Environmental and Energy Study Institute

Fact Sheet

Shale Gas and Oil Terminology Explained:

Technology, Inputs & Operations

The most common way to retrieve natural gas and oil from shale formations is through hydraulic fracturing, or fracking. Fracking involves injecting fluid into a body of rock to create fissures from which natural gas and oil can be extracted. While fracking has been credited with opening an extremely large amount of previously unrecoverable fossil fuels, the development of shale gas and oil formations, called "plays" in industry jargon, can involve many different types of technology, chemicals, byproducts, and wastes. This factsheet describes some of the most common techniques and technologies to shale gas and oil development.

TECHNOLOGY

Vertical Drilling

- Vertical drilling is a technique that does not use extensive lateral components, though the structure may include some shorter horizontal components.
- The term "vertical fracking" can also refer to conventional fracking methods that preceded horizontal fracking.[1]

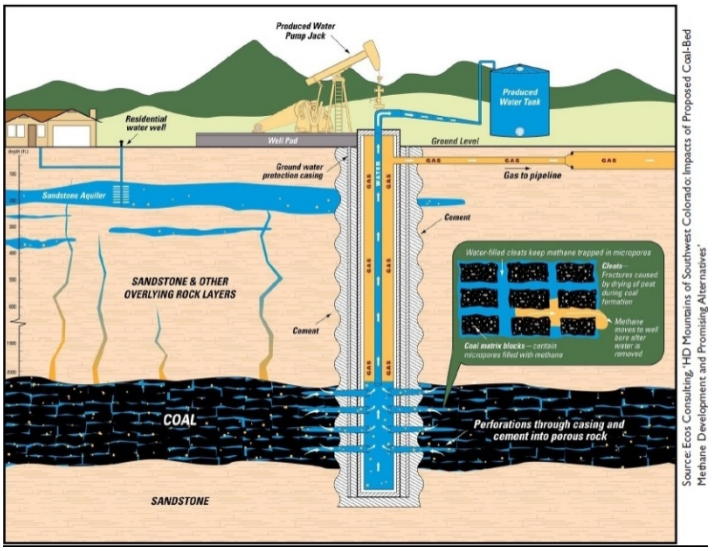

Diagram of vertical fracking.
Source: Ecos Consulting, LLC. http://oilfreefuture.org/hydrofracking.html

Horizontal Drilling

- Horizontal drilling allows wells to move laterally instead of going straight down, so a larger area can be reached without boring as many holes into the surface. Unlike a vertical well, a horizontal well can stretch for up to two miles along a shale deposit.
- The lateral structure of horizonal drilling enables **high volume hydraulic fracturing**.[2] High volume fracking is a technique developed in the 1990s that involves a different blend of chemicals than earlier forms of fracking. High volume hydraulic fracturing uses less gelling agents and more friction-reducing chemicals than previous methods (see the *Hydraulic Fracturing Fluids*). For this reason, it is also known as 'slick-water hydraulic fracturing.' This method uses 70 to 300 times more fluid than previous methods.[3]

Rotary Drilling

- Rotary drilling is a technology necessary to shale gas and oil extraction that involves using a sharp, rotating drill to bore a hole in the earth's crust.[4]
- Rotary drilling requires a fluid known as "mud" that typically includes clays and minerals such as barite, chalk or hemotite, and other chemicals. The mud is typically oil-based, using a petroleum product such as diesel or synthetic oil. Basic water and clay blends can also be used.[5]

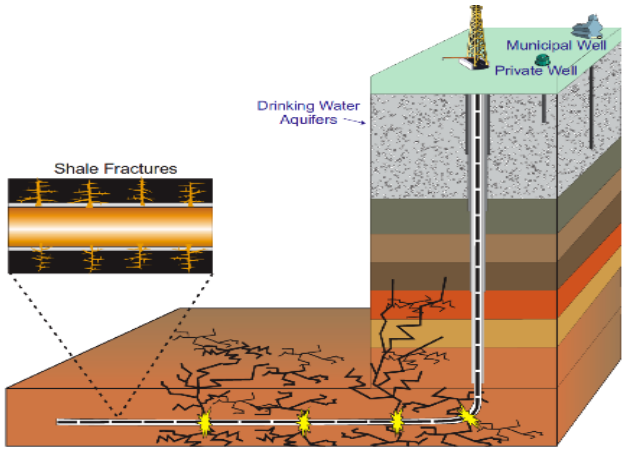

Diagram of horizontal fracking.
Source: Clean Water for North Carolina
www.cwfnc.org/documents/Fracking- for-gas-in-NC.ppt

