Pipeline Modal Profile

WEST VIRGINIA STATE FREIGHT PLAN

November 2023

Tech Memo

West Virginia State Freight Plan

Pipeline Modal Profile

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date

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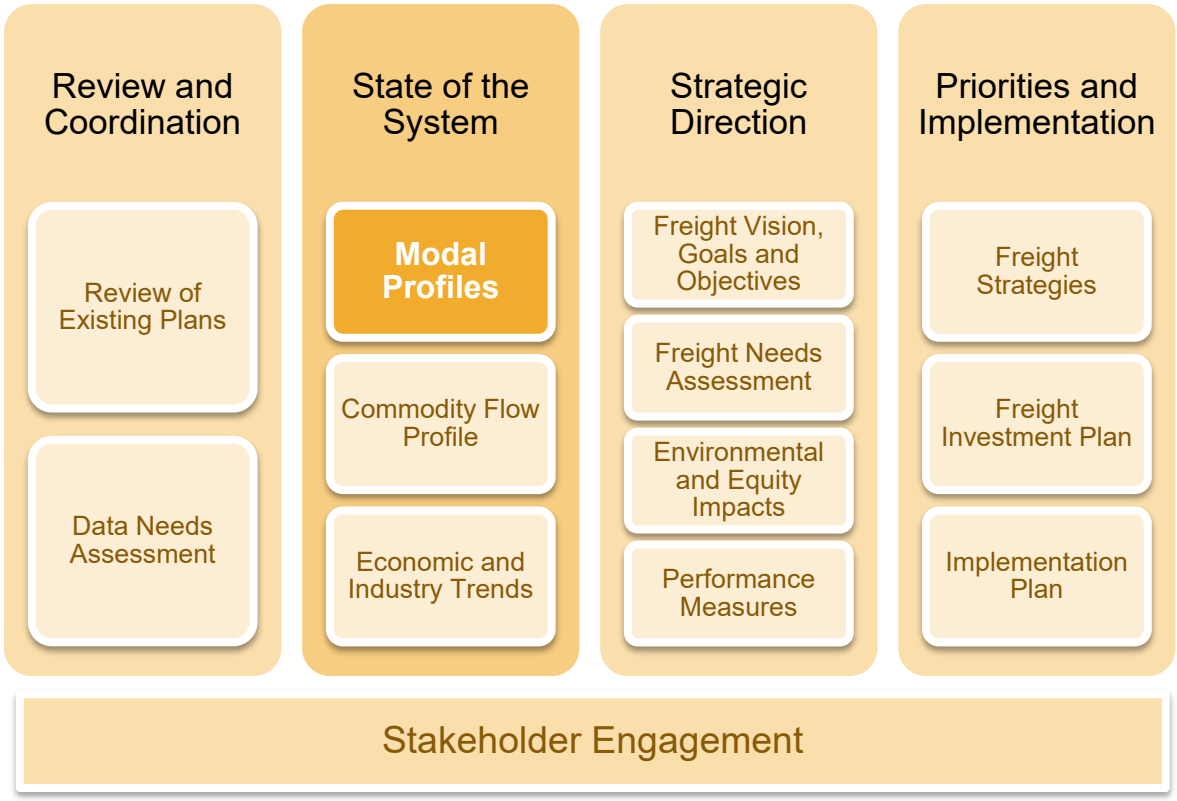
1.0 INTRODUCTION

1.1 Overview of the Plan

In 2022, the West Virginia Department of Transportation (WVDOT) began its update of the West Virginia State Freight Plan. This Plan will fulfill federal requirements for state freight planning, identify opportunities for West Virginia to invest in its freight system, and position WVDOT to take full advantage of federal formula and discretionary funding programs for freight transportation investments. Additionally, the Plan will detail freight activity, needs, and priorities, and support WVDOT in meeting the agency's overall goals as well as those of this Plan.

The purpose of this *Pipeline Modal Profile* is to identify West Virginia's existing pipeline assets and pipeline freight demand and assess their performance and condition. Documenting existing challenges helps identify strategies and solutions to aid the state going forward. It is one of many complementary technical activities that will be developed as part of this planning process. The overall process is shown in Figure 1-1, and will be developed in conjunction with a robust stakeholder engagement effort that will support the data driven aspects of this Plan.

Figure 1-1 West Virginia State Freight Plan Technical Activities



1.2 West Virginia Freight Transportation Vision and Goals

The Vision of the West Virginia State Freight Plan is as follows:

THE WEST VIRGINIA DEPARTMENT OF TRANSPORTATION'S MISSION IS TO RESPONSIBLY PROVIDE A SAFE, EFFICIENT AND RELIABLE TRANSPORTATION SYSTEM THAT SUPPORTS ECONOMIC OPPORTUNITY AND QUALITY OF LIFE.

WVDOT will achieve this vision through the following goals:

- **System Condition, Efficiency, and Fiscal Sustainability:** Maintain multimodal and intermodal freight transportation infrastructure in a state of good repair and manage lifecycle costs; efficiently deliver projects, programs and services supporting goods movement; and work to maintain existing funding mechanisms while exploring new alternative and sustainable funding mechanisms.
- **Safety and Security for All Users:** Reduce transportation fatalities and serious injuries involving freight vehicles, improve the safety and security of drivers, cargo, and intermodal facilities, and improve the resilience of the freight system particularly to severe weather events and other disruptions.
- **Economic Vitality:** Strengthen the ability of communities and industries to access national and international trade markets, retain and grow existing WV statewide and regional economic focus sectors, and support regional economic development that will diversity WV's economy.
- **Multimodal Mobility, Reliability, and Accessibility:** Facilitate freight mobility and connections for on-demand and reliable goods delivery across all West Virginia communities, including critical services such as health care and emergency management.
- **Livable and Healthy Communities:** Create freight transportation systems that operate efficiently and cleanly, protect the natural environment and maintain access for residents and visitors to experience WV's natural and cultural destinations.

1.3 Pipeline Profile Overview and Organization

The remainder of this technical memorandum is organized as follows:

- Section 2.0 – Pipeline Freight Network Inventory
- Section 3.0 – Pipeline Freight Demand
- Section 4.0 – Pipeline Infrastructure Condition and Capacity
- Section 5.0 – Pipeline Safety

2.0 PIPELINE NETWORK INVENTORY

Pipelines provide the safest mode for moving liquid energy commodities through a system of pipes, production areas, and storage facilities. Since 2021, the U.S. has been the 2nd largest energy producer in the world, with 65 percent of the world's pipelines, followed by Russia at eight percent and Canada at three percent. Natural gas was one of the main commodities moving through the U.S. pipeline network in 2021, followed by liquid petroleum (oil), and liquefied ethylene, propane, butane, and some petrochemical feedstock[1]. In 2021, U.S. natural gas exports reached a record high and allowed natural gas production to exceed domestic consumption. Contribution to this growth of natural gas in the U.S. is the extraction of shale gas. The production of shale grew exponentially after 2008 due to the combination of hydraulic fracturing and horizontal drilling, which has increased the efficiency of energy production in the U.S.[2] and in particular, West Virginia.

West Virginia has become an important player in the energy industry and is currently the fourth-largest energy producer in the nation. Historically, coal has been the driving economic force in West Virginia, but in 2019 natural gas surpassed coal to become the largest driver of the state's energy economy. To highlight the significance of energy production in West Virginia, this section provides an overview of the West Virginia pipeline inventory network which transports these valuable commodities.

2.1 Overview of Pipelines in West Virginia

Energy production is one of the leading industries driving West Virginia's economy. Historically, coal has been the primary driver of the state's economy, but the availability of an abundance of natural gas supplies within the Marcellus and Utica Shale regions have displaced the dominance of coal in favor of natural gas[3]. National laws, such as the Inflation Reduction Act (IRA), and international climate goals are some of the policies that have reduced demand for coal and will be discussed in Section 3.2.

2.1.1 Pipeline Terms

Terms used throughout this modal profile to describe pipeline inventory, demand, capacity, and safety as defined by the Pipeline & Hazardous Materials Safety Administration (PHMSA) and the U.S. Energy Information Administration (EIA) are listed in Table 2-1.

[1] https://www.phmsa.dot.gov/faqs/general-pipeline-faqs

[2] https://www.strausscenter.org/energy-and-security-project/the-u-s-shale-revolution/#:~:text=The%20%E2%80%9CShale%20Revolution%E2%80%9D%20refers%20to,total%20U.S.%20crude%20oil%20production

[3] US Oil and Natural Gas, US Department of Energy (2020)

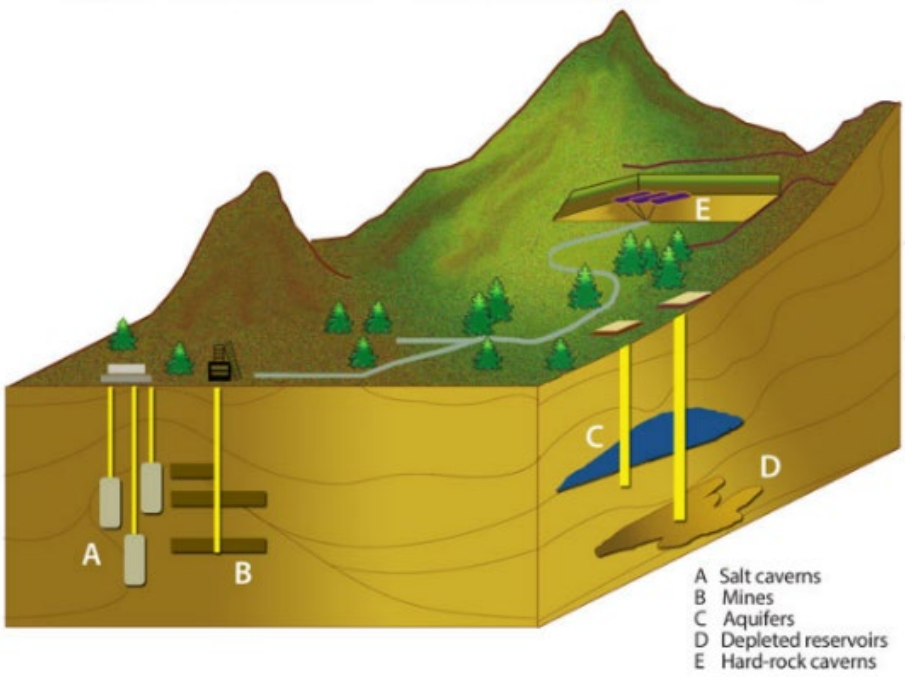
Table 2-1 Pipeline Terms

Term	Definition
Distribution	Delivery of natural gas from the major pipeline to the end user (e.g., residential, commercial, and industrial).
Dry Natural Gas	Predominantly methane gas as opposed to liquid natural gas and consists of methane and natural gas liquids (NGLs) including ethane and butane[4]. NGLs are typically sold as separate products such as plastic bags, synthetic rubber, and lighter fuel[5].
Gas Distribution	A distribution line which is used to supply natural gas to a consumer and is located in a network of piping located downstream of a natural gas transmission line. As defined in natural gas pipeline safety regulations, a distribution line is a pipeline other than a gathering or transmission line.
Gas Gathering	Pipelines that transport oil or natural gas from the wellhead to a transmission line.
Gas Transmission	Pipelines used to transport natural gas from a gathering, processing or storage facility to a processing or storage facility, large volume customer or distribution system. A large volume customer may receive similar volumes of gas as a distribution center, and include factories, power plants, and institutional users of gas. Often used to describe hazardous liquid pipelines also, a transmission line is a pipeline used to transport crude oil from a gathering line to a refinery and refined products from a refinery to a distribution center.
Gathering and Processing	Stripping out impurities and other hydrocarbons and fluids to produce pipeline-grade natural gas that meets specified tariffs (pipeline-quality natural gas is 95-98 percent methane).
Hazardous Liquids	A liquid that is dangerous to human health or safety or the environment if used incorrectly or if not properly stored or contained. Pipeline regulations identify petroleum, petroleum productions, or anhydrous ammonia as hazardous liquids.
Hydraulic Fracturing	The process of accessing natural gas by injecting millions of gallons of water - mixed with a variety of chemicals and sand - into the shale at high pressure to crack the rock and release the natural gas.
Liquefied Natural Gas	A natural gas or synthetic gas having methane as its major constituents, which has been transformed into a liquid.
Production	Taking raw natural gas from underground formations.
Shale Gas	Natural gas produced from wells that have shale formations. Shale is a fine-grained rock which consists of mud from flakes of clay minerals and other tiny fragments. Shale is a source a reservoir of natural gas.
Transmission Line	Transmission line is a pipeline that (1) transports gas from a gathering line or storage facility to a distribution center, storage facility, or large volume customer that is not down-stream from a distribution center; (2) operators at a hoop stress of 20 percent of more of SYMS; or (3) transports gas within a storage field.
Underground Natural Gas Storage	Natural gas, a colorless, odorless and a gaseous hydrocarbon, is most often held in underground locations. The figure below shows the types of underground natural gas storage facilities which include salt caverns, mines, aquifers, depleted reservoirs, and hard-rock caverns.

[4] https://stateimpact.npr.org/pennsylvania/tag/natural-gas-prices/

[5] https://www.eia.gov/todayinenergy/detail.php?id=5930

Figure 2-1 Natural Gas Storage Facilities



Source: Energy Information Administration | https://www.eia.gov/naturalgas/storage/basics/

Currently, more than 80 percent of the pipelines in West Virginia move natural gas[6]. Pipelines are the safest and most efficient way to move this energy commodity when compared with other modes. For example, rail was 4.5 times more likely to experience an incident than pipelines and result in larger spills[7].

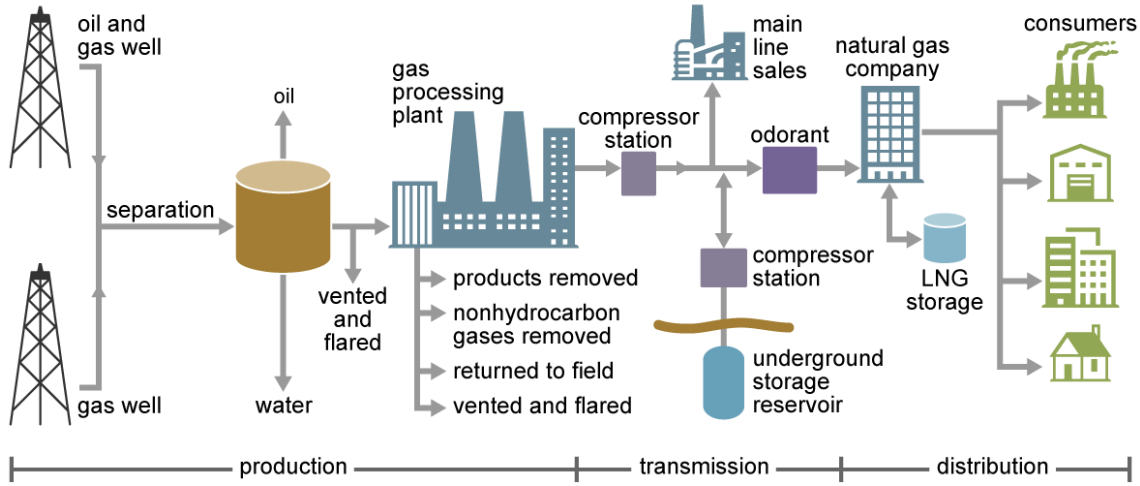
2.1.2 Production and Delivery Process

Delivery of natural gas from the wellhead and processing plant to city gate stations and industrial end users occurs through a vast network of high-pressure pipelines. Natural gas is typically stored in depleted underground reservoirs, aquifers, and salt caverns. The delivery of natural gas from the major pipelines to the end users (e.g., residential, commercial, and industrial) is outlined in Figure 2-2.

