Forecasting technology improvements for U.S. crude oil production

For

EIA Conference 2018

June 04, 2018 | Washington, DC

By

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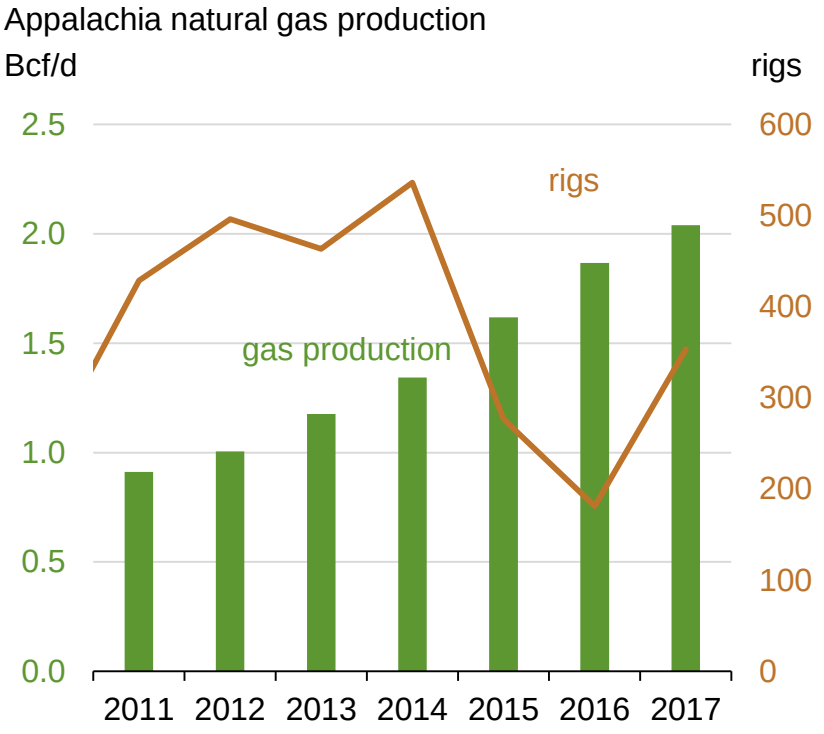
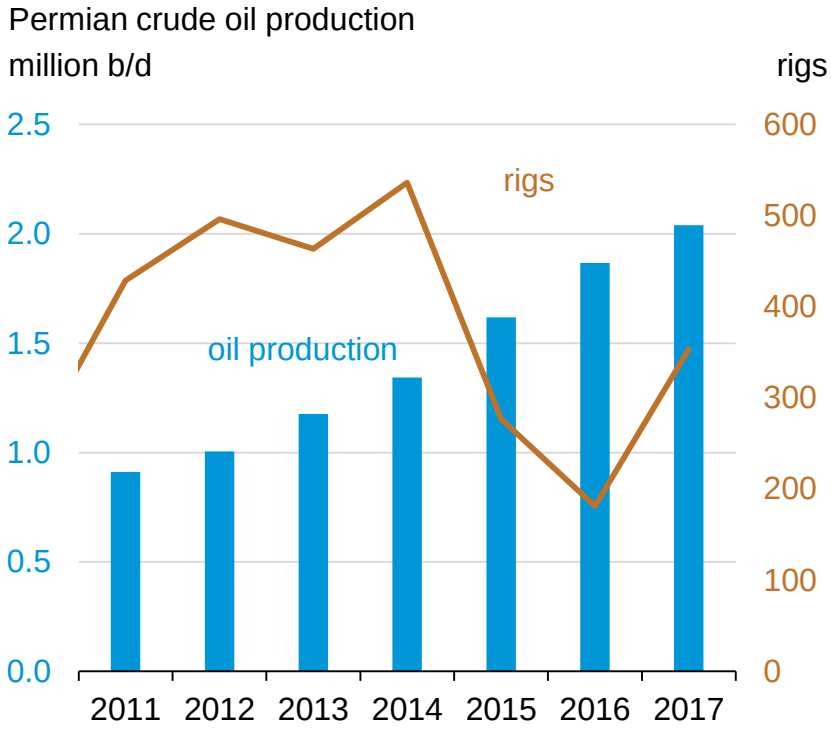
Big Questions

- How quickly can we identify technological changes in data?
- How can we capture the timing and intensity of the market penetration of new technologies in our modeling?
- Volatile prices incentivize technology – how do we anticipate volatility?
- How do we use signals in available data to categorize types of technology?

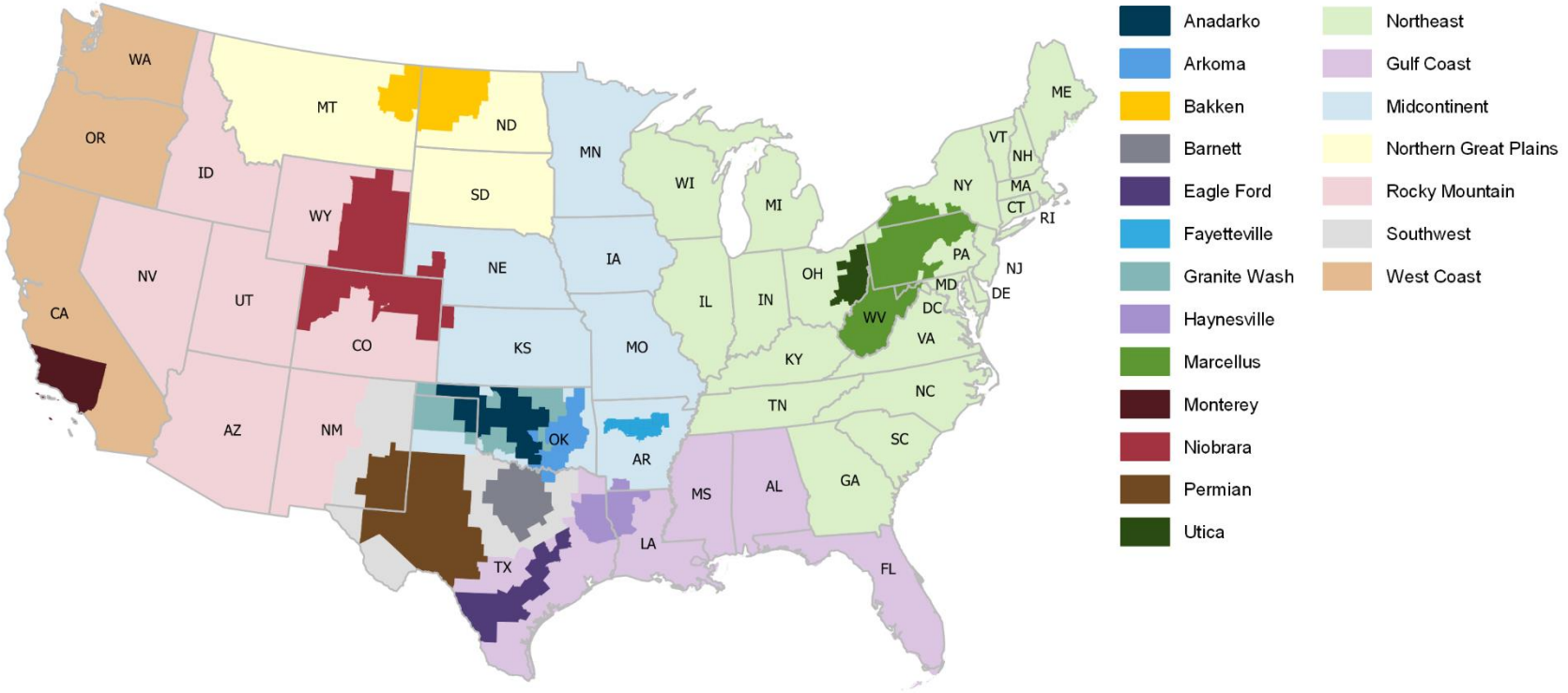
Why do we care? The relationship between rigs and production started decoupling in key regions in 2015





