

Natural Gas: The Basics

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TUG HILL COMMISSION ISSUE PAPER SERIES

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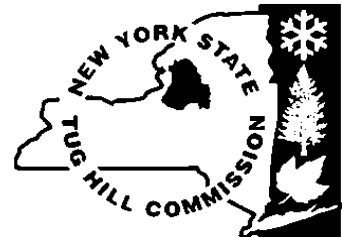


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The Tug Hill Commission *Technical and Issue Paper Series* are designed to help local officials and citizens in the Tug Hill region and other rural parts of New York State. The *Technical Paper Series* provides guidance on procedures based on questions frequently received by the Commission. The *Issue Paper Series* provides background on key issues facing the region without taking advocacy positions. Other papers in each series are available from the Tug Hill Commission at the address and phone number on the cover.

What is natural gas?

Natural gas is a fossil fuel like oil and coal, formed from the remains of plants and animals and microorganisms that lived millions and millions of years ago. It is a colorless, shapeless, odorless mixture of hydrocarbon gases that gives off a great deal of energy when burned. Formed mostly of methane, it can also contain ethane, propane, butane, and pentane. Natural gas is a non-renewable resource, the formation of which takes thousands and possibly millions of years.

Natural gas is found in reservoirs beneath the earth, and is commonly associated with oil deposits. Once brought from underground, the natural gas is refined to remove impurities like water, other gases, sand, and other compounds. Some hydrocarbons are removed and sold separately, including propane and butane. Other impurities are also removed, like hydrogen sulfide (the refining of which can produce sulfur, which is then also sold separately). After refining, the clean natural gas is transmitted through a network of pipelines, thousands of miles of which exist in the United States alone. From these pipelines, natural gas is delivered to its point of use.

Where is natural gas found?

Most of the natural gas that is found in North America is concentrated in relatively distinct geographical areas, or basins. Given this distribution of natural gas deposits, those states which are located on top of a major basin have the highest level of natural gas reserves. According to the Energy Information Administration, as of 2006 proved U.S. dry natural gas reserves are most abundant in Texas (61,836 billion cubic feet), as opposed to proved dry gas reserves in New York (363 billion cubic feet). However, New York State does contain significant natural gas resources. For example, Marcellus shale, also referred to as the Marcellus Formation, contains natural gas, and occurs beneath much of Ohio, West Virginia, Pennsylvania and New York. Small areas of Maryland, Kentucky, Tennessee, and Virginia are also underlain by the Marcellus shale.

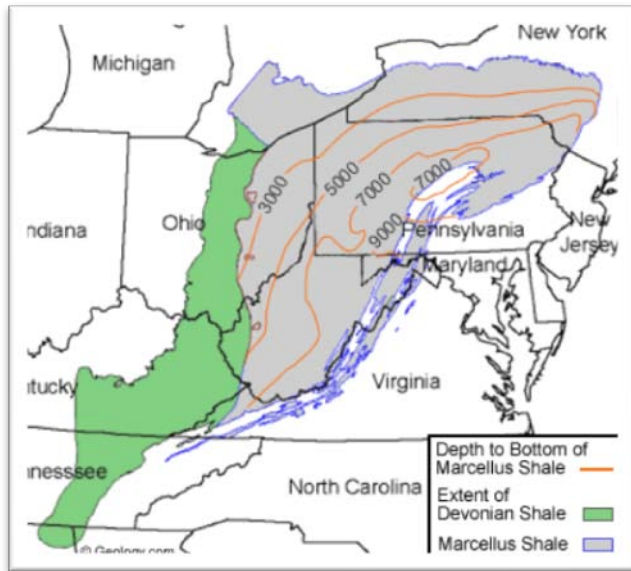
Natural gas is also found in New York within Utica and Trenton/Black River limestone layers, which are located geographically beneath areas north of the Marcellus Shale formation, in Oswego, Oneida and Lewis counties. Utica and Trenton/Black River shales tend to trap gases in a less uniform way, resulting in pockets of gas rather than a larger, distributed field of trapped gas. Trenton/Black River shale is located in a layer deeper than Marcellus shale and requires sophisticated seismic plotting in order to locate gas pockets. Locating and extracting natural gas from Utica and Trenton/Black River formations is difficult, but likely to become more lucrative as demand for natural gas increases and technologies for finding and extracting these resources improve over time.