[6] FHWA Freight Analysis Framework V5

[7] https://www.fraserinstitute.org/sites/default/files/safety-in-the-transportation-of-oil-and-gas-pipelines-or-rail-rev2.pdf

Figure 2-2 Natural Gas Production and Delivery



Source: U.S. Energy Information Administration

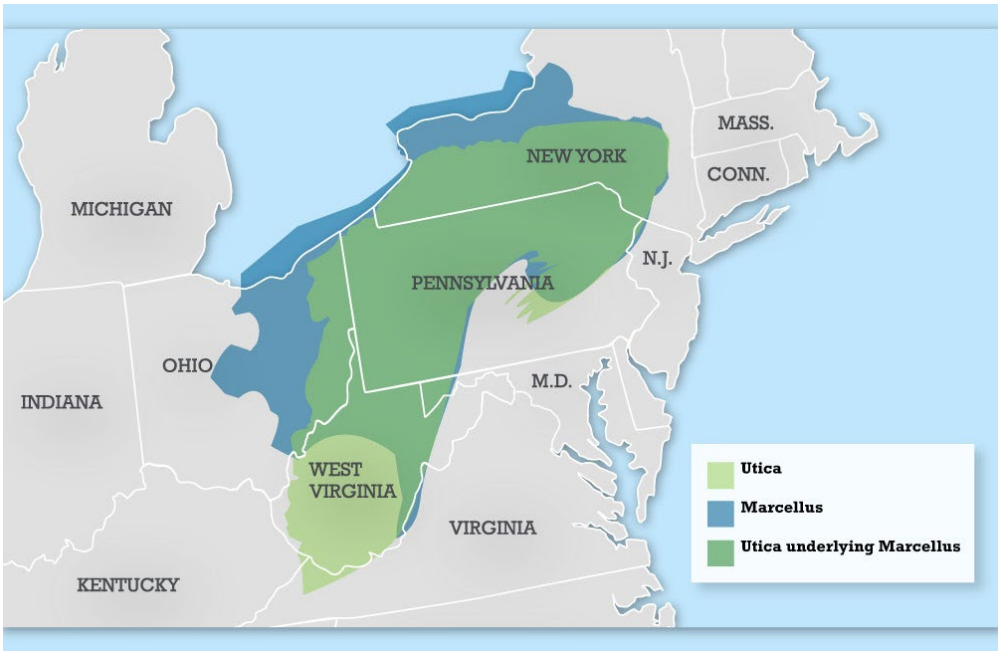
2.1.3 Energy Sources

Shale Gas is a natural gas located within shale formations and can contain petroleum and natural gas. The Marcellus and Utica shale gas wells produce an abundant amount of natural gas, located in New York, Pennsylvania, Ohio, and West Virginia. These shale wells consist of multiple geologic seams that are layered below the earth's surface (Figure 2-3). These wells account for 95 percent of natural gas sources supporting West Virginia natural gas production (Figure 2-4). Nationally, West Virginia is the fourth-largest natural gas producer in the U.S., with 2021 gross withdrawals totaling 2.8 million cubic feet (mcf). The only states producing more natural gas include Texas (9.87 mcf), Pennsylvania (7.62 mcf), and Louisiana (3.43 mcf)[8]. Supporting this production of shale gas in North America's energy market is the utilization of horizontal drilling and hydraulic fracturing, with natural gas production predicted to increase by 45 percent by 2040[9].

[8] United States - U.S. Energy Information Administration (EIA)

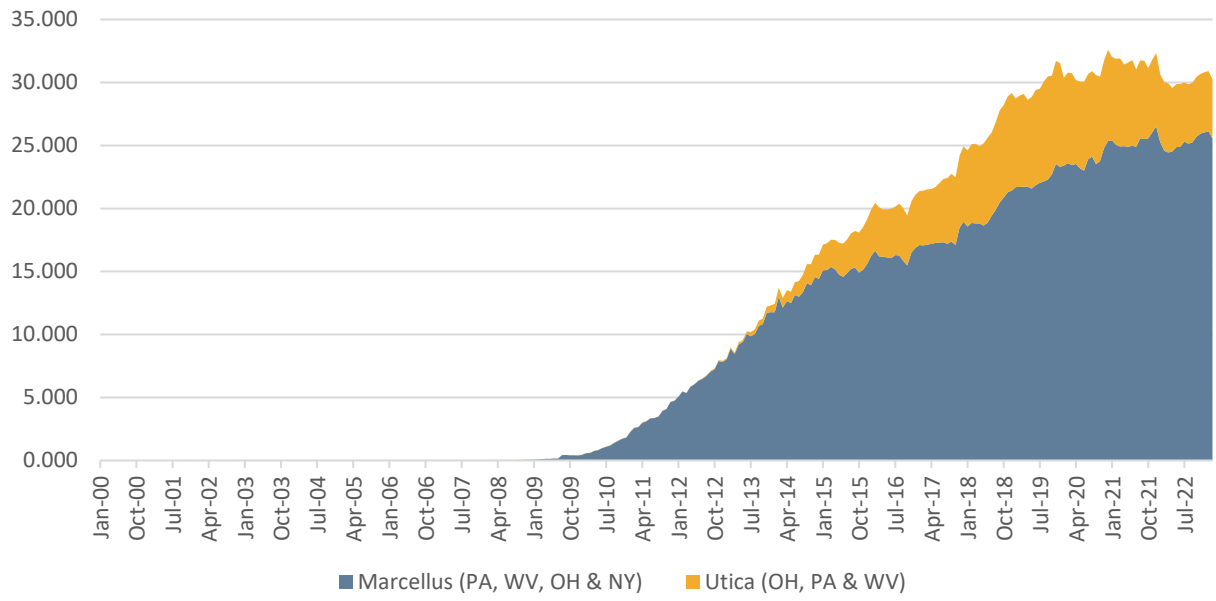
[9] https://www.sciencedirect.com/topics/engineering/shale-gas

Figure 2-3 Marcellus and Utica Shale



Source: [Oracle BI Interactive Dashboards - Public Reports (dot.gov)]

Figure 2-4 Regional Shale Production

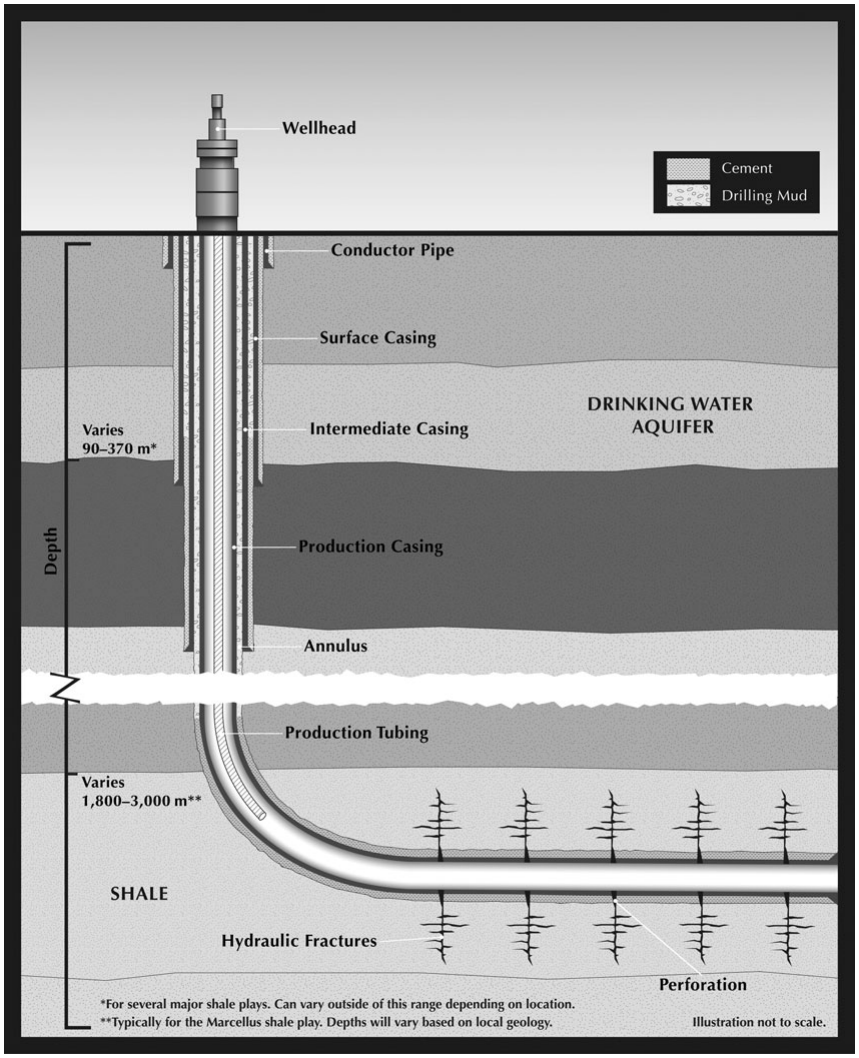


Source: *Marcellus Shale Coalition*

According to the U.S. Energy Information Administration (EIA), horizontal hydraulic fracturing accounts for nearly 70 percent of the existing wells in the U.S. Since the early 2000s, horizontal drilling has become the dominant method of accessing natural gas in the U.S. because drilling horizontally underground allows for more access to oil and natural gas-bearing rock than drilling vertically. The efficiencies of horizontal hydraulic fracturing have made the United States one of the top producers of natural gas. The process for this drilling

is shown in Figure 2-5. Horizontal drilling is the primary method of extracting natural gas in West Virginia. Currently, 99 percent of all hydrocarbon production for the Marcellus area has been produced using the horizontal hydraulic fracturing process[10]. Horizontal wells are more costly to construct than vertical wells, but they are more efficient and leave less of a surface footprint.

Figure 2-5 Horizontal Hydraulic Fracturing Process



Source: Hydraulic Fracturing and Shale Gas Production: Technology, Impacts, and Regulations | U.S Department of Energy | https://afdc.energy.gov/files/u/publication/anl_hydraulic_fracturing.pdf

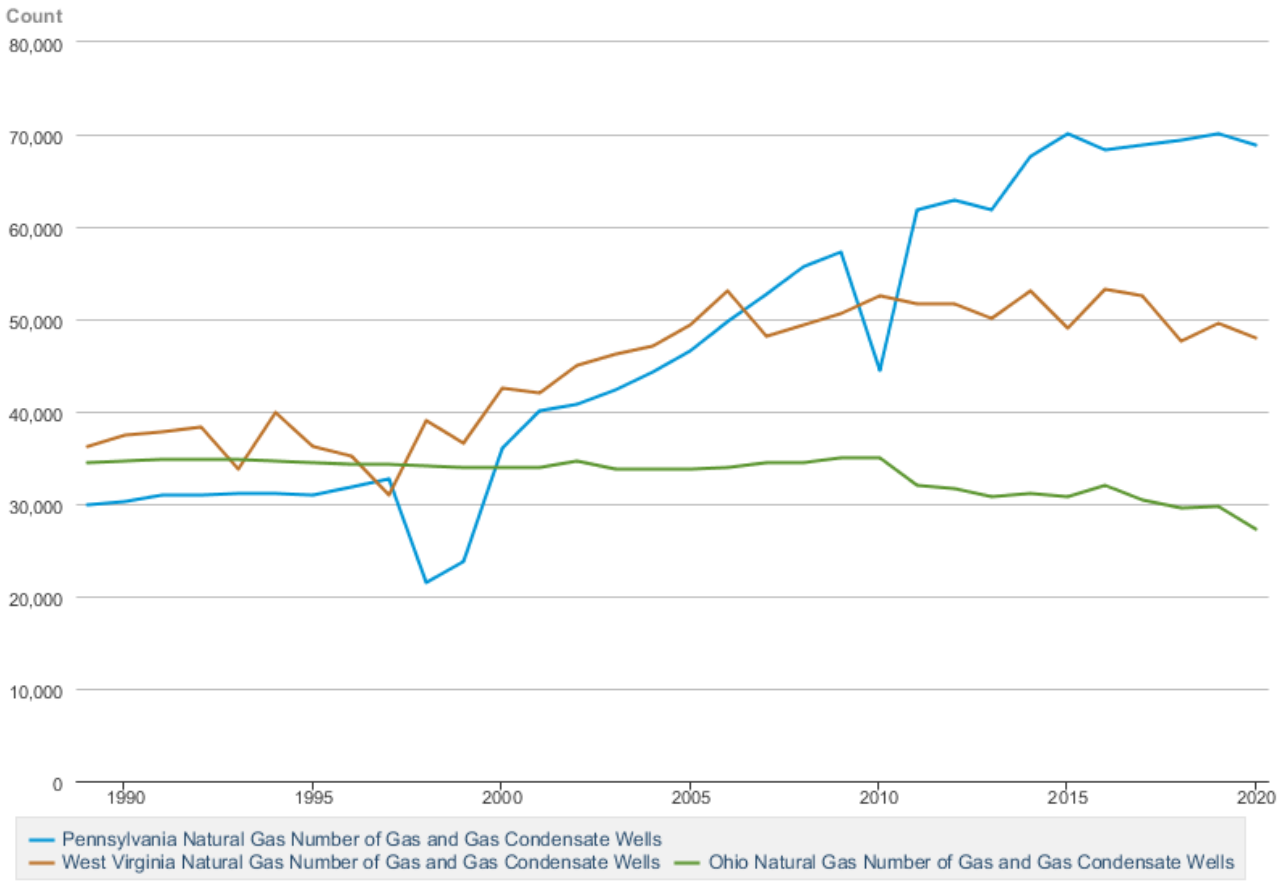
The increased efficiencies of extracting natural gas have allowed for higher production despite the number of existing wells remaining constant since 2005. Since 2010, what has been commonly referred to as the "U.S. Shale Revolution" involved the use of hydraulic fracturing and horizontal drilling that has enabled the U.S. to

[10] https://www.eia.gov/todayinenergy/detail.php?id=39752

utilize its natural gas resources[11]. Within West Virginia, this revolution has led to the increased extraction of natural gas from the Marcellus and Utica shales.

Since 1990, West Virginia has grown steadily in natural gas production. Compared to neighboring natural gas producers, West Virginia's natural gas production has increased while production in Ohio and Pennsylvania has declined (Figure 2-5).

