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Shale- What is its end state and impact?

The need to move beyond forecasts to frameworks

February 2018

Shale still evolving, and source of most market uncertainty

- 2018 shale supply is vastly different than 2014
- The unconventional is becoming more conventional, with fewer, larger and slower projects
- Costs declined sharply from 2014-2017, allowing for greater efficiencies and lower break-evens
- Shale will continue to grow, but headwinds are emerging
  - Costs are just beginning to rise
  - Decline rates now 400 kb/d per month
  - Weak WTI prices relative to Brent
  - Drift outside of sweet spots
- Shale is not, and never will be the swing supplier- but is one element of a changing oil market landscape

Shale is not big enough to keep price in a tight band

Shale

5%
Shale share of global supply

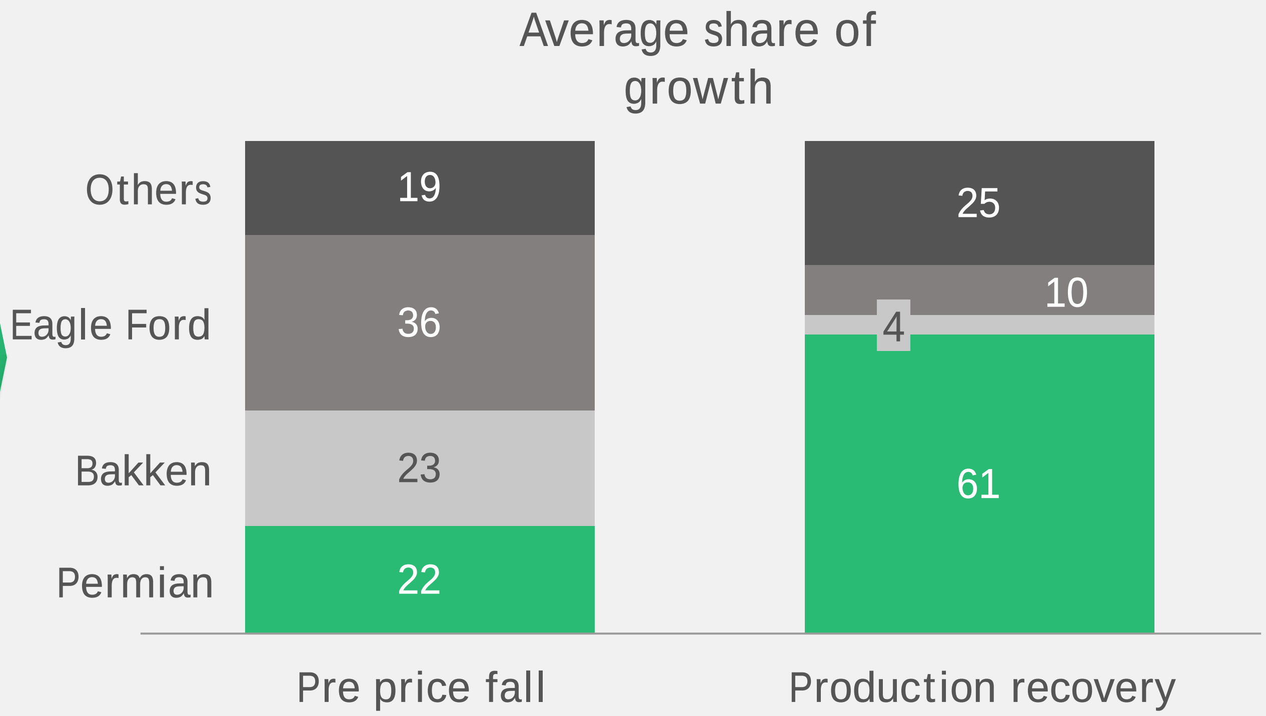
1.4 mmb/d
Max growth year

OPEC

40%
OPEC share of global supply

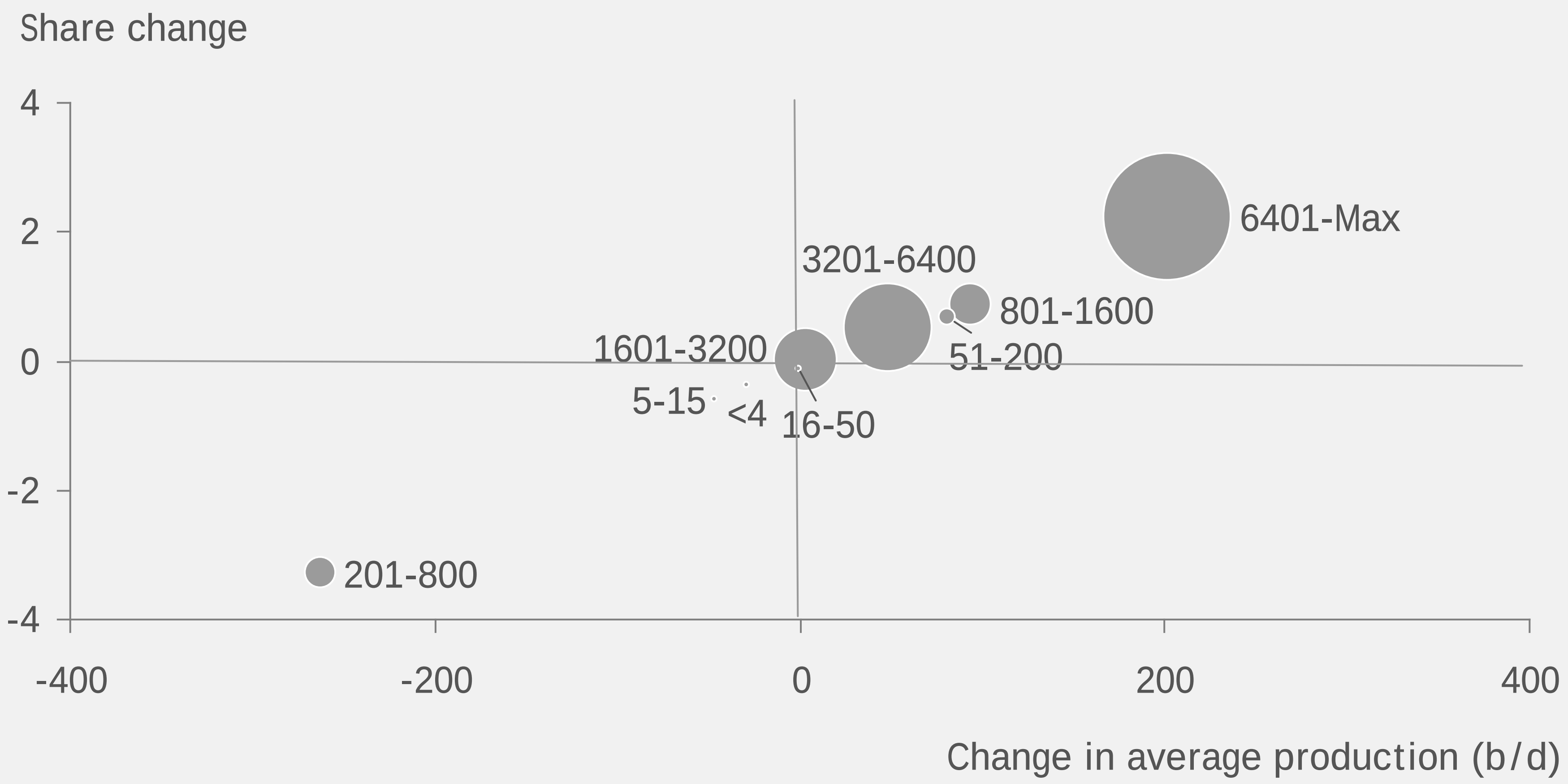
2.26 mmb/d
Avg OPEC spare capacity

Growth has shrunk from many plays to primarily just Permian



Is unconventional becoming conventional?

