Tight Oil Innovation Overview

Robert Kleinberg

Columbia University Center on Global Energy Policy
Boston University Institute for Sustainable Energy

25 September 2018
“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.
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
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

Have we run out of easy innovations?

Breakeven Point (USD/barrel)

Period of Oil Price Stability

Period of Oil Price Collapse

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.

Permian Basin, Texas
Single Operator
Sept 2014 – Oct 2017

Have we run out of easy innovations?

SafeRock, Basin Report – Permian Basin, August 2018
Data Courtesy of Shah Karim, SafeRock
A Way Forward? Remove Bitumen

Reeder, Craddock, Rylander, Pirie, Lewis, Kausik, Kleinberg, Yang, Pomerantz, Petrophysics, April 2016
Robert L. Kleinberg, Ph.D.
Senior Research Scholar
Center on Global Energy Policy
Columbia University

Senior Fellow
Institute for Sustainable Energy
Boston University

robert@robertkleinberg.com
http://www.linkedin.com/pub/robert-kleinberg/19/177/131
Member of the National Academy of Engineering