EIA's Natural Gas Production Data

This special report examines the stages of natural gas processing from the wellhead to the pipeline network through which the raw product becomes ready for transportation and eventual consumption, and how this sequence is reflected in the data published by the Energy Information Administration (EIA). The discussion will be helpful to users of the data published by EIA in the *Natural Gas Annual* and *Natural Gas Monthly,* in particular, and industry analysts interested in gaining a better understanding of the production process. Questions about this report should be directed to Andy Hoegh at andrew.hoegh@eia.doe.gov or (202) 586-9502.

Natural gas generally must be processed before it can be delivered into pipelines for transportation to be used for heating homes, generating electricity, industrial purposes, or other applications. Natural gas that is extracted from underground reserves consists primarily of methane gas. In addition, it may include limited concentrations of ethane, propane, butane, pentane, water vapor, carbon dioxide, hydrogen sulfide, nitrogen, and helium. In processing, the total volume of gross gas withdrawals (including methane gas) and liquids that comes out of the ground is reduced as compounds are separated and extracted to meet pipeline standards or for economic reasons. The volumes relevant to each stage are measured by operators and reported by the Energy Information Administration (EIA) in a simplified framework that reflects each general processing stage. This report describes these stages and maps the associated volumes to the categories established in the EIA data reports, including the *Natural Gas Annual* and the *Natural Gas Monthly*.

Natural gas must meet several requirements before it is ready to be transported and consumed. These criteria are designed to protect pipeline infrastructure and ensure consistent delivered product.

- The heat content of natural gas must be within a specified range in British thermal units, generally 985 to 1085 per cubic foot.[1]
- The hydrocarbon dew point of the gas must be sufficiently high that the gas will not liquefy in pipelines.
- The gas must be free of compounds, such as hydrogen sulfide or carbon dioxide, that corrode pipelines.
- Finally the gas must be free of small particles and moisture.

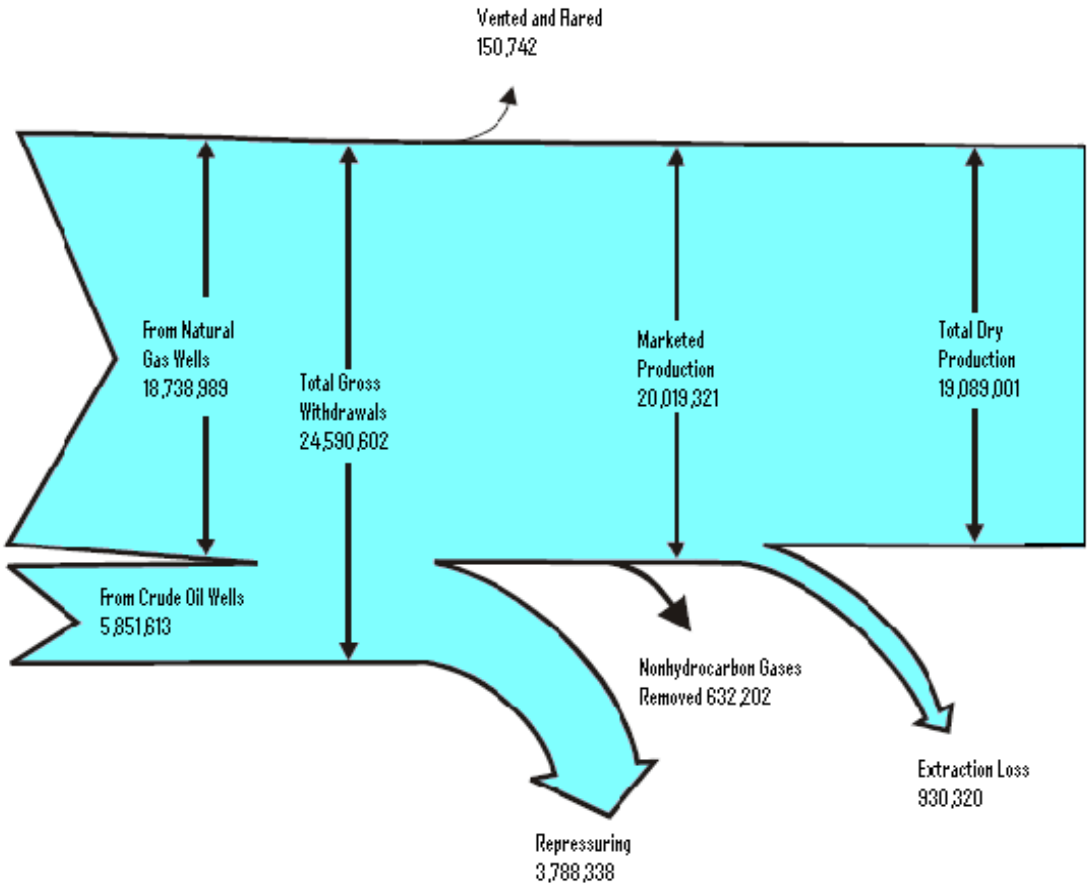
The term "natural gas" can apply at any step in the process, despite physical and chemical differences. EIA publishes production volumes[2] measured at three steps in processing: total gross withdrawals, marketed production, and total dry production (Table 1). As the natural gas goes from total gross withdrawals to marketed production to total dry production, the volume is reduced (Figure 1). The following discussion walks through the natural gas processing stream and describes the differences in the natural gas at each step.