Bigger slower projects, lumpier production



Source: EIA, BCG CEI

US shale may look very different with a profit focus

But this evolution may impact larger shale independents first

0
# of new plays developed

1
Permian cements place as top play

3-5
~# of companies that can easily turn a profit

↓
Pace of supply growth

Source: BCG CEI qualitative analysis

Headwinds may impede shale growth

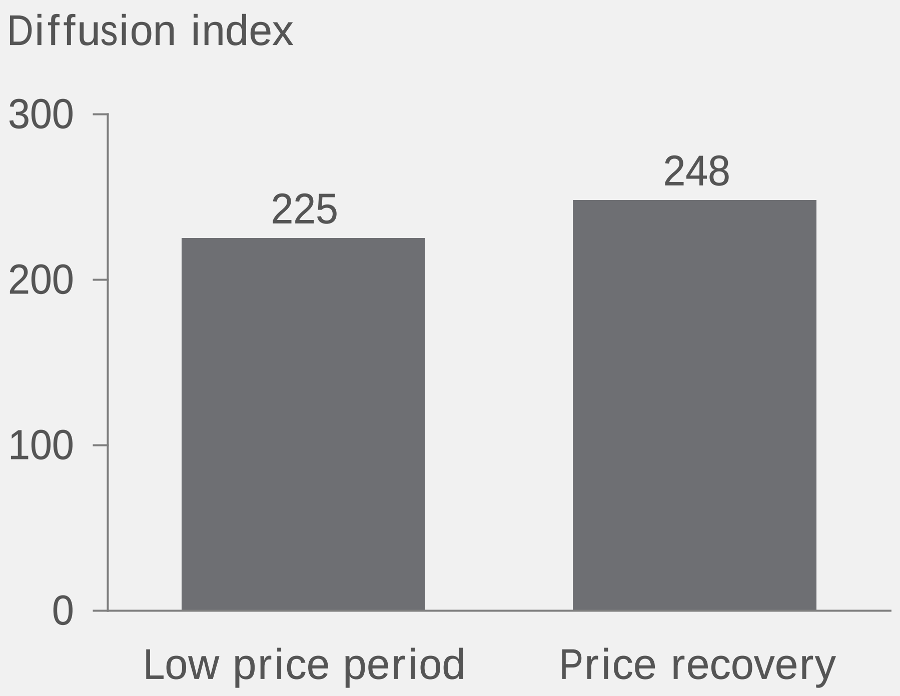
Rising **service sector costs**- with more to come in 2018 as capacity grows tighter

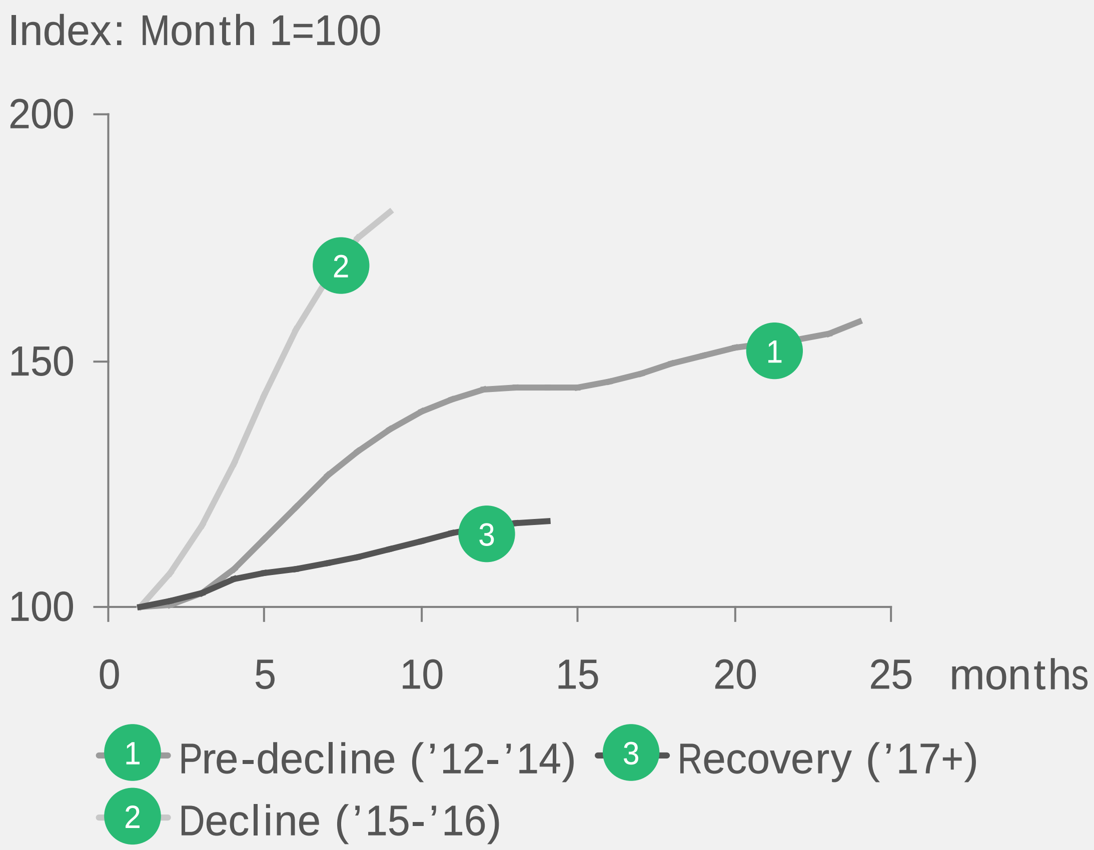
Higher prices allow focus outside of **sweet spots**, lowering average growth