WELL OPERATIONS AND INPUTS

Hydraulic Fracturing Fluids

- The majority of fluid used in hydraulic fracking is water—less than one percent is comprised of other chemicals. Other chemicals included in the solution are surfactants, gelling agents, propants, and biocides.[6]
    - **Propants** are sandy materials that are used to hold open the fractures, keeping them from closing.
    - **Gelling agents** are used to aid the sand-water mixture to pry open fractures in the rock. Some common gelling agents are guar gum and xantham gum.
        - **Diesel** can be used to form a viscous fracking gel when combined with guar concentrate. Though the EPA has attempted to regulate the use of diesel fuel in hydraulic fracturing in the past, it is often still used in place of water because it can carry more guar concentrate per unit volume than water.
    - **Surfactants**, the largest chemical component by weight, are chemicals that are prone to migrate to the surface of a substance. Most soaps are surfactants, for example. Surfactants are used to reduce surface friction during the fracturing process. Many surfactants are known to be toxic to animals and ecosystems.
    - **Biocides** are chemicals used to kill bacteria. They are necessary to prevent bacteria, which are present naturally in the fresh water used for fracking, from forming colonies on the rock face and causing serious problems such as biogenic hydrogen sulfide production, corrosion, and formation damage.
    - **Acidizing** is a process performed either before or during fracking. It involves pumping acid—usually hydrochloric acid—into the rock formation so that the fractures in the well can be opened more effectively.[7]

Wellbore Casing

- The hole drilled into the ground is known as a **wellbore**. The **wellbore casing** is a layered wall, composed of mostly cement and steel, that provides support for the wellbore, and separates the well from the surrounding geologic structure.
- There is usually a gap of about an inch wide between the well pipe and the rock face from which methane can escape. This empty space between the rock and the steel pipe in a borehole is called the **anulus**. The anulus is usually filled with cement.
- As the natural gas and oil travel through the well, wellbore casings are crucial to protecting aquifers from the possibility of migrating fluids. State regulations determine how deep below an aquifer the wellbore casing must extend.[8] Much of the public concern about the safety of fracking operations center on the integrity of wellbore casings.

- A cement bond log records data about whether or not the cement is bonded to the steel in a wellbore casing. The monitoring and upkeep of wellbore casing is regulated by states.

Venting and Flaring

- **Venting** typically refers to the release of natural gas into the atmosphere during the extraction process. Drilling operations may vent different types of gases, including methane, benzene, toluene, and volatile organic compounds (VOCs).[9] Venting is an intentional act, usually performed when oil is recovered, and operators are not economically compelled to recover the less valuable natural gas.
- **Flaring** is the burning of natural gas that is released during drilling, but is deemed not to be economically beneficial to capture.[10] However, methane, the principal component of natural gas is highly flammable as well as a very potent greenhouse gas, and therefore is flared for safety purposes.
- Flaring can be useful for controlling certain chemicals that are emitted into the environment, such as converting hydrogen sulfide gas (H2S) into sulfur dioxide (SO2). However, SO2 is known to cause acid rain when it is oxidized further, by reacting with a compound such as nitrogen dioxide. Flares may emit many air pollutants, depending on the chemical composition of the natural gas and the temperature of the flare.[11]

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[1] "Shale Gas: Focus on the Marcellus Shale" http://www.earthworksaction.org/pubs/OGAPMarcellusShaleReport-6-12-08.pdf
[2] "Shale Gas: Focus on the Marcellus Shale" http://www.earthworksaction.org/pubs/OGAPMarcellusShaleReport-6-12-08.pdf
[3] "The Environmental Review Process for Natural Gas Exploration in the Marcellus Shale" http://www.dec.ny.gov/energy/46288.html#horizontal
[4] "Engineering Natural Gas from U.S. Shale Deposits" http://buildipedia.com/operations/engineering-operations-news/engineering-natural-gas-from-us-shale-deposits?print=1&tmpl=component
[5] "The Use of Clays in Drilling Fluids" http://www.clays.org/journal/archive/volume%201/1-1-269.pdf
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