[PS]Future Water Needs of the Oil and Gas Industry in Texas*

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Abstract

The Barnett Shale gas play, located in North Texas, has seen a quick growth in the past decade with the development of new "frac" technologies able to create pathways to produce gas from the very low permeability shales. More plays such as the Haynesville, Woodford, and Eagle Ford are coming online at a steeper rate than the Barnett did. A typical horizontal well completion consumes more than 3 millions gallons of fresh water in a very short time (days). The trend in the industry is to increase the length of laterals with an increased water use. There are currently over 14,000 completed shale gas wells in the State of Texas and many more will be drilled in the next decades. If tight-gas completions are included, the volume of water used is even larger. Adding fresh-water make-up for water and WAG-CO_2 floods, mostly in the Permian Basin, increases even more the overall industry water use. However, the volume remains low on average compared to irrigation and municipal demand. Locally, competition for water resources can lead to conflicts, raising some concerns among local communities and other groundwater stakeholders. Nevertheless, the industry is improving its water footprint by increased recycling, developing alternative sources of water (brackish, treatment plants) and by using more efficient additives, and other innovative strategies. This paper presents industry water use in Texas compiled from various sources as well as water use projections for the next decades.

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Future Water Needs of the Oil and Gas Industry in Texas

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1- Summary

The **Barnett Shale** gas play, located in North Texas, has seen a quick growth in the past decade with the development of new "frac" technologies able to create pathways to produce gas from the very low permeability shales. More plays such as the **Haynesville**, **Woodford**, and **Eagle Ford** (**Figure 1**) are coming online at a steeper rate than the Barnett did (**Figure 2**). A typical horizontal well completion consumes more than 3 millions gallons of fresh water in a very short time (days). The trend in the industry is to increase the length of laterals with an increased water use. There are currently over 16,000 completed shale gas wells in the State of Texas and many more will be drilled in the next decades. If tight-gas completions are included, the volume of water used is even larger (**Figure 1**). Adding fresh-water make-up for water and WAG-CO_2 floods, mostly in the Permian Basin, increases even more the overall industry water use. However, the volume remains low on average compared to irrigation and municipal demand (**Figure 3**). Locally, competition for water resources can lead to conflicts, raising some concerns among local communities and other groundwater stakeholders. Nevertheless, the industry is improving its water footprint by increased recycling, developing alternative sources of water (brackish, treatment plants) and more efficient additives, and other innovative strategies. This paper presents industry water use in Texas compiled from various sources as well as water use projections for the next decades.

1 AF = 325,851 gallons = 7758 barrels

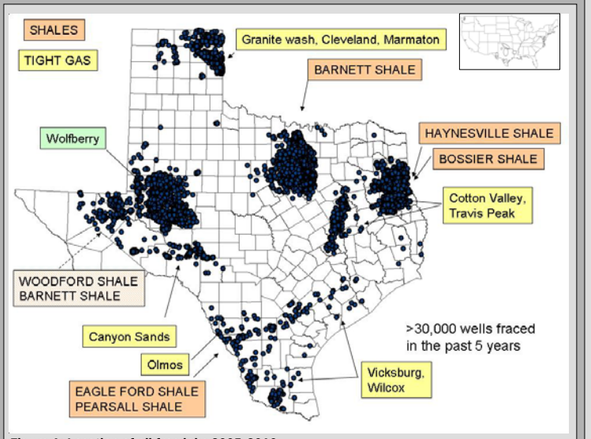


Figure 1: Location of all frac jobs 2005-2010

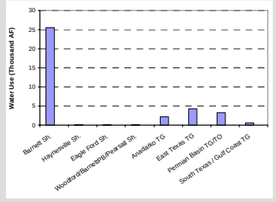


Figure 2a. Completion ("fracing") water use in 2008 (total = 36,000AF)

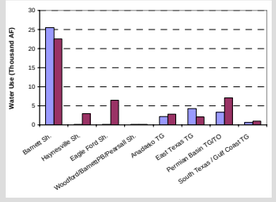


Figure 2b. Completion ("fracing") water use in 2010 (total = 45,000AF)

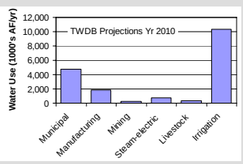
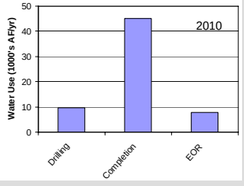


Figure 3. Total annual water use in the State of Texas (projected 2010). Oil and Gas is less than half of mining water use, itself (<200,000 AF/yr) a negligible fraction of the total water use (~18.3 Million AF/yr).

