



Water Efficiency of Texas Shale Plays: A Discussion

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SHALES

TIGHT GAS

Granite wash, Cleveland, Marmaton

BARNETT SHALE

Bureau of Economic Geology

HAYNESVILLE SHALE

BOSSIER SHALE

Cotton Valley,
Travis Peak

Wolfberry

WOODFORD SHALE
BARNETT SHALE

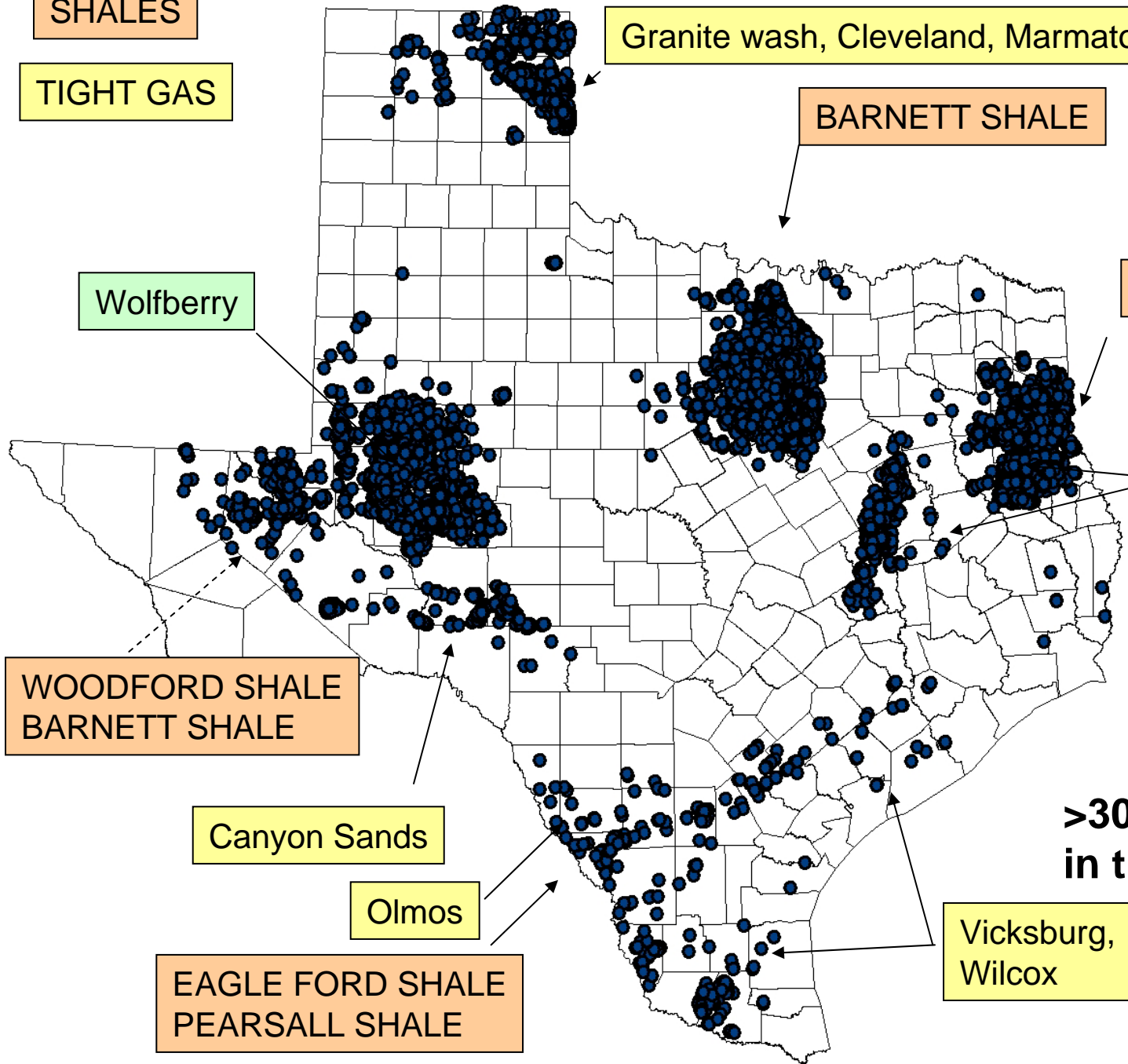
Canyon Sands

Olmos

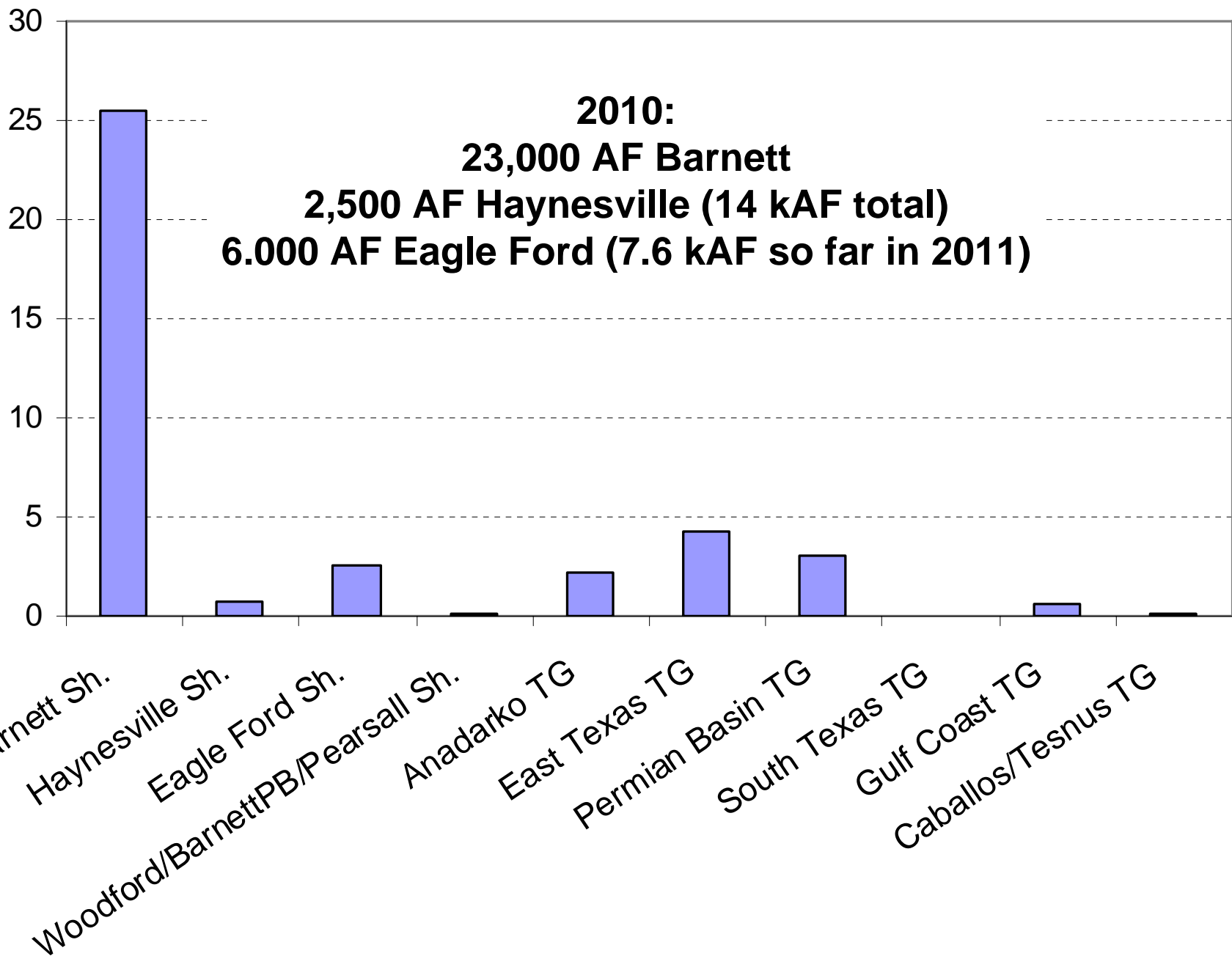
EAGLE FORD SHALE
PEARSALL SHALE

Vicksburg,
Wilcox

**>30,000 wells fraced
in the past 5 years**

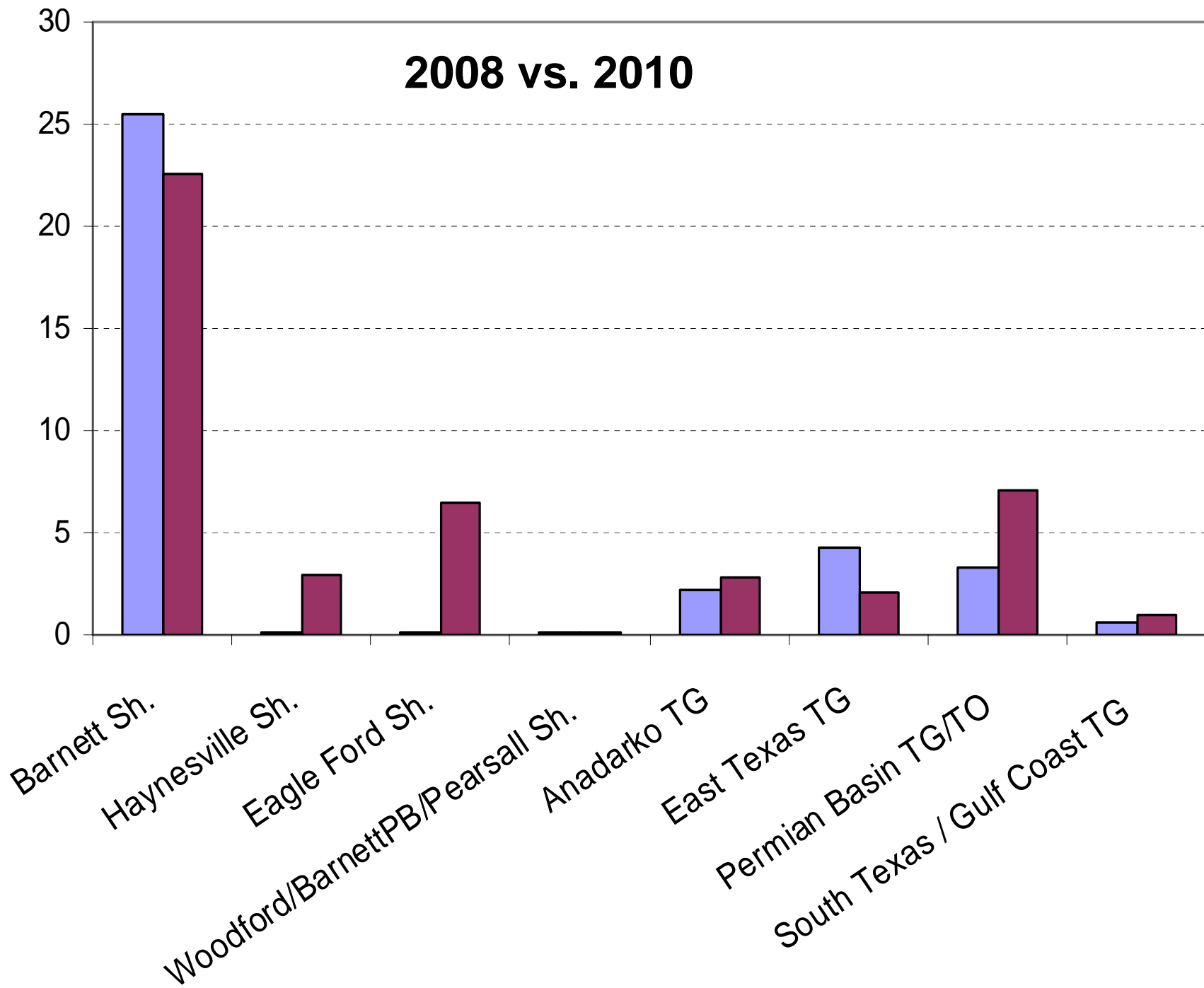


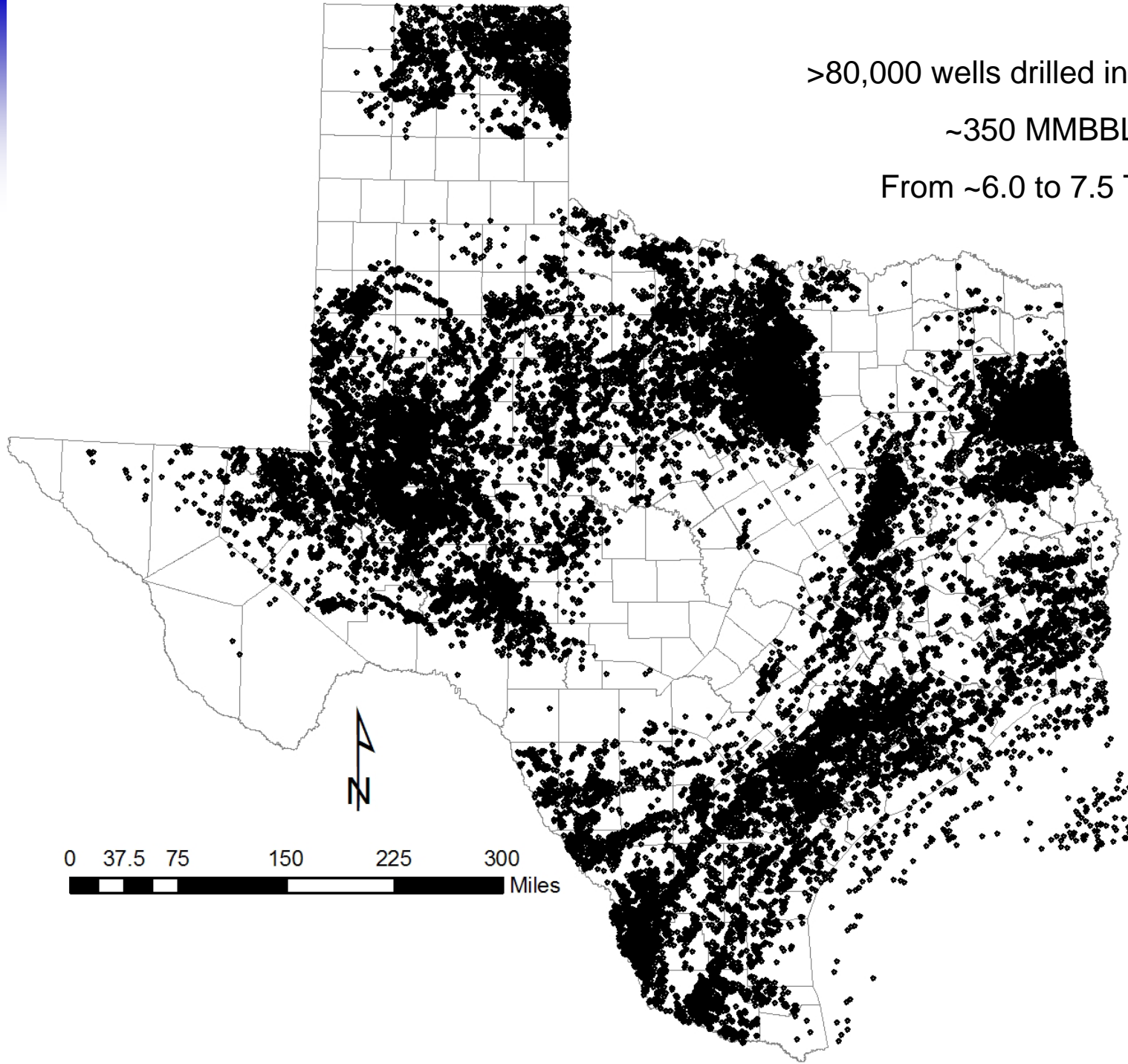
2008 Water Use (Thousand AF)



