshore.
- The value of natural gas in the Virginia offshore administrative boundary areas could total more than \$10 billion (1.66 TCF at \$6/MCF).
 - The value will depend on the actual amount of recoverable resources, cost of developing gas, and the price of natural gas when it comes to market.
 - Offshore natural gas production would support infrastructure expansion in Hampton Roads, attracting new business and creating jobs in the supply chain and exploration and production.
- Development of offshore natural gas resources is dependent on an extensive federal lease sale and permitting process.
 - There is currently a new lease authorization for 2017-2022.
- Offshore extraction will need to be compatible with U.S. Department of Defense operations in Virginia's offshore waters and commercial maritime activity. Federal and state cooperation can lead to development of a compatible exploration and production plan.
- Virginia's coastal regions may hold producible methane hydrate resources offshore. The technology to produce these resources is not expected to be developed in the 10-year term of this Plan.