

The Marcellus Shale: Energy to Fuel our Future

Pennsylvania has produced oil and gas since 1859, when Col. Edwin Drake successfully drilled the first 70-foot deep oil well in Venango County. More than 350,000 oil and gas wells have been drilled in Pennsylvania since Drake's first venture to extract petroleum products from the earth.

The production of natural gas from the Marcellus Shale formation is important because it produces a clean-burning, Pennsylvania-based energy source in an environmentally sound manner. It also provides economic benefits to communities across the Commonwealth. Natural gas producers have already invested more than \$4 billion in Pennsylvania in lease and land acquisition, new well drilling, infrastructure development and community partnerships, with an even greater investment expected in the future.

The high-volume reservoir of natural gas in the Marcellus Shale is estimated to hold more than 500 trillion cubic feet of natural gas that is worth more than one trillion dollars.

What is the Marcellus Shale?

Marcellus Shale is a deep geologic formation stretching more than 95,000 square miles through parts of Ohio, Pennsylvania, West Virginia and New York. Formed about 380 million years ago, the Marcellus Shale is rich in organic material from plants and animals. As these organics were compressed through time and geologic pressures, natural gas was trapped in the shale's natural fractures.

The Marcellus Shale, a deep geologic formation stretching more than 95,000 square miles through parts of Ohio, Pennsylvania, West Virginia and New York.

Where is the Marcellus Shale formation found?

The Marcellus Shale formation is found 4,000 - 8,500 feet below ground surface and is between 50 and 200 feet thick. The high-volume reservoir of natural gas in the Marcellus Shale formation is estimated to hold more than 500 trillion cubic feet of natural gas. Even if only 10 percent of the gas is recovered, it is enough to fuel the United States for two years and would be worth more than one trillion dollars.

Why the interest in the Marcellus Shale?

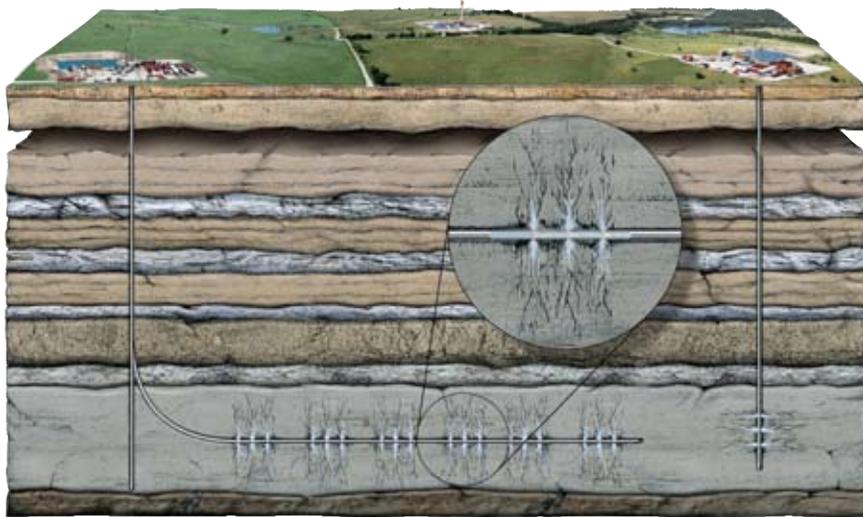
A combination of factors is driving the interest in developing natural gas from the Marcellus Shale. Primarily, the techniques – like three-dimensional imaging and horizontal drilling – enhanced to produce natural gas economically from other shale formations in the United States, are being used to access gas in the Marcellus Shale formation. Because of past and current drilling in the Marcellus Shale formation, much is known about its characteristics. In addition, the economics between natural gas prices and close proximity to gas-hungry Northeast markets have made the Marcellus Shale an excellent exploration opportunity.

How is the natural gas extracted?

The process of extracting natural gas from Marcellus Shale includes several steps. Gas producers first must obtain mineral and gas rights to begin the process of natural gas exploration. Producers also must secure mineral and gas rights for all sub-surface properties that the wellbore accesses. Geologists use seismic data to



The Marcellus Shale formation, shaded green in the above map, lies beneath about 60 percent of Pennsylvania's land mass.



Marcellus Shale wells can be drilled both horizontally (on left) and vertically (on right). The fracture stimulation process (shown magnified) allows more gas to be extracted from each well.

determine the best location to drill into the formation. Seismic waves are sent down into the earth and are reflected back to the surface, where they are picked up by listening devices and sent to a computer for interpretation.

The drilling is accomplished with a series of long drilling pipes that push vertically into the earth. After drilling vertically to the depth that reaches the shale deposit, wells can be completed vertically to produce natural gas.

The drill bit also can be turned to push its way horizontally through the Marcellus Shale formation – sometimes as far as 5,000 feet – allowing for the extraction of larger quantities of gas from multiple wellheads located on one well pad.

Extracting natural gas from the Marcellus Shale formation requires the use of more water than traditional vertical natural gas wells. Drillers pump large amounts of high-pressure water, mixed with sand and other agents, to expand and hold open the fractures in the shale formation, allowing the natural gas to flow more freely. Once this hydraulic fracturing or “fracing” process is completed, this

used water is typically collected and treated at a Pennsylvania Department of Environmental Protection (DEP) permitted treatment facility. The well pad and surrounding land are restored after drilling is completed, with only a small amount of equipment remaining.

Gas producers protect the environment by using the industry’s best management practices and following regulations for all aspects of the drilling process, including soil erosion and sedimentation controls, the protection of groundwater resources, water allocation and the proper management of wastewater.

Why is Marcellus Shale natural gas production important to Pennsylvania?

The production of natural gas from the Marcellus Shale formation is important because it produces a clean-burning, Pennsylvania-based energy source in

an environmentally sound manner. It also provides economic benefits to communities across the Commonwealth.

Natural gas producers already have invested more than \$4 billion in lease and land acquisition, new well drilling, infrastructure development and community partnerships, with an even greater investment expected in the future. The Pennsylvania oil and gas industry saw a 19 percent growth in average wages for its workers between 2005 and 2007, an amount that also is expected to increase as more companies drill new wells.

There are also new business development and growth opportunities throughout the state. Services that directly support the production of the Marcellus Shale include engineering and surveying, construction and earthmoving, environmental

permitting, water hauling and wastewater management, gas well servicing, equipment manufacturing, maintenance and repair and legal services. Workers in these fields, in turn, help to provide economic support in housing, utilities, food, clothing and other services.

Pennsylvania stands to gain significant economic benefits that will have a positive and lasting impact on individuals, families and entire communities for decades to come.

Pennsylvania residents and municipalities are seeing direct economic benefits that will continue as development of the Marcellus Shale formation expands. Gas producers make lease bonus payments for the opportunity to drill for natural gas and royalty payments on the natural gas that is produced from a well over its lifetime. This can result in significant benefits to both families and government entities with land holdings.

For more information about the Marcellus Shale, visit www.pamarcellus.com