Figure 2-6 Number of Natural Gas Condensate Wells in West Virginia, 1990-2020



Source: U.S. Energy Information Administration

2.2 Pipeline Infrastructure Ownership

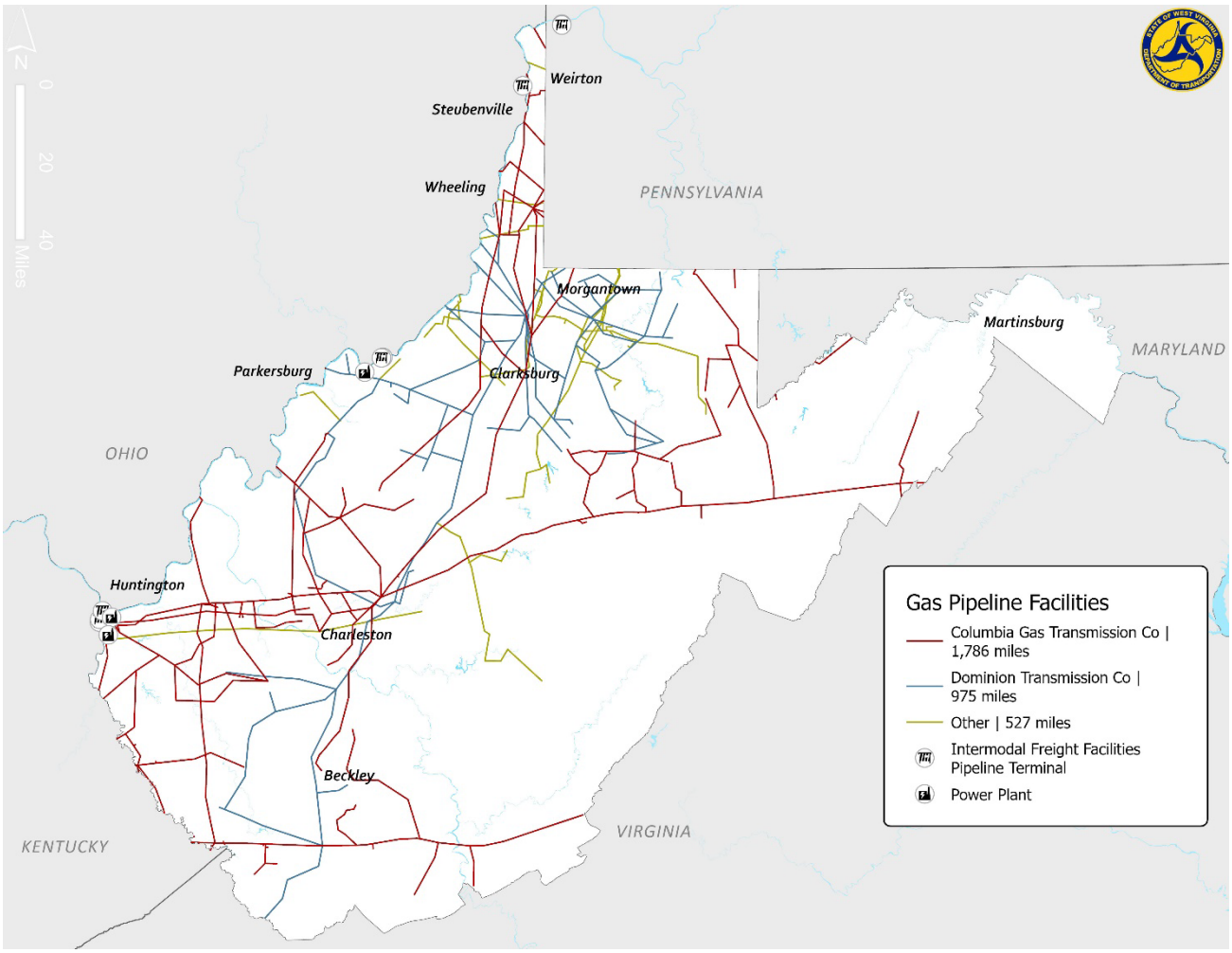
Pipelines are a critical piece of infrastructure for the West Virginia economy, transporting the state's high value energy commodities. This section outlines the pipeline infrastructure ownership of the natural gas pipelines, the hydrogen gas liquid pipelines and pipelines that are currently under construction. In the U.S., pipelines are privately owned and publicly regulated. The data in this section provides a brief overview of the main pipeline operators in West Virginia that have publicly available data through the Homeland Infrastructure Foundation-Level Data (HIFLD) and the Bureau of Transportation Statistics (BTS).

[11] https://www.strausscenter.org/energy-and-security-project/the-u-s-shale-revolution/#:~:text=The%20%E2%80%9CShale%20Revolution%E2%80%9D%20refers%20to,total%20U.S.%20crude%20oil%20production.

Figure 2-7 shows the major operators in the state, with Columbia Gas Trans Cooperating over 54 percent of the state's 3,288 miles of operating and mapped pipelines. There are also eight mapped terminals, four operated by MPLX LP (Hydrogen Gas Terminal), one by Ergon Terminaling Inc, one by Nustar Energy LP, and one by the Ohio Oil Gathering Corporation. The three mapped power plants in West Virginia are Pleasants Energy (Pleasant County), Ceredo Generating Station (Wayne County), and Big Sandy Peaker Plant (Catlettsburg, Kentucky).

Most liquid natural gas deliveries outside of pipelines requires Class I freight rail to transport commodities to markets in nearby states or to liquid natural gas terminals. In West Virginia, dry gas is not transported outside of the existing pipeline network. As a result, there are no planned pipeline terminal projects in West Virginia[12] due to the enhanced efficiency of pipelines for the movement of natural gas out of the state.

Figure 2-7 West Virginia Natural Gas Pipeline Ownership by Mile



Source: https://hifld-geoplatform.opendata.arcgis.com/datasets/natural-gas-pipelines/explore?location=34.538302%2C-109.077389%2C3.77

[12] North American LNG Export Terminals – Existing, Approved not Yet Built, and Proposed | Federal Energy Regulatory Commission (ferc.gov)

Table 2-2 West Virginia Natural Gas Pipeline Ownership by Mile

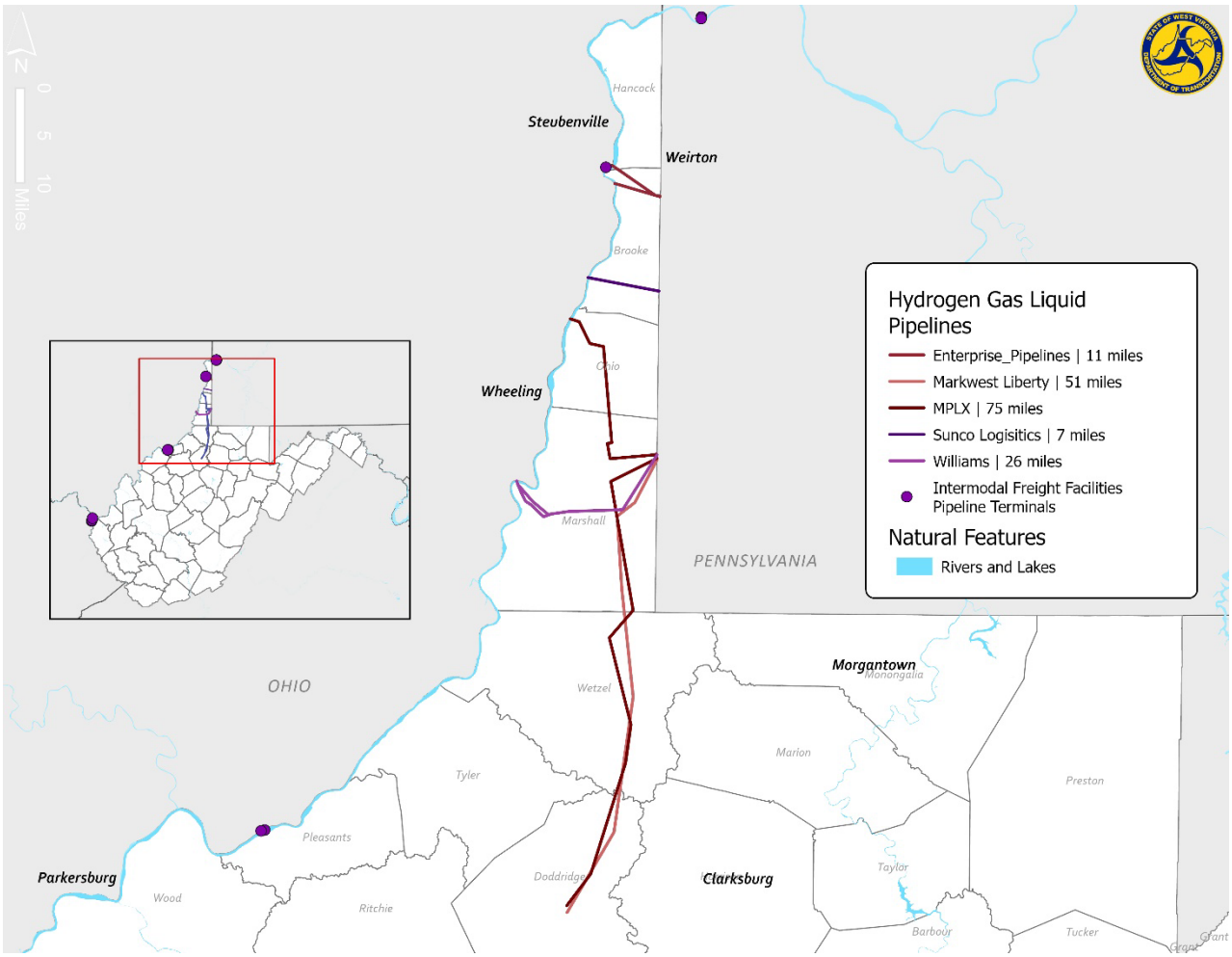
Operator	Miles	Percent of Mileage
Columbia Gas Trans Co	1,786	54%
Dominion Transmission Co	975	30%
Equitrans Inc	191	6%
Hope Natural Gas Co	189	6%
Tennessee Gas Pipeline	83	3%
Rover Pipeline	47	1%
Texas Eastern Trans Co	17	1%

Source: *Homeland Infrastructure Foundation-Level Data (HIFLD)*

Additionally, hydrogen gas liquids move through pipelines within West Virginia. Hydrogen gas liquids need to be cooled so they can liquify for transport. These liquid gases have many purposes such as feedstock, fuels for heating cooking, and drying, fuels for transportation, and additives for motor gasoline production[13]. Figure 2-8 shows the pipelines that support the flows of hydrogen gas liquids at the most northern panhandle section of the state.

[13] https://www.eia.gov/energyexplained/hydrocarbon-gas-liquids/

Figure 2-8 Hydrogen Gas Liquid Pipelines



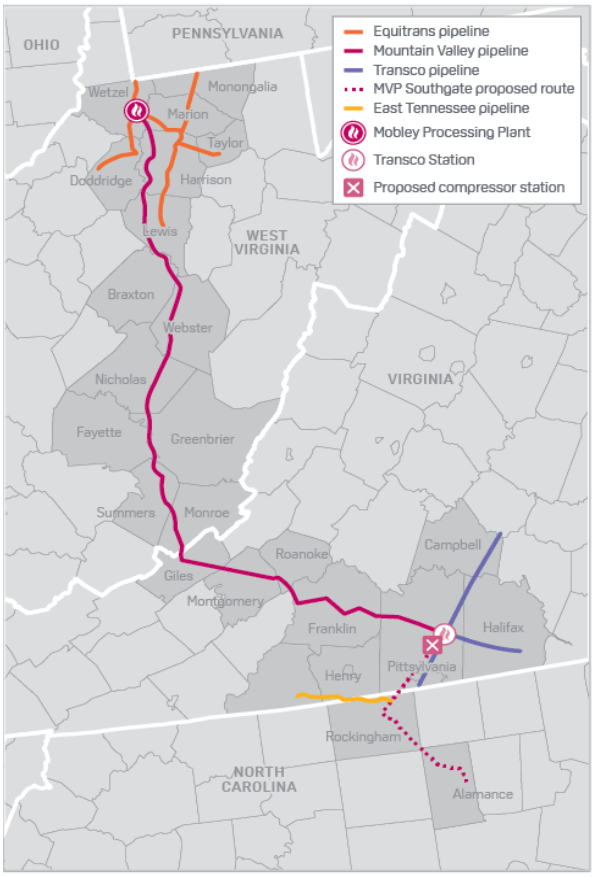
Source: https://hifld-geoplatform.opendata.arcgis.com/datasets/natural-gas-pipelines/explore?location=34.538302%2C-109.077389%2C3.77

2.3 Current and Future Pipeline Projects

This section outlines major current and future pipeline projects in West Virginia. As of 2023, there are two active projects in West Virginia at various stages of development, including design, regulatory approval, and/or construction:[14]

- **The Mountain Valley Pipeline (MVP)** is a $6.6 billion natural gas pipeline, approximately 303 miles in length from northern West Virginia to southwestern Virginia. The MVP will be constructed and owned by Mountain Valley Pipeline, LLC, which is a joint Venture led by EQM Midstream Partners, LP[15]. The MVP will extend the Equitrans transmission system from Wetzel County, WV to the Transcontinental Gas Pipeline Company's (Transco) Zone 5 compressor station 165 in Pittsylvania County, VA, impacting a total of 11 counties within West Virginia[16].
- **Tri-State Corridor Gas Pipeline** is a proposed natural gas pipeline that runs from southwest Pennsylvania to West Virginia. This proposed 17-mile project, operated by Equitrans, would run from Washington County, PA to the Energy Solutions Consortium power plant in Brook County, WV and connect to the Rover pipeline to provide NGL's to West Virginia's first natural-gas fired electric power plant. Currently this project is on hold with minimal data that is publicly available.

Figure 2-9 Mountain Valley Pipeline



Source: EQM Midstream Partners

Figure 2-10 Pipeline Under Construction in West Virginia

Source: EQM Midstream Partners

[14] https://www.eia.gov/naturalgas/pipelines/EIA-NaturalGasPipelineProjects.xlsx

[15] Other partners include NextEra US Gas Assets, LLC, Con Edison Transmission, Inc., WGL Midstream, and RGC Midstream, LLC

[16] https://mountainvalleypipeline.info

3.0 PIPELINE FREIGHT DEMAND

Existing pipeline freight demand in West Virginia was evaluated using Freight Analysis Framework (FAF5). FAF5 is provided by a joint collaboration of the Bureau of Transportation Statistics (BTS) and the Federal Highway Administration (FHWA) to provide a comprehensive view of freight movement throughout the U.S. and major metropolitan areas by mode of transportation. Future pipeline freight movement was also evaluated by utilizing data from the International Energy Agency (IEA) and the U.S Energy Information Administration (EIA) to analyze projected pipeline commodity demand. Additionally, this section discusses future prospects for the energy industry to understand future demand needs of the West Virginia pipeline network.

3.1 Existing Pipeline Freight Demand

In 2019, nearly 73 million tons valued at $14.3 billion flowed throughout West Virginia's pipeline network. Overall, pipelines represented 22 percent of the state's total volume of freight movement for all modes and 11 percent of the total value. Table 3-1 presents pipeline tonnage by value and direction for inbound, outbound, and intrastate flows. The largest proportion of movement by volume and value was domestic outbound flows, which accounted for 77 percent of total volume and 67 percent of total value. All of West Virginia recorded pipeline volumes flow to domestic locations, there are no flows recorded to international locations.

Table 3-1 West Virginia Pipeline Flows by Direction, 2019

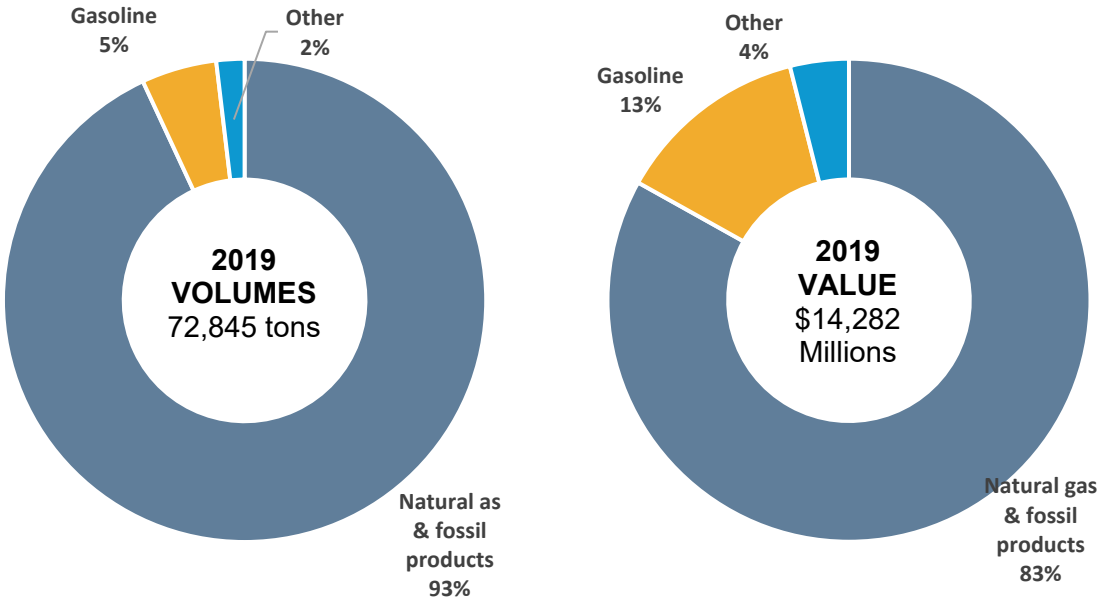
Direction	Tonnage (in thousands)	% of Total	Value ($M)	% of Total
Inbound	13,882	19%	$4,223	30%
Outbound	56,290	77%	$9,599	67%
Intrastate	2,674	4%	$460	3%
Total	**72,846**	**100%**	**$14,282**	**100%**

Source: Freight Analysis Framework V5, Cambridge Systematics | Note: Data not available for through-state flows.