Decline rates now at 400kb/d per month- 85 kb/d higher in 1 year

Price spread/quality reduce revenue growth; wide WTI/Brent spread, increased super-light production

Bakken case study: Beyond sweet spots? Activity diffuses, productivity growth slows



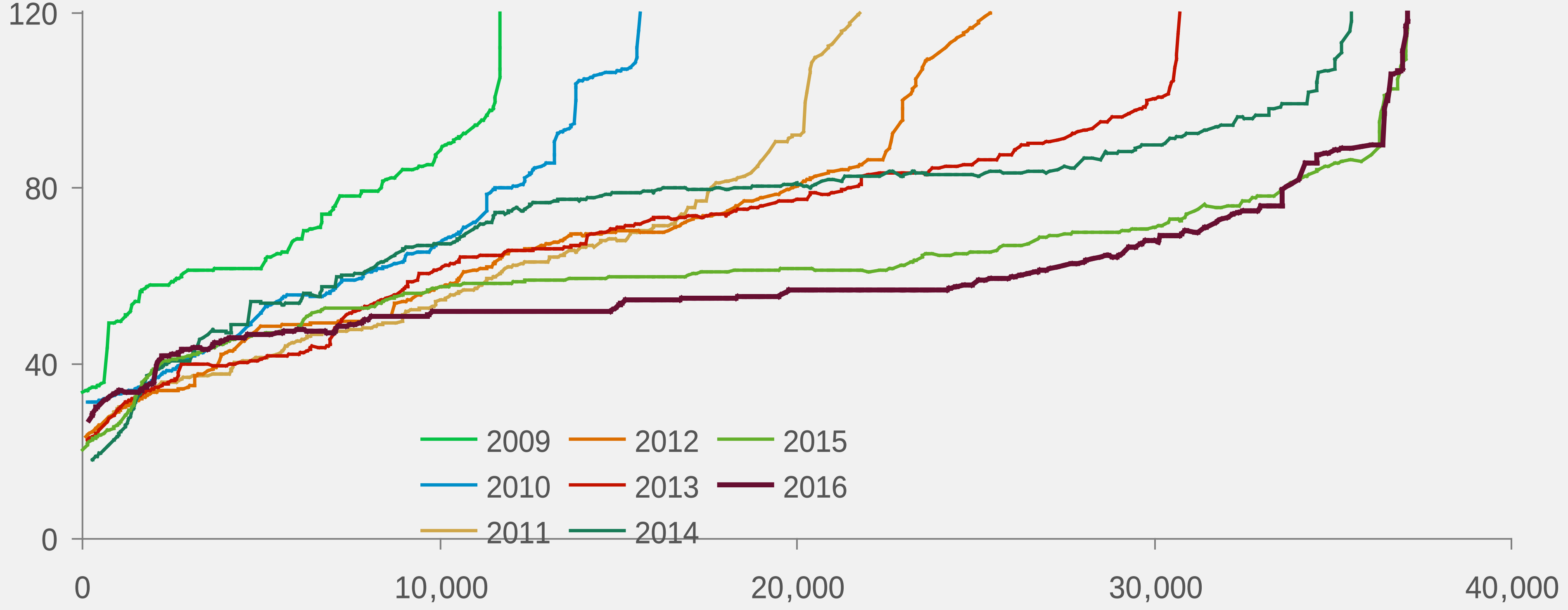


Notes: Left graph: comparison of Bakken productivity growth rates. Right graph: Production diffusion index for ND counties using Hirschman-Herfindahl index method
Source: North Dakota Oil and Gas Commission, EIA DPR January 2018, BCG CEI

Oil project costs declined

2.5x more oil available at $60/b over 5 years

Breakeven (vertical; USD/b) vs. cumulative production of identified projects
(pre-sanction, under development and producing; thousand barrels per day)

