US Association for Energy Economics
International Association for Energy Economics

Tight Oil Innovation Overview

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“US shale resilience a product of innovation, CEOs say”

– Oil & Gas Journal, March 2016

What do they mean by “innovation”?

Types of Innovation

- **Process and efficiency improvements**. These are routine and continue through the life of an oil or gas field independently of business cycles.

- **Technical improvements**. These are innovative but do not require significant R&D investment. These too typically continue irrespective of business cycles. Examples are pad drilling and super fracks.

- **Major technological inventions**. These require substantial R&D resources in order to be brought to market. Examples are three-dimensional seismic surveys and formation evaluation while drilling.

- **Industry-changing innovations that profoundly affect oil supply.** An example from the twentieth century is secondary oil recovery by water flood or reservoir pressure maintenance. A more recent example is the combination of horizontal well construction and staged, massive hydraulic fracturing.

Business Cycles and Innovation Cycles in the U.S. Upstream Oil & Gas Industry
Kleinberg & Fagan, preprint

Comparison of Innovation Landscape Across Industries

Petroleum

- Severe mismatch between business cycles and development cycles
- Petroleum markets are unusually volatile
- Combination of front-loaded capital expenditure and substantial geological risk discourages the use of untried innovations

Consumer Electronics & Software

- Short development cycles
- Customer population is biased toward novelty

Pharmaceuticals

- Development cycles even longer than in upstream oil and gas
- Market conditions are fundamentally more predictable