Source: EIA, Short-Term Energy Outlook, Baker Hughes

There are 20 regions in the STEO Lower 48 model

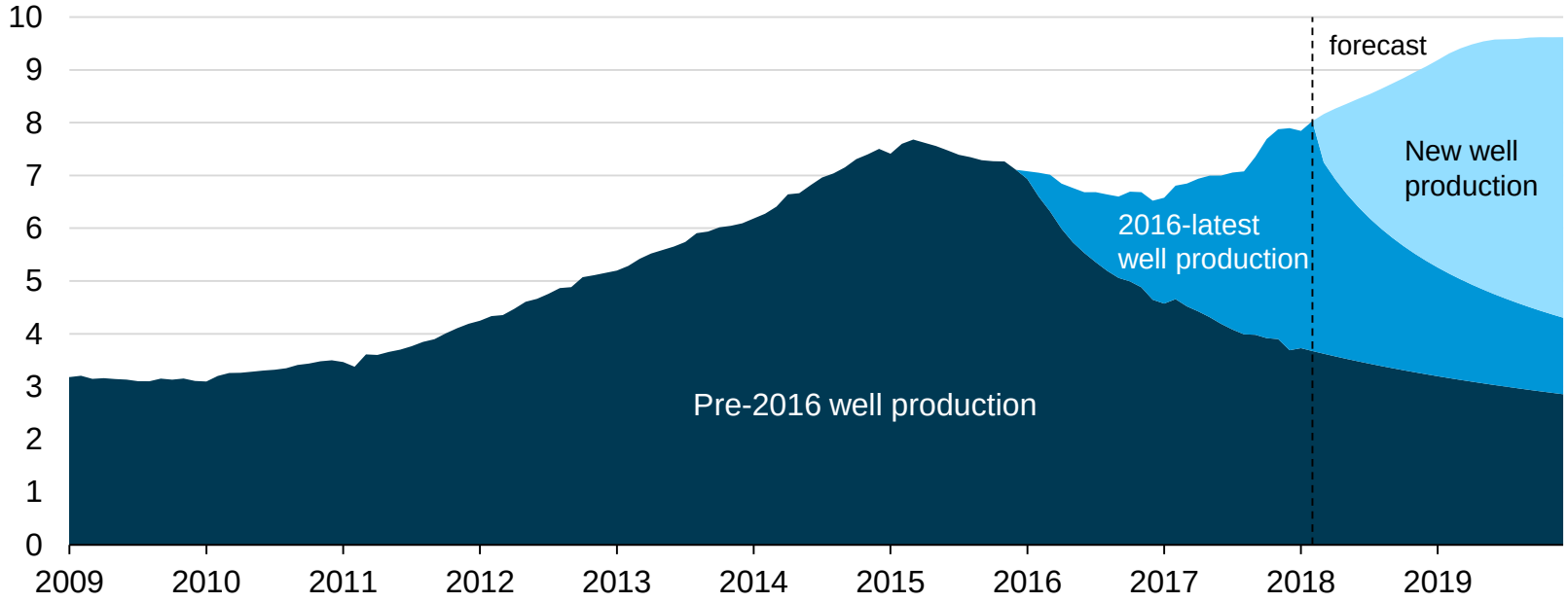


Source: EIA, Short-Term Energy Outlook

The forecast for Lower 48 crude production comes from 3 cohorts

Lower 48 crude oil production (excludes federal Gulf of Mexico)