Table 1. Summary Statistics for Natural Gas in the United States, 2003- 2007

	2003	2004	2005	2006	2007
Number of Wells Producing at End of Year	393,327	406,147	425,887	R440,516	452,768
Production (million cubic feet)					
Gross Withdrawals					
From Gas Wells	17,881,802	17,885,247	17,471,847	R17,995,554	18,738,989
From Oil Wells	6,237,176	6,084,431	5,984,975	R5,539,464	5,851,613
Total	**24,118,978**	**23,969,678**	**23,456,822**	R**23,535,018**	**24,590,602**
Repressuring	3,547,781	3,701,656	3,699,535	3,264,929	3,788,338
Vented and Flared	98,113	96,408	119,097	R129,469	150,742
Nonhydrocarbon Gases Removed	498,724	654,124	711,095	R730,946	632,202
Marketed Production	19,974,360	19,517,491	18,927,095	R19,409,674	20,019,321
Extraction Loss	875,816	926,600	876,497	906,069	930,320
Total Dry Production	**19,098,544**	**18,590,891**	**18,050,598**	R**18,503,605**	**19,089,001**

Source: Energy Information Administration, *Natural Gas Annual 2007* (January 2009).

Figure 1. Natural Gas Flow (million cubic feet), 2007



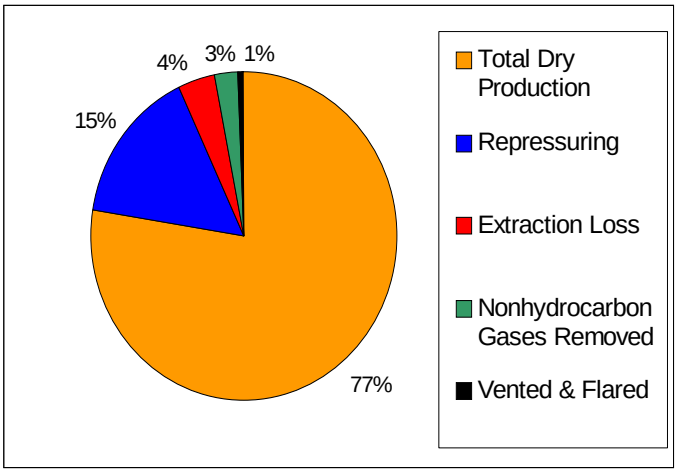
Source: Adapted from the Energy Information Administration report, *Natural Gas Annual 2007* (January 2009).

Natural Gas Data: from Wellhead to Pipeline

Total gross withdrawals. This is the full well stream volume of natural gas and associated gases, excluding lease condensate. This volume includes all natural gas plant liquids and all nonhydrocarbon gases. Lease condensate is a mix of pentane and heavier hydrocarbons that are recovered as a liquid in lease separation facilities. Total gross withdrawals also include amounts of natural gas delivered as royalty payments or consumed in field operations.