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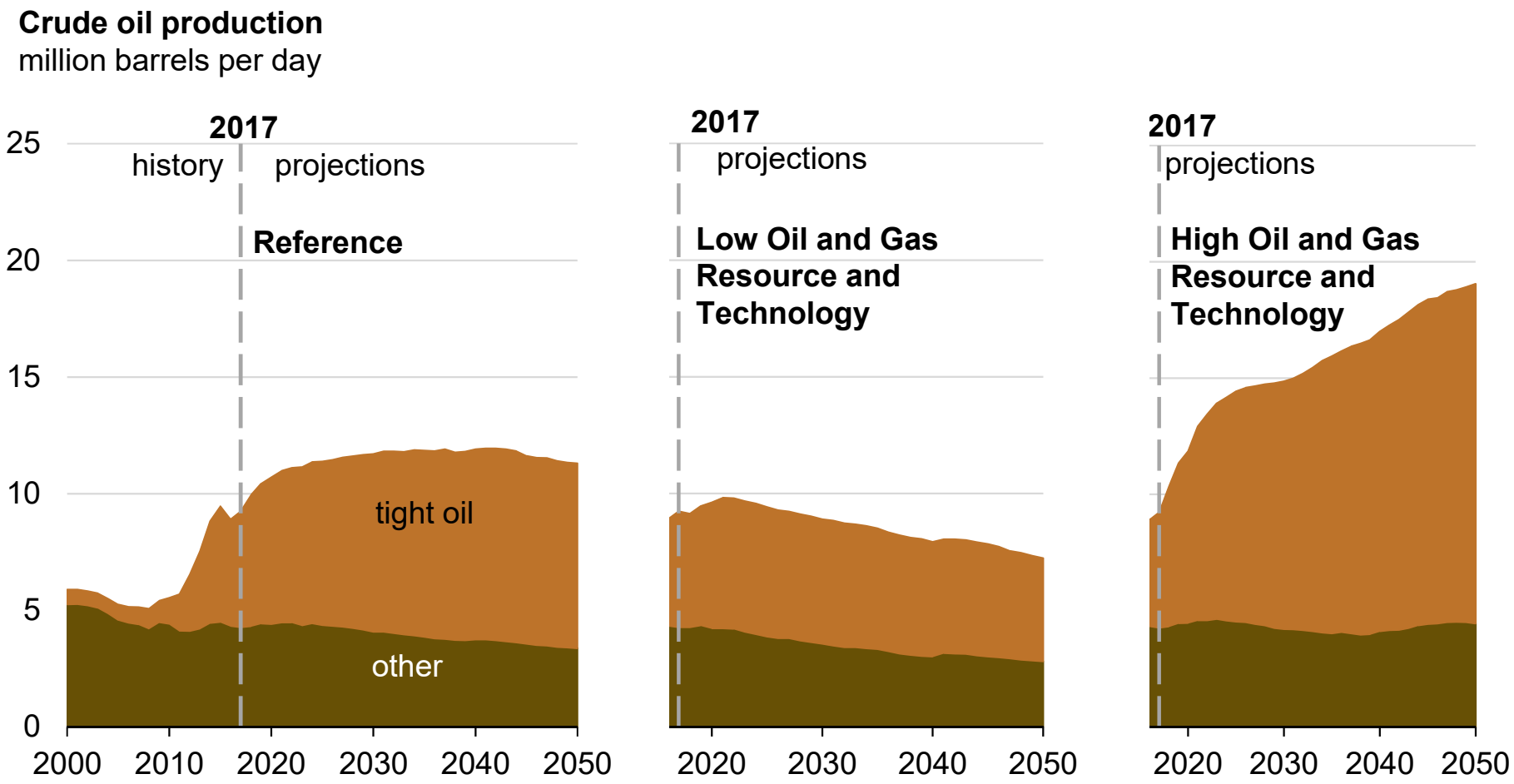
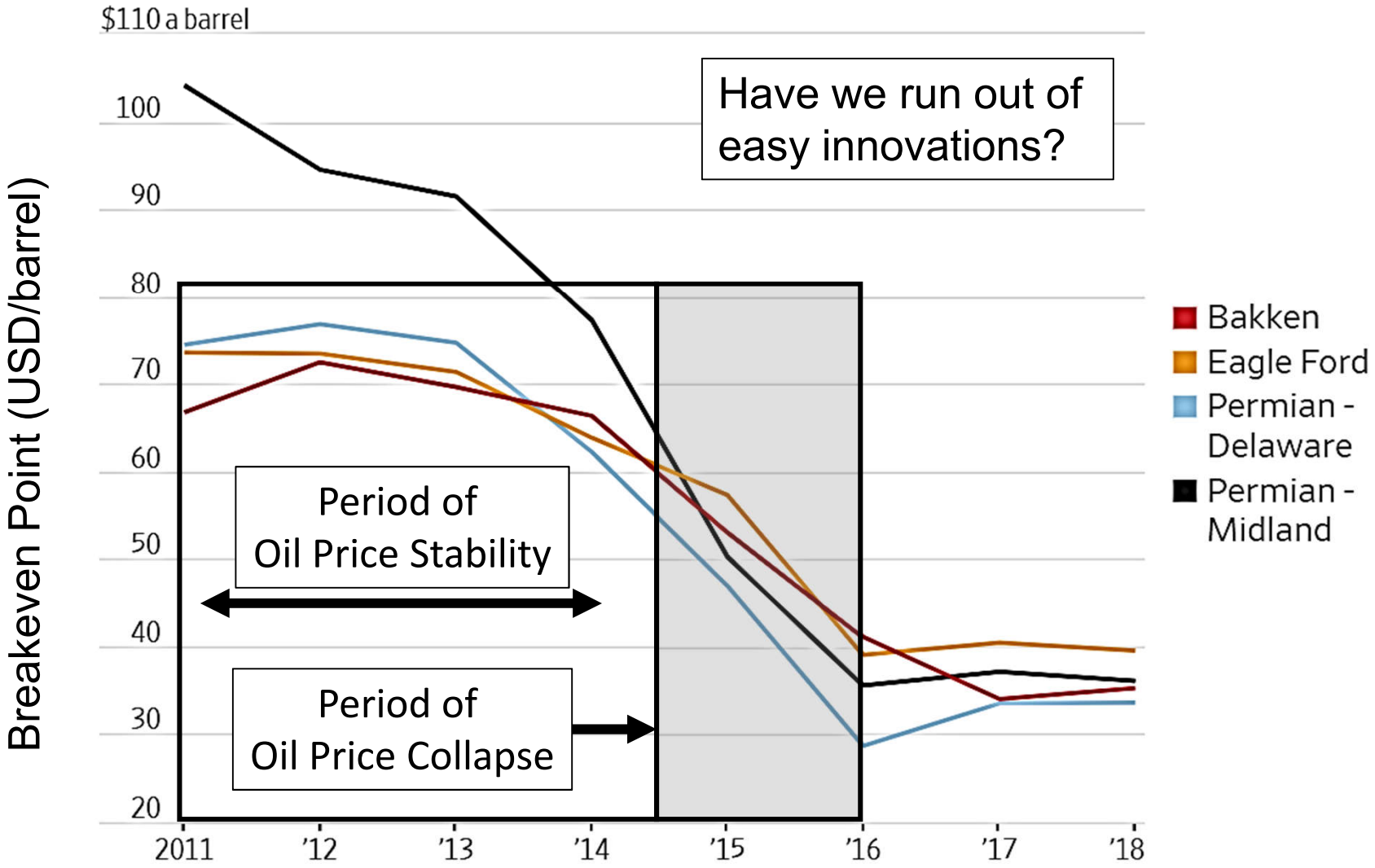
Tight oil production remains the leading source of U.S. crude oil production from 2017 to 2050 in the Reference case—