million barrels per day



Source: EIA, Short-Term Energy Outlook February 2018

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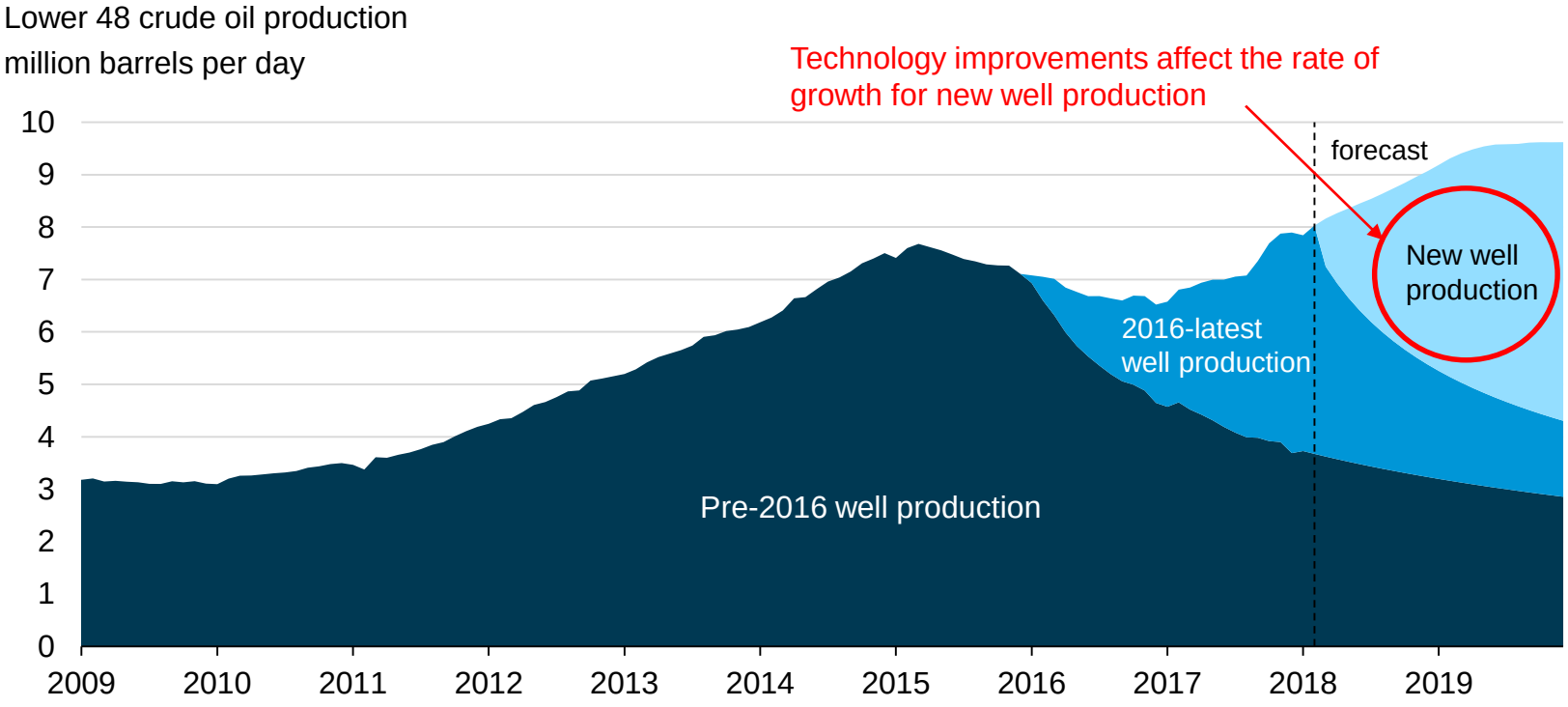
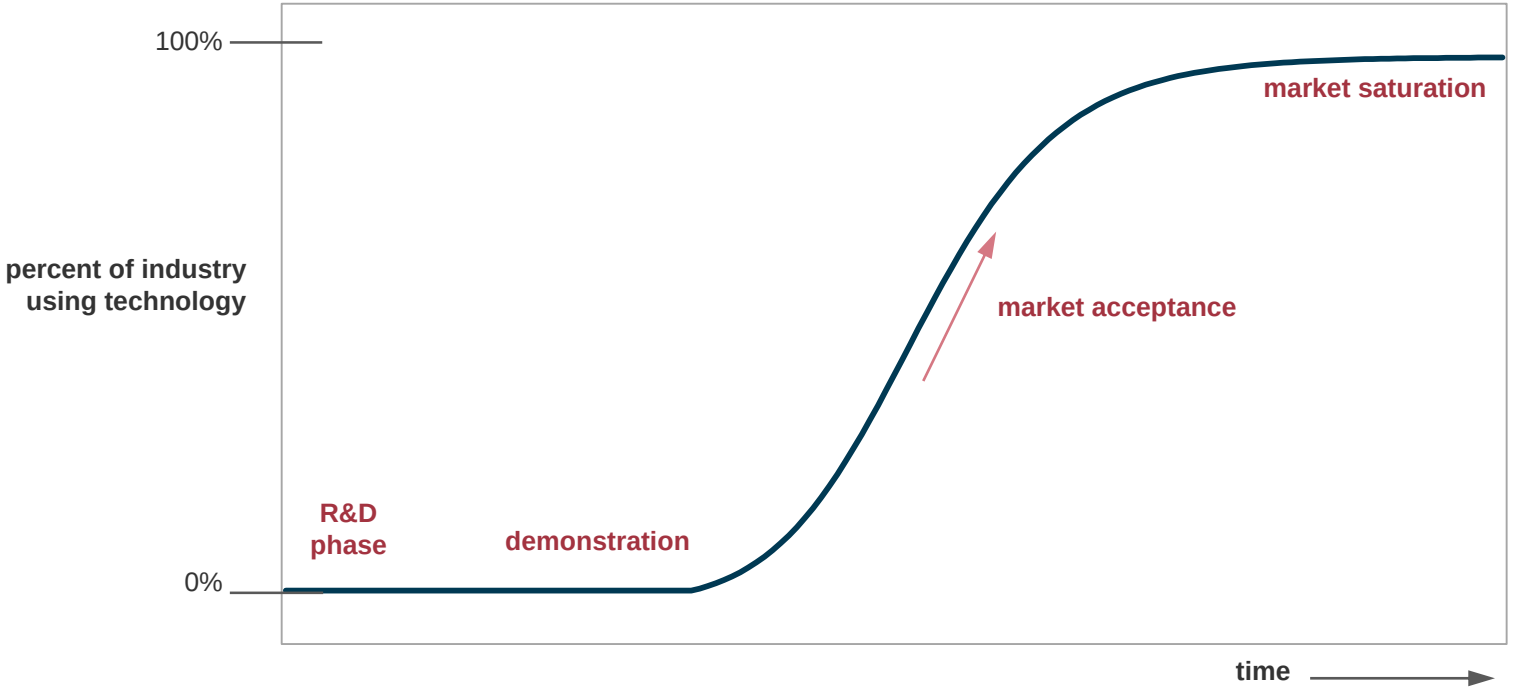