Why is there so much interest now in New York's natural gas resources?

It's all about increased demand and the economics of production. Historically, conventional natural gas deposits have been the most practical, and easiest, deposits to mine. However, as technology and geological knowledge advances, unconventional natural gas deposits such as the Marcellus shale in the Southern Tier of New York are beginning to make up an increasingly larger percent of the supply picture. In some cases they may be located closer to the end users of the natural gas, which is an advantage as well.

Successful wells must yield large volumes of gas to pay for the drilling costs that can easily exceed a million dollars for a traditional vertical well and much more for a horizontal well with hydraulic fracturing. New York's Marcellus shale deposits are harder to extract, however increased demand for natural gas, combined with the increased market cost of importing and refining petroleum, is making the effort worth the investment for gas companies.

The presence of an enormous volume of potentially recoverable gas in the eastern United States has a



great economic significance. This will be some of the closest natural gas to the high population areas of New Jersey, New York and New England. This transportation advantage will give Marcellus gas a distinct advantage in the marketplace.

In early 2008, Terry Englander, a geoscience professor at Pennsylvania State University, and Gary Lash, a geology professor at the State University of New York at Fredonia, surprised everyone with estimates that the Marcellus might contain more than 500 trillion cubic feet of natural gas. That volume of natural gas would be enough to supply the entire United States for about two years and have a wellhead value of about one trillion dollars. More recent estimates calculate that the Marcellus shale gas resource is

large enough to provide the entire United States needed supply for 14 years.

Gas produced from the shallower, western portion of the Marcellus extent might be transported to cities along the east coast of the United States. It should have a positive impact on the stability of natural gas supply of the surrounding region for at least several years resource estimates prove accurate.

How are natural gas resources located?

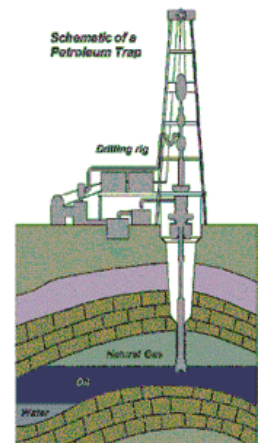
Locating natural gas resources begins with using a geologist to determine what areas would likely yield oil or natural gas. The geologist is looking for a trap – a place where natural gas would not have been able to naturally dissipate into the air, but got caught underneath a solid layer of material. By examining aerial and satellite photographs of a site and mapping the surface, the geologist can figure out how the rock layers under the earth are arranged, and which rocks may be at what depth. The geologist might also make subsurface maps from data obtained by existing wells nearby.

The geologist will also conduct a number of tests—including gravity, magnetic, and seismic surveys—that supply data about the properties of the rocks below and thereby help the scientist to determine where these gas traps are located. However, the only definitive test is to drill a well and see if it produces any natural gas.

How is natural gas removed from underground?

Natural gas trapped under the earth can be recovered by drilling a hole through the rock beneath which it has collected in a reservoir. Gas in these reservoirs is typically under pressure, allowing it to escape from the reservoir on its own without having to pump it out.

The fractures (also known as "joints") in Marcellus Shale are vertical. So, a vertical borehole would be expected to intersect very few of them. However, a horizontal well, drilled perpendicular to the most common fracture orientation should intersect a maximum number of fractures.



Source: U.S. Environmental Information Association

A second method used to increase the productivity of a well is known as "hydraulic fracturing" or "hydrofracing". This method uses high-pressure water or a gel to induce fractures in the rock surrounding the well bore. Hydrofracing is done by sealing off a portion of the well and injecting water or gel under very high pressure into the isolated portion of the hole. The high pressure fractures the rock and pushes the fractures open.

To prevent the fractures from closing when the pressure is reduced several tons of sand or other "propanant" is pumped down the well and into the pressurized portion of the hole. When the fracturing occurs millions of sand grains are forced into the fractures. If enough sand grains are trapped in the fracture it will be propped partially open when the pressure is reduced. This provides an improved flow of gas to the well.