2008 vs. 2010

Water Use (Thousand AF)

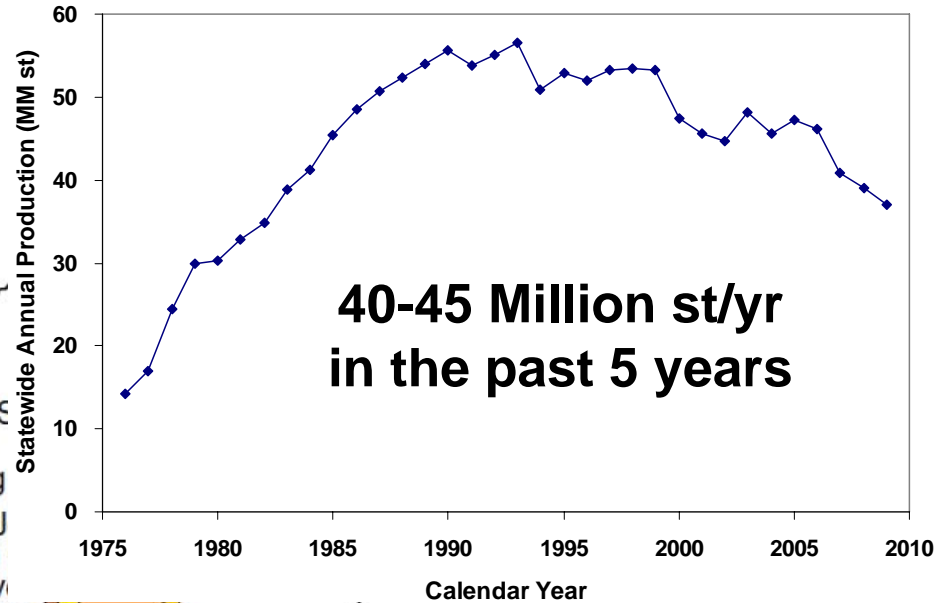
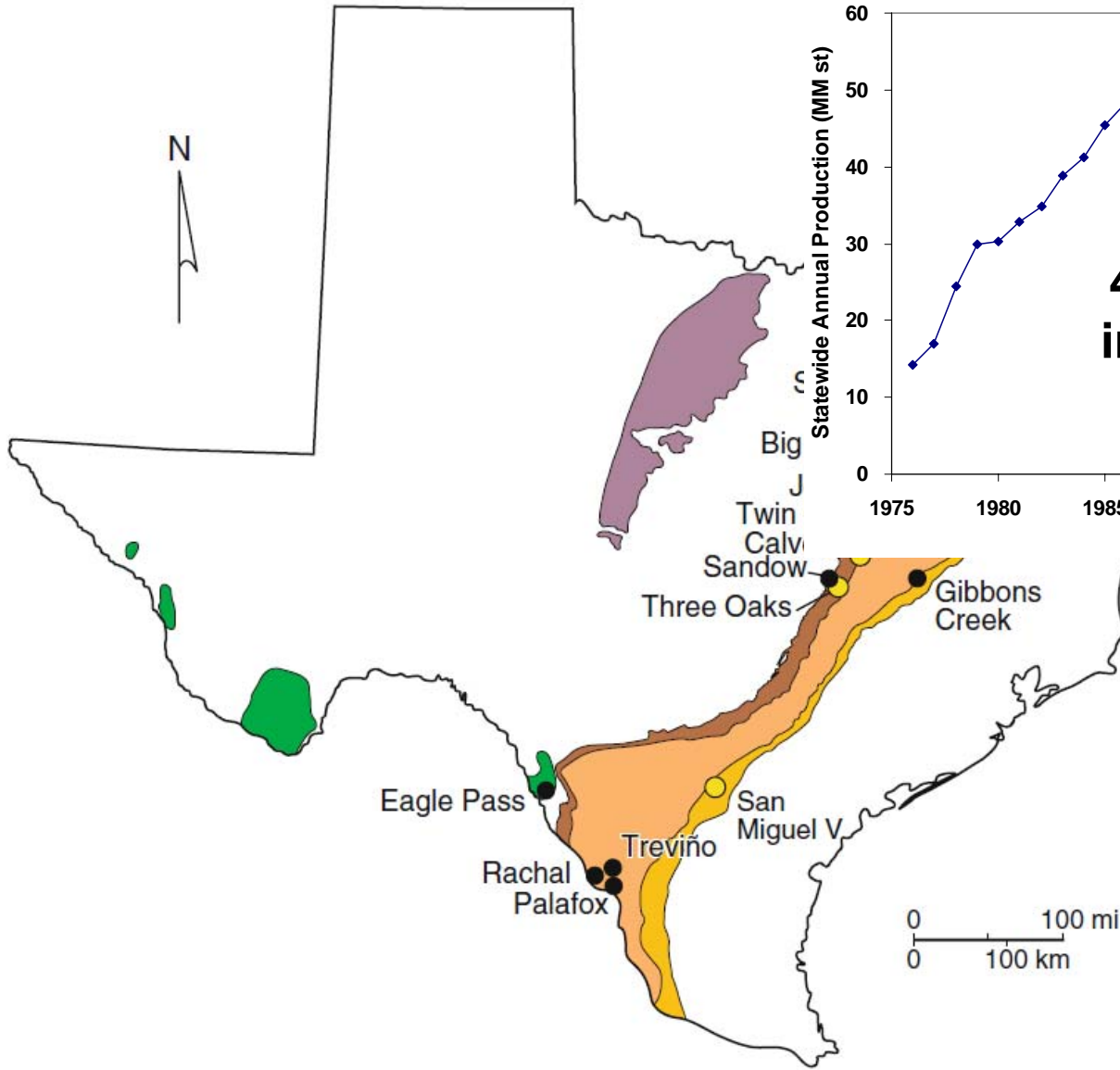