Source: EIA, Short-Term Energy Outlook

Technology penetrates the market in four stages

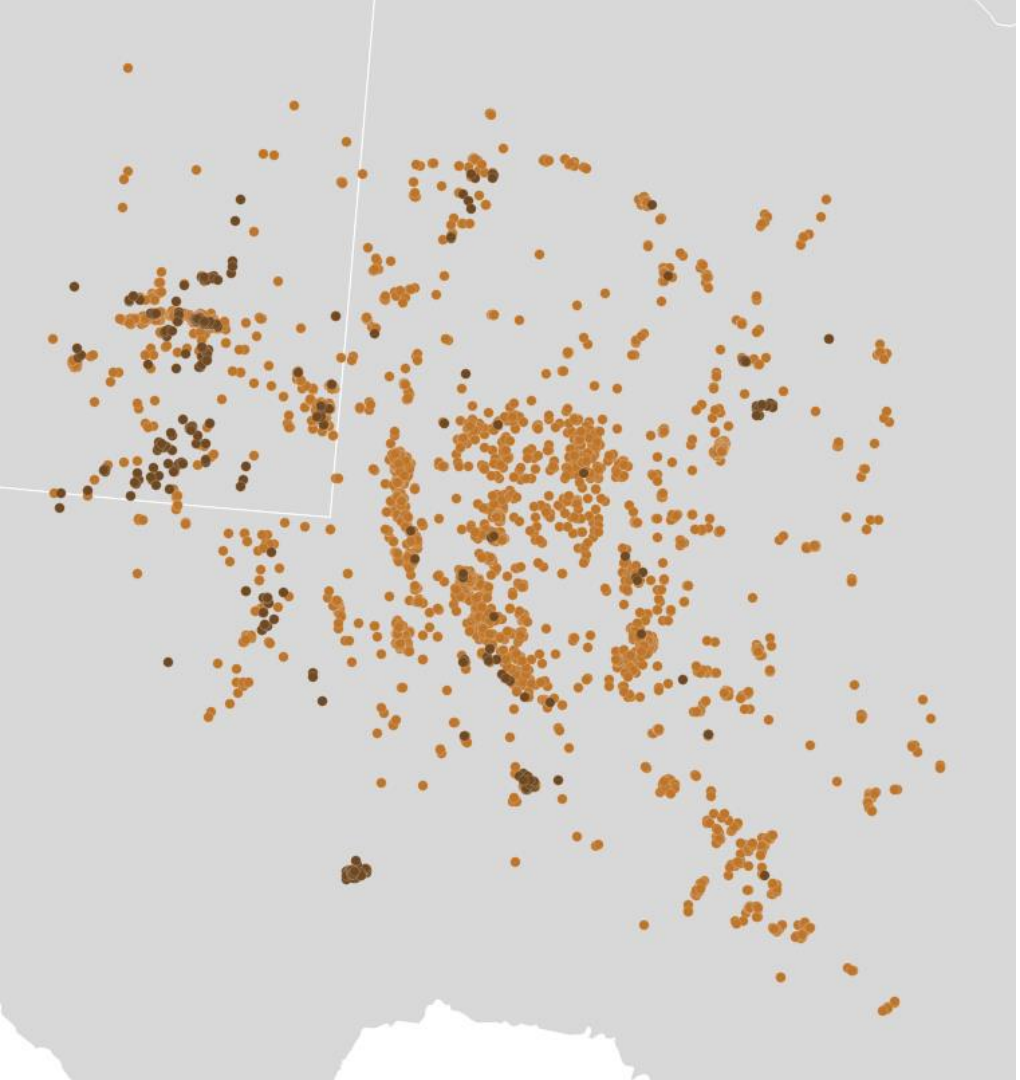


Technological improvement manifests through EUR increases and cost reduction

- Improvements to EURs (through technology)
  - Combining horizontal drilling and hydraulic fracturing to extract oil and natural gas
  - Optimizing horizontal drilling techniques specific to the geology of different plays
- Improvements to EURs (through operational improvements)
  - Optimizing lateral lengths
  - Increasing volume and sand per foot
  - Optimizing the cross linked gel and slick water ratios
- Reducing costs

Operational improvements in recent years has changed the relationship between production and prices

- Longer laterals with more fracture stages
- Multi-well pad drilling
- Increased initial production (IP) per foot
- Lower service costs per unit
- More efficient sand and water handling
- Reduced distances for sand and water



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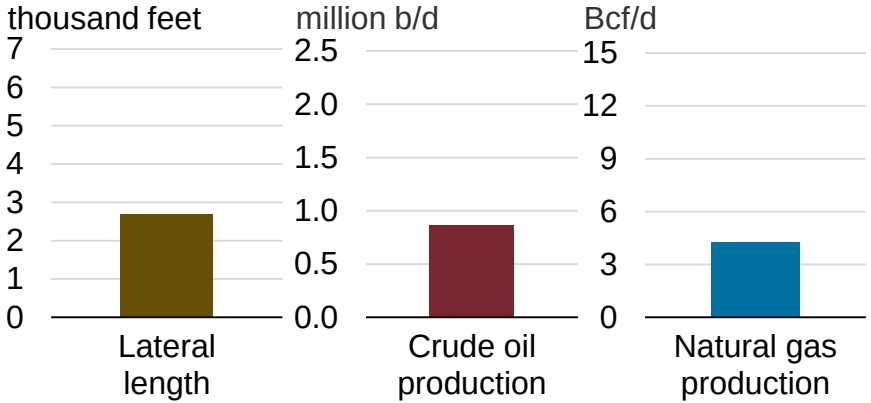
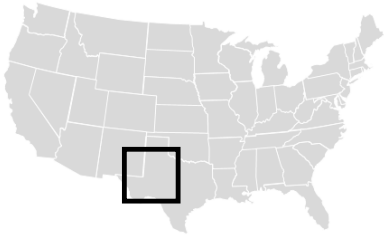


horizontal well

vertical well

existing well (post-2009)



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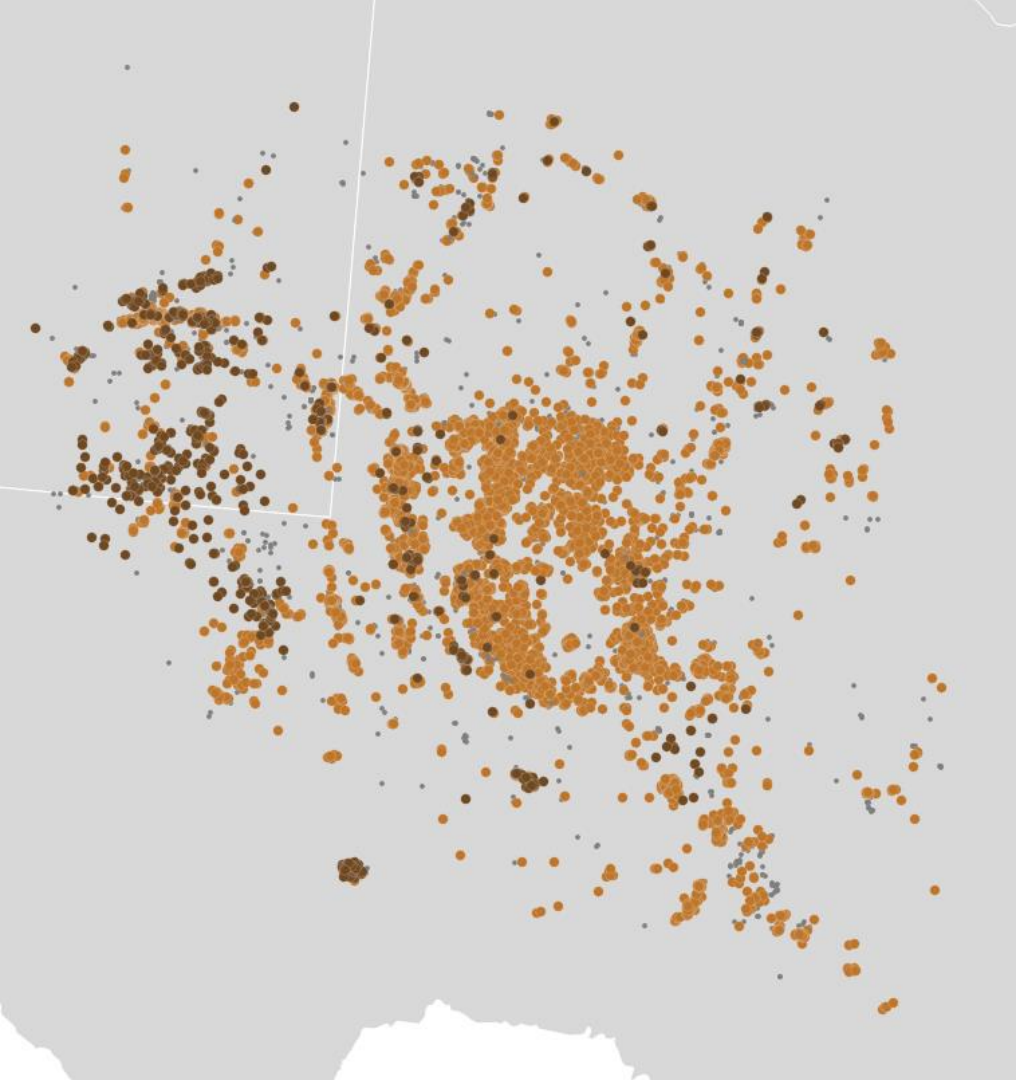