There are four types of commodities that flow throughout West Virginia via pipeline. Natural gas and fossil products [17] accounted for 93 percent of the total pipeline tonnage and 83 percent of the total value. Gasoline accounted for five percent of the volume and 13 percent of value. The smallest portion of commodities moved by pipelines was fuel oils and basic chemicals at two percent of total volume and four percent of total value. Figure 3-1 shows the total volume and total value of commodities in 2019.

[17] Commodities in this group include liquefied natural gas, propane, butane, and other liquefied gaseous hydrocarbons that can be transported in pipelines.

Figure 3-1 Pipeline Commodities by Volumes and Value, 2019

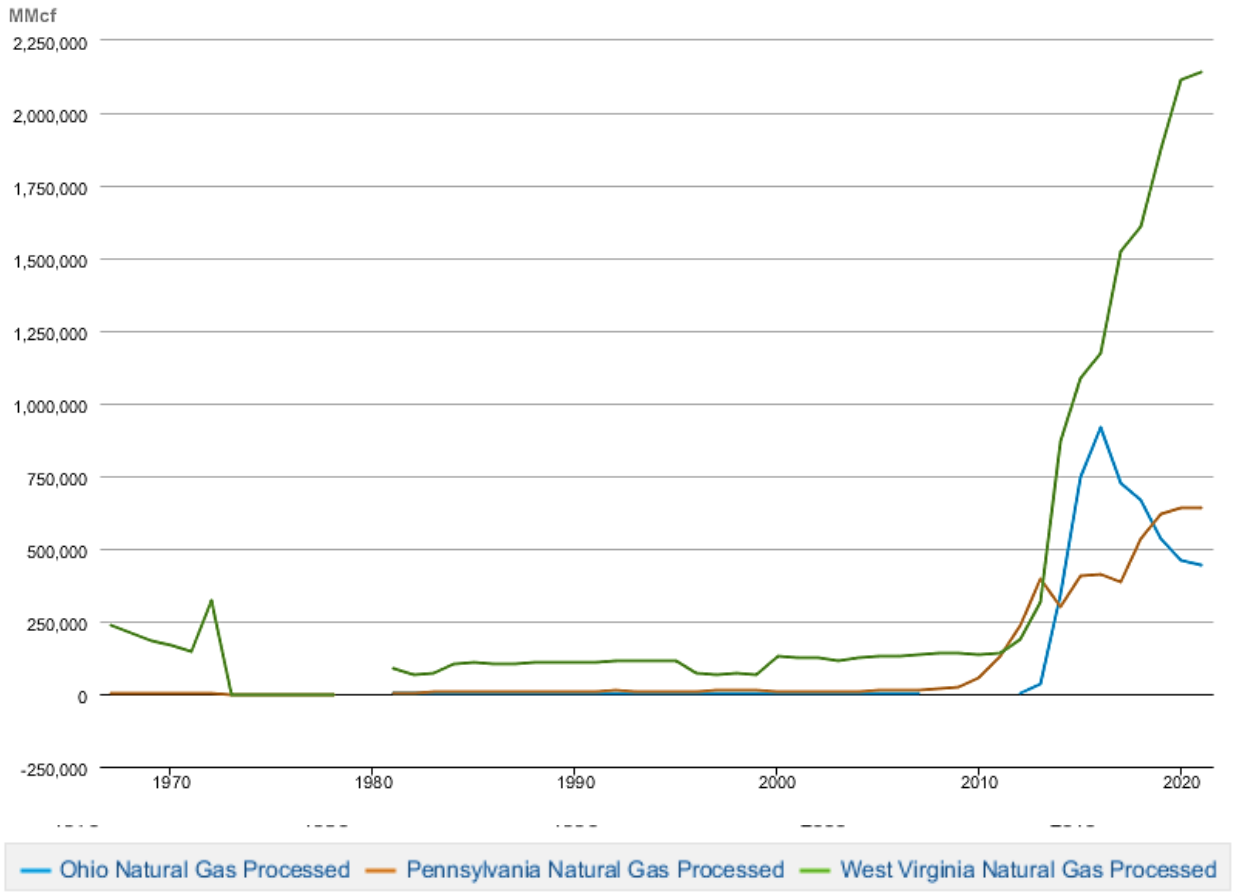


Source: *FHWA Freight Analysis Framework V5 |*

Note: *Other includes Fuel Oils and Basic Chemicals*

Figure 3-2 shows the gas plant processing in Ohio, Pennsylvania, and West Virginia. Out of the three states in the region from 1970 to 2020, West Virginia has seen the most significant growth in 2010 to 2020. West Virginia also outpaces Ohio and Pennsylvania in natural gas production.

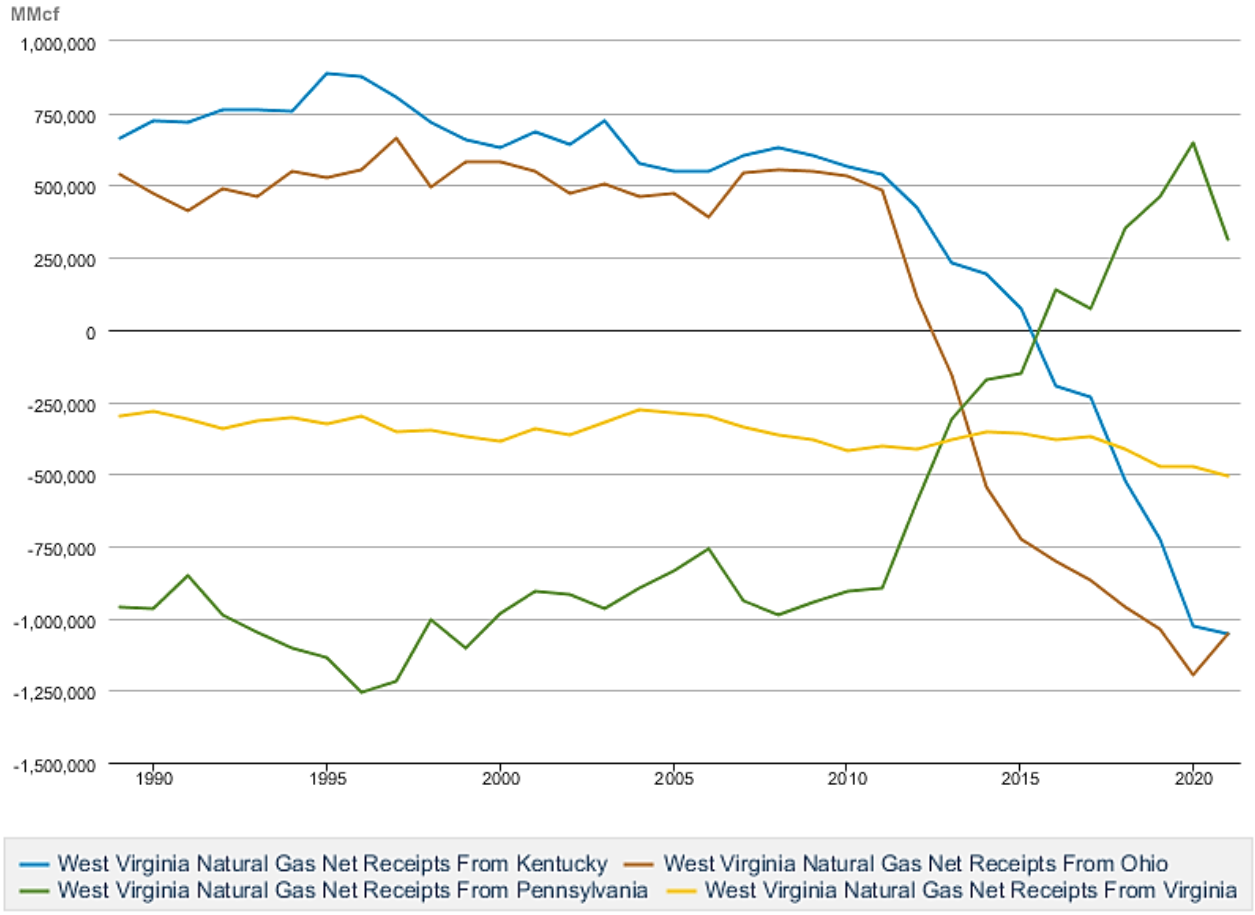
Figure 3-2 Natural Gas Processing



Source: U.S Energy Information Administration - http://www.eia.gov/dnav/ng/ng_prod_pp_a_epg0_ygp_mmcf_a.htm

Figure 3-3 shows interstate movements of natural gas by state in the northeast. Most notable is the increase of gas movements from Pennsylvania and the decreases of gas movements from Kentucky and Ohio. This represents the shift in flows from neighboring states before and after the Marcellus and Utica shale area discovery.

Figure 3-3 Interstate Movements of Natural Gas in the Northeast



Source: *U.S. Energy Administration*

West Virginia's top inbound pipeline trade partners are outlined in Table 3-2. Kentucky accounted for the largest proportion of volume and value, at 62 percent and 19 percent, and Pennsylvania at 38 percent of volume and 12 percent of value for 2019. Together, these states accounted for all inbound pipeline volume.

Table 3-2 Top Inbound Pipeline Trade Partners, 2019

Trade Partner	Tonnage (in thousands)	% Of Total	Value ($M)	% Of Total
Kentucky	8,643	62%	$2,596	61%
Pennsylvania	5,238	38%	$1,627	39%
Total	**13,882**	**100%**	**$4,223**	**100%**

Source: *FHWA Freight Analysis Framework V5*

West Virginia's top outbound pipeline trade partners for 2019 are outlined in Table 3-3. Ohio accounted for half the volume and value, followed by Virginia at 21 percent of volume and 21 percent of value, Pennsylvania at 15 percent of volume and 15 percent of value, and Kentucky at 13 percent of volume and 13 percent of volume.

Table 3-3 Top Outbound Pipeline Trade Partners, 2019

Trade Partner	Tonnage (in thousands)	% Of total	Value ($M)	% Of Total
Ohio	28,110	50%	$4,794	50%
Virginia	11,977	21%	$2,042	21%
Pennsylvania	8,666	15%	$1,478	15%
Kentucky	7,538	13%	$1,285	13%
Total	**56,290**	**100%**	**$9,599**	**100%**

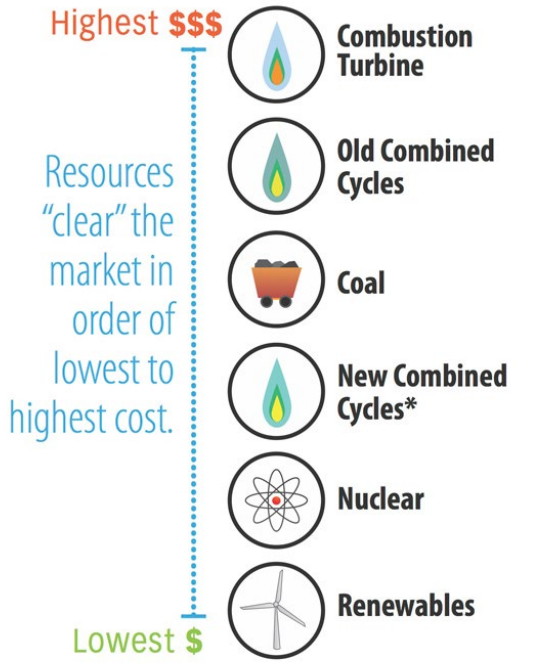
Source: FHWA Freight Analysis Framework V5

3.2 Future Pipeline Freight Demand

Pipeline freight demand is correlated to domestic natural gas demand and natural gas demand is closely correlated with seasonal weather patterns. Demand for natural gas within West Virginia is primarily driven by commercial and residential electricity; however, West Virginia is in the bottom 10 states in the country that uses natural gas for electricity production because coal accounts for 90 percent of the generated electricity within the state.

The wholesale and retail market price competitiveness for coal electricity declined precipitously over the past decade as renewables (solar, wind, hydropower) and natural gas became cheaper per kilowatt hour[18]. Figure 3-4 Electricity Market Prices shows the market prices by energy source, with renewables and nuclear having the lowest market cost. In addition to competitive market price, recent regulations on hydrogen and methane have created a regulatory environment that supports the production and distribution of liquid natural gas through pipelines. The following two sections outline regulatory policy impacting future pipeline freight demand and FAF5 data illustrating demand up to the horizon year 2050.

Figure 3-4 Electricity Market Prices



Source: https://learn.pjm.com/electricity-basics/market-for-electricity.aspx

3.2.1 Regulatory Policies Impacting Pipeline Freight Demand

Federal policies prescribe the infrastructure permitting that impacts the nation's energy supply. Without the pipeline infrastructure to support natural gas commodities, other forms of energy production would need to be assessed to meet demand. Regulatory policies impacting pipelines in West Virginia stem from permitting. To support pipeline construction in West Virginia, the Building American Energy Securities Act of 2023 was introduced to Congress in May of 2023 and seeks to set maximum timelines for National Environmental

[18] https://ieefa.org/resources/us-coal-generation-falls-record-first-quarter-low

Policy Act (NEPA) reviews, address excessive litigation delays, and prioritize infrastructure projects of national importance[19]. This initiative would support the completion of the Mountain Valley Pipeline which had been paused indefinitely due to permitting regulations. However, on June 3, 2023, the President of the United States signed legislation that raises the Nation's debt limit and ratifies and approves all permits and authorizations necessary for the construction and initial operation of the MVP and directs the applicable Federal officials and agencies to maintain such authorizations. On June 24, 2023, the Secretary of the Army issued all permits necessary to complete project construction and allow for MVP's operation and maintenance. Equitrans Midstream, operator of the MVP, intends to work with its project partners to complete construction of the MVP project by year-end 2023, at an estimated total project cost of approximately $6.6 billion.[20]

The following sections outline policies impacting pipelines through supporting hydrogen-based fuels and applying fees on methane gas.

Hydrogen Based Fuels

The 2022 "Net Zero Emissions by 2050 Scenario" report by the IEA detailed how the global energy sector can achieve net zero emissions by 2050. Supporting hydrogen-based fuels would help achieve this net zero based future. The Infrastructure Investment and Jobs Act (IIJA), which was signed into law in November 2021, provides $8 billion to fund 6-10 hydrogen hubs (H2Hubs) with a goal to produce and deliver clean hydrogen to achieve a clean energy grid by 2035[21]. Natural gas plays a large role generating cleaner burning hydrogen by combining with ammonia enabling the hydrogen transport via established pipeline networks.

Two large natural gas producing areas of the U.S. will establish regional hubs to produce hydrogen. The first of 18 applicants encouraged by the U.S. Department of Energy (DOE) to apply for funding is ARCH2, the "Appalachian Regional Clean Hydrogen Hub." Table 3-4 shows the 18 applicants for the hydrogen hubs in the U.S. that have confirmed DOE's green light to move forward.

Table 3-4 Proposed Hydrogen Hubs

	Proposal	Areas to Benefit
1.	Appalachian Regional Clean Hydrogen Hub (ARCH2)	West Virginia-led with Kentucky, Maryland, Ohio and Pennsylvania
2.	Decarbonization Network of Appalachia (DNA)	Pennsylvania-led with Ohio and West Virginia
3.	Southwest Hydrogen Hub	Alabama, Georgia, Kentucky, North Carolina, South Carolina, Tennessee
4.	Midwest Alliance for Clean Hydrogen	Illinois, Indiana, Kentucky, Michigan, Minnesota, Ohio, Wisconsin
5.	Greater St. Louis and Illinois Regional Clean Hydrogen Hub Industrial Cluster	Greater St. Louis and Illinois
6.	Alliance for Renewable Clean Hydrogen Energy Systems (ARCHES)	California
7.	Pacific Northwest Hydrogen Association	Washington

[19] https://www.energy.senate.gov/2023/5/manchin-moves-ball-forward-on-permitting-reform

[20] https://www.mountainvalleypipeline.info/news-info/, accessed June 19, 2023.