Repressuring. Natural gas is sometimes reinjected back into reservoirs to stimulate further crude oil production. This activity, called repressuring, maintains pressure in the reservoir that helps move crude oil to the producing wells. Historically, over 80 percent of natural gas used in repressuring occurs in Alaska. Much of the Alaskan natural gas is extracted from fields located on the North Slope, where no pipeline is currently available to transport the gas to external markets. In 2007, 15 percent of total gross production was used for repressuring (Figure 2).

Figure 2. Components of U.S. Total Gross Withdrawals of Natural Gas Volumes 2007 (percent)



Source: Adapted from the Energy Information Administration report, *Natural Gas Annual 2007 (January 2009).*

Vented and flared. Historically, natural gas was seen as a waste product of oil production and burned off or released into the atmosphere. As prices rose and the industry evolved, this has changed. Only about 1 percent of total gross withdrawals is vented or flared. Most of the venting and flaring that takes place today is done as a safety mechanism to maintain proper pressure in equipment. The small flames visible on stacks at natural gas processing plants serve a function similar to a pilot light, burning continuously should the sudden need to flare gas arise. Flaring gas converts methane and oxygen to carbon dioxide and water vapor. This actually reduces the greenhouse effect in comparison with venting methane gas, which is a greenhouse gas with an environmental impact more than 20 times greater than carbon dioxide.[3]

Nonhydrocarbon gases removed. In addition to methane gas, wet natural gas may also contain gases such as carbon dioxide, hydrogen sulfide, nitrogen, and helium. These nonhydrocarbon gases are separated and removed from natural gas to meet pipeline requirements. Carbon dioxide and hydrogen sulfide are removed because of the corrosive effect on pipelines. These products generally have minimal economic value in comparison with hydrocarbon compounds. Nonetheless, there is a market for elemental sulfur and carbon dioxide can be used for enhanced oil recovery. Inert gases such as helium and nitrogen are undesirable because they reduce the heat content of natural gas. If infrastructure and local markets exist, these gases can be sold. In fact, the natural gas industry is the primary producer of consumer-use helium. The volume of removed nonhydrocarbon gases accounts for about 3 percent of the total gross withdrawals.

Marketed production. After vented and flared, repressuring, and nonhydrocarbon volumes have been removed from total gross withdrawals, the remaining volume of the natural gas stream is called marketed production.

Extraction loss. Liquid hydrocarbons called natural gas liquids (NGLs) commonly found in natural gas include ethane, propane, and butane, among others. NGLs, which make up around 4 percent of the total gross withdrawal volume, become liquid at atmospheric temperature and pressure. Economics drive decisions about the volume of NGLs to remove from the natural gas stream. NGLs will be removed if the net return from separating and selling the NGLs outweighs the value of the natural gas

product. Otherwise the NGLs can be left in the natural gas, provided pipeline standards are met, resulting in a higher heat content. The removal of NGLs takes place at natural gas processing plants and the volume is called extraction loss[4].

Total Dry Production. Once gas is treated for impurities and processed for NGLs, the remaining natural gas is known as total dry production and ready for shipment through the pipeline network and for final end use.

This paper has described the data framework used to present natural gas production data in the *Natural Gas Annual* and *Natural Gas Monthly* published by EIA. This framework reflects the various stages through which natural gas processing proceeds before entering the pipeline network for transportation to consumers. There is no single correct approach to presentation of the data, and some differences occur between publications. However, all data must conform to the basic concepts as presented here.

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[1]Energy Information Administration, *Natural Gas Processing: The Crucial Link Between Natural Gas Production and Its Transportation to Market* (2006), p1. http://www.eia.doe.gov/pub/oil_gas/natural_gas/feature_articles/2006/ngprocess/ngprocess.pdf

[2]Energy Information Administration, *Natural Gas Annual 2007* (January 2009), Table 1. http://www.eia.doe.gov/oil_gas/natural_gas/data_publications/natural_gas_annual/nga.html

[3]Environmental Protection Agency. http://www.epa.gov/methane/

[4]NGLs are converted from barrels to million cubic feet based on the heat content of the particular liquid. Source: Energy Information Administration, *Natural Gas Annual 2007* (January 2009), Appendix A, p.172. http://www.eia.doe.gov/pub/oil_gas/natural_gas/data_publications/natural_gas_annual/current/pdf/appendix_a.pdf