Water Efficiency of Texas Shale Plays: A Discussion

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>30,000 wells fraced in the past 5 years

Granite wash, Cleveland, Marmaton

BARNETT SHALE

HAYNESVILLE SHALE

BOSSIER SHALE

Cotton Valley, Travis Peak

SHALES

TIGHT GAS

Wolfberry

WOODFORD SHALE

BARNETT SHALE

EAGLE FORD SHALE

PEARSALL SHALE

Canyon Sands

Olmos

Vicksburg, Wilcox

TIGHT GAS

Granite wash, Cleveland, Marmaton
2010:
23,000 AF Barnett
2,500 AF Haynesville (14 kAF total)
6,000 AF Eagle Ford (7.6 kAF so far in 2011)
>80,000 wells drilled in the past 5 years

~350 MMBBL/yr **Oil**

From ~6.0 to 7.5 TCF/yr **Gas**
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Statewide Annual Production (MM st)

Calendar Year

40-45 Million st/yr in the past 5 years

Texas coal/lignite mines
2008 annual production (short tons)
- 0
- 0–2 million
- 2–4 million
- 4–8 million

Texas coal and lignite trends
- North Texas
- Cretaceous
- Permian bituminous
- Wilcox Group
- Claiborne Group
- Tertiary lignite
- Jackson Group
Mining and steam-electric water use are a small fraction of total water use (Texas)
Shift from waterflooding -oil- to fracing - mostly gas + oil
(Permian Basin, Eagle Ford)
~20,000 AF in 2008 but most of it is depressurization. Actual consumption is ~2.6 kAF.
Uranium in South Texas: 1.1 million lbs U3O8
Solution Mining = 840 AF/yr
Most of the water consumed during reclamation (+ current reclamation of legacy strip mines)
Stakeholder anxiety increases as water use increases

1,000 AF = ~7.8 million bbls

Very steep rise compared to coal or aggregates.
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>\times 3 \text{ in the next decade}

1,000 \text{ AF} = \sim 7.8 \text{ million bbls}

![Graph showing water use over time](image)

Domestic water use of 1 million people for 1 year

Big unknown is refracing
Energy Content and Instantaneous Water Efficiency

• 1 bbl oil ~ 5.9 MMBtu (million Btus)
• 1 MCF gas ~ 1 MMBtu
• 1 ton lignite ~ 9-18 MMBtu
• 1 lb U ~170 MMBtu

• Oil (West Tx, 2002): 4 gal/MMBtu -2.6 if applied to state
• Oil (West Tx, 2008): 2.4 gal/MMBtu -1.6 if applied to state
Energy Content and Instantaneous Water Efficiency

- 1 bbl oil ~ 5.9 MMBtu
- 1 MCF gas ~ 1 MMBtu
- 1 ton lignite ~ 9-18 MMBtu
- 1 lb U ~ 170 MMBtu

- West Texas Waterflood & CO2 Flood Make-up Water

- Est Annual Brackish & Saline Make-up Water
- Est Annual Fresh Make-up Water
Energy Content and Instantaneous Water Efficiency

• 1 bbl oil ~ 5.9 MMBtu
• 1 MCF gas ~ 1 MMBtu
• 1 ton lignite ~ 9-18 MMBtu
• 1 lb U ~ 170 MMBtu

• Gas (2010): 2.3 gal/MMBtu
• Proppant mining: 600 gal/ton with average proppant loading of 0.8 lb/gal – add 20% to fracting
• Drilling: very variable add 10%
• Total Gas: 2.9 gal/MMBtu
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- Lignite: ~2.3-4.6 gal/MMBtu –consumption only
- Lignite: ~17.5-35 gal/MMBtu –depress. included
- Uranium: ~1.7 gal/MMBtu –no reclamation, no processing
Conclusions

• Need to define instantaneous (annual) vs. ultimate water efficiency for these decade-long operations

• Water use relative to energy content at:
  – Well head, mine mouth
  – Refined product (kWh, gasoline)
  – Include distribution?

• Location-dependent (closed loop, once-through, air-cooled)

• Consider externalities (proppant, reclamation)
QUESTIONS?

Some of the material is in:

**Current and Projected Water Use in the Texas Mining and Oil and Gas Industry**
June 2011, prepared by UT-BEG for TWDB

http://www.twdb.state.tx.us/rwpg/rpgm_rpts/0904830939_MiningWaterUse