>80,000 wells drilled in the past 5 years

~350 MMBBL/yr **Oil**

From ~6.0 to 7.5 TCF/yr **Gas**

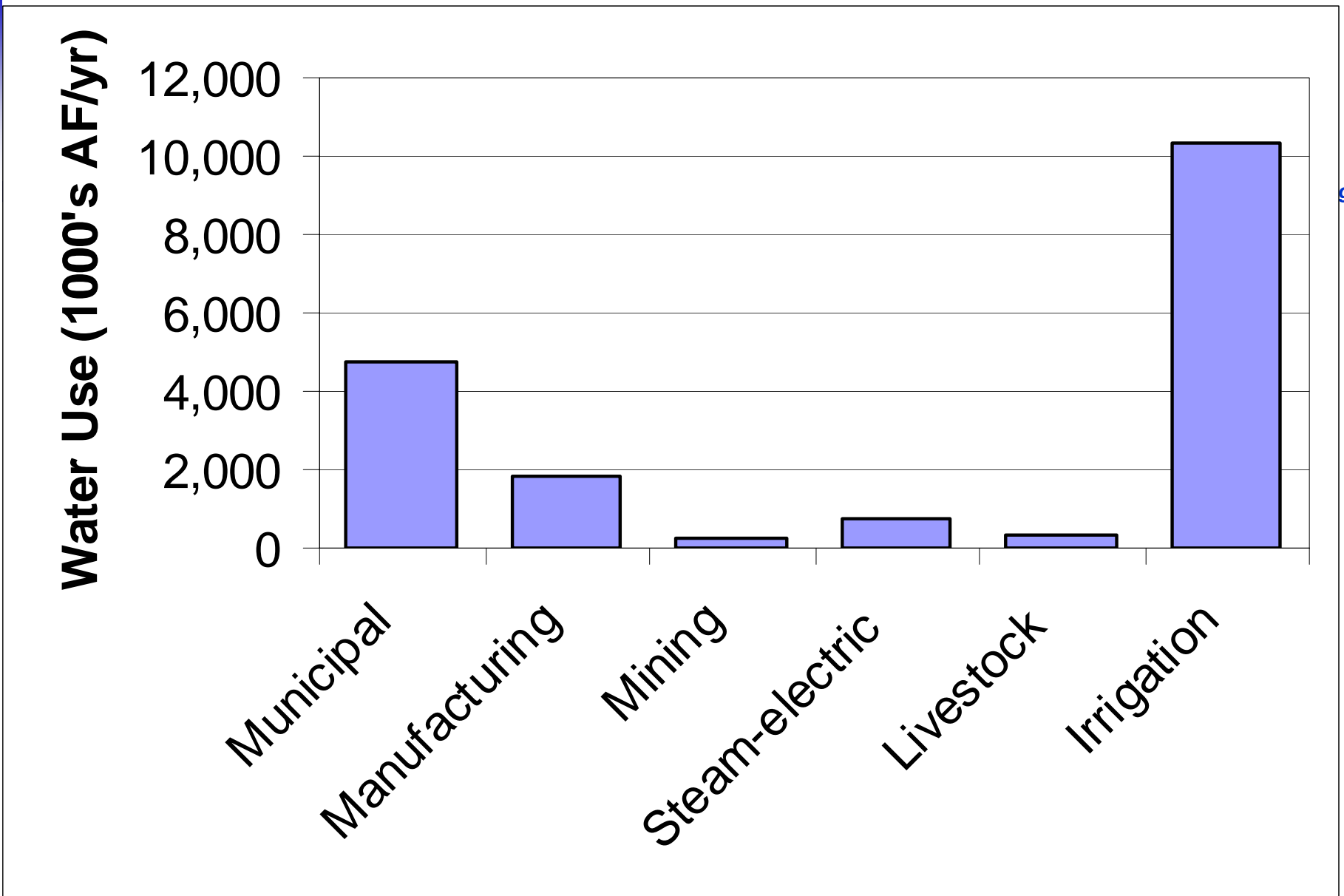


Texas coal/lignite mines
2008 annual production
(short tons)

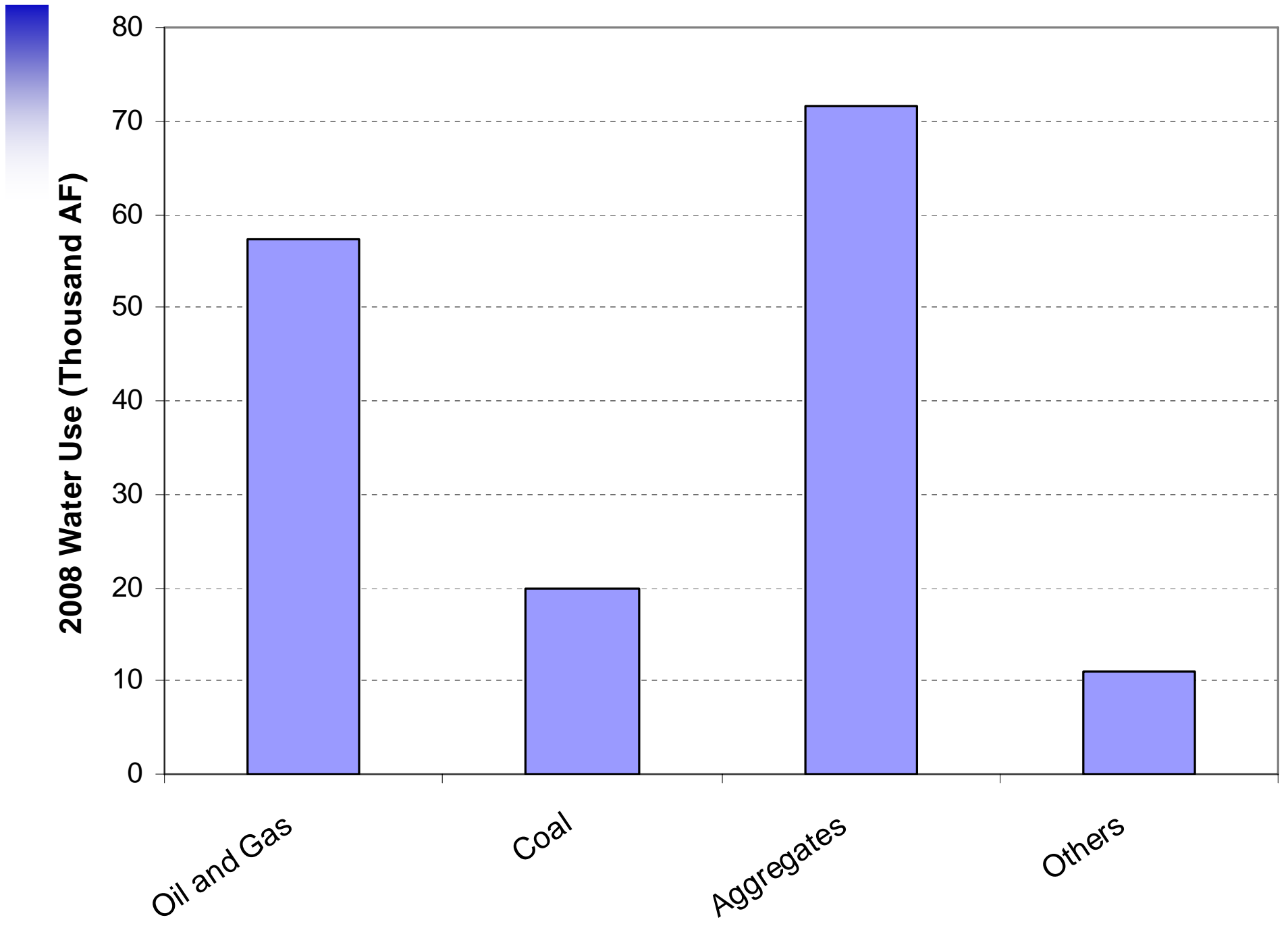
- 0
- 0–2 million
- 2–4 million
- 4–8 million