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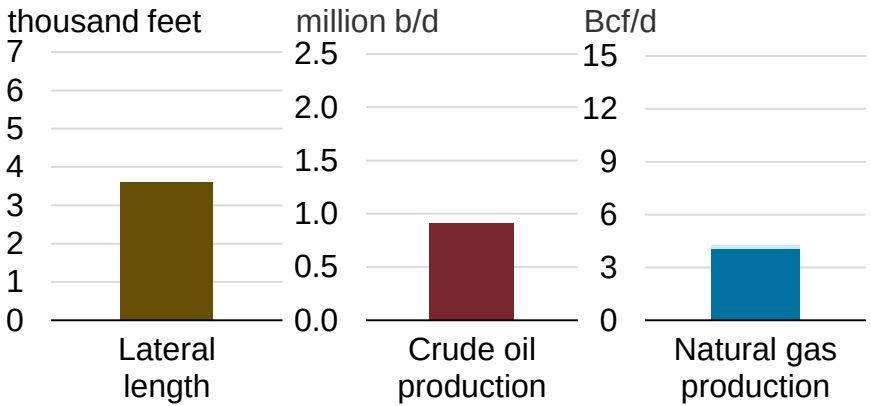

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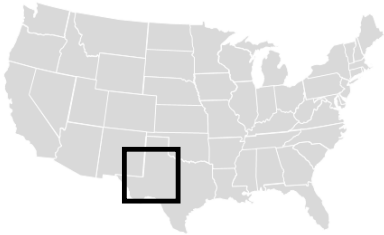

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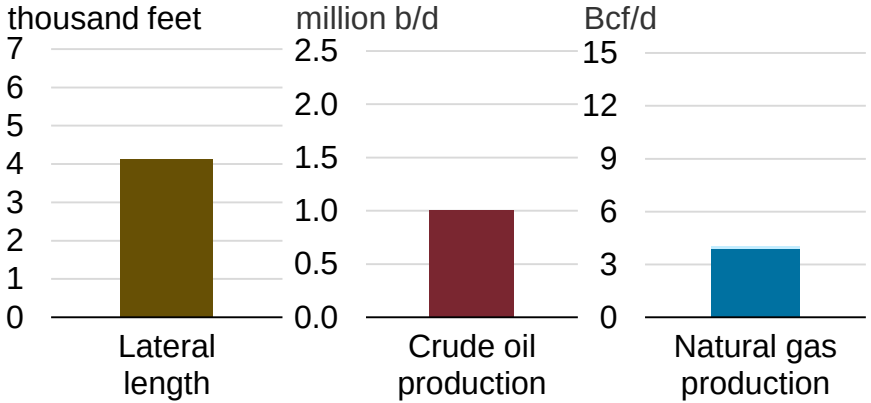
2011



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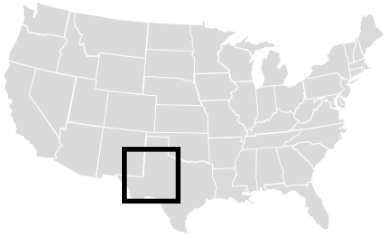

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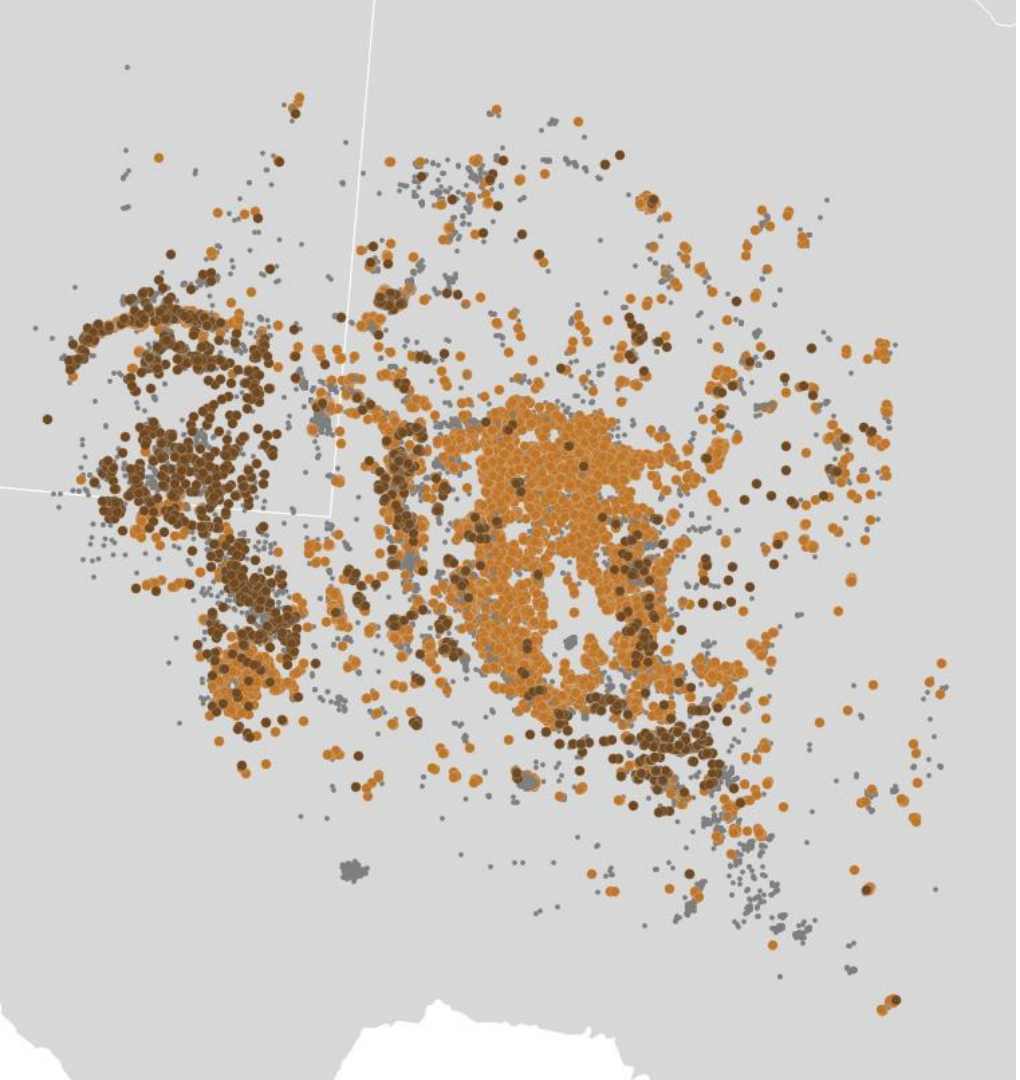
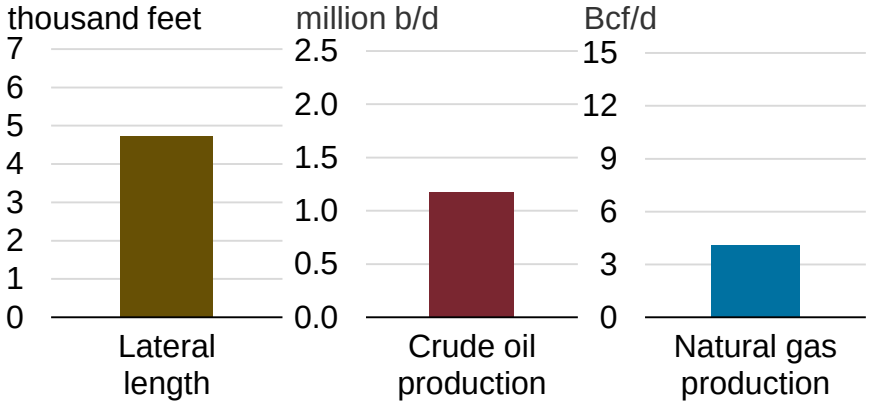