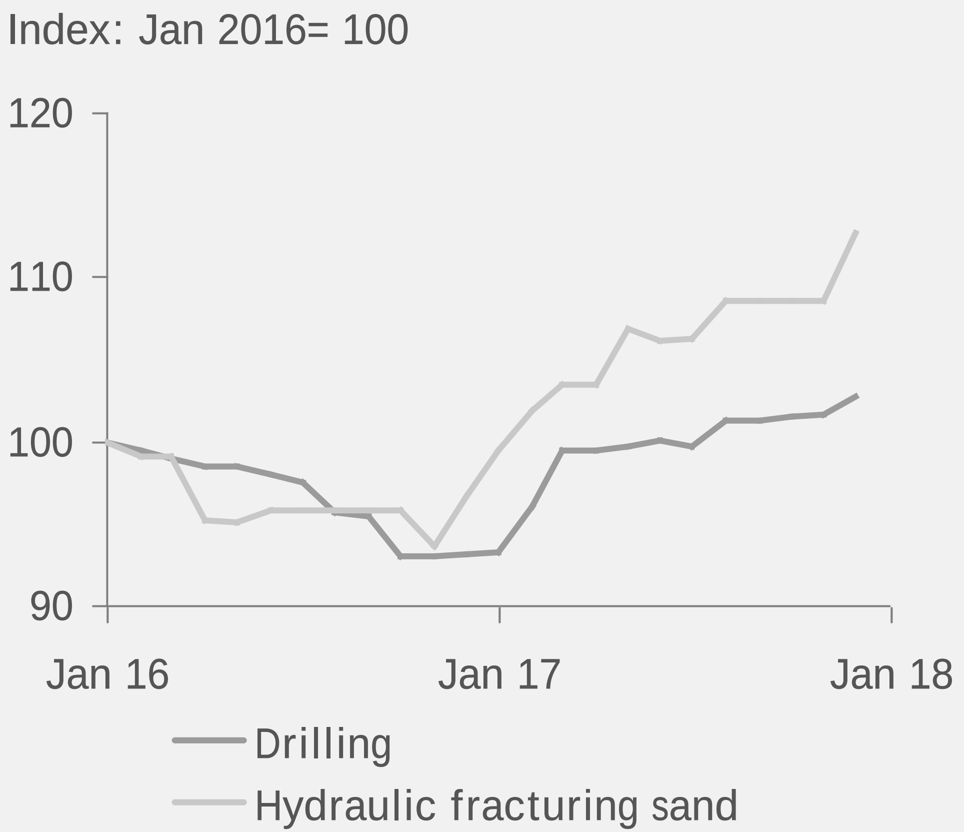


Source: Company data, Goldman Sachs; Global Investment research, BCG CEI

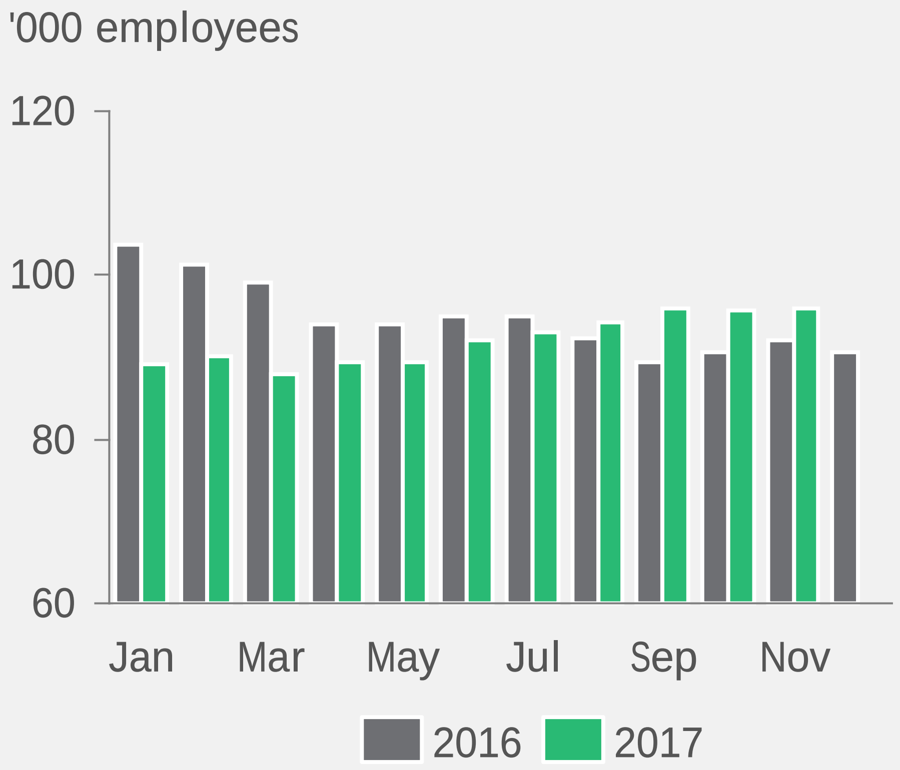
…but are again rising

How much of the cost savings is permanent?