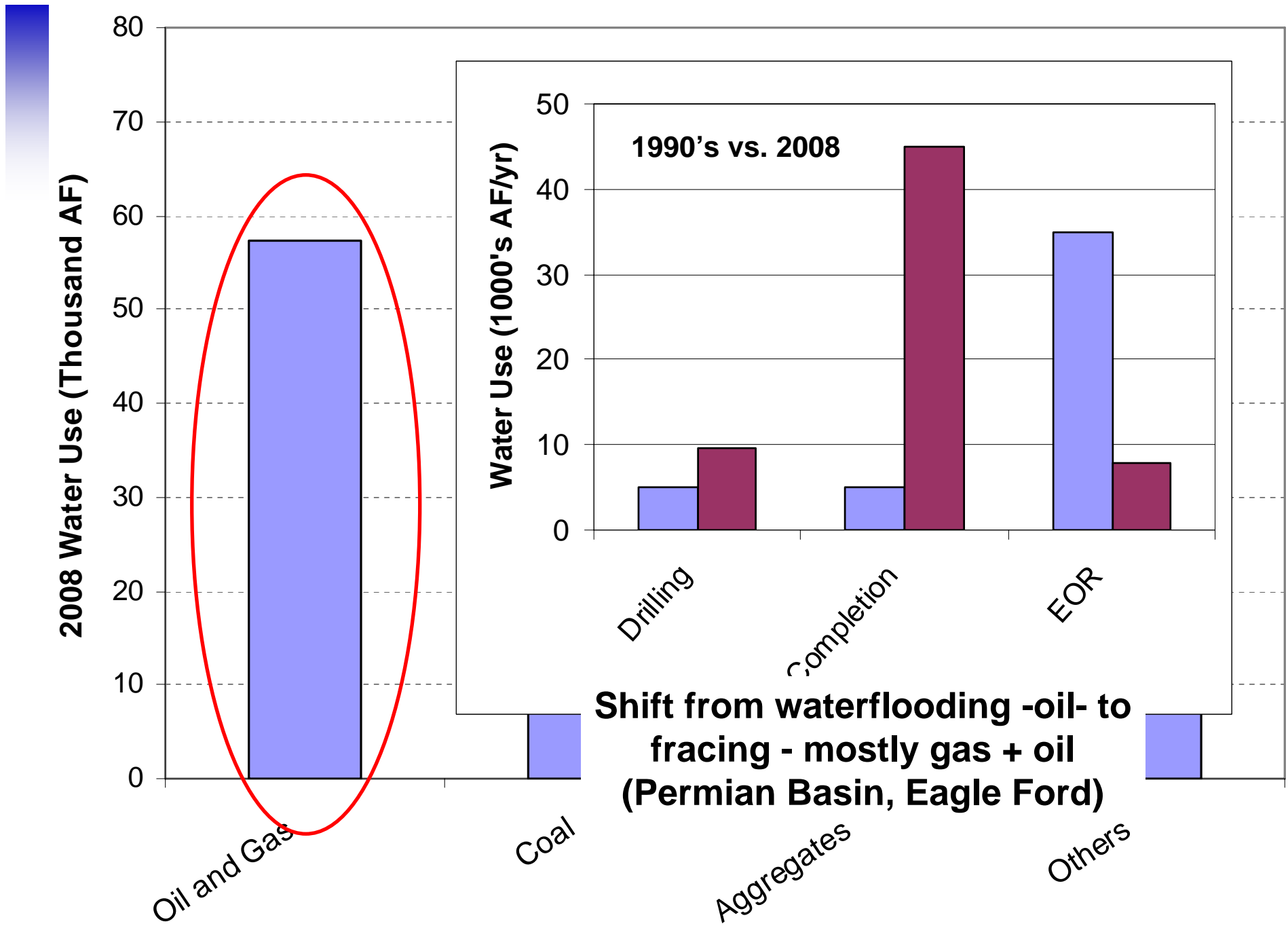
Texas coal and lignite trends

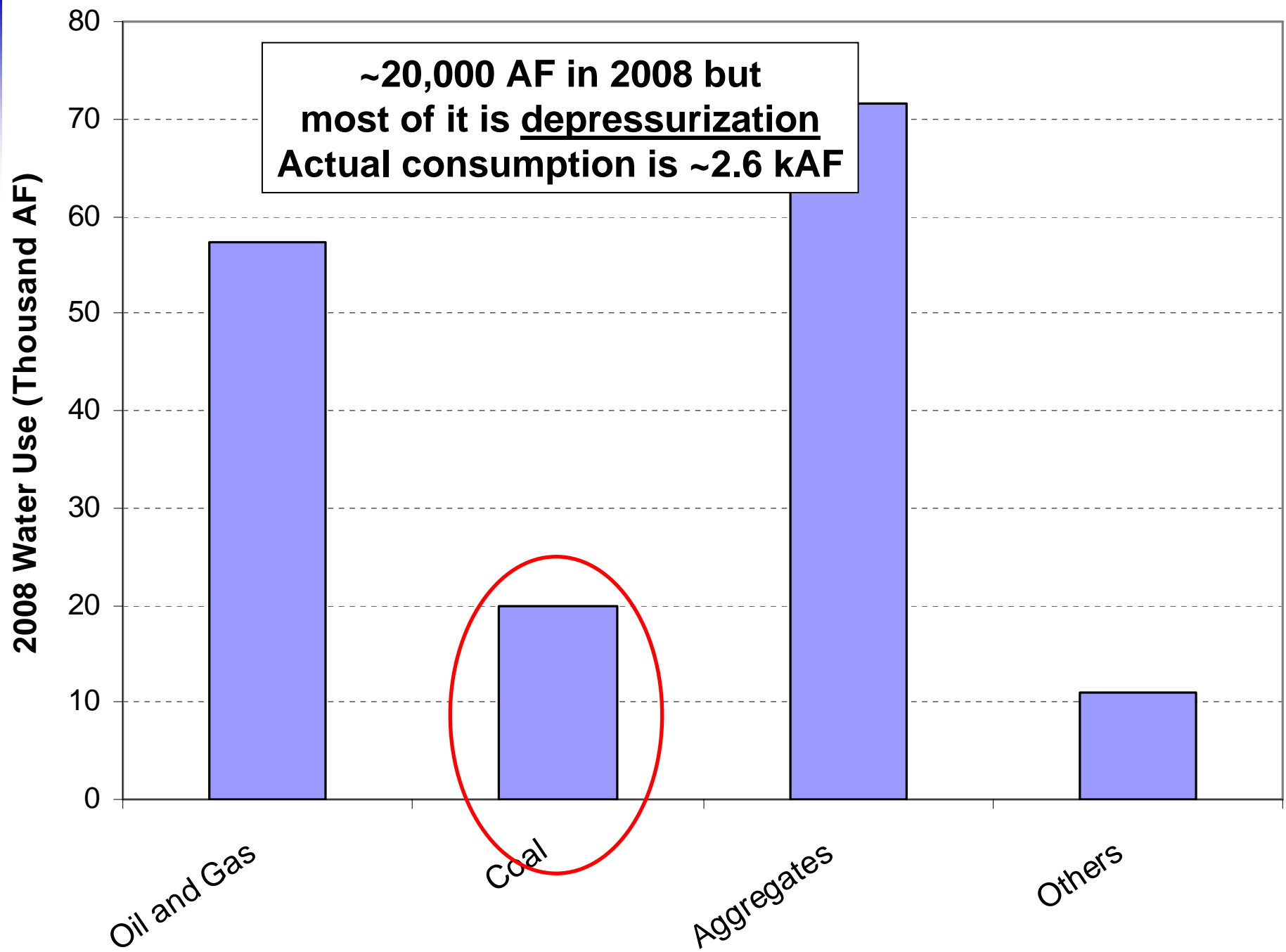
- North Texas { Pennsylvanian and Permian bituminous
- Cretaceous
- Wilcox Group
- Claiborne Group } Tertiary lignite
- Jackson Group