[21] https://www.energy.gov/oced/regional-clean-hydrogen-hubs

	Proposal	Areas to Benefit
8.	Obsidian Pacific Northwest Hydrogen Hub	Oregon and Washington state
9.	Hawaii Pacific Hydrogen Hub	Hawaii
10.	Great Lakes Clean Hydrogen	Indiana, Michigan, Ohio and Pennsylvania
11.	HALO Hydrogen Hub	Arkansas, Louisiana and Oklahoma
12.	HARVEST Hydrogen Hub Coalition	Kansas
13.	Horizons Clean Hydrogen Hub (HCH2)	Led by Port of Corpus Christi Authority for Texas and West South-Central U.S.
14.	HyVelocity Hub	Texas, Southwest Louisiana and Gulf Coast
15.	Trans Permian H2Hub	Texas cities of San Antonio, San Angelo, Big Spring, Midland, Odessa, El Paso, Fort Stockton, Alpine, Presidio and Del Rio
16.	Southwest Clean Hydrogen Innovation Network	Arizona, Nevada and the Navajo Nation
17.	Western Interstate Hydrogen Hub	Colorado, New Mexico, Utah and Wyoming
18.	Northeast Regional Clean Hydrogen Hub	New York-led with Connecticut, Maine, Massachusetts, New Jersey, Rhode Island and Vermont

Source: https://www.ttnews.com/articles/doe-encourages-33-regional-hydrogen-hubs-compete-final-funding-phase

ARCH2 is a coalition that includes the State of West Virginia, EQT Corporation, Battelle, and GTI Energy with announcements of final award decisions to be made by fall of 2023[22].

The use of ammonia for these hydrogen hubs would make the transport of hydrogen safer and easier by utilizing existing pipeline networks that the U.S. has used for agricultural fertilizer during the past century. Ammonia will be a vital component in using hydrogen fuel for the shipping and agriculture industries to displace oil-based diesel fuels on a path to decarbonization. Existing natural gas turbines and coal power plants can be repurposed to manufacture ammonia rather than requiring new infrastructure. Future regulatory permitting measures are contingent on supporting these demand trends.

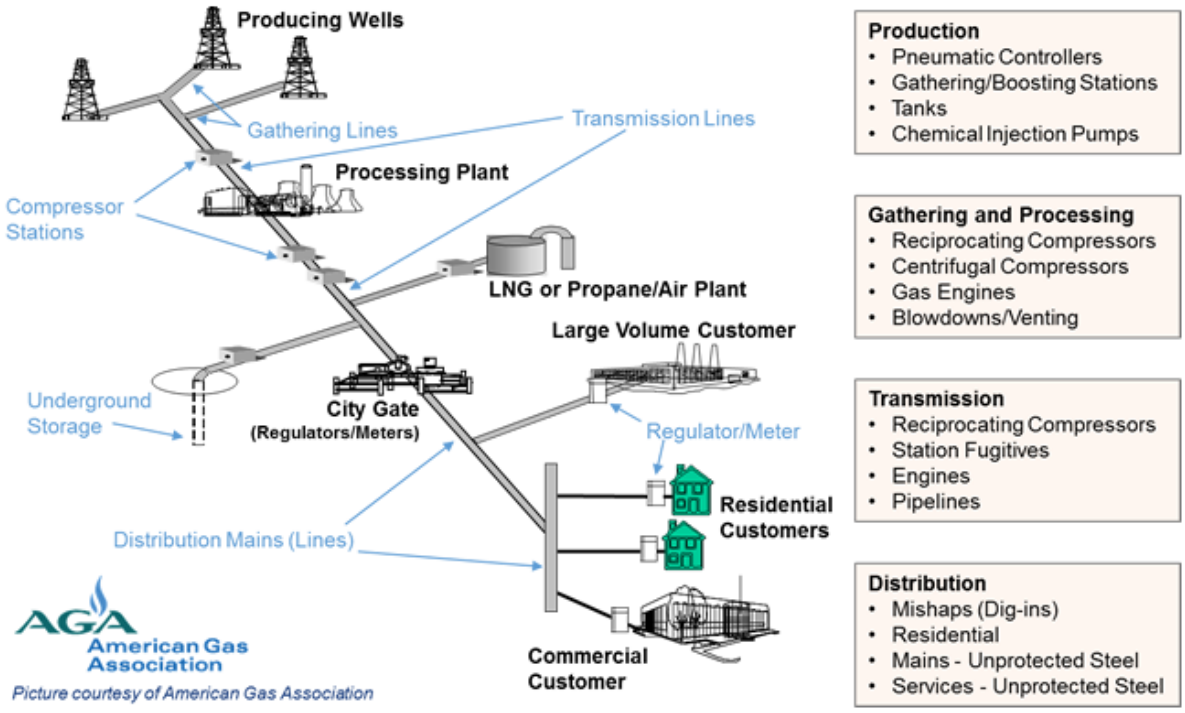
Methane Fees

The Inflation Reduction Act (IRA), signed into law in 2022, has an objective to reduce carbon emissions in the energy sector by 40 percent by 2030. A feature of the IRA includes the Methane Emissions Reduction Program (MERP)[23] which charges a fee to companies that emit over 25,000 metric tons of CO_2 per year and exceed waste emissions thresholds. Methane is 25 times more impactful than CO_2 in trapping heat in the earth's atmosphere, and the natural gas and petroleum industries are the largest emitters of methane in the United States. Pipeline quality dry natural gas is 95-98 percent methane and there are several segments in the production and delivery process where methane emissions occur. Figure 3-5 illustrates each segment of production and the top emission sources for each sector.

[22] https://www.battelle.org/insights/newsroom/press-release-details/appalachian-regional-clean-hydrogen-hub-submits-multi-state-application-for-the-department-of-energy's-hydrogen-hub

[23] https://www.regulations.gov/docket/EPA-HQ-OAR-2022-0875

Figure 3-5 Methane Leak Sources



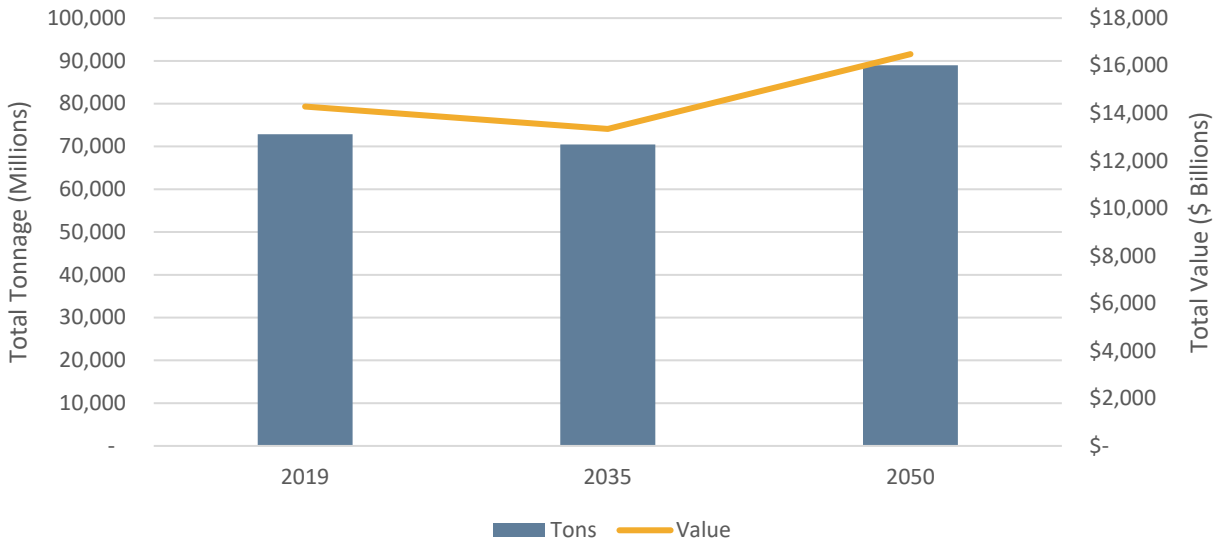
Source: https://www.epa.gov/natural-gas-star-program/overview-oil-and-natural-gas-industry

3.2.2 Pipeline Commodity Projections

This section details projected demand forecasts for West Virginia Energy production. Natural gas production has increased significantly in West Virginia from 2010 to 2020. This is primarily due to the construction of wells of the Marcellus and Utica shale regions and increased efficiencies in well and drilling production as discussed in Section 2.1.3.

According to FAF5, pipeline flows are expected to increase by 22 percent by tonnage from 2019 to 2050. The value of the tonnage is projected to increase by 15 percent with a slight decrease in 2035. Figure 3-6 shows this 30-year growth trajectory.

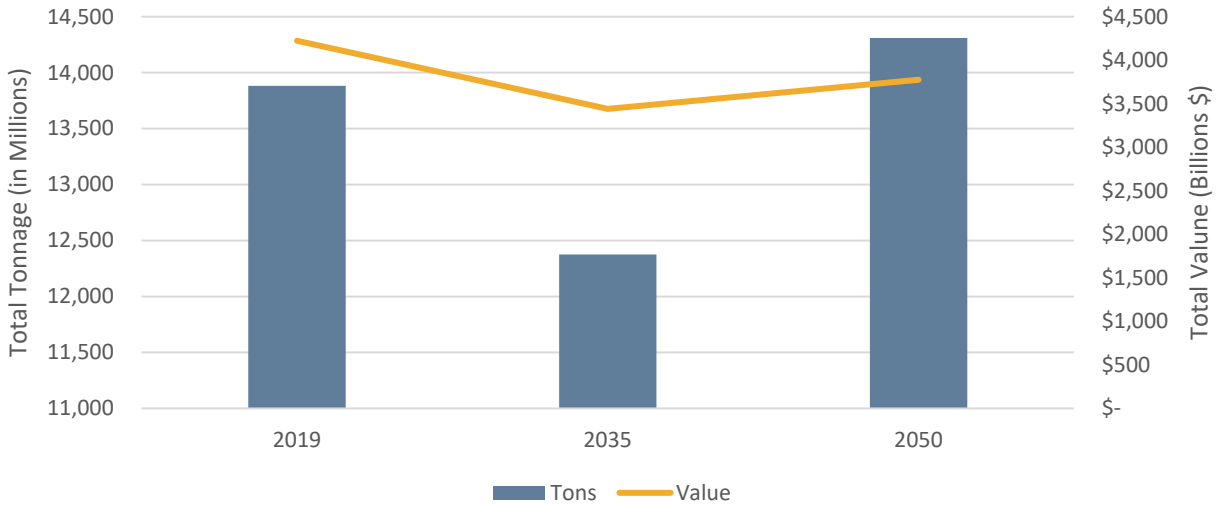
Figure 3-6 Pipeline Flows in West Virginia, 2019, 2035, and 2050



Source: FHWA Freight Analysis Framework V5, Cambridge Systematics | Note: This table excludes through-state flows.

Figure 3-7 shows pipeline imports to West Virginia for 2019, 2035 and 2050. Import tonnage increases three percent from 2019 to 2050 and decreases by 11 percent from 2019 to 2035. The dominance of the Marcellus basin which is expected to reach 70 Bcf/d (billion cubic feet per day) by 2030[24] is likely to impact the demand for importing natural gas commodities by pipeline to West Virginia.

Figure 3-7 Pipeline Imports to West Virginia, 2019, 2035, and 2050



Source: FHWA Freight Analysis Framework V5, Cambridge Systematics

[24] https://www.energy.gov/policy/articles/report-natural-gas-infrastructure-implications-increased-demand-electric-power

Table 3-5 shows the top pipeline import partners for West Virginia in 2019, 2035, and 2050. Imports from Kentucky decreased from 5.2 million tons in 2019 to 3.4 million tons in 2050. For Pennsylvania the import tonnage increased from 8.6 million tons in 2019 to 10.9 million tons in 2050.

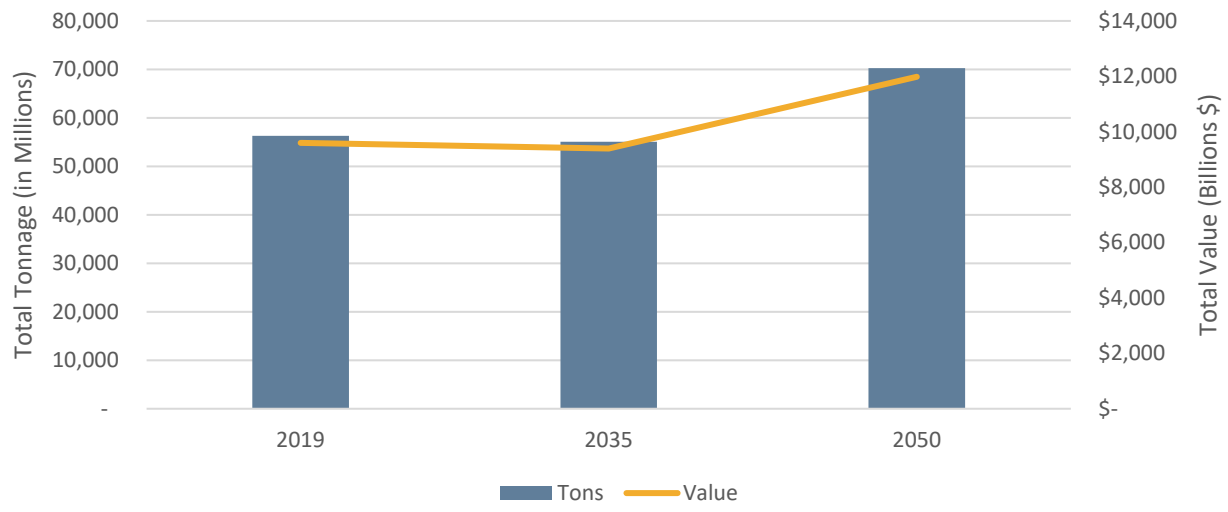
Table 3-5 Top Pipeline Import Trade Partners to West Virginia, 2019 - 2050

Year	State	Tonnage (in thousands)	% Of Total	Value ($M)	% Of Total
2019	Kentucky	5,238	38%	$2,596	61%
	Pennsylvania	8,643	62%	$1,627	39%
	2019 Total	**13,882**		**$4,223**	
2035	Kentucky	3,560	29%	$1,781	52%
	Pennsylvania	8,815	71%	$1,659	48%
	2035 Total	**12,375**		**$3,441**	
2050	Kentucky	3,407	24%	$1,724	46%
	Pennsylvania	10,902	76%	$2,052	54%
	2050 Total	**14,309**		**$3,775**	

Source: FHWA Freight Analysis Framework V5, Cambridge Systematics

Figure 3-8 shows pipeline exports from West Virginia for 2019, 2035 and 2050. Import tonnage and value is projected to increase by 25 percent from 2019 to 2050.

Figure 3-8 Pipeline Exports from West Virginia 2019 - 2050



Source: FHWA Freight Analysis Framework V5, Cambridge Systematics

Table 3-6 outlines the top export trade partners from West Virginia for 2019, 2035, and 2050. Ohio is expected to comprise nearly half the pipeline exports from West Virginia for 2019, 2035 and 2050.