Why is natural gas so much in demand?

Unlike other fossil fuels, natural gas is clean burning and emits lower levels of potentially harmful byproducts into the air. For hundreds of years, natural gas has been known as a very useful substance. The Chinese discovered a very long time ago that the energy in natural gas could be harnessed, and used to heat water. In the early days of the natural gas industry, the gas was mainly used to light streetlamps, and the occasional house. However, with much improved distribution channels and technological advancements, natural gas is being used in ways never thought possible.

There are so many different applications for this fossil fuel that it is hard to provide an exhaustive list of everything it is used for. And no doubt, new uses are being discovered all the time. Natural gas has many applications, commercially, in your home, in industry, and even in the transportation sector! While the uses described here are not exhaustive, they may help to show just how many things natural gas can do.

What is a gas lease?

A lease is a legal agreement that conveys a real property interest from one party to another. Oil and gas are not technically minerals, but are treated as minerals for leasing purposes. When mineral rights associated with a property are leased, this transfers the possession of the minerals found on or beneath the property to that individual or company. Typically, leases are written by the leasing company and presented to the landowner for consideration.

There is no "standard" lease. Each lease can be specifically negotiated, and may be written according to the needs of both parties. Every aspect of a lease contract can and should be carefully weighed and worded to make sure both parties are protected against any injury, physical or monetary. Items such as where access roads can be located, the restoration of roads and construction areas, hours of drilling operations, and many, many more considerations can be handcrafted in a leasing agreement.

A lease may be a term lease, with a date specified as to when the lease agreement will end, or it may be a permanent lease with no ending date specified. Most oil and gas leases are written as term leases. The purchase of a lease by a company does not necessarily mean that drilling will definitely take place, and in some instances, the lease itself becomes a commodity. A lease agreement should detail the specific situations under which a company may sell a lease to another entity without any need for the landowner's approval or consent.



Installing a small diameter distribution pipe; Photo from Naturaas.org, courtesy of Duke Energy Gas Transmission, Canada

It is very important that a landowner have an attorney familiar with gas and oil leasing review any lease presented to them before entering into any leasing agreement in order to make sure that the landowner's rights and interests are protected adequately.

Does the New York State Department of Environmental Conservation (NYSDEC) regulate natural gas well drilling in New York State?

Yes. New York State's regulatory program oversees drilling. DEC's Mineral Resources staff conducts a rigorous permitting process which protects the environment and landowner before the permit is issued, during drilling, when the well is plugged and when the site is restored. This includes:

- Review of each drilling application for environmental compliance before any drilling, which involves;
 - Screening of the proposed well location to identify any environmental sensitivities; and
 - Review of the proposed well design to ensure that it is protective.
- On-site inspection of actual drilling operations; and
- Enforcement of strict restoration rules when drilling is completed.

Municipal water wells are protected by the requirement for a full environmental assessment if a proposed oil or gas well is within 2,000 feet of the municipal well and a supplemental environmental impact statement if within 1,000 feet. All groundwater, including private wells, is protected by strict construction requirements for oil and gas wells.



An active natural gas well in Chemung County after the drilling and completion work is done and the site has been reclaimed. Courtesy of NYSDEC.

Other Department programs address potential impacts to wetlands, streams and sensitive habitats through permitting and approval requirements and through participation on the Delaware and Susquehanna River Basin Commissions. These groups have their own regulatory programs.

What are the environmental impacts of gas drilling?

Although the cleanest burning of any fossil fuels used for energy, natural gas extraction, distribution and processing, and burning results in the release of a variety of greenhouse gases, including carbon dioxide and methane. Disturbance to landscapes during construction of drilling pads is another impact.

Horizontal, or directional drilling, can require fracturing the rock underground to release natural gas, which uses large amounts of water and potentially harmful acids. The disposal and storage of the used fluid after fracturing is also a concern. The natural gas industry is working hard to improve practices and

reduce the impact of natural gas use through technological advances in all phases, from exploration to distribution.