Shale costs increase with growth



Hiring & wages increasing

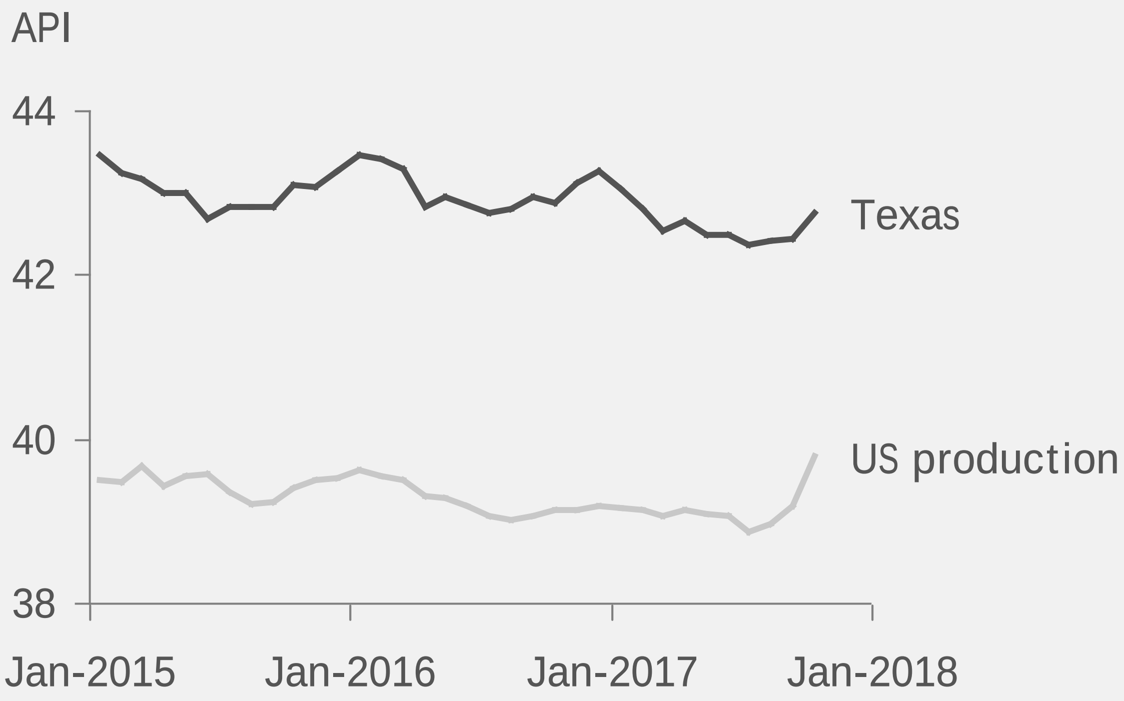


Source: Census bureau data NAICS PCU213111213111, PCU213112213112, Bureau of Labor Statistics, BCG CEI

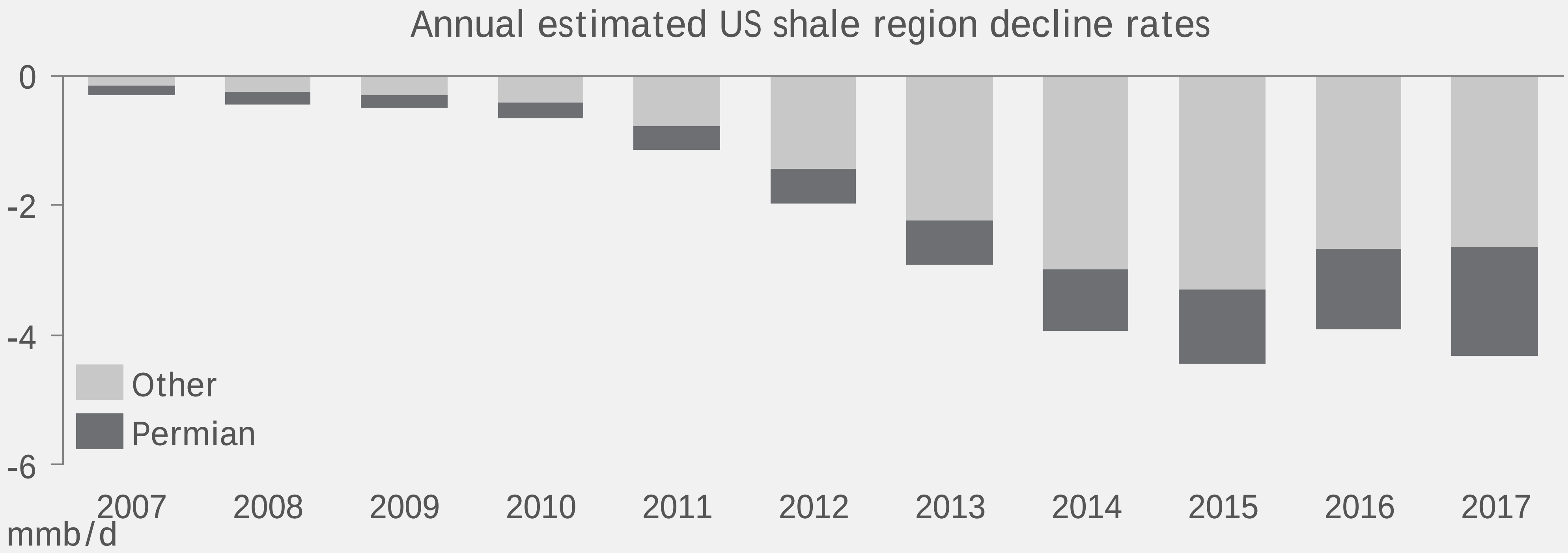
US crude discounted + growing super-light grades need more blending to refine

US crude benchmark below Brent

US production getting lighter



Shale decline rate still growing- requiring more new production to show net growth



A rule of thumb for shale:

Ignore rules of thumb

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