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The Story Of Marcellus Shale Gas

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Feb. 23--While the Marcellus shale has recently become a popular news item, there is nothing new about the natural gas it contains. It has been forming under the earth for millions of years.

While various theories explain the development of natural gas, the most widely accepted is that the action of extreme heat and pressure on the remains of microorganisms, plant and animal matter creates material suitable for fossil fuels. As the organic material is buried by mud and sediment, resulting pressure and the temperature of the earth's core "cooks" organic matter into natural gas or other fossil fuels.

The intense compression and heat causes carbon bonds to break down and turn into various other material, including natural gas. Different combinations of pressure and heat create different fossil fuels, including coal and oil.

In many cases, the newly formed natural gas would leak to the surface and dissipate into the atmosphere. However, the gas sought by the industry today, has become trapped underground. In the case of the Marcellus shale play, the gas is trapped in the pores and fractures of a shale that is, on average, about a mile below the ground.

"The Marcellus shale is an organic-shale, a very fine grained rock," Michael Hohn, West Virginia's state geologist said. "It's very low in permeability, it's hard to get anything to move through it, whether it's gas or liquid."

Though knowledge of the resource has existed for years, until now, tapping the resource was too expensive.

"One of the reasons why it hasn't been exploited until now, in addition to be fairly deep, is that it takes a special completion method," Hohn said.

Before advancements in technology, early drillers of oil and gas had to depend on surface evidence for finding sources of valuable underground resources. If there was no leakage of oil or gas coming from the earth, it could be difficult to determine where to place a well.

Now, with geological surveys and knowledge of the properties of underground natural gas deposits, drilling is much more predictable.

Utilizing knowledge gleaned from visible rock formations, previously drilled wells, the surface structure of the earth and other clues, locations likely to contain oil or gas can be determined relatively quickly and precisely. Additionally, analysis of seismic properties of the earth and other technological developments can offer clues as to what lies beneath the surface.

Further advancements in technology have provided drillers with more and more information about the potential

resource content found below ground.

Traditionally, wells were drilled straight into the ground and gas was collected into a well that brought the gas to the surface. However, new technology now allows drillers to turn the drill horizontally, so as to better take advantage of the geology of the natural gas deposit.

Further, "frac fluid" may be pumped into the well to break apart the porous shale and allow the entrapped natural gas to flow to the surface.

If after drilling, the site is determined to be a "productive" well, the well site is further prepared for extraction and it is further developed. Not every drilled site is successful, and if drillers hit a "dry well" production stops.

If natural gas is present, the process of preparing the well begins. One step in this process is the development of a well casing, a series of metal tubes placed where the well was drilled. The casing prevents contamination and leakage of the gas.

Then the well is "completed," meaning it is ready to produce the gas.

A wellhead is installed on the surface to manage potential leaks and blowouts and otherwise control extraction from the ground.

Once the gas is located and the well is prepared, the process from the ground to the consumer begins. Charles Penn of Dominion energy summarized the general steps in natural gas production.

"In general, gas is drilled from the ground and is gathered in a network of small pipes called a gathering system," Penn said. "As the gathering system collects more and more gas, the size of the pipe diameter increases. When enough gas is accumulated, the gas is moved into a transmission system."

The transmission system, Penn said, moves the gas from the gathering system at the source to the market.

"The transmission system generally uses very large pipes to move the gas over long distances," Penn said. "As the gas flows it loses pressure and needs to be re-pressurized in order to move further down the line. This is accomplished with gas compressors that usually burn natural gas to drive the compressor."

The transmission system, usually consisting of pipes 6 to 48 inches in diameter, will feed the natural gas into a distribution system which then carries the gas at lower pressures to homes and businesses. Large natural gas pipelines connect high-production areas to high-need areas.

"Wet" natural gas, which contains additional chemicals highly valued by the chemical industry, are also separated from the stream of natural gas. Tim Carr, a geology professor at West Virginia University, said some of the additional chemicals include methane, propane, butane, ethane and natural gasoline liquids.

"Those are worth a whole lot of money," Carr said. "Those natural gas liquids are worth more than methane."

Those chemicals are not only stripped from the natural gas stream for their value, but also because they would be dangerous for home use.

"If you pumped that into your house, you'd burn your house down," Carr said. "It'd be too hot. It would be like pumping gasoline into your furnace and trying to light it."

The concentrations of these heavier hydrocarbons vary across the Marcellus shale. The "wet gas," Penn said, is sent to a processing plant before it enters the transmission system.

"In the processing plant, the heavier hydrocarbons are stripped out of the gas and recovered as liquids," Penn said. "The remaining 'lean' natural gas is then sent into the transmission system. The liquids are further refined and sold as individual products namely propane, normal butane, ISO-butane and natural gasolines."

Before the gas is delivered it is also treated with an odorant. This gives the usually odorless gas a noticeable smell in case of leakage.

Decreasing cost of natural gas and low capital constructions costs, the U.S. Energy Information Administration predicts, means natural gas is becoming increasingly more attractive than coal. Coal, however still dominates the electrical generation industry.

About 87 percent of the natural gas that is consumed in the United States is produced domestically. According to the EIA Annual Energy Outlook 2011, natural gas from shale resources could continue to provide energy for 110 years at 2009 rates of consumption.

While natural gas prices are currently fairly low, prices are linked to a variety of factors. Production cycles may lag, leading to an increase in prices, which in turn leads to a boost in production. Less predictable factors such as severe weather also play a role in setting the price of natural gas before it enters the home.

Activity in other industry markets, such as oil and coal can also lead to fluctuating prices of natural gas.

Because natural gas is typically used for heating purposes, it's demand is largely seasonal. Because of its seasonal nature, and to guard against unforeseeable disruptions in supply, natural gas is also stored. Several underground storage facilities are located in West Virginia.

Underground storage of natural gas may occur in salt caverns, aquifers or depleted fields.

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