As a result of New York's rigorous regulatory process, the types of problems reported to have occurred in states without such strong environmental laws and rigorous regulations haven't happened here. No known instances of groundwater contamination have occurred from previous horizontal drilling or hydraulic fracturing projects in New York State.

How Does the NYSDEC Review Potential Environmental Impacts of Gas Drilling?

A Generic Environmental Impact Statement (GEIS) provides a comprehensive review of the potential environmental impacts of oil and gas drilling and production and how they are mitigated. At the time of this paper's writing, the NYSDEC had initiated a formal public review process to supplement this GEIS to ensure that any issues unique to Marcellus and other horizontal shale formation drilling are adequately addressed.

Governor David A. Paterson approved a bill that extends uniform gas well spacing rules and establishes boundary setbacks to protect the interests of adjacent property owners. This new law has been widely misreported as allowing a new type of drilling, or somehow making it easier to get the environmental permits necessary for drilling. In fact, the new law only addresses well spacing. It authorizes nothing new nor in any way does it reduce the environmental review needed before a drilling permit is issued.

While the process of scoping and preparing the Supplemental GEIS is ongoing, any entity that applies for a drilling permit for horizontal drilling in the Marcellus Shale and opts to proceed with its permit application will be required to undertake an individual, site-specific environmental review. That review must take into account the same issues being considered in the Supplemental GEIS process and must be consistent with the requirements of the State Environmental Quality Review Act and the state Environmental Conservation Law.

The draft scope for the Supplemental GEIS was released for public review and comment on October 6, 2008. Written comments are being accepted through December 15, 2008.

Topics in the draft scope include the potential impacts of:

- Water withdrawals from surface water bodies and groundwater sources for hydraulic fracturing
- Transportation of water to the well site
- The use of additives in the hydraulic fracturing fluid
- Space and facilities required at the well site to ensure proper handling of water and additives
- Removal of spent fracturing fluid from the well site and its ultimate disposition
- Noise, visual and air quality considerations
- Potential community impacts

Six public scoping meetings were scheduled to provide an opportunity for all interested persons to comment. The schedule of meetings is available at: <http://www.dec.ny.gov/energy/46288.html#meetings>.

What responsibilities or actions does a municipality need to know about, or what can a municipality do to regulate gas drilling?

In the case of natural gas drilling, State law supercedes any local regulation. Regulation concerning natural gas drilling is specified in Article 23 of New York State's Environmental Conservation Law relating to Mineral Resources, which states:

2. The provisions of this article shall supersede all local laws or ordinances relating to the regulation of the oil, gas and solution mining industries; but shall not supersede local government jurisdiction over local roads or the rights of local governments under the real property tax law.

Where can I obtain more information?

The following websites and organizations have more information for further research:

Chenango County Farm Bureau's Oil and Gas Leasing Resource Page

Information, assistance and tips for landowners

http://www.ccfbny.org/issues/oil_lease/leasing2.htm

Cornell Cooperative Extension's Natural Gas Leasing Information Page

FAQs, maps, fact sheets, slide shows, discussion forum, and loads of additional web links

<http://gasleasing.cce.cornell.edu/>

WTVH Channel 5 report on Gas and Oil Leasing Trend

http://www.syracuse.com/wtvh/index.ssf/2008/10/landowners_hope_to_cash_in_on.html

Empire State Oil and Gas Information System

Query and view data for all of New York's 34,000+ wells; General Well data and production data are available to the public

<http://esogis.nysm.nysed.gov/>

New York Farm Bureau's Oil and Gas Leasing Page

Workshop schedule, complaint form, fact sheet, additional web links

<http://www.nyfb.org/Gas&OilLeasing.htm>

Natural Gas Supply Association's Education Site

An educational website covering a variety of topics related to the natural gas industry. The purpose of this website is to provide visitors with a comprehensive information source for topics related to natural gas, and present an unbiased learning tool for students, teachers, industry, media, and government.

<http://www.naturalgas.org/>

Energy Information Administration

Official energy statistics from the U.S. government

<http://www.eia.doe.gov/>

Natural Gas Supply Association

Links, issues, studies, filings & testimonies, fact sheets, and more

<http://www.ngsa.org/>