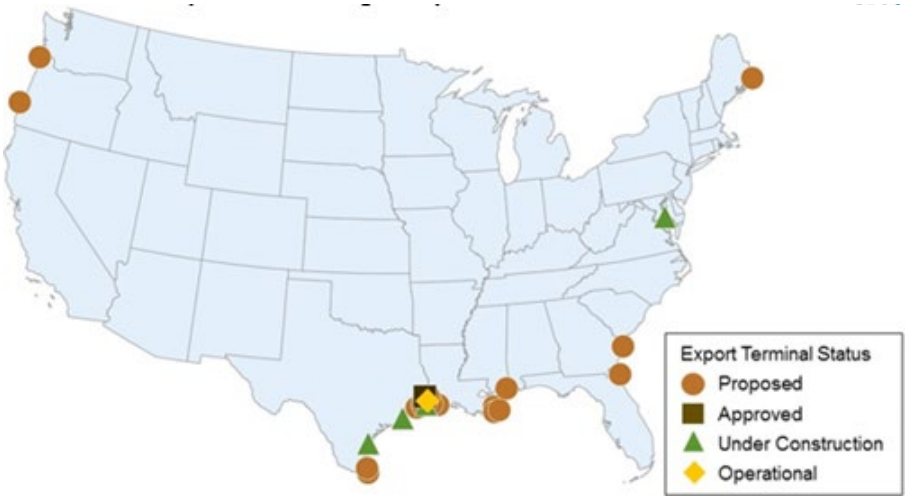
Table 3-6 Top Pipeline Export Trade Partners from West Virginia, 2019 - 2050

Year	State	Tonnage (in thousands)	% Of Total	Value ($M)	% Of Total
2019	Kentucky	7,538	13%	$1,285	13%
	Ohio	28,110	50%	$4,794	50%
	Pennsylvania	8,666	15%	$1,478	15%
	Virginia	11,977	21%	$2,042	21%
	Total 2019	**56,290**		**$9,599**	
2035	Kentucky	6,997	13%	$1,193	13%
	Ohio	27,407	50%	$4,674	50%
	Pennsylvania	10,729	19%	$1,830	19%
	Virginia	9,952	18%	$1,697	18%
	Total 2035	**55,085**		**$9,394**	
2050	Kentucky	8,596	12%	$1,466	12%
	Ohio	34,707	49%	$5,919	49%
	Pennsylvania	14,932	21%	$2,546	21%
	Virginia	12,036	17%	$2,053	17%
	Total 2050	**70,272**		**$11,984**	

Source: FHWA Freight Analysis Framework V5, Cambridge Systematics

The proposed Penn Liquefied Natural Gas (LNG) terminal project would be sited along the Delaware River and link to the existing shale gas pipelines[25]. Additional terminals would alleviate the need for additional storage for excess production. Figure 3-9 shows the locations of LNG terminals in the U.S.

Figure 3-9 Liquefied Natural Gas Export Terminals in the United States



Source: https://www.eia.gov/todayinenergy/detail.php?id=25232

[25] https://www.naturalgasintel.com/proposed-pennsylvania-lng-export-terminal-in-talks-to-commercialize-project/

Table 3-7 shows the projections by commodity in West Virginia pipelines. Natural gas and other fossil products accounts for more than 83 percent of the commodities moving through West Virginia pipelines.

Table 3-7 Projections by Commodity

Year	Commodity	Tonnage (in thousands)	% Of Total	Value($M)	% Of Total
2019	Natural gas and fossil products	67,805	93.08%	$11,869	83.10%
	Gasoline	3,670	5.04%	$1,851	12.96%
	Fuel oils	1,264	1.74%	$560	3.92%
	Basic chemicals	107	0.15%	$2	0.01%
	Total 2019	**72,846**		**$14,282**	
2035	Natural gas and fossil products	67,085	95.18%	$11,787	88.37%
	Gasoline	2,294	3.25%	$1,157	8.68%
	Fuel oils	880	1.25%	$390	2.92%
	Basic chemicals	225	0.32%	$4	0.03%
	Total 2035	**70,483**		**$13,338**	
2050	Natural gas and fossil products	85,762	96.37%	$15,093	91.55%
	Gasoline	2,005	2.25%	$1,012	6.14%
	Fuel oils	844	0.95%	$374	2.27%
	Basic chemicals	377	0.42%	$7	0.04%
	Total 2050	**88,989**		**$16,485**	

Source: FHWA Freight Analysis Framework V5 |

4.0 PIPELINE INFRASTRUCTURE CONDITION AND CAPACITY

West Virginia's pipeline infrastructure is critical to the distribution of natural gas to surrounding states, as the state produces more natural gas than it consumes[26]. This section describes the infrastructure condition of the existing pipeline network using the Pipeline and Hazardous Materials Safety Administration (PHMSA) as a framework for evaluation. The PHMSA is part of U.S. DOT and is responsible for the safe transportation of energy and other hazardous materials throughout the U.S. For evaluating the capacity of pipelines, the U.S. Energy Administration regulates the commodities that flow within the pipeline system and produces forecasts for projected growth.

4.1 Infrastructure Condition

The PHMSA collects data from private pipeline operators to measure pipeline performance measures. Data evaluated in this section from PHMSA outlines the conditions of the West Virginia pipeline system based on national performance measures. These performance measures provide metrics to help prevent incidents, accidents, injuries, fatalities, and system failures. The measures are classified in the following categories and outlined in Table 4-1.

Table 4-1 National Pipeline Performance Measures

Pipeline Commodity	Performance Measure	
Crude Oil/Refined Petroleum/Biofuel	**Serious Incidents** Rate per mile and cause	
	Accidents impacting people or the environment Rate per mile and volume spilled per barrel-mile transported	
	Miles Inspected Miles inspected by inspection method	
Gas	**Gas Distribution (GD) and Gas Transmission (GT)** Serious Incident Rate and Cause are incidents which involve a fatality or injury requiring hospitalization Higher-Risk Materials include cast and wrought iron, bare steel, unprotected steel, unprotected coastal steel, and pipeline installed before 1970	
	Gas Distribution (GD)[27] Significant Incident Rate and Cause involves fatality or injury requiring hospitalization, $50,000 or more in costs, highly volatile liquid releases, and liquid releases resulting in a fire or explosion Leaks a small opening, crack or hole in a pipeline allowing for a release of oil or gas Excavation damage are damages to external coating of a pipe	**Gas Transmission (GT)** OnShore Significant Incident Rate and Cause are incidents that are on land and not in offshore area. Also collected by decade OnShore Significant Incident High Consequence Area (HCA) are high population areas, commercially navigable waterways, areas sensitive to environmental damage HCA Immediate Repairs & Leaks

[26] U.S. EIA, Natural Gas, Pipeline Projects (XLS), accessed November 16, 2022.

[27] https://primis.phmsa.dot.gov/comm/glossary/#ASTMInternational

Pipeline Commodity	Performance Measure
Pipeline Mileage and Facilities	Database of nationwide and statewide totals of pipeline operators, mileage, and facilities. Totals include commodity, pipeline material, and system type - gas distribution, gas gathering, gas transmission, hazardous liquids, and LNG.
Pipeline Incidents: 20-Year Trends	PHMSA uses data for 20-year trends on incidents which include: • Serious Incident Rate and Cause • Significant Incident Rate and Cause • All other reported incidents
Excavation Damage - Incidents, Leaks and Damages	Excavation is any operation involving movement of earth, rock or other materials below existing grade or surface level. Excavation can include digging blasting, boring, tunneling and backfilling. PHMSA tracks excavation damage by cause, including excavation damage to pipeline.
Incidents and Leaks Repaired on Federal Land or Outer Continental Shelf (OCS)	Data on incidents and leaks on Federal Land or Outer Continental Shelf

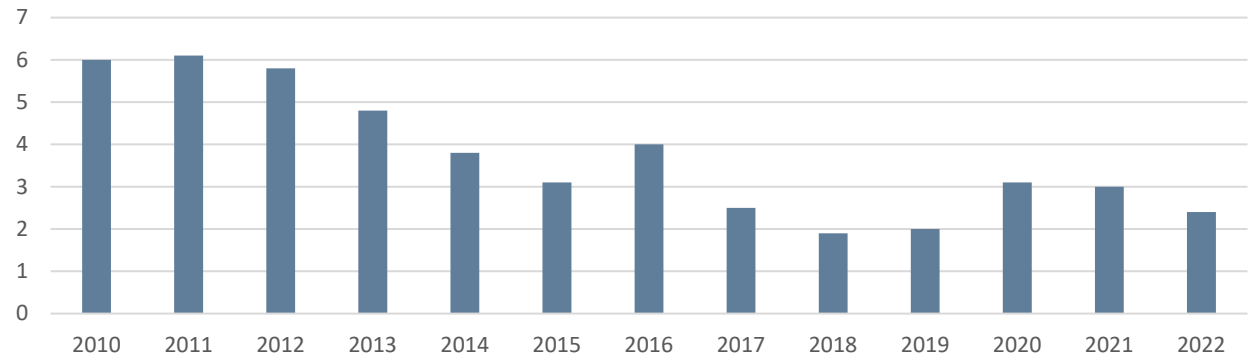
Source: Pipeline and Hazardous Materials Safety Administration

Using the performance metrics available for West Virginia outlined in Table 4-1, the following measures of evaluation have been identified to describe pipeline condition of West Virginia. The measures evaluated are excavation damage, gas distribution system leaks, gas pipeline enforcement, hazardous liquid enforcement program evaluation, gas distribution for bare steel main miles and gas distribution service count and are outlined in the subsequent sections. These metrics are shown because they are publicly available through PHMSA and provide an overview of the condition of West Virginia's pipeline infrastructure.

4.1.1 Natural Gas Distribution Excavation Damages

According to PHMSA, excavation damage is the leading cause of natural gas distribution pipeline incidents in the nation. Figure 4-1 shows the number of excavation damage occurrences per 1,000 incidents, providing an important indicator of damage prevention and program performance. In West Virginia, excavation damages topped six per 1,000 tickets from 2010 to 2011. Excavation damages have been on the decline since 2011, with 2022 recording a total of 2.6 per 1,000 tickets. Increased enforcement of the performance metrics outlined by PHMSA have helped improve West Virginia's natural gas distribution excavation damages in the past 10 years.

Figure 4-1 West Virginia Natural Gas Distribution Excavation Damages per 1,000 tickets, 2010-2022

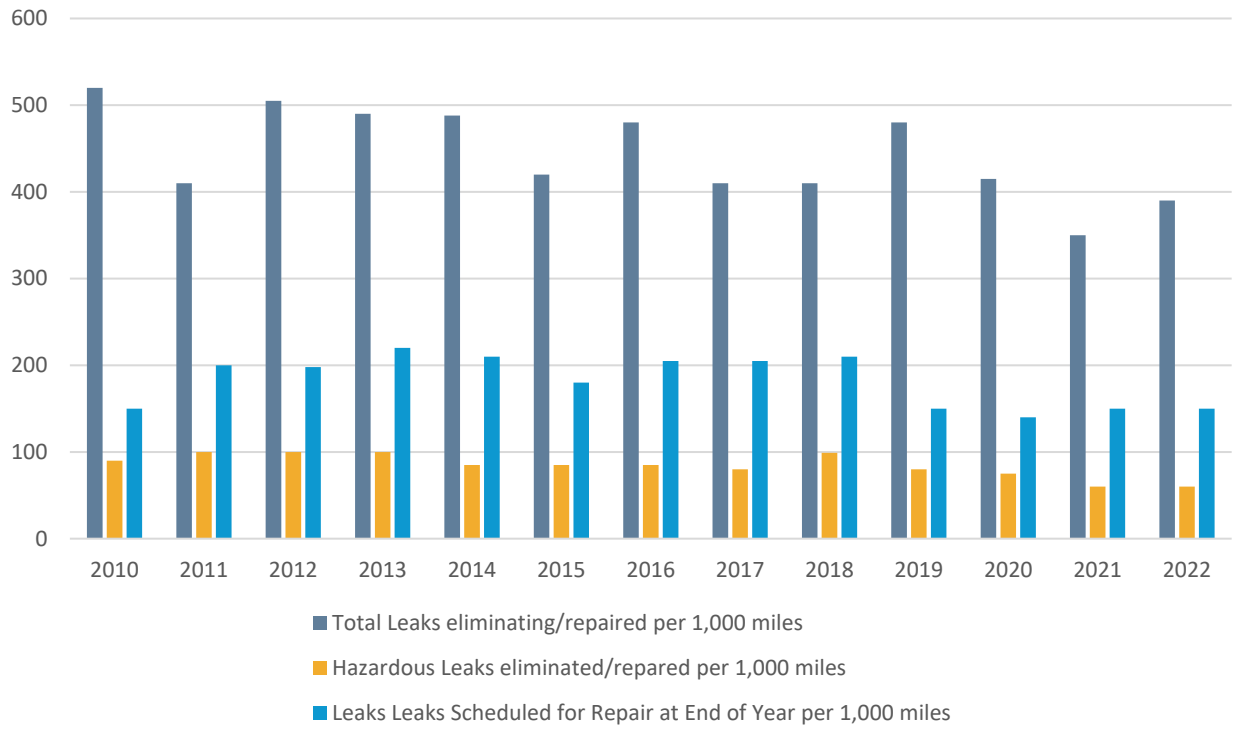


Source: U.S. DOT Pipeline and Hazardous Materials Safety Administration

4.1.2 Gas Distribution System Leaks

Figure 4-2 shows the total number of leaks repaired per 1,000 miles, the total number of hazardous leaks repaired per 1,000 miles and the total leaks scheduled for repair per 1,000 miles for gas distribution in West Virginia. Total leaks repaired and eliminated has remained below 400 since 2021, with leak repairs averaging between 140-160 repairs since 2019.