2012



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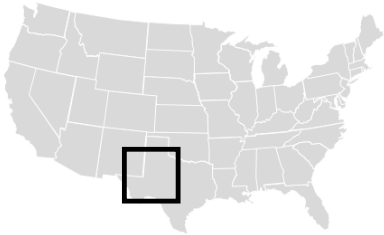

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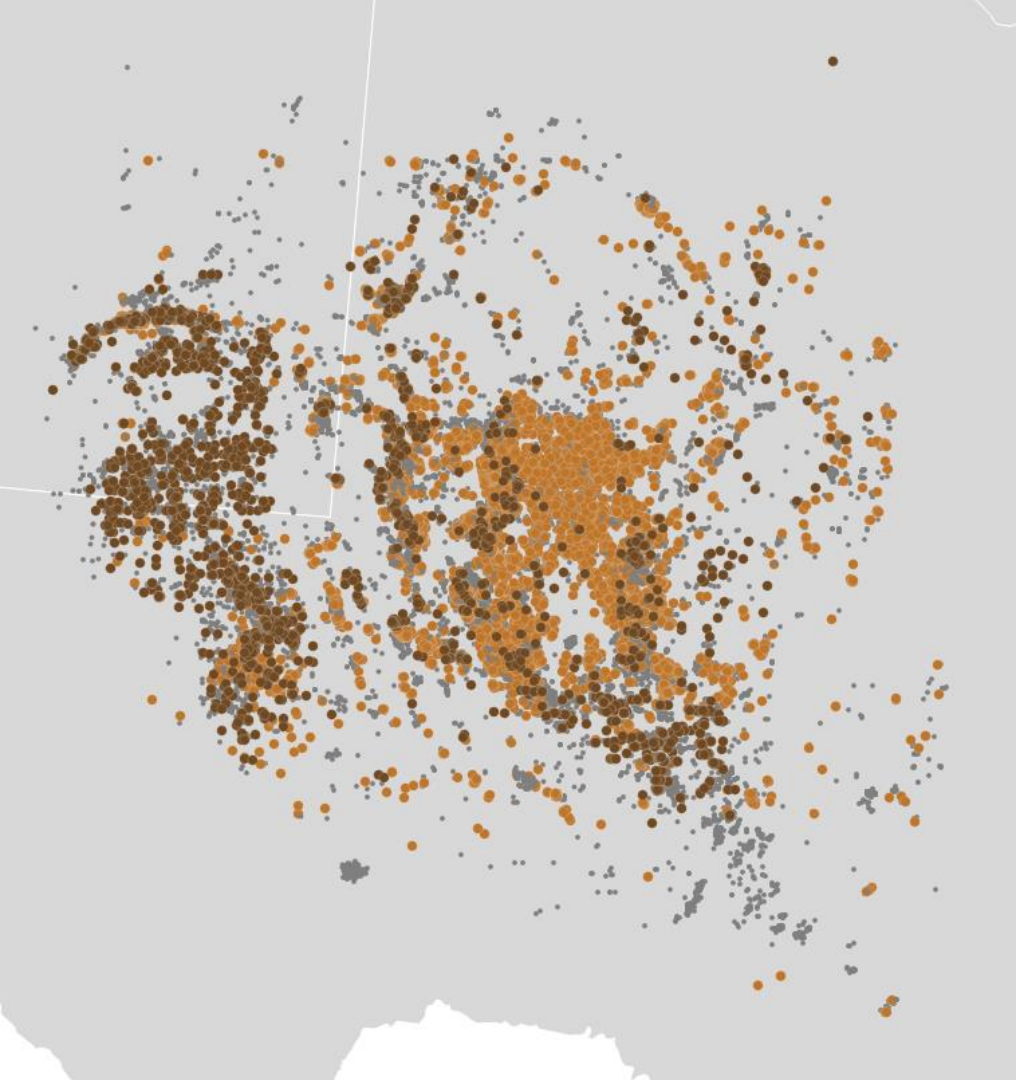
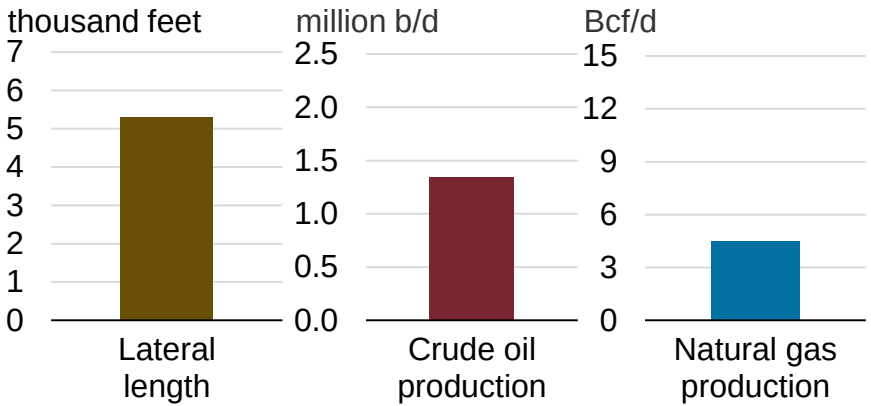


2013



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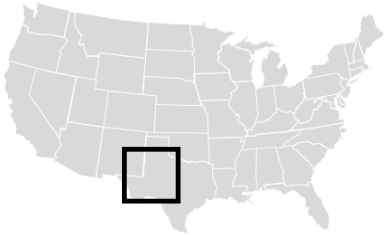

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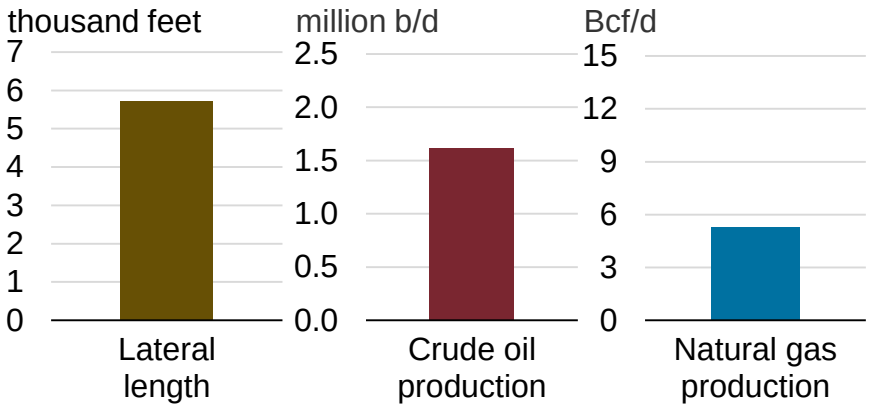
2014



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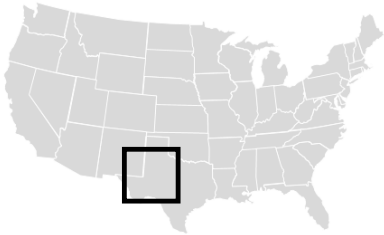

