

WATER USE IN BARNETT DEEP SHALE GAS EXPLORATION



FACT SHEET

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How much water is used in Barnett deep shale gas development?

Water is an essential component of Chesapeake Energy's (Chesapeake) deep shale gas development. Chesapeake uses water for drilling, where a mixture of clay and water is used to carry rock cuttings to the surface, as well as to cool and lubricate the drillbit. Drilling a typical Chesapeake Barnett deep shale gas well requires approximately 250,000 gallons of water.

Water is also used in hydraulic fracturing, where a mixture of water and sand is injected into the deep shale at a high pressure to create small cracks in the rock which allows gas to flow. Hydraulically fracturing a typical Chesapeake Barnett horizontal deep shale gas well requires an average of 3.8 million gallons per well.

How does Barnett deep shale gas water use compare to regional uses?

The volume of water necessary to drill and fracture Barnett deep shale gas wells represents a very small percentage of the total water resources used in the Barnett Shale geographic area. This region includes 20 counties in North-central Texas. The total water use in the Barnett Shale area in 2006 was approximately 450 billion gallons. The natural gas industry is expected to increase the amount used by less than 1%, and is well within available resources in the region. Again, this volume is very small in terms of the overall water budget for the area. The largest water users in the Barnett Shale

How much is 4 million gallons?

The 4 million gallons of water needed to drill and fracture a Barnett deep shale gas well is equivalent to the amount of water consumed by:

- **The Dallas-Fort Worth Metroplex in six minutes**
- **A 1,000 megawatt coal-fired power plant in 9.5 hours**
- **A golf course in 20 days**
- **Six acres of corn in a season**

While these represent continuing consumption, the water used for a shale gas well is a one-time use.

KEY POINTS

- Water resources are protected through stringent federal, state and local permitting processes.
- Natural gas production uses significantly less water per BTU of energy produced than other fuel sources such as coal, oil or ethanol.
- Water is essential for Barnett deep shale gas development.
- Barnett deep shale gas drilling and hydraulic fracturing uses a small amount of water compared to other uses in the North Texas area, and does not represent a long-term commitment of the resource.

area are municipal/public water supply (approximately 82.5%), irrigation (approximately 6%), industry and mining (approximately 4.5%), power generation (approximately 4%) and livestock (approximately 2%). Water used in Chesapeake Barnett deep shale gas wells differs most notably from all other uses because it is temporary, occurring only once during the drilling and completion phases of each well. Use of this water does not represent a long-term commitment of the resource in the Barnett Shale geographic area.

How much water is used in Barnett deep shale gas development compared with other energy sources?

Water and energy are interdependent. Water is essential to energy resource development. Conversely, energy resources are needed for producing, processing, distributing and using water resources. Assuming a typical Barnett deep shale gas well will produce approximately 2.65 Bcf (billion cubic feet) of gas over its lifetime, the amount of water used to produce the gas equates to about 1.47 gallons for every one million British thermal units (MMBTU - one MMBTU equals about a thousand cubic feet of gas). To put this in perspective, this is less than 20% of the water needed to produce one MMBTU of coal that is ready to burn in a power plant or 0.05% of the water needed to produce the same energy equivalent of ethanol for fuel. The table on the following page compares water use per unit of energy for several energy sources.

Water requirements for various energy resources

Energy Resource	Range of Gallons of Water Used per MMBTU of Energy Produced
Barnett Shale Natural Gas ¹	1.47 ²
Coal (no slurry transport)	2 – 8
Coal (with slurry transport)	13 – 32
Nuclear (uranium ready to use in a power plant)	8 – 14
Conventional Oil	8 – 20
Synfuel - Coal Gasification	11 – 26
Oil Shale	22 – 56
Tar Sands	27 – 68
Synfuel - Fisher Tropsch (from coal)	41 – 60
Enhanced Oil Recovery (EOR)	21 – 2,500
Biofuels (Irrigated Corn Ethanol, Irrigated Soy Biodiesel)	> 2,500

¹Source: GWPC Report

²The transport of natural gas can add between zero and two gallons per MMBTU.

Other Sources: DOE

Where does the water come from?

Chesapeake utilizes several sources of water in Barnett deep shale gas exploration including municipalities, regional water districts, river authorities (water purchase), rivers, ponds, lakes and groundwater wells. Chesapeake is also currently reviewing the use of a variety of other water resources such as discharge water from industrial or city wastewater treatment plants, power plant cooling water, marginal (saline) groundwater and reuse of fracturing water. Chesapeake works directly with local officials to arrange water purchases from a municipality when drilling inside city limits. Water is typically transported by temporary pipelines to drilling locations for storage in tanks or impoundments prior to use. Chesapeake also uses trucks to transport water supplies. Due to the diverse geographic area overlying the Barnett Shale, the overall mix of water sources used depends on the region and the availability of sources near drilling sites.

Are water resources protected and regulated?

Regardless of the source, water used in the drilling and fracturing process by Chesapeake is purchased and, as required, properly permitted. This permitting ensures that water used for drilling and hydraulic fracturing does not interfere with the available supply for other users.

Chesapeake works collaboratively with federal, state and local agencies to ensure that water used for deep shale gas development is consistent with water use plans and does not adversely affect other users.

In the Barnett Shale area, Chesapeake works closely with entities such as the U.S. Army Corps of Engineers, Texas Commission on Environmental Quality, Texas Water Development Board and a multitude of area groundwater conservation districts, regional river authorities, regional water districts and local municipalities on its proposed water use.

Chesapeake's deep shale gas development, with its comparatively small water use per unit of energy, is consistent with the nation's energy/water strategy by making a positive energy and economic contribution at a relatively low cost to the overall water supply. Chesapeake's deep shale gas has the potential to supply decades of natural gas for the U.S., while using less water than other currently available viable energy sources.

Information Sources

- Argonne National Laboratory
- Environmental Resources Management
- Ground Water Protection Council (GWPC)
- Gas Technology Institute
- Sandia National Laboratory
- Texas Water Development Board (TWDB)
- U.S. Department of Energy (DOE)
- U.S. Geological Survey

About Chesapeake

Chesapeake Energy Corporation is one of the leading producers of natural gas in the U.S. Headquartered in Oklahoma City, the company's operations are focused on the development of onshore unconventional and conventional natural gas in the U.S. in the Barnett Shale, Haynesville Shale, Fayetteville Shale, Marcellus Shale, Anadarko Basin, Arkoma Basin, Appalachian Basin, Permian Basin, Delaware Basin, South Texas, Texas Gulf Coast and East Texas regions of the United States. If you have questions about water use in deep shale gas exploration or other facets of our operations, visit www.chk.com or email us at barnettshale@askchesapeake.com.