Figure 4-2 West Virginia Gas Distribution System Leaks, 2010-2022

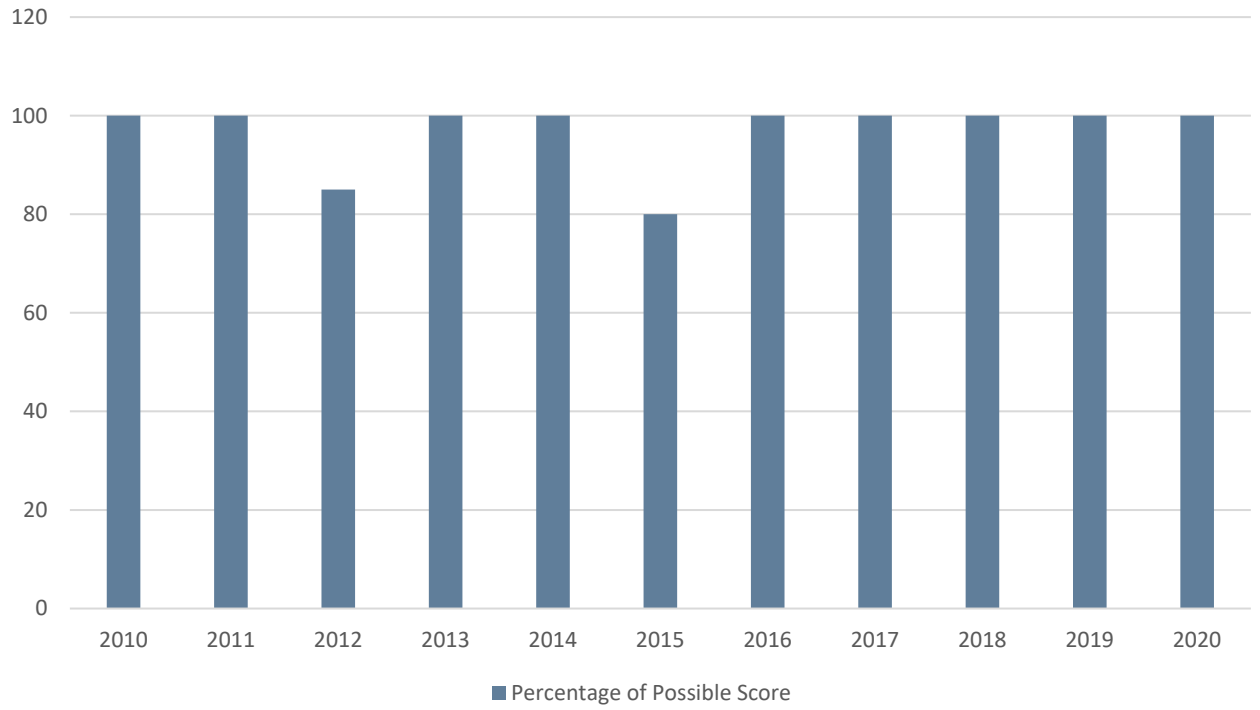


Source: U.S. DOT Pipeline and Hazardous Materials Safety Administration

4.1.3 Pipeline Enforcement

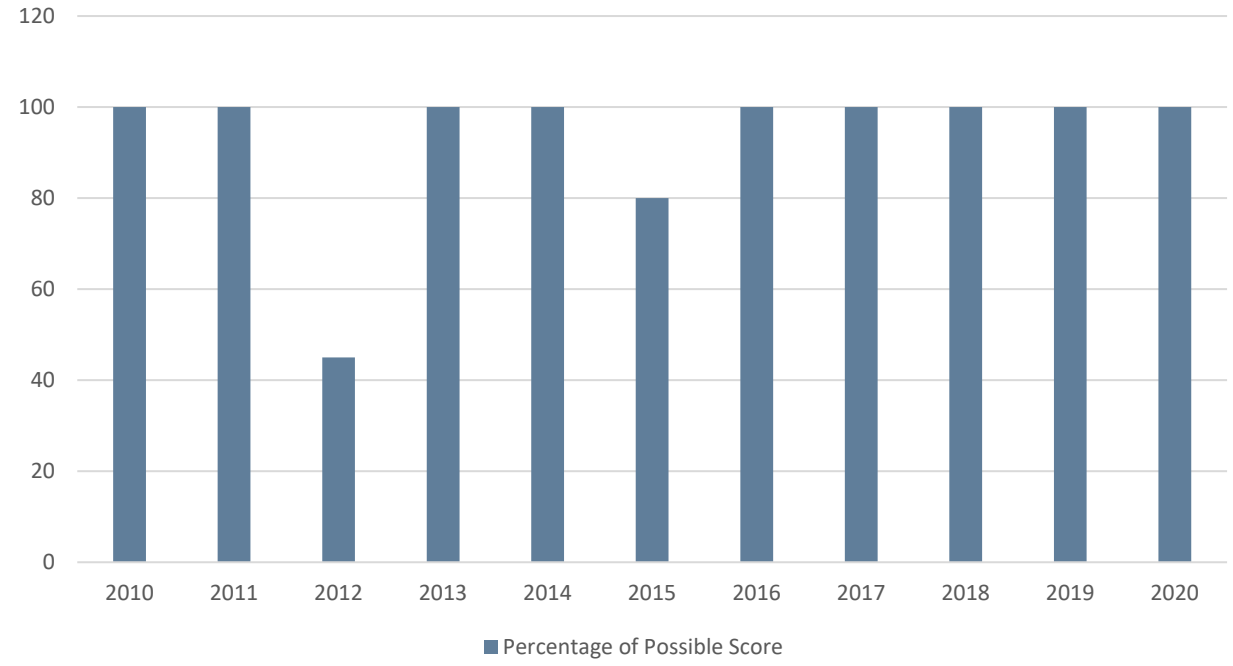
Effective pipeline enforcement ensures the safe and efficient operations of the nation's pipeline network. A state's pipeline infrastructure is only as effective as the information collected by the state's agency to insure the safe and efficient operations of its pipelines. Figure 4-3 and Figure 4-4 show the enforcement programs for pipelines in West Virginia that carry gas and hazardous liquids. Since 2015, West Virginia pipelines carrying gas and hazardous liquids have both received a score of 100. Continued program evaluation of gas and hazardous liquid pipelines ensures the safe and efficient conditions of pipelines within West Virginia.

Figure 4-3 West Virginia Gas Pipeline Enforcement Program Evaluation, 2010-2020



Source: U.S. DOT Pipeline and Hazardous Materials Safety Administration

Figure 4-4 West Virginia Hazardous Liquid Pipeline Enforcement Program Evaluation, 2010-2020

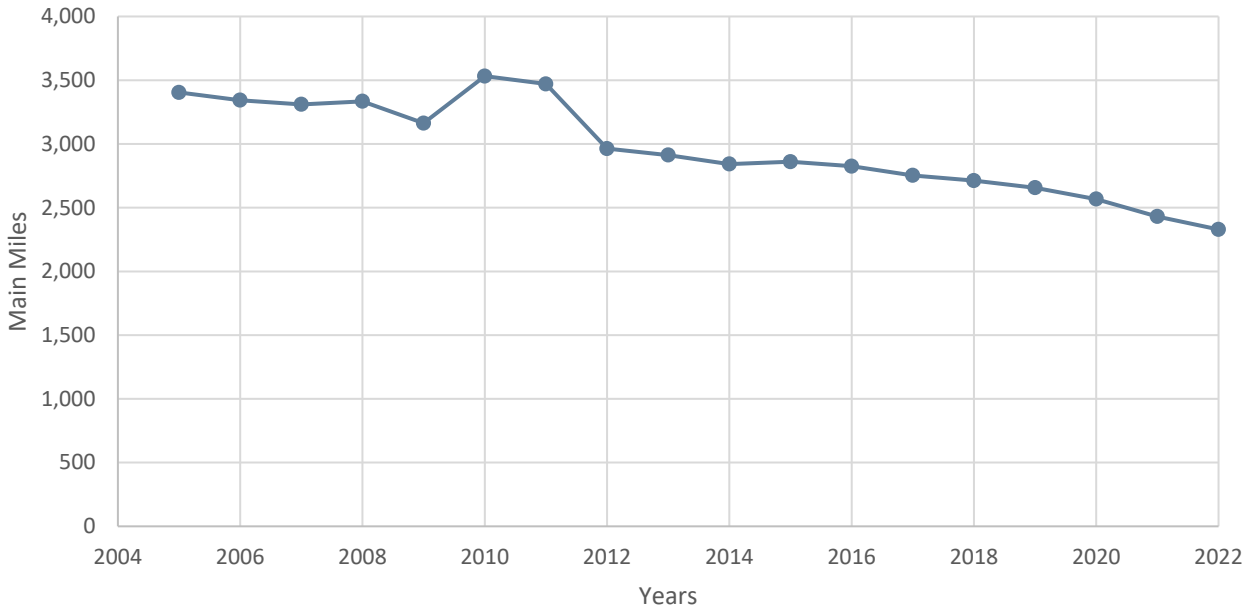


Source: U.S. DOT Pipeline and Hazardous Materials Safety Administration

4.1.4 Higher Risk Materials

Bare steel on pipelines is classified a high-risk material under gas transmission performance measures. In West Virginia, operators are gradually replacing bare steel pipes which are at increased risk of failure due to the lack of protective coating. Figure 4-5 shows the gas distribution for bare steel main miles in West Virginia, noting the phasing out of bare steel pipes in both mileage and service count throughout the state.

Figure 4-5 West Virginia Gas Distribution Bare Steel Main Miles, 2005-2022



Source: U.S. DOT Pipeline and Hazardous Materials Safety Administration

Continued partnership and collaboration between WVDOT, PHMSA and private pipeline operators is needed to ensure the efficient and safe condition of pipelines throughout West Virginia.

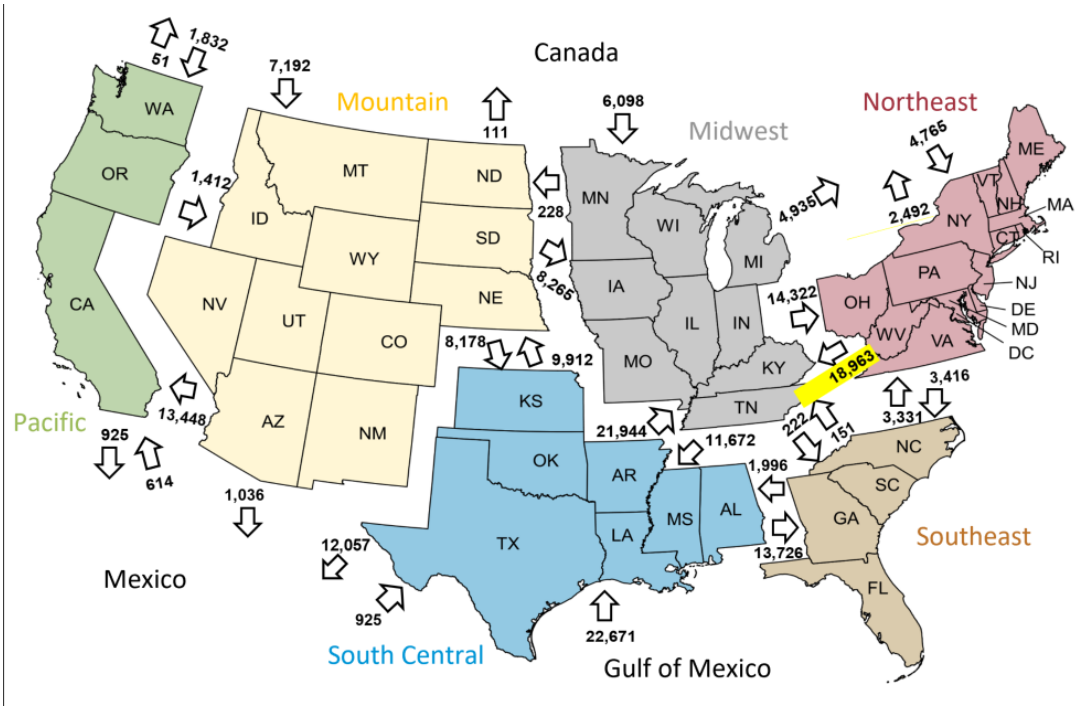
4.2 Capacity

Pipeline capacity in the U.S. is estimated at 300 billion cubic feet per day. The U.S. Energy Information Administration defines pipeline capacity as "the ratio of the electrical energy produced by a generating unit for the period of time considered to the electrical energy that could have been produced at continuous full power operation during the same period."[28]

The construction of new pipelines in the Appalachia region reflects the regions energy production capacity. In 1990, the exports from West Virginia to the Midwest was 2,668 MMCf/d (million cubic feet per day). Figure 4-6 shows the current capacity of flows in 2022 at 18,963 MMCf/d - a 611 percent increase.

[28] https://www.eia.gov/tools/glossary/index.php?id=Capacity_factor

Figure 4-6 Total Pipeline Region to Region Capacity, 2022



Source: U.S. Energy Information Administration

Table 4-2 shows the inflow from pipelines to West Virginia. Out of the total 15.8 billion cubic feet per day (MMcf/d) flow moving through the pipelines, about 8,116 MMcf/d or 51 percent of the flow comes from Pennsylvania.

Table 4-2 West Virginia Pipeline Inflow Capacity, 2022

State Inflow	Million cubic feet per day (MMcf/d)	Percent by State
Kentucky	2,843	18%
Columbia Gas Trans Corp	2,162	
Tennessee Gas Pipeline Co	681	
Maryland	**5**	0%
Columbia Gas Trans Corp	5	
Ohio	**4,855**	31%
Columbia Gas Trans Corp	1,515	
Texas Eastern Trans Corp	3,340	

State Inflow	Million cubic feet per day (MMcf/d)	Percent by State
Pennsylvania	**8,116**	**51%**
Columbia Gas Trans Corp	3,880	
Dominion Transmission Co	245	
Equitrans Inc	670	
Rover Pipeline	400	
Texas Eastern Trans Corp	2,921	
Grand Total	**15,819**	

Source: https://www.eia.gov/naturalgas/pipelines/EIA-StatetoStateCapacity_Jan2023.xlsx

As noted in Table 4-3, a majority of the outflow from West Virginia pipelines is transported to Ohio.

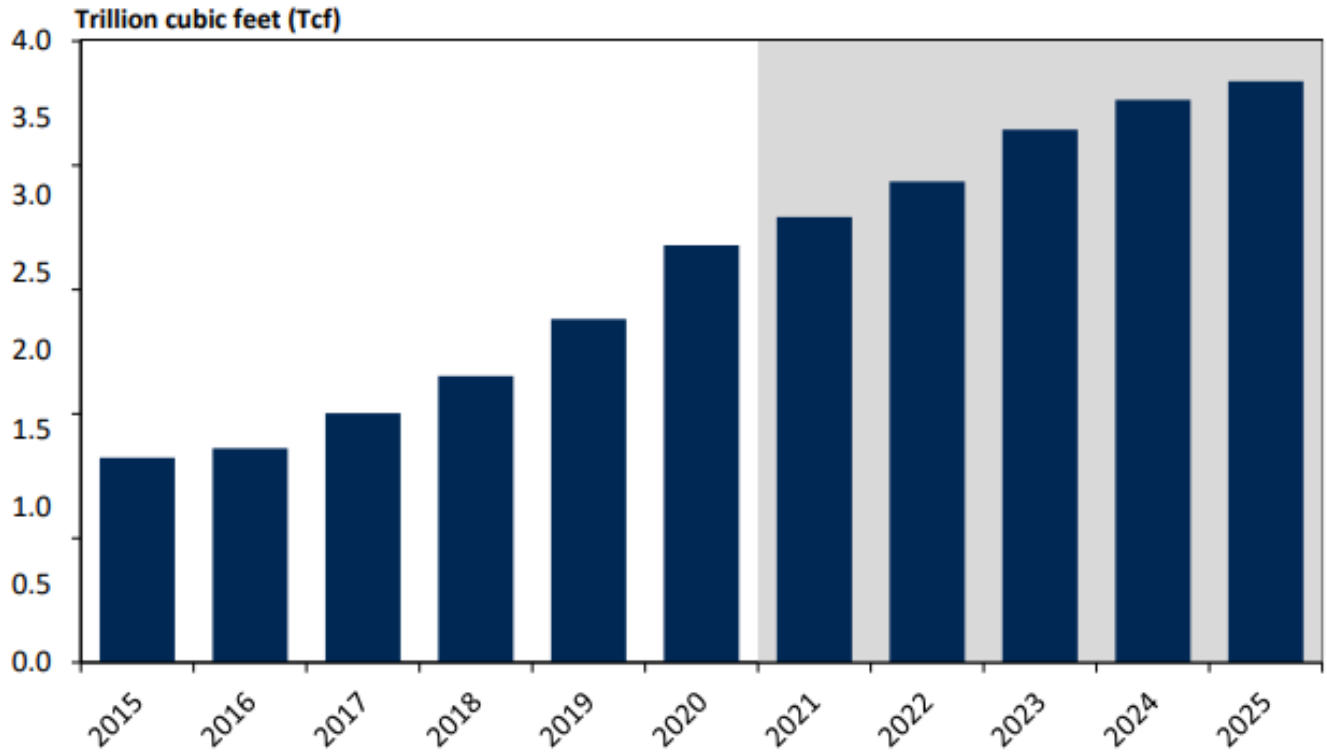
Table 4-3 West Virginia Pipeline Outflow Capacity, 2022

State Outflow	Million cubic feet per day (MMcf/d)	Percent by State
Kentucky	**4,028**	**17%**
Columbia Gas Trans Corp	3,126	
Tennessee Gas Pipeline Co	902	
Maryland	**5**	**0%**
Columbia Gas Trans Corp	5	
Ohio	**9,485**	**41%**
Columbia Gas Trans Corp	3,126	
Dominion Transmission Co	959	
Equitrans Inc	850	
Gas Transport Inc	30	
Rover Pipeline	1,600	
Texas Eastern Trans Corp	2,920	
Pennsylvania	**6,903**	**30%**
Columbia Gas Trans Corp	1,275	
Dominion Transmission Co	1,469	
Equitrans Inc	934	
Texas Eastern Trans Corp	3,225	
Virginia	**2,656**	**12%**
Bluefield Gas Co	12	
Columbia Gas Trans Corp	2,644	
Grand Total	**23,076**	

Source: https://www.eia.gov/naturalgas/pipelines/EIA-StatetoStateCapacity_Jan2023.xlsx

Production forecasts for West Virginia's natural gas commodities indicate increasing capacity for West Virginia exports to other states within the region.[29] According to a study completed by West Virginia University on the economic impact of natural gas unitization in West Virginia, increased pipeline capacity is an indicator of demand for West Virginia's supply of natural gas to population hubs on the east coast. Figure 4-7 shows the natural gas baseline production forecast which is projected to increase by nearly 68 percent from 2.2 Tcf (trillion cubic feet) in 2019 to 3.7 Tcf in 2025.

Figure 4-7 West Virginia Natural Gas Baseline Production Forecast



Source: WVU BBER Econometric Model

The additional pipeline capacity in West Virginia has made the state the largest net exporter of natural gas in the country. The continued growth projections of natural gas production in the state reflects the increased capacity of the pipelines that will be pivotal in supplying energy to the surrounding region.