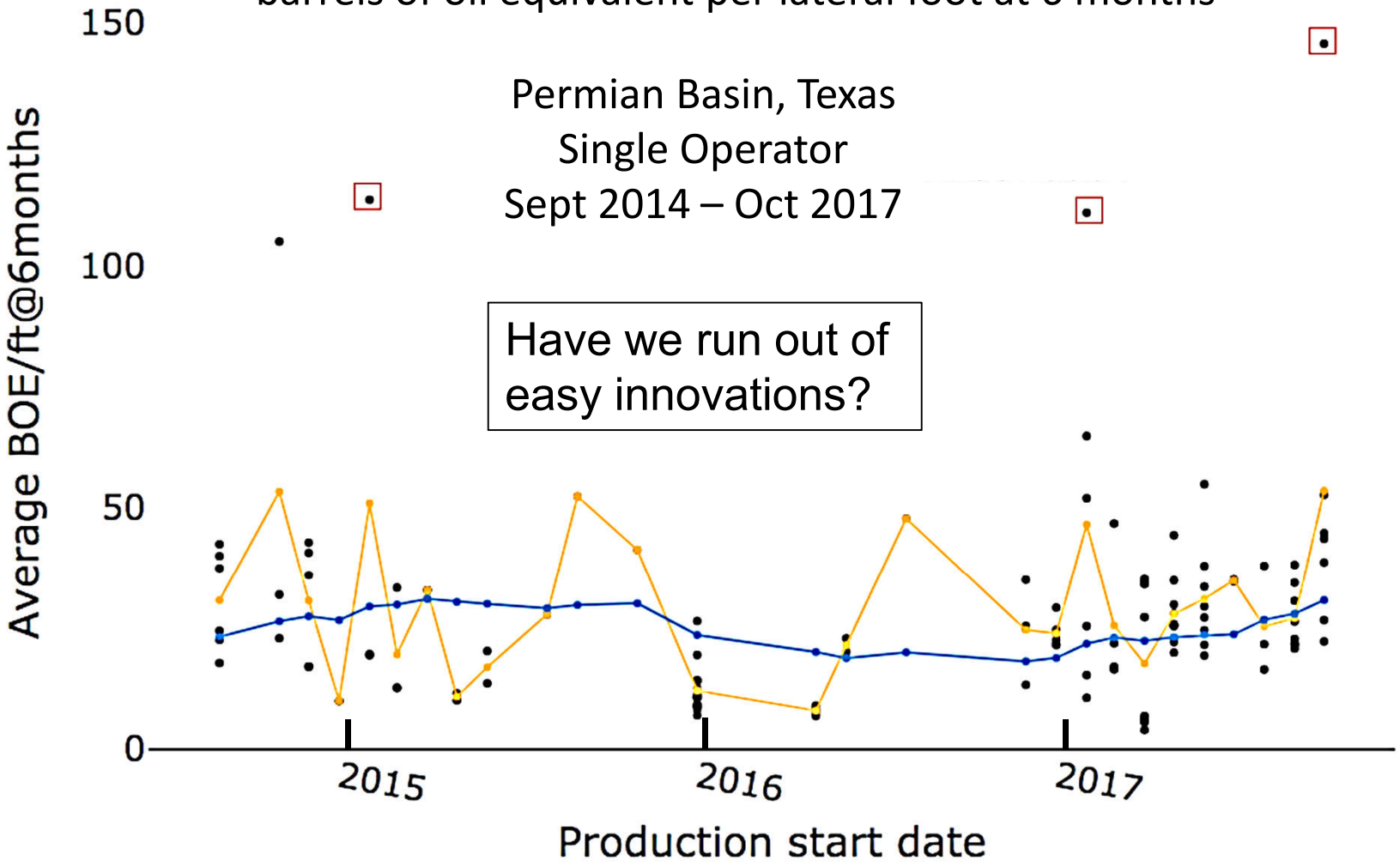
Tight Oil Breakeven Points



Wall Street Journal, 12 August 2018
Source: Rystad Energy ShaleWellCube

Very Little Production Improvement Over 120 Wells

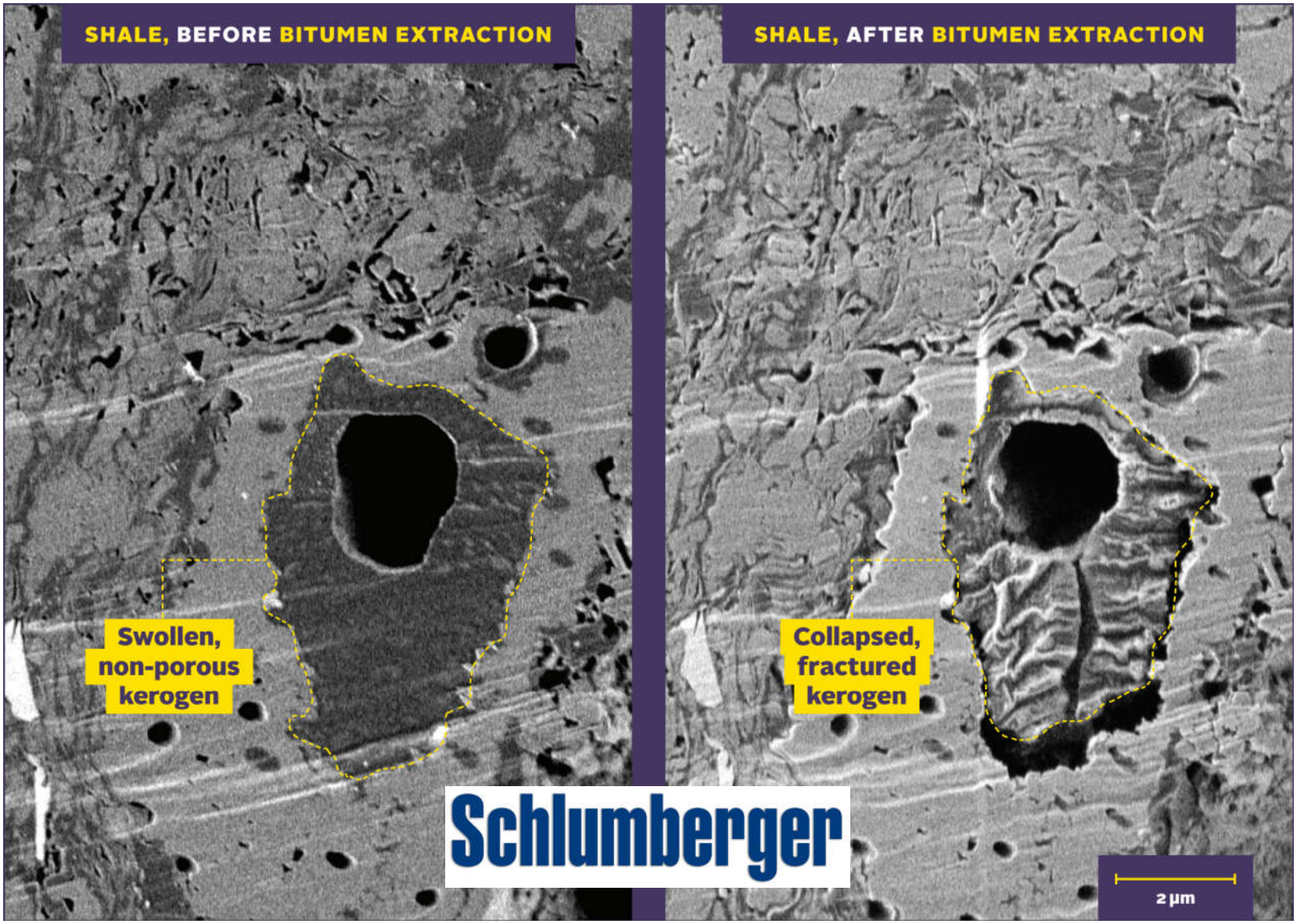
barrels of oil equivalent per lateral foot at 6 months



SafeRock, Basin Report – Permian Basin, August 2018
Data Courtesy of Shah Karim, SafeRock

SafeRock

A Way Forward? Remove Bitumen



Reeder, Craddock, Rylander, Pirie, Lewis, Kausik, Kleinberg, Yang, Pomerantz, Petrophysics, April 2016

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