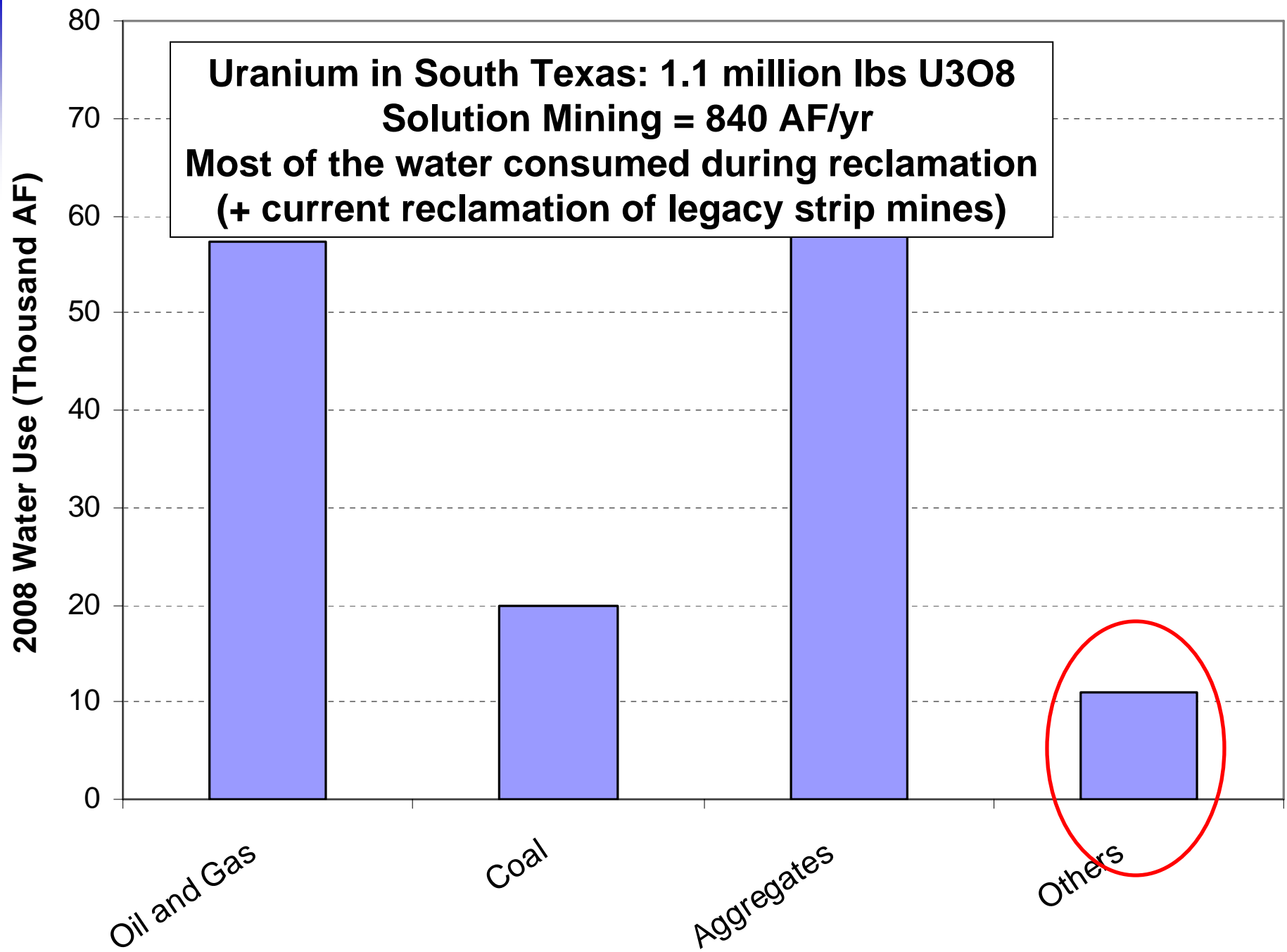


Mining and steam-electric water use are a small fraction of total water use (Texas)

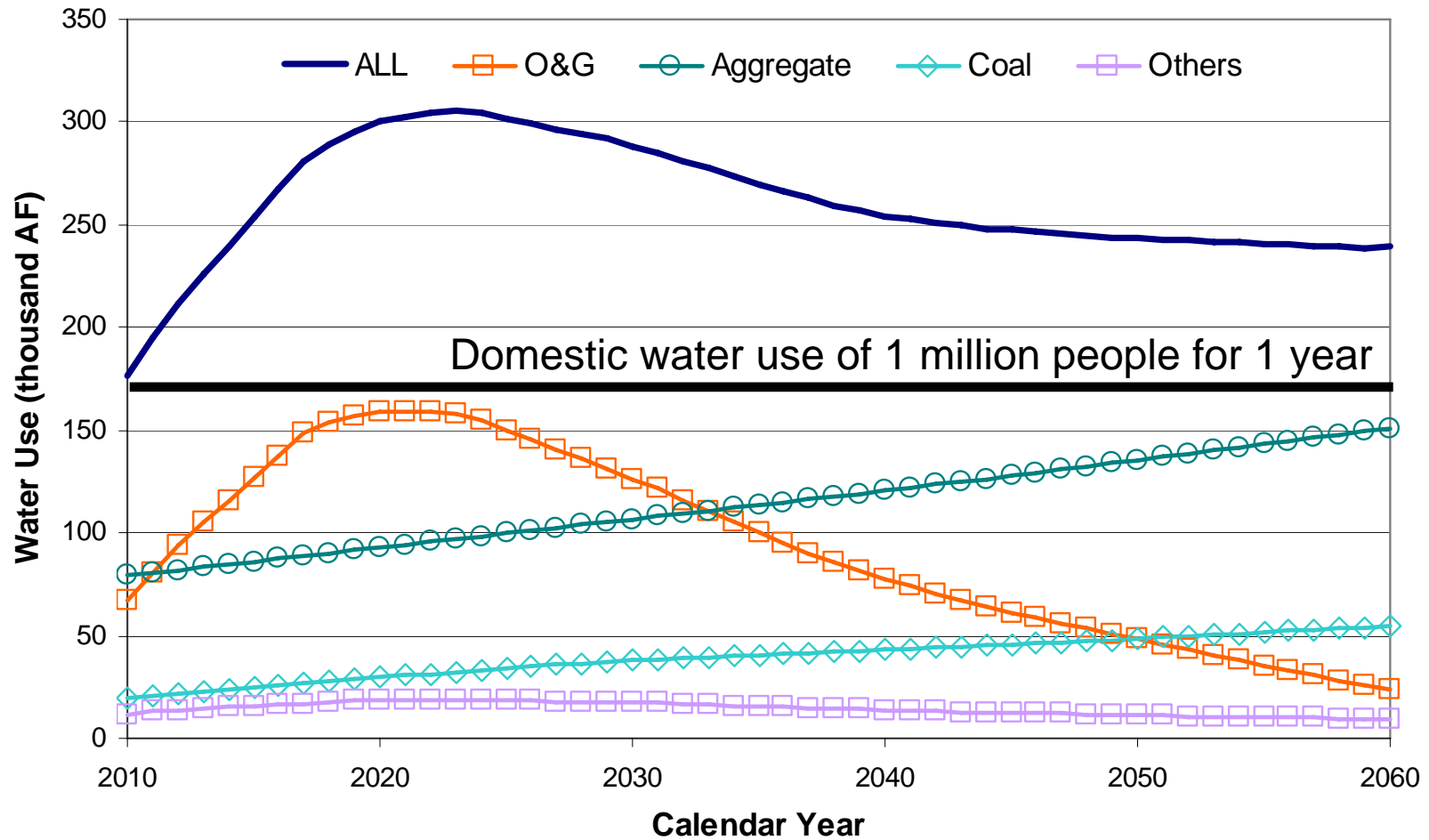








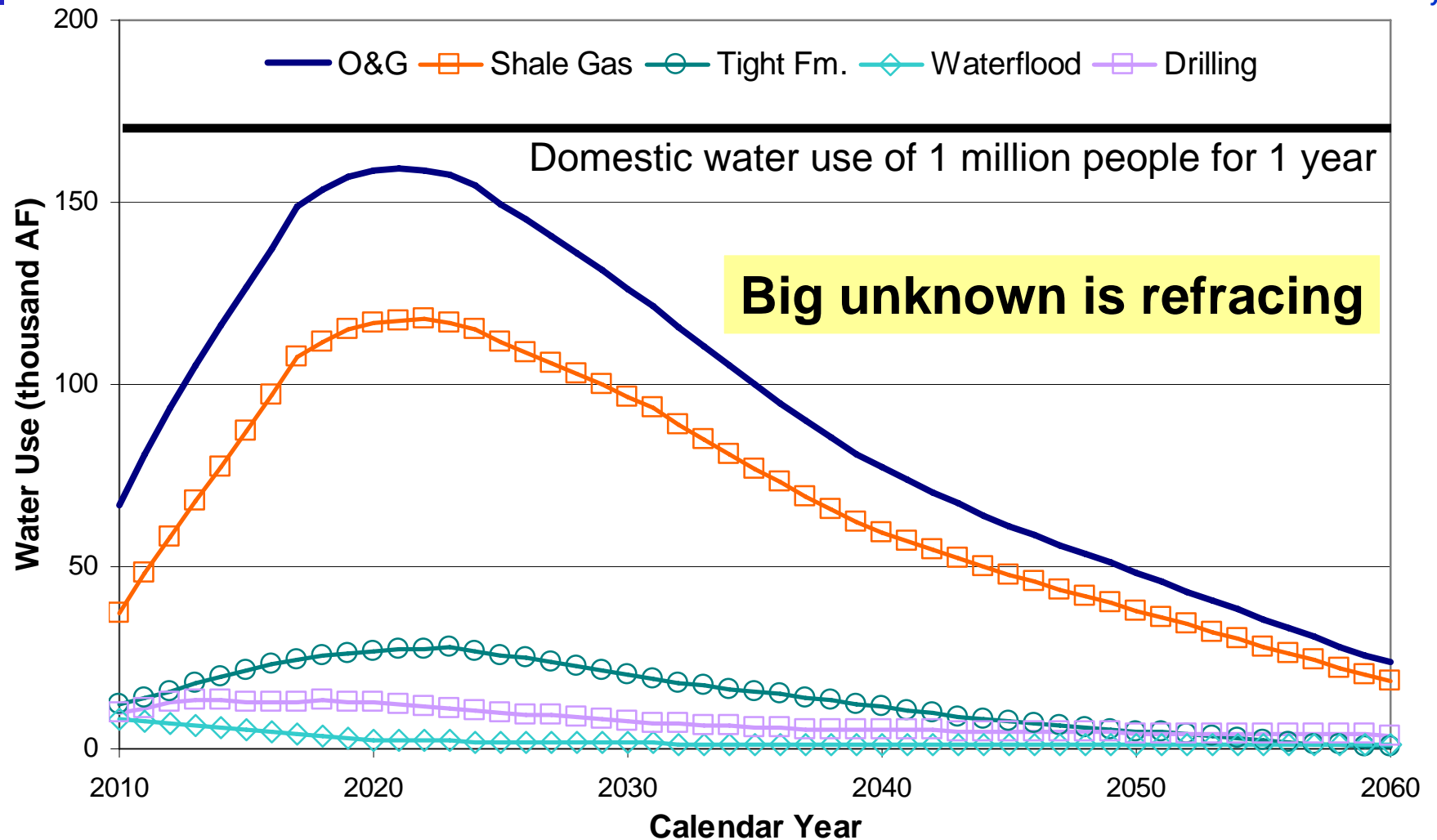
Stakeholder anxiety increases as water use increases



1,000 AF = ~7.8 million bbls

Very steep rise compared to coal or aggregates

>x3 in the next decade



1,000 AF = ~7.8 million bbls

Energy Content and Instantaneous Water Efficiency

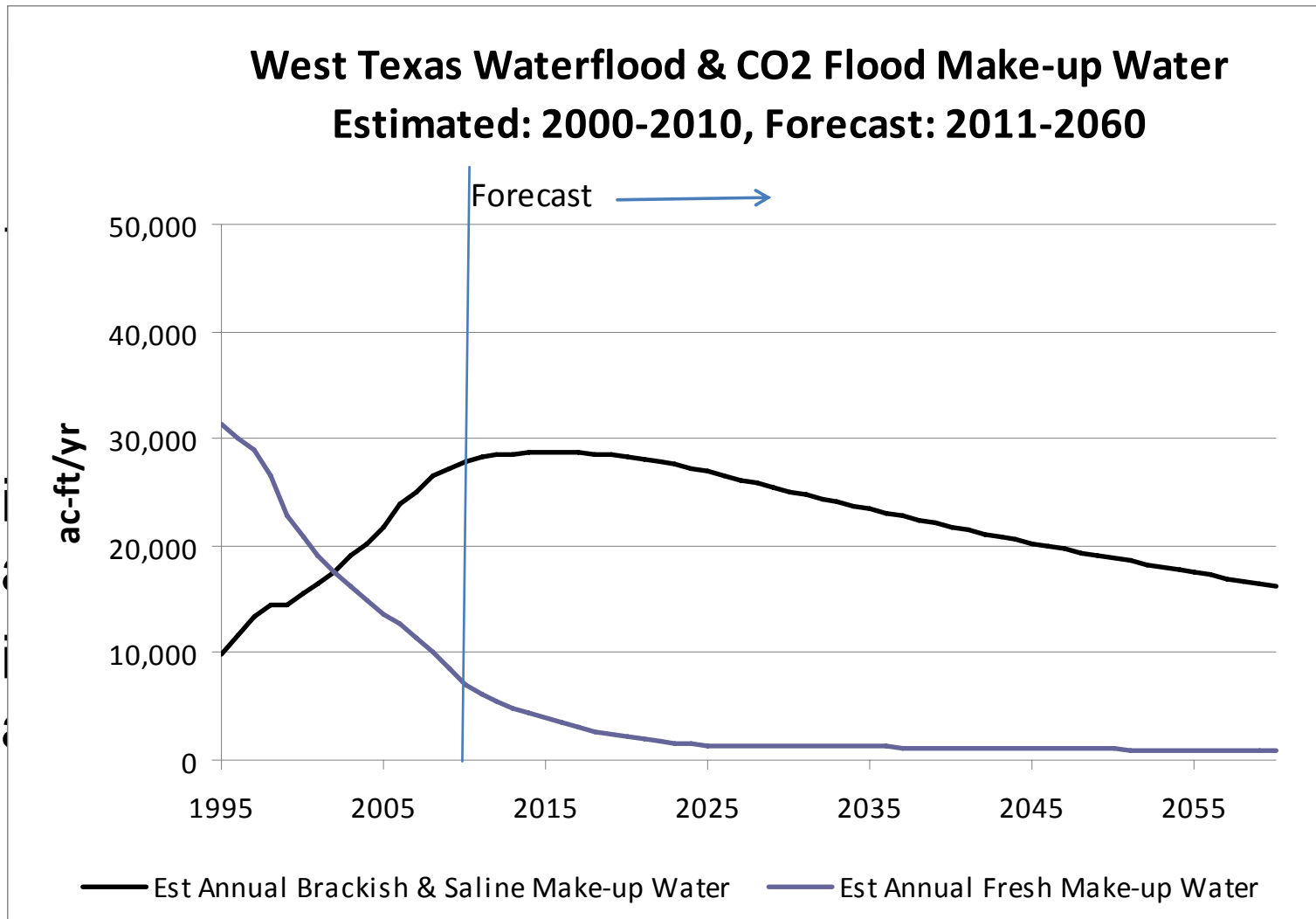
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- 1 bbl oil ~ 5.9 MMBtu (million Btus)
- 1 MCF gas ~ 1 MMBtu
- 1 ton lignite ~ 9-18 MMBtu
- 1 lb U ~170 MMBtu

- 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
- 1
- 1
- 1
- 0
- 1
- 0
- 1



Energy Content and Instantaneous Water Efficiency

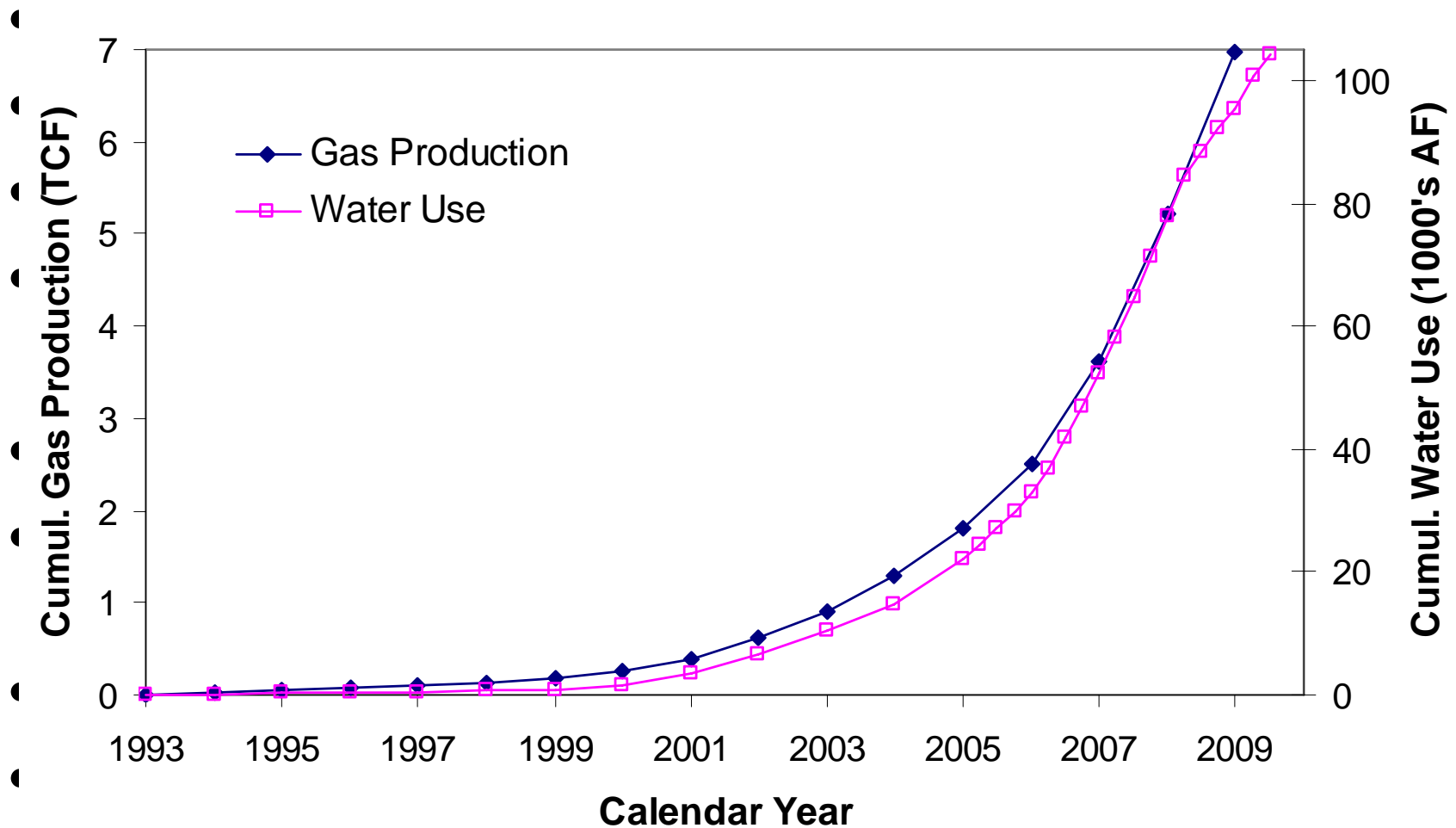
Bureau of Economic Geology

- 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 fracing
- Drilling: very variable add 10%
- Total Gas: 2.9 gal/MMBtu

Energy Content and Instantaneous Water Efficiency

Bureau of Economic Geology



Energy Content and Instantaneous Water Efficiency

Bureau of Economic Geology

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