[29] The Economic Impact of Natural Gas Unitization in West Virginia (wvu.edu)

5.0 PIPELINE SAFETY

West Virginia's pipeline network is regulated by the PHMSA which ensures the safety standards of the pipeline network. PHMSA has collected data on pipeline incidents since 1970 related to gas distribution, gas gathering, gas transmission, hazardous liquids, liquefied natural gas and underground natural gas storage.

PHMSA defines "incidents" as any of the following[30]:

- An event that involves a release of gas from a pipeline, gas from an underground natural gas storage facility (UNGSF), liquefied natural gas, liquefied petroleum gas, refrigerant gas, or gas from an LNG facility, and that results in one or more of the following consequences:
    - » A death, or personal injury necessitating in-patient hospitalization.
    - » Estimated property damage of $122,000 or more, including loss to the operator and others, or both, but excluding the cost of gas lost. For adjustments for inflation observed in calendar year 2021 onwards, changes to the reporting threshold will be posted on PHMSA's website. These changes will be determined in accordance with the procedures in appendix A to part 191.
    - » Unintentional estimated gas loss of three million cubic feet or more.
- An event that results in an emergency shutdown of an LNG facility or a UNGSF. Activation of an emergency shutdown system for reasons other than an actual emergency within the facility does not constitute an incident.
- An event that is significant in the judgment of the operator, even though it did not meet the criteria of paragraph (1) or (2) of this definition.

This section will discuss the safety incidents that have occurred in West Virginia since 2003 as defined by PHMSA.

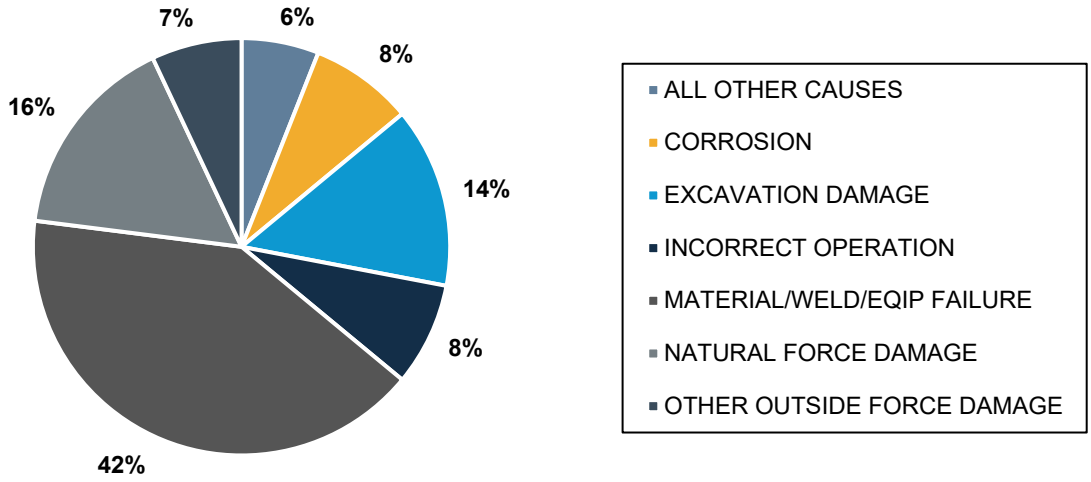
5.1 Incident Statistics

According to PHMSA, there were 88 recorded incidents in West Virginia from 2003 to 2022. As shown in Figure 5-1, the two major causes of incidents were equipment failure and natural forces. Equipment failure accounted for 42 percent of incidents and natural forces accounted for 16 percent of the incidents recorded.

Equipment failure includes causes such as construction, installation related failures, malfunction of equipment, non-threaded connection failure or pump compressor related failures. Natural force damage can include earth movement, heavy rains and floods and lightning.

[30] https://www.phmsa.dot.gov/incident-reporting#:~:text=Incident%20or%20accident%20report%20forms,gas%20or%20hazardous%20liquid%20pipeline

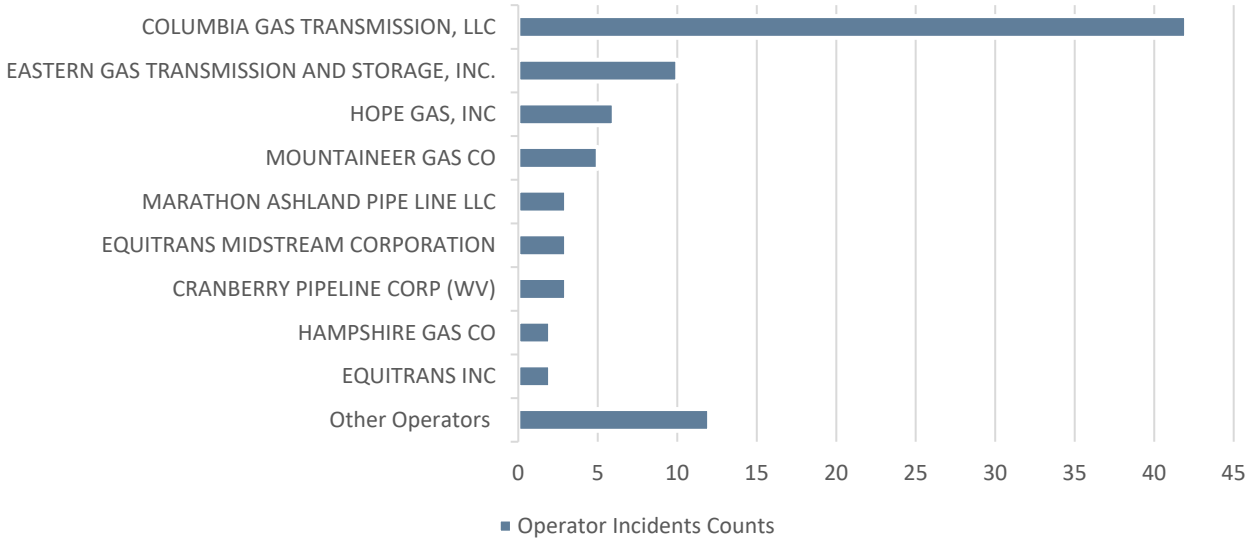
Figure 5-1 Significant Incident Cause (2003-2022)



Source: U.S. Energy Information Administration

When comparing incidents by service operator, Columbia Gas Transmission has incurred nearly half the reported incidents in the past 20 years (Figure 5-2). This is a result of Columbia Gas operating a larger portion of pipeline within the state. "Other" operators include those who only had one incident in the past 20 years, including Blue Racer Midstream, LLC, Canaan Valley Gas Co, Cardinal Natural Gas Company, Consumers Gas Utility Co, Enterprise Products Operating LLC, Marathon Pipe Line LLC, Markwest, Liberty Midstream & Resources, LLC, Markwest Liberty NGL Pipeline, LLC, MPLX LP, Southern Public Service Co, Union Oil & Gas Inc, and Welch Gas Coop.

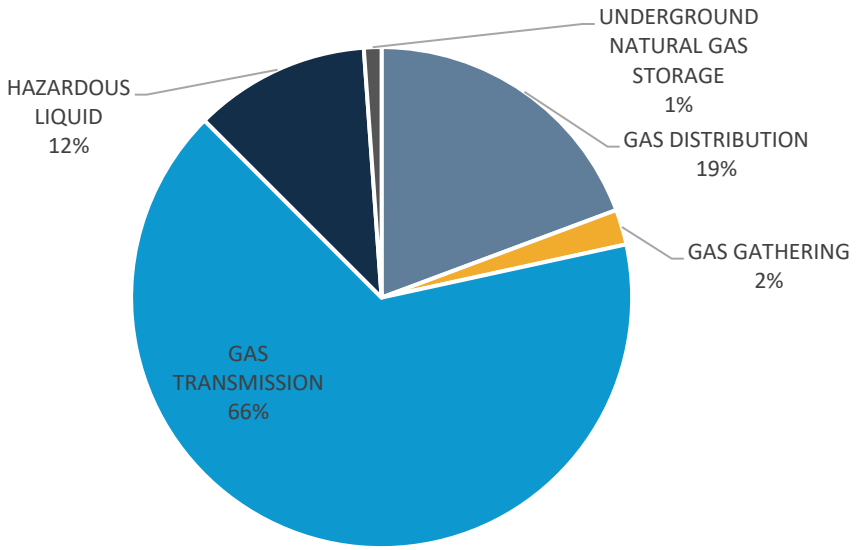
Figure 5-2 Pipeline Incident by Operator in West Virginia, (2003-2022)



Source: U.S. DOT Pipeline and Hazardous Materials Safety Administration

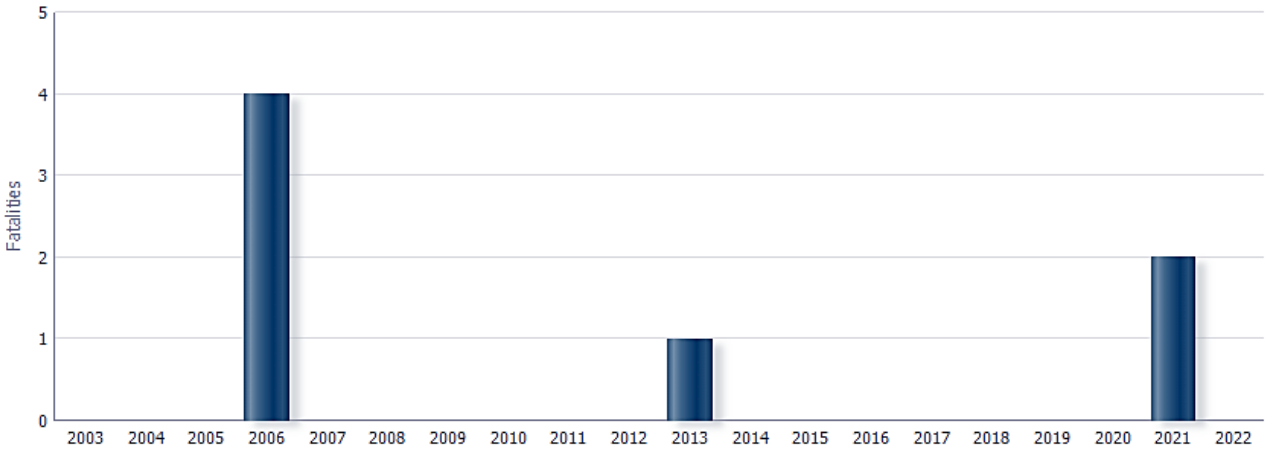
In West Virginia, gas transmission has had the most reported incidents (66 percent), followed by gas distribution (19 percent) and hazardous liquid incidents (12 percent), as shown in Figure 5-3. Gas distribution accounts for all the fatalities in the past 20 years, a total of seven fatalities (Figure 5-4). There has been a total of nine injuries reported on West Virginia pipelines since 2003 (Figure 5-5). The most reported injuries reported in one year was 2005, with two injuries.

Figure 5-3 System Type by Incident in West Virginia (2003-2022)



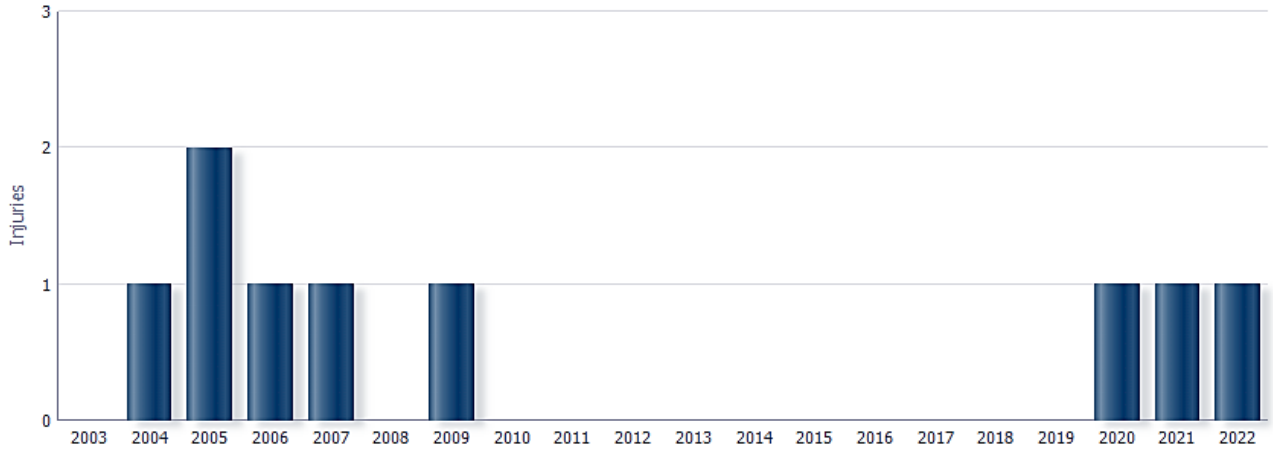
Source: U.S. DOT Pipeline and Hazardous Materials Safety Administration

Figure 5-4 Pipeline Fatalities by Incident in West Virginia (2003-2022)



Source: U.S. DOT Pipeline and Hazardous Materials Safety Administration

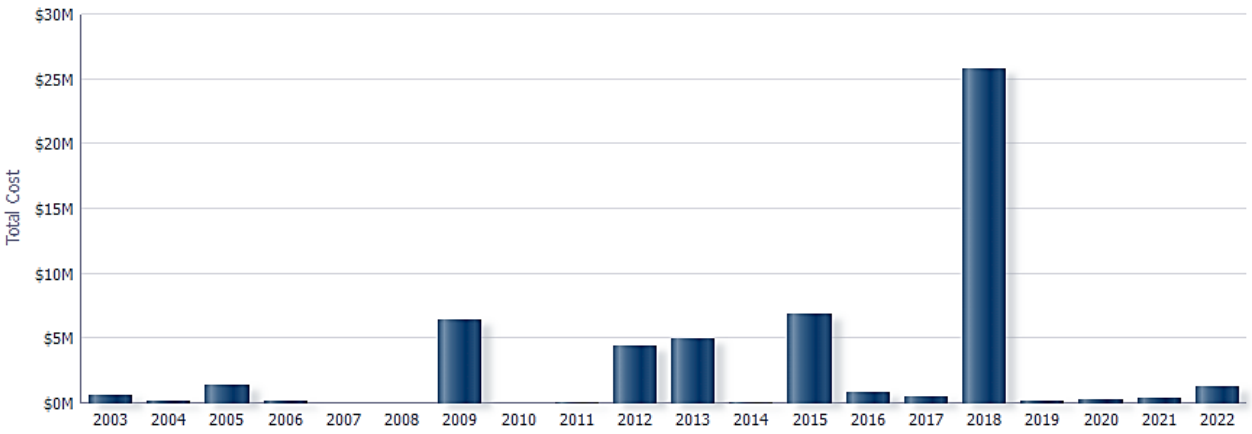
Figure 5-5 Pipeline Injuries by Incident in West Virginia (2003-2022)



Source: U.S. DOT Pipeline and Hazardous Materials Safety Administration

In total, the cost of reported pipeline incidents was $55.7 million, with 2018 having the highest cost of any other year at $25.7 million. Columbia Gas Transmission suffered the most losses at $20 million in 2018 due to natural force damage in Marshall County.

Figure 5-6 Cost by Pipeline Incident in West Virginia (2003-2022)



Source: U.S. DOT Pipeline and Hazardous Materials Safety Administration

Overall, West Virginia accounted for fewer than five percent of the reported pipeline incidents in the U.S. for the past 20 years, as shown in Table 5-1 where there was a total of 88 incidents, 7 fatalities, 9 injuries and $55M in total cost reported. Continued data utilization by PHMSA to help optimize safety standards for the safe movement of our energy sources will be critical to maintaining and improving pipeline safety standards in West Virginia and the greater United States.

Table 5-1 West Virginia and Nationwide Pipeline Incidents (2000-2020)

Location	Incidents	Fatalities	Injuries	Total Cost Reported
West Virginia	88	7	9	$55.7 million
United States	12,782	274	1,120	$10.8 billion

Source: U.S. DOT Pipeline and Hazardous Materials Safety Administration