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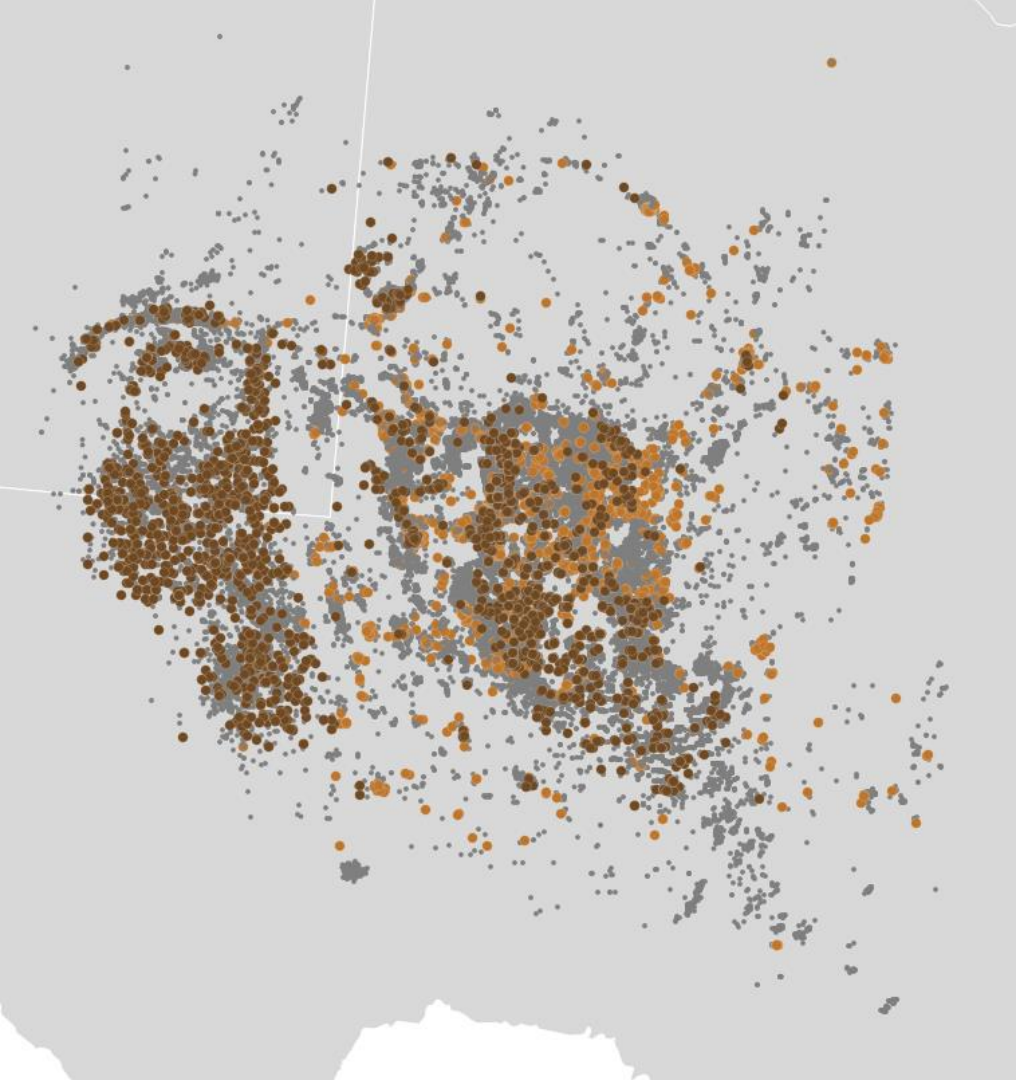
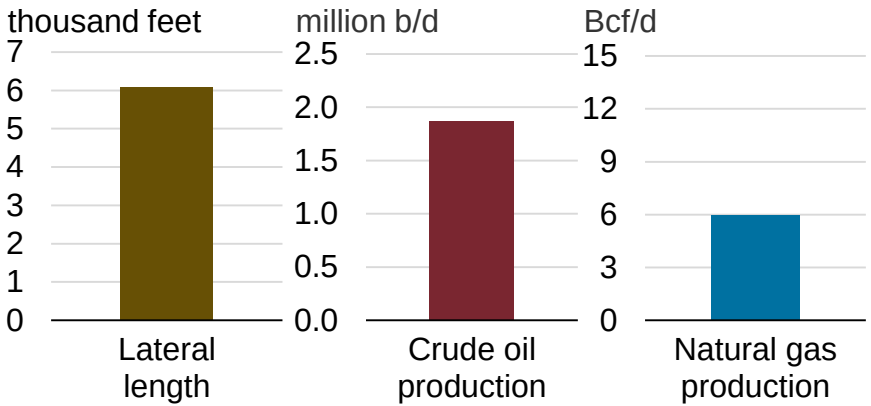