2010 Mining Water Use:
Oil and Gas = ~60,000 AF
Coal/Lignite = ~25,000 AF
Aggregates = ~70,000 AF
Others= ~10,000 AF



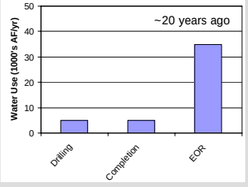


Figure 4: The overall water use in the oil and gas industry has increased but not by a major amount

2- Current Water Use in the Oil and Gas Industry

We were able to gather relatively accurate data from the completion / stimulation stage (HF), as a well is being readied for production (**Figure 3**). Operators have to report the amount of water used in the process, and tabulated data are available in a format easy to process from private vendors (IHS Energy). The data were not without typos, but they and other issues were resolved by ensuring consistency between amount of water, number of stages, and proppant loading. We assigned median values to those wells with no usable data. The split between surface water, groundwater, and other sources (waste water) was much harder to determine. It seems that neither groundwater nor surface water dominates in most plays, and both are used across the state. To the best of our knowledge, alternative water sources are still marginal in Texas. The amount of reuse/recycling was also difficult to discern. We estimated it at ~5% of the amount injected for shale-gas plays. We are more uncertain about water use for drilling wells and waterfloods, although it is clearly nonnegligible. Completion includes acid treatment and other treatments but hydraulic fracturing requires the largest water volume by far. Completion was 40,000+ AF in 2010 and is likely to grow in the next few years (on average). EOR is also a large net water consumer although the fraction of fresh water in the total of 825,000 AF is just a few percent (~10,000 AF in 2010, latest survey in 1995 produced a number close to 32,000 AF).

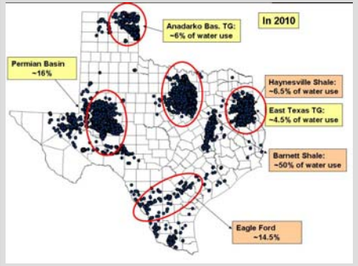


Figure 5: Fracing water use broken down by play in 2010

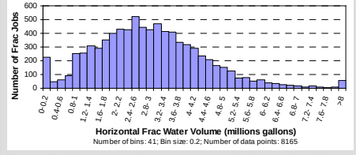
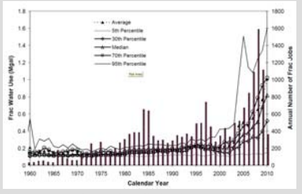


Figure 7: Histogram of water use per horizontal well in the Barnett play. It is used to extract median for projections



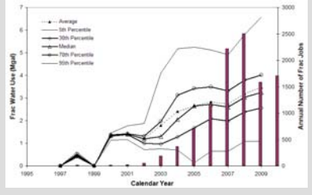


Figure 6. Horizontal wells in the Barnett Play (bottom) and in the Permian Basin (top) number of wells fraced (columns) and percentiles of water used (curves)

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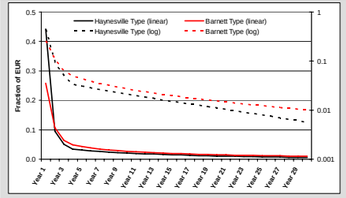


Figure 8: Decline curves assumed in this study (production-based approach)

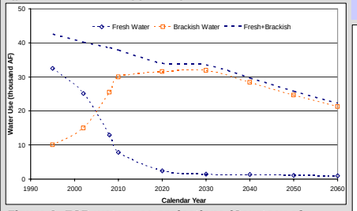


Figure 9: EOR water use projections (Courtesy of Peter Galuski, Texerra)

3- Projection Methodology for Completion Water Use

Completion water use projections were done according to 2 methodologies: "resource-based" and "production-based". The former assumes (1) assumes that the whole footprint of the formation is contacted, (2) assume some well spacing, (3) assume some water length per unit length of lateral, (4) assume some correcting multiplier, and (5) distribute the water use through time through time (Nicot and Potter, 2007). The production-based methodology assumes (1) recoverable reserves and (2) some decline curve (for example, **Figure 8**). Values from both methodologies are compared and adjusted for consistency to produce the final projection values.

Drilling and EOR water use (**Figure 9**) requirements are extrapolated from surveys

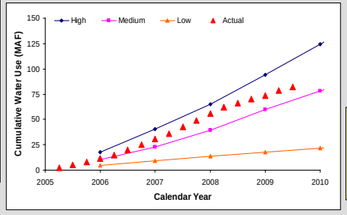


Figure 10: Comparison of 2006 projections (Nicot and Potter, 2007) and actual water use in the Barnett shale play

Figure 10 suggests good post-audit evaluation (Projections made with the resource-based approach)

4- Conclusions

Overall, in 2010, we estimate that the oil and gas industry used (preliminary numbers) ~45,000 acre-feet (AF) for fracturing wells and ~18,000 AF for other purposes To put these figures in perspective, Texas has been projected to have consumed ~18.3 million AF of water in 2010, according the most recent 2007 state water plan, including >10 and ~4.8 million AF for irrigation and municipal use, respectively. Projections were made with the help of various sources by estimating the amount of oil and gas (including shale gas) to be produced in the state in the next few decades and by distributing it through time. Given the volatility of the price of oil and gas, the figures provided clearly indicate only a possible future. We project (**Figure 11**) that state overall water use in the oil and gas industry will peak in the 2020–2030 decade at ~<150,000 AF, thanks to the oil and gas unconventional resources that "will start" to decrease in terms of water use around that time.

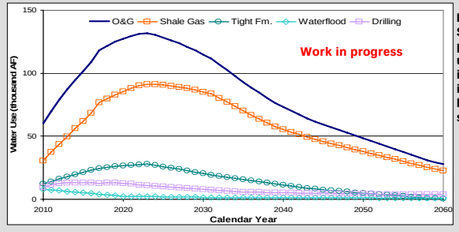
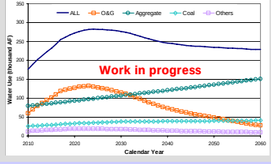


Figure 11: Summary of projected water use (2010–2060) in the oil and gas industry (left) and by mining industry segment (right)



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