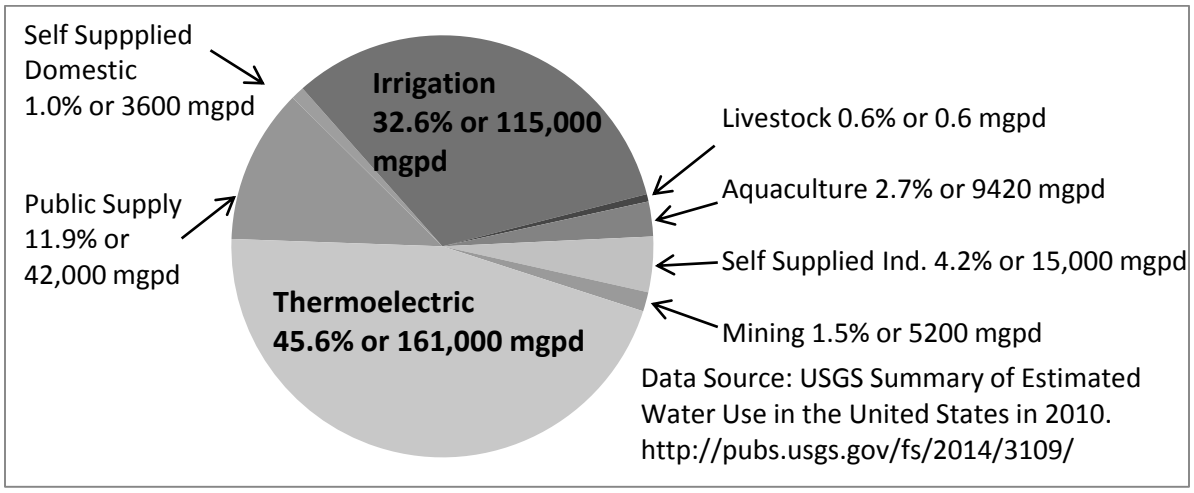
The Basics of Wells – Water Usage in Drilling & Fracturing

Drilling and fracturing wells requires what appears to be a very large volume of water in each well, with a total of about one to seven million gallons of water for all activities of drilling and fracturing. While the total volume may seem large, comparison of the water volumes used in many forms of energy production is quite eye-opening.

The water volume used in fracturing is rarely over 1 to 2% of the total water used in areas where fracturing is practiced. However, if the development area is suffering water shortage, any water withdrawal is highly visible to the public. In these areas of severe water shortage, recycling produced water and mixing with high salinity brines that are too saline for any agricultural use is both possible and, surprisingly effective and economic in in large scale fracturing operations.

Nation-wide, fracturing may use about 50 to 100 billion gallons of water in a year (combined fresh and salt water) during years when well development activity is high. Although a seemingly large volume, the water usage for fracturing pales by comparison to millions of gallons per day (mgpd) volumes used in water withdrawals for single-pass cooling in thermo-electric power generation, irrigation, domestic fresh water usage and the two billion gallons of water used *per day* for US golf course irrigation. Within the US public sector, just the leakage from residential and industrial fresh water supply lines is estimated at almost 6 billion gallons per day or 2.1 trillion gallons per year.



Fracturing supply water sources include surface water, fresh water wells, salt water from oil field produced water, other brines that are too saline for agriculture and even treated sewage effluent. High salinity brines may be available, particularly those above 10,000 ppm, where there may be too much salt reject to make reverse osmosis units economical or practical. The amount of recycling of produced and salt waters and the use of high TDS brines varies with the cost of and availability of fresh water and the cost and availability of disposal or treating of produced water. In large operations, Apache Corporation, for example, has found that the mixture of brines with produced water can be actually cheaper than fresh water and much less problematic than transport and disposal of produced water streams. (Note that most produced water from wells cannot legally be sent to treatment plants or dumped in rivers, a very curious practice in Pennsylvania that ended in about 2010, but was unlawful in western states for more than 50 years.)

A comparison of water volumes needed for primary fuel production (gas, oil, coal and biofuels) illustrates the efficiency of fracturing to produce gas from either conventional or unconventional reservoirs.

Gallons of Water Used by an Energy Source to Produce 1 Million BTUs of Energy		
Primary Energy Resource	**Range of gallons of water used per million BTU generated**	Data Source
Natural Gas (based on all water needs for gas from shales including fracturing)	**1 to 3 (conventional gas uses even less than shale gas development)**	USDOE. 2006. Report to Congress on the Interdependency of Energy and Water. United States Department of Energy. Washington D.C. http://www.sandia.gov/energy-water/congress_report.htm, P59.
Coal (no slurry transport) (with slurry transport)	**2 to 8** **13 to 32**	USDOE 2006, p53-55.
Nuclear (processed uranium ready to use in plant)	**8 to 14**	USDOE 2006, p 56.
Conventional Oil	**8 to 20**	USDOE 2006, p 57-59.
Synfuel – Coal Gas	**11 to 26**	USDOE 2006, p 60.
Oil (liquid) from shale	**22 to 56**	USDOE 2006, p 57-59.
Oil from Tar Sands	**27 to 68**	USDOE 2006, p 57-59.
Ethanol (irrigated corn)	**2510 to 29,100**	USDOE 2006, p 61.
Biodiesel (irrigated soy)	**14,000 to 75000**	USDOE 2006, p 62.

The 1 to 3 gallons of water used per million BTUs generated for gas production enabled by fracturing is 0.08% of the water volume required for the same energy production from ethanol.

One of the most interesting things about natural gas as a fuel is that the four hydrogen atoms of the CH_4 methane molecule generate fresh water when the gas is consumed as a fuel.

$$CH_4 + 2O_2 \longrightarrow CO_2 + 2H_2O$$

The volume of water produced from this reaction is roughly 11 million gallons of per billion cubic feet (bcf) of natural gas burned, or twice the average fracture treatment volume for a shale well that will produce two bcf of gas. Water produced when gas is burned does not return to the area of the wells just as water used to grow bio-fuel crops is not restored to areas of farmland, whether crops are grown by rainfall or irrigation.

Disclosure: George E. King is a Texas Registered Professional Engineer with over 44 years oilfield experience. His technical background includes fracturing, workovers, chemicals, acidizing, well integrity and horizontal wells.