2015



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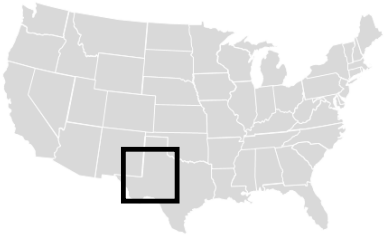
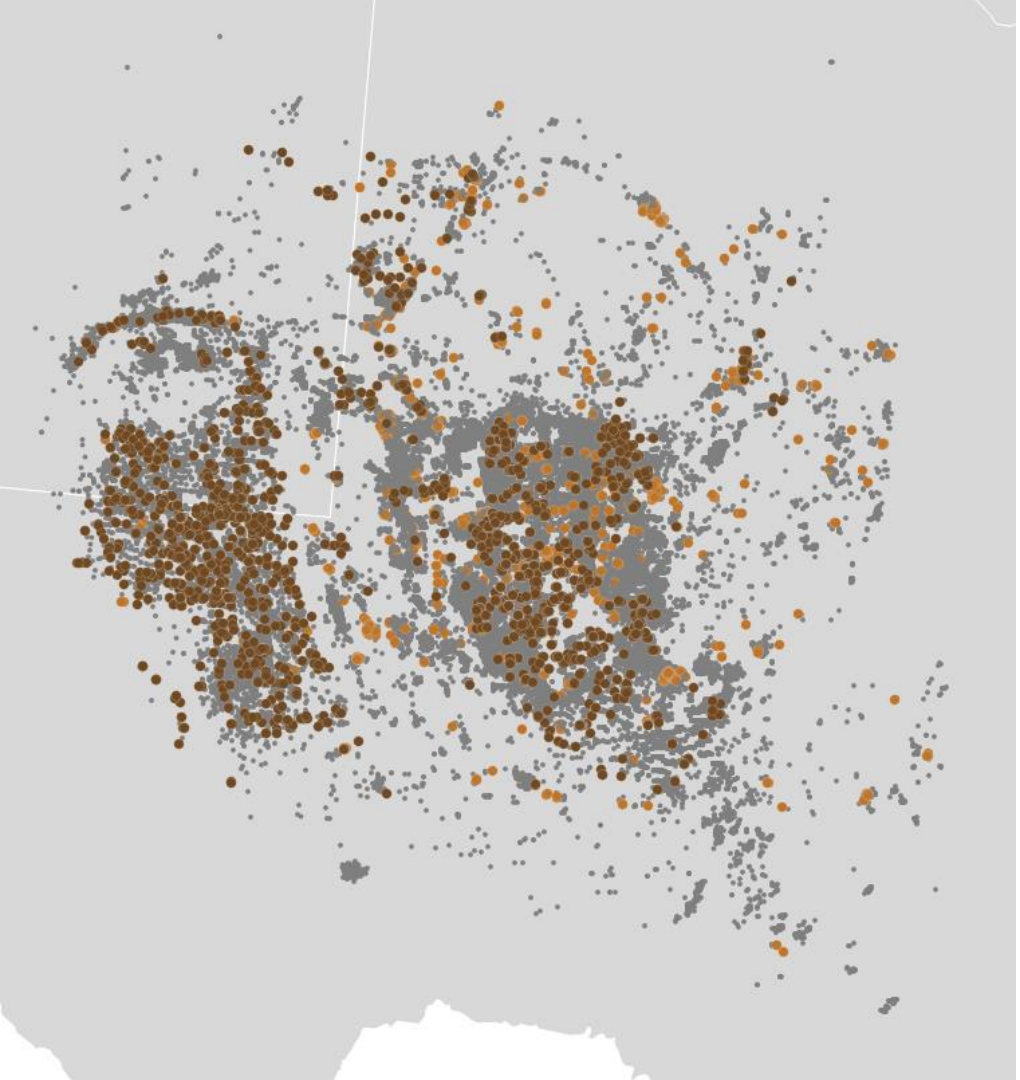
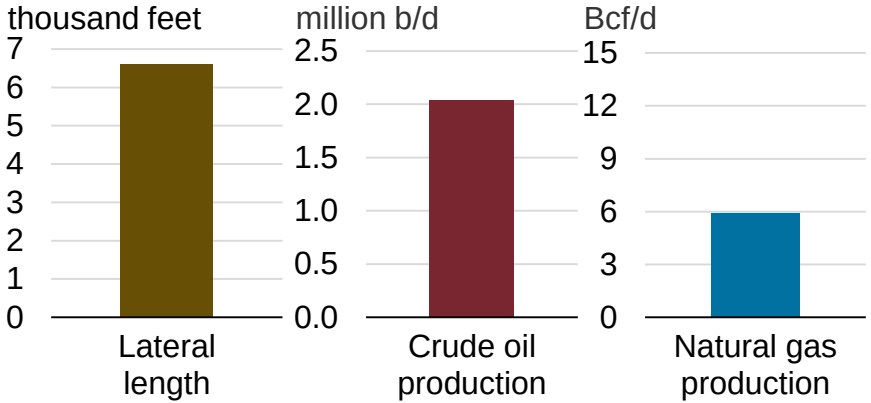




2016



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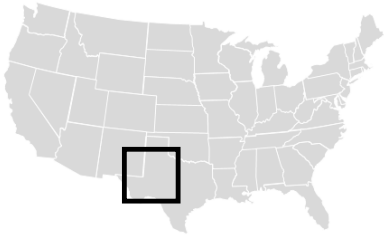
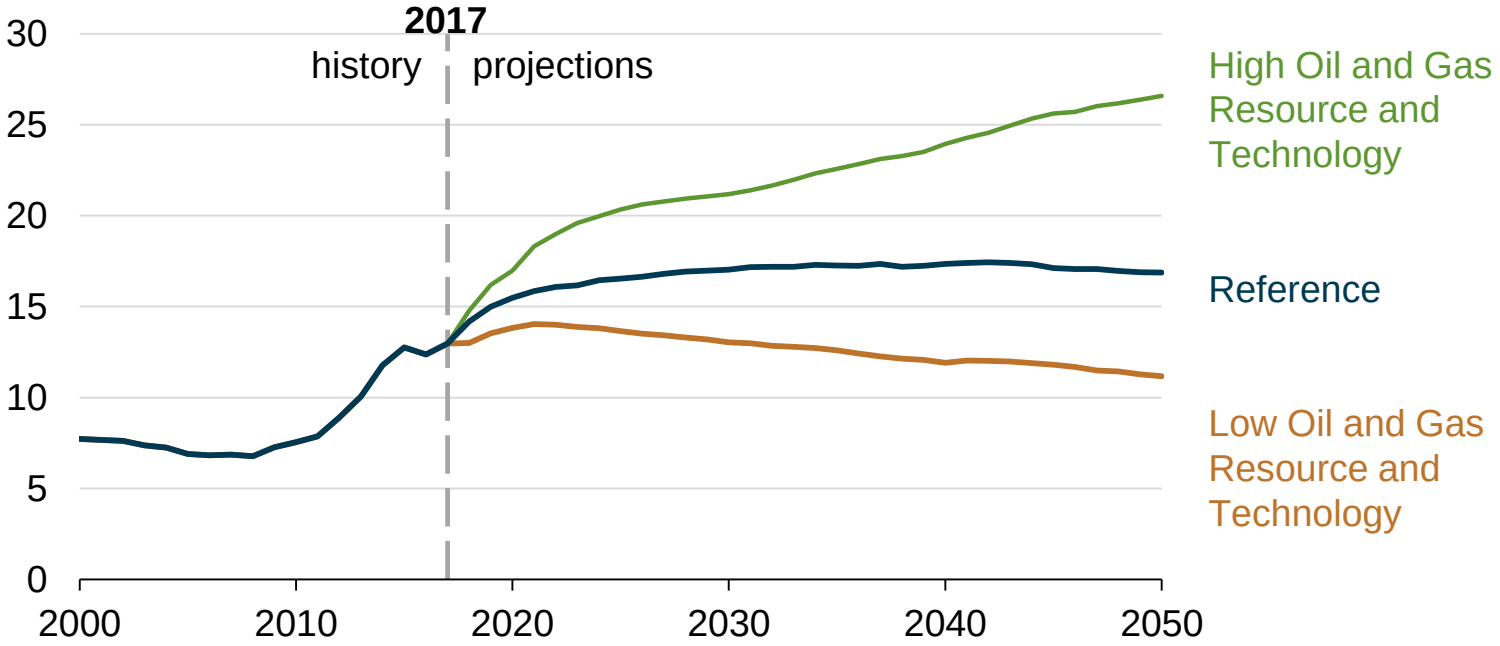


In the AEO, resource and technology assumptions have a strong effect on the total U.S. liquids and natural gas projections

U.S. crude oil and natural gas plant liquids production

million barrels per day



Source: EIA, Annual Energy Outlook 2018

Concluding questions

- EIA's goal is improve our ability to understand the present and better our forecasts: What techniques can we leverage to achieve this?
- What is the next landmark or step change?
- How much more value can we get from optimization?

For more information

U.S. Energy Information Administration home page | www.eia.gov

Annual Energy Outlook | www.eia.gov/aeo

Short-Term Energy Outlook | www.eia.gov/steo

Drilling Productivity Report | www.eia.gov/petroleum/drilling/