

2014 EIA Energy Conference
Tight Oil Production Trends

Technology On the Horizon & Over the Horizon

Robert Kleinberg
Schlumberger

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Schlumberger is a provider of hydraulic fracturing services that

- develops and provides fracture fluid chemicals
- designs and executes hydraulic fractures
using its own personnel and equipment

The opinions expressed here are my own and do not necessarily reflect the views of Schlumberger.

Status

Technical Improvements Focused on Efficiency & Cost Reduction

- Easy to measure – and reward
- Pad drilling has been a game-changer and has swept the industry
→ Fewer rigs + more production
- Equipment design now emphasizes reliability over mobility
- Supply chain managers are gods
“Amateurs talk strategy; professionals study logistics”

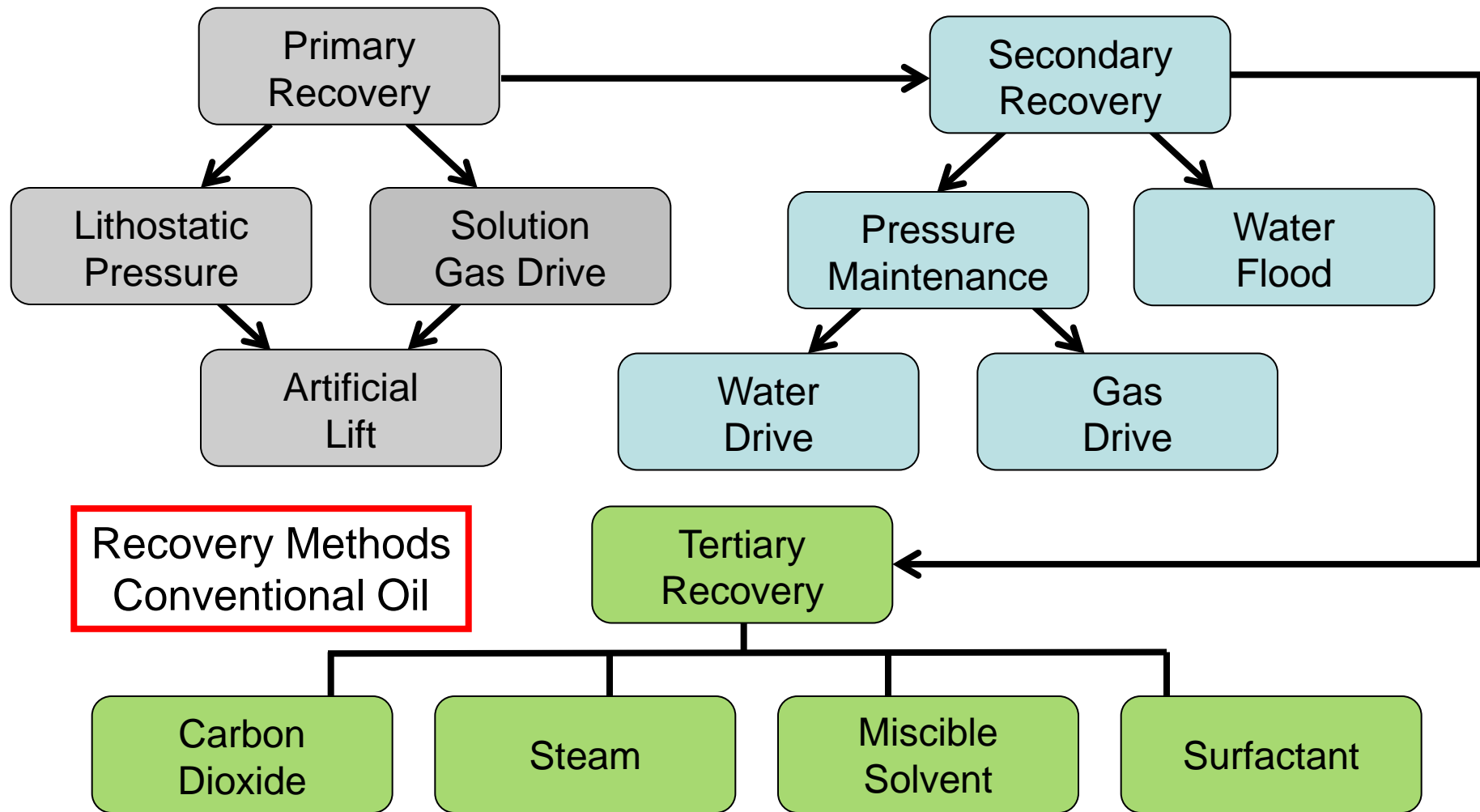
Production Enhancement Has Taken a Back Seat

- Harder to quantify
- Initial production is an early indicator, but declines quickly
- EUR uncertain due to poorly-understood reservoir dynamics

The Pathetic Performance of Tight Oil Wells

rough numbers

	Annual Decline Rate	Recovery Factor
Conventional Oil Wells	5%	50%
Tight Oil Wells	50%	5%



Primary
Recovery



Lithostatic
Pressure

Solution
Gas Drive

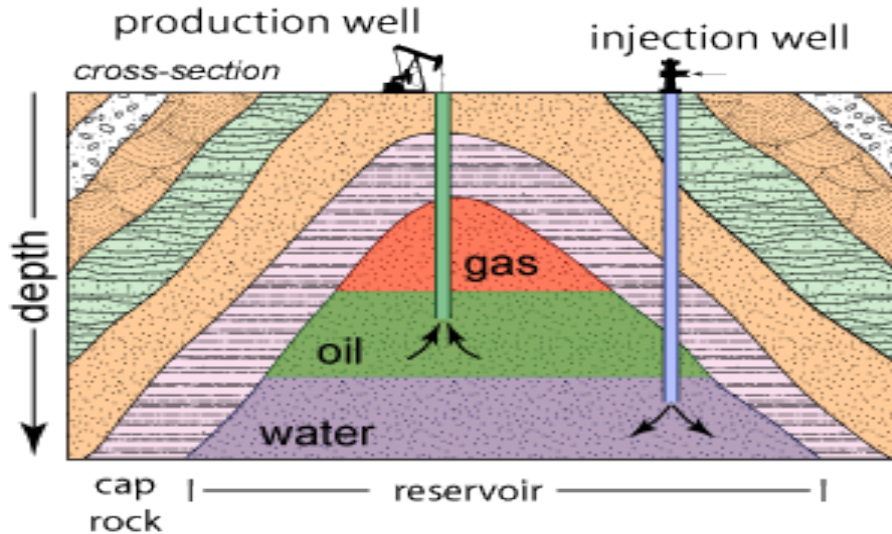


Artificial
Lift

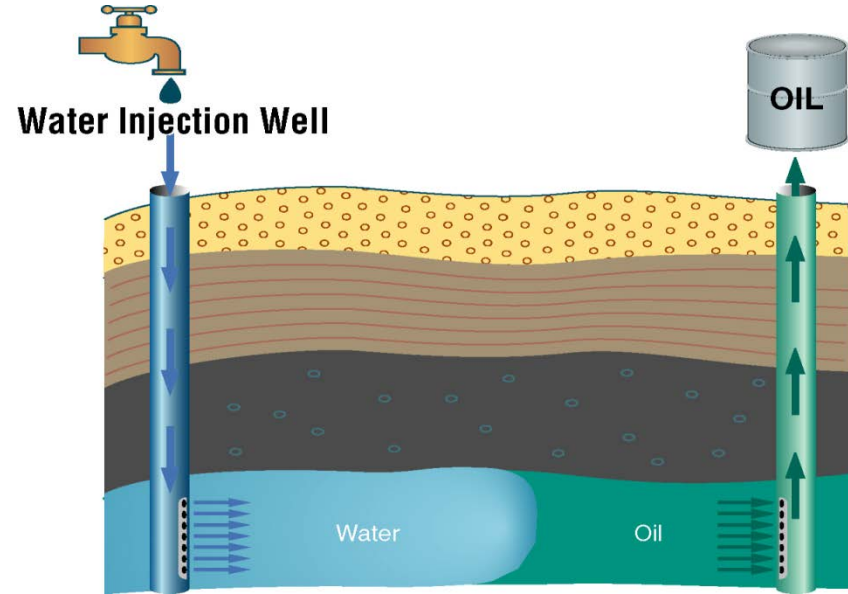
Recovery Methods
Tight Oil

Why Secondary Recovery Doesn't Work

Pressure Maintenance Doesn't Work:
Tight Oil Plays Not Buoyancy Driven



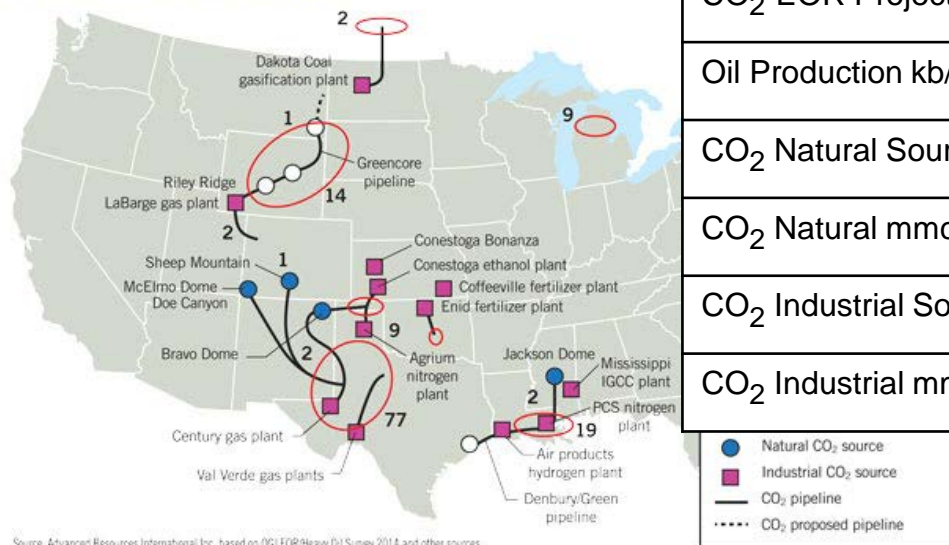
Water Flood Doesn't Work:
Formation Permeability Too Low



Tertiary Recovery

Steam	Unlikely to be economic when oil is 3% of rock volume
CO₂ Huff & Puff	<p>Many academic/theoretical publications</p> <p>No tertiary recovery field tests (to my knowledge)</p> <p>The oil industry lives in a CO₂-constrained world</p>

CO₂-EOR OPERATIONS, CO₂ SOURCES: 2014



CO ₂ -EOR Projects	156
Oil Production kb/d	300
CO ₂ Natural Sources	5
CO ₂ Natural mmcf/d	2.8
CO ₂ Industrial Sources	12
CO ₂ Industrial mmcf/d	0.7

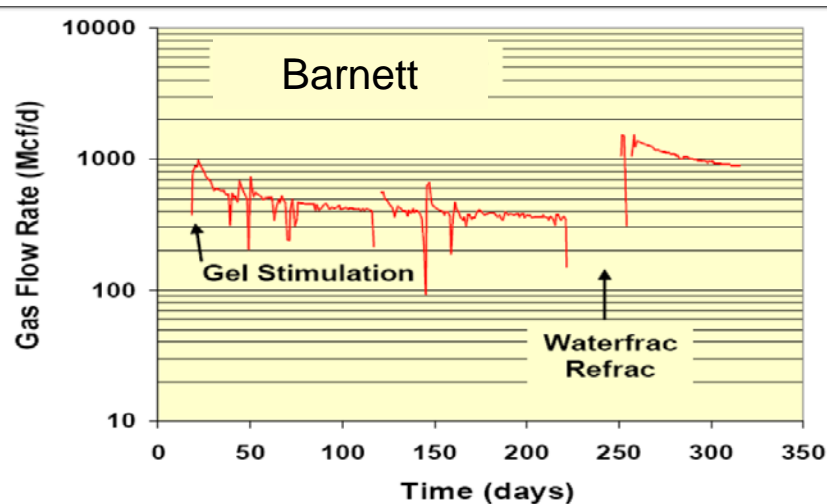
“While oil production from CO₂-EOR has steadily increased, its growth has slowed in the past few years. This is due primarily to limits on accessible, affordable supplies of CO₂.”

Kuuskras & Wallace
O&GJ, 5 May 2014

Possible Routes to Production Enhancement

Refrac

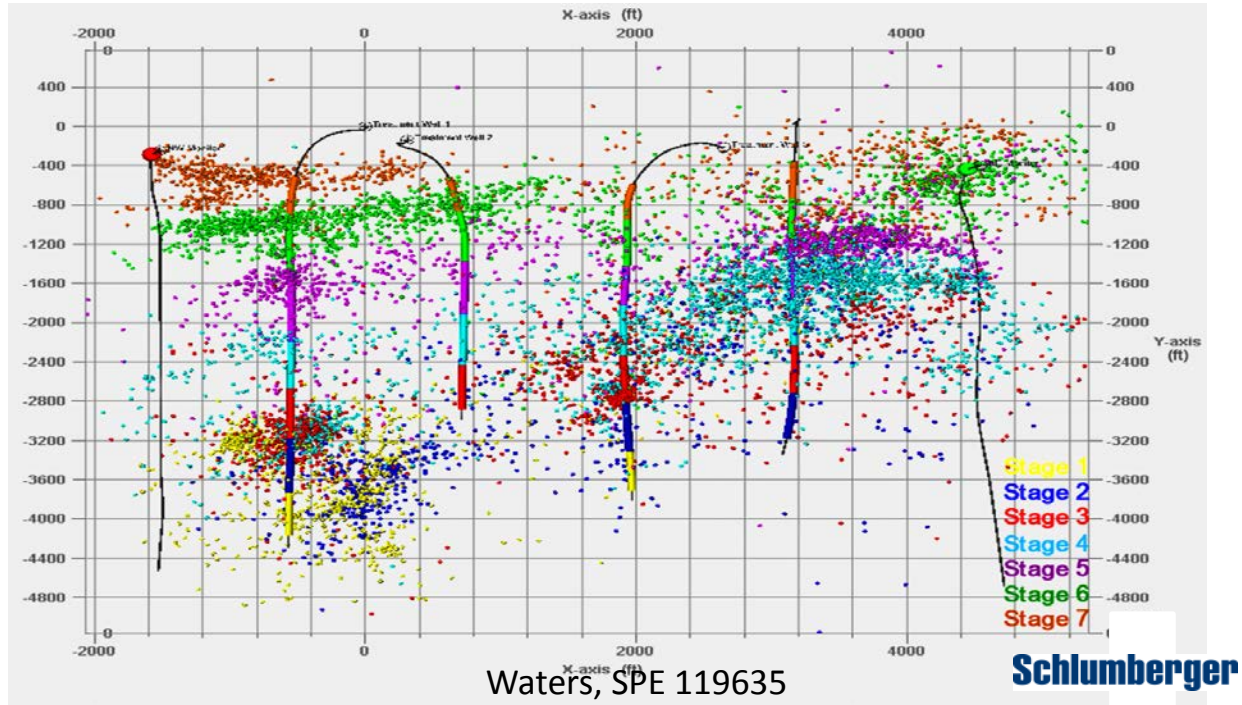
- Effectiveness is debated
- Publications seem to be “success-biased”
- Will work in selected situations to solve known problems
- New technology available to improve process (e.g. diversion)
- Local supply chain has to be restarted
- Current strategy is to drill a new well elsewhere



Vincent, SPE 134330
after Cipolla, 2005

In-Fill Drilling

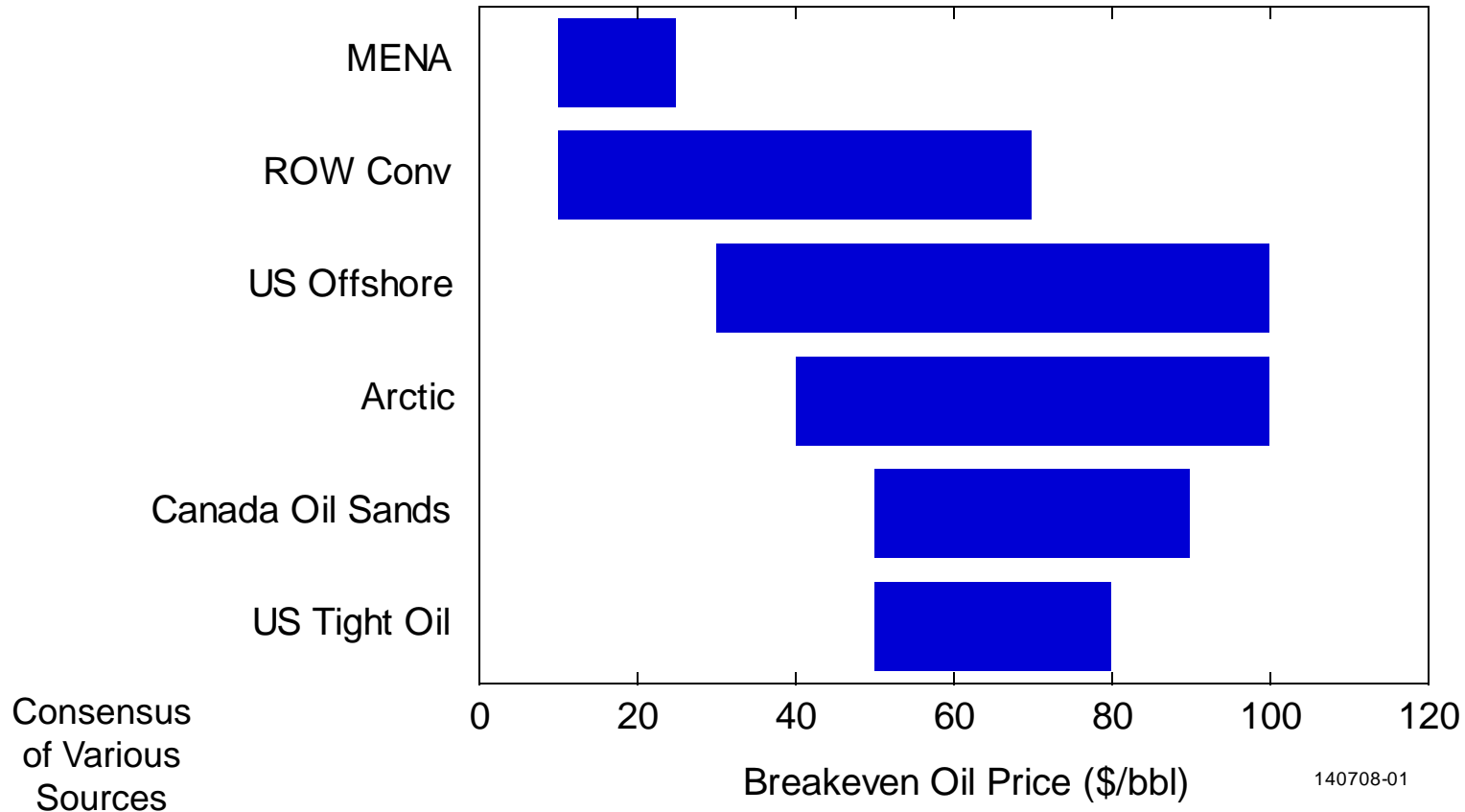
- Another raging debate
- Pressure interference at 1000 ft, but SRV radius < 300 ft
- A few tests have been performed



In-Fill Drilling vs Proppant Transport

- We are fracturing 1000 foot wings to place proppant a few hundred feet
- Wastes water, sand, chemicals, and time.
- A problem technologists love to work on
 - fiber fracs, clever pumping schedules, proppant modification
- Potentially a cheap alternative to in-fill drilling
- Look for incremental improvements

Tight Oil is Competitive with Other High-Price Resources and has the Greatest Potential for Cost Reduction



Robert L. Kleinberg, Ph.D.
Unconventional Resources
Schlumberger-Doll Research
One Hampshire Street
Cambridge, MA 02139

617-768-2277

kleinberg@slb.com

<http://www.linkedin.com/pub/robert-kleