Oil & Gas Developments in Texas

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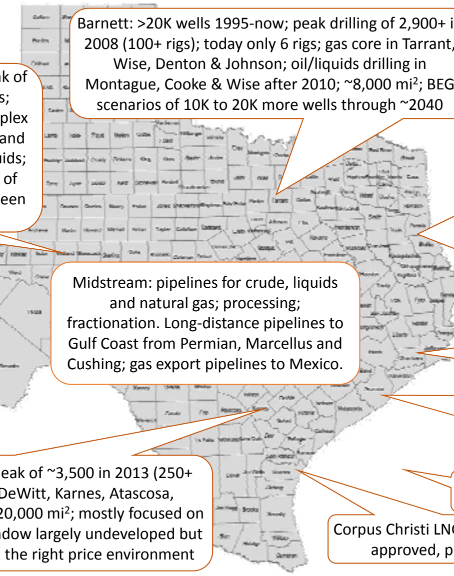
Overview



Permian: 4-5K per year 2011-14; peak of 560+ rigs in Oct14; today 230+ rigs; largest (~60,000 mi² in TX) most complex (multiple formations); conventional and unconventional mixed; oil, gas & liquids; long history of drilling but the level of activity has been more intense between 2011 and 2014

Barnett: >20K wells 1995-now; peak drilling of 2,900+ in 2008 (100+ rigs); today only 6 rigs; gas core in Tarrant, Wise, Denton & Johnson; oil/liquids drilling in Montague, Cooke & Wise after 2010; ~8,000 mi²; BEG scenarios of 10K to 20K more wells through ~2040

Haynesville (TX): >1,000 wells 2008-now (including Bossier); peak of ~190 in 2011 (~30 rigs); today only ~5 rigs; San Augustine, Shelby, Nacogdoches, Harrison, Panola, Rusk (~2,000 mi² in TX, mostly outside ERCOT); BEG scenarios for all Haynesville of 5K to 10K more wells through ~2045

Midstream: pipelines for crude, liquids and natural gas; processing; fractionation. Long-distance pipelines to Gulf Coast from Permian, Marcellus and Cushing; gas export pipelines to Mexico.

Downstream: 30+ projects 2012-14; 35+ projects 2015-18; up to $33 billion; 23 MTPA capacity (some outside ERCOT)

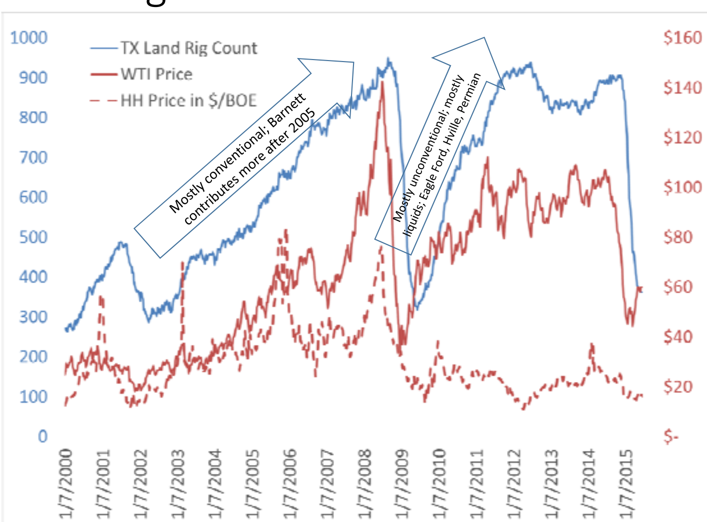
Freeport LNG (13.2 MTPA): construction started Nov14; first shipment from the first train in late 2018; trains 2 and 3 estimated in 2019

Several LPG, condensate and ethane export projects along the coast

Corpus Christi LNG (13.5 MTPA): FERC-approved, pending non-FTA

Eagle Ford: >10K wells 2008-now; peak of ~3,500 in 2013 (250+ rigs); today 100+ rigs; Gonzalez, DeWitt, Karnes, Atascosa, McMullen, LaSalle, Dimmit, Webb; ~20,000 mi²; mostly focused on oil and condensate windows; gas window largely undeveloped but can be developed in the future with the right price environment

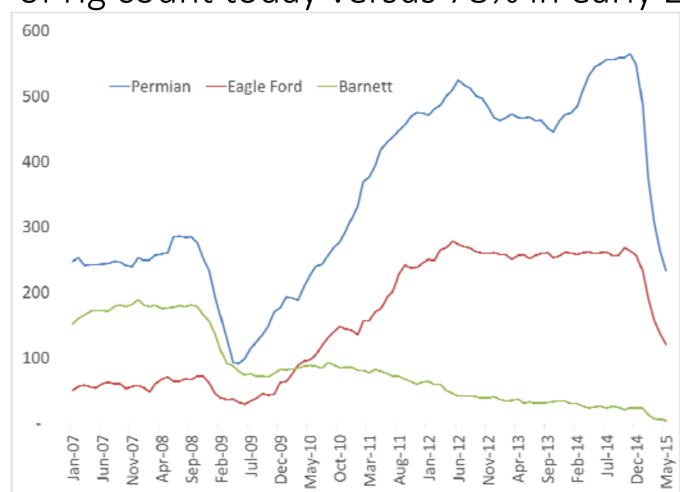
Land Rig Count Back to 2009 Low



- Drilling is very responsive to the oil price
- NGL prices traditionally linked to oil price; but today ethane is priced as methane (mostly)
- Oil and natural gas prices decoupled since the late 2000s

Calculations based on Baker Hughes rig data and EIA price data.

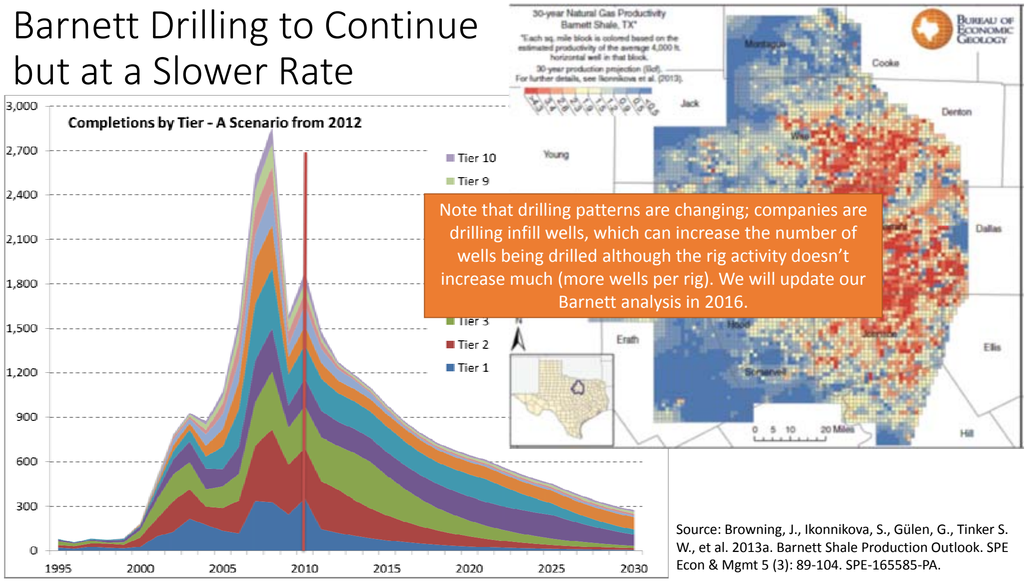
Permian, Eagle Ford and Barnett account for 94% of rig count today versus 78% in early 2007



- Permian drilling is a mix of conventional and unconventional wells
- There are several formations in the Permian that will likely be developed over time
- Eagle Ford drilling started targeting gas but quickly switched to oil and liquids

Calculations based on Baker Hughes and EIA rig data.

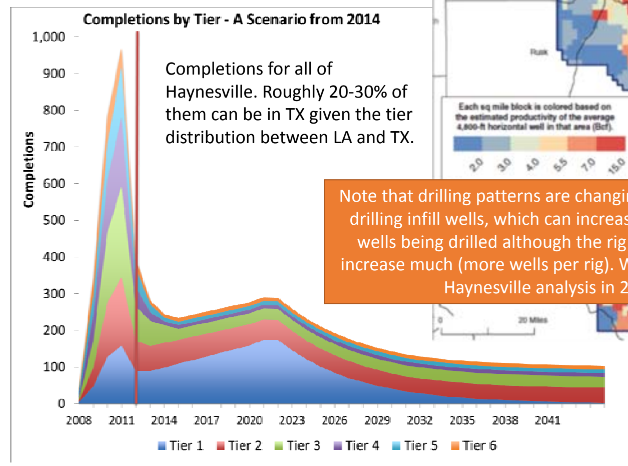
Barnett Drilling to Continue but at a Slower Rate

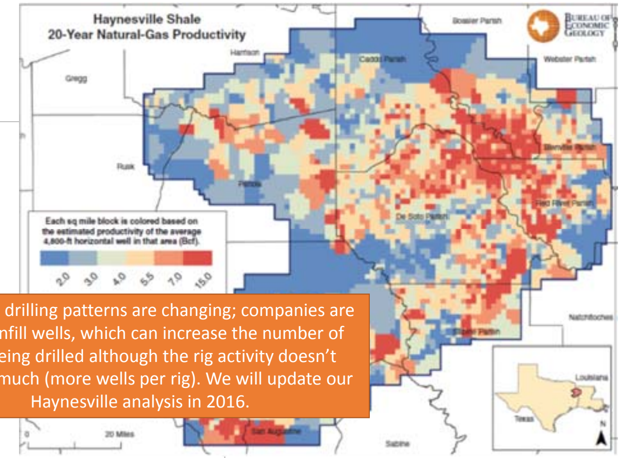


Note that drilling patterns are changing; companies are drilling infill wells, which can increase the number of wells being drilled although the rig activity doesn't increase much (more wells per rig). We will update our Barnett analysis in 2016.

Source: Browning, J., Ikonnikova, S., Gülen, G., Tinker S. W., et al. 2013a. Barnett Shale Production Outlook. SPE Econ & Mgmt 5 (3): 89-104. SPE-165585-PA.

Haynesville Drilling is More Sensitive to Price





Completions for all of Haynesville. Roughly 20-30% of them can be in TX given the tier distribution between LA and TX.

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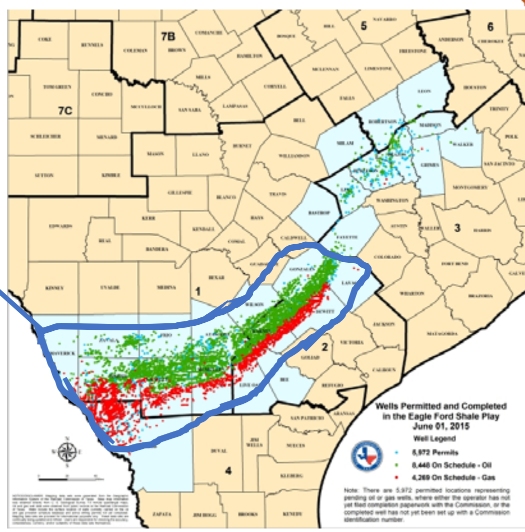
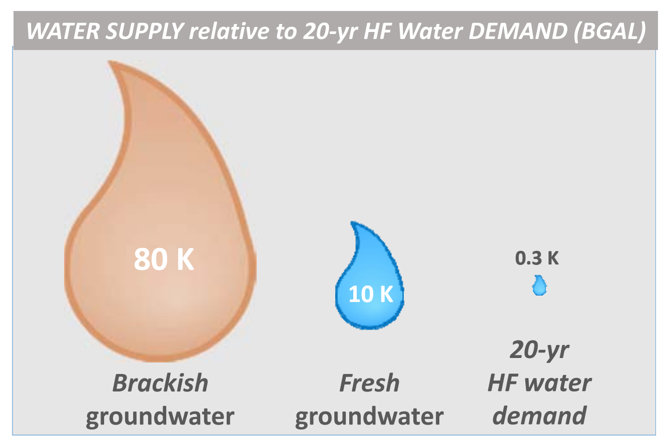
Source: Gülen, G., Ikonnikova, S., Browning, J., Smye, K., Tinker S. W., et al. 2013a. Production Scenarios for the Haynesville Shale Play. SPE Econ & Mgmt, July 2015 http://dx.doi.org/10.2118/176022-PA.

Eagle Ford Drilling Slowed Down but Interest Remains High

Most commonly accepted boundary of the Eagle Ford



Water is not a Problem in the Eagle Ford: Brackish Groundwater is an Alternative



Scanlon et al., Env. Res. Lett. 2014

Hydraulic Fracturing Saves Water

For every gallon of water used to produce natural gas through hydraulic fracturing

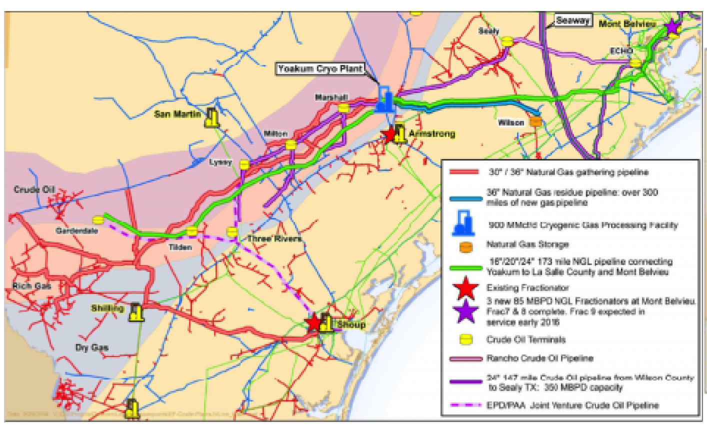
- Water use for shale gas extraction = 6% of water used to generate electricity using that gas

Texas saved 33 gallons of water by generating electricity with that natural gas instead of coal or nuclear power (in 2011)

Eagle Ford & Permian Will Continue to be Drilled but Infrastructure Issues Need to be Addressed ➔ $ Billions of Investment

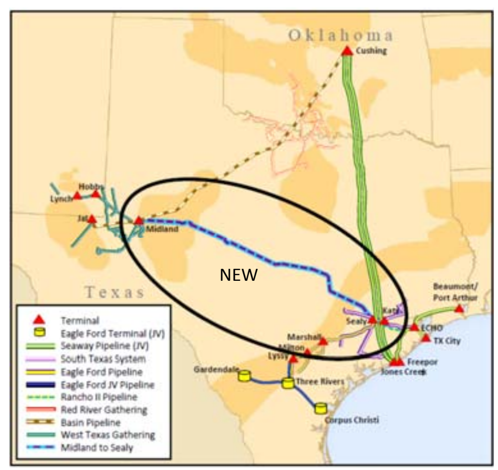
- Gas flaring in EF: new pipelines & processing under development.
  - Other options: in-field generation, trucks running on LNG/CNG, drilling rigs that run on natural gas, micro power generation at the field
- Condensate splitting is necessary to meet refinery specs and/or “refine oil” to enable product export (primarily EF)
- NGL production handling and shipping: investment in new processing plants, fractionators and liquids pipelines (both EF and Permian)
- Crude shipping (both EF and Permian)
- Water infrastructure in the Permian (not as many options as EF): wastewater treatment & pipeline networks

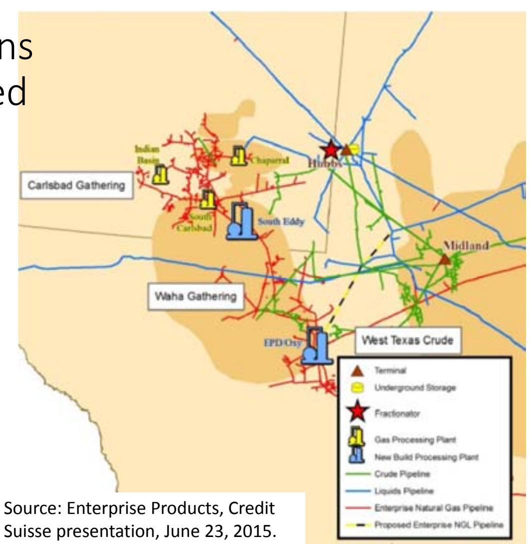
Eagle Ford Midstream – $Billions Already Invested in Infrastructure; More Being Invested



Source: Enterprise Products, Credit Suisse presentation, June 23, 2015.

Permian Midstream - $ Billions Invested; More Being Invested





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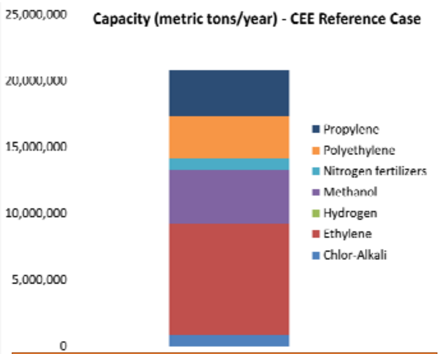
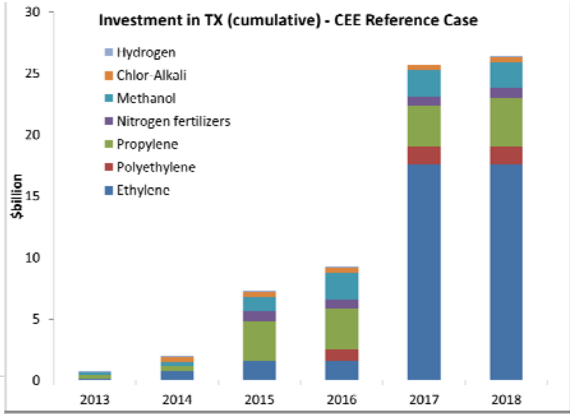
Petrochemicals & Other Industrial Projects





- $26.5 billion in the Reference Case
- Incremental gas demand of 0.8 BCFD.
- If we include projects under consideration or planning: $33 billion, 0.9 BCFD.

Source: BEG-CEE industrial projects database

http://www.beg.utexas.edu/energyecon/documents/Industrial%20Gas%20Demand%20052215.pdf

Some Concluding Observations

- Although slowed down significantly since October 2014 owing to low oil and natural gas prices, oil & gas activity in Texas remains significant across the value chain and across most of the State
  - As the oil price stabilizes and/or natural gas price recovers, the activity is likely to pick up.
- Eagle Ford and Permian will dominate in drilling and most midstream investments
- But all roads lead to the Gulf Coast for refining, fractionation, petrochemicals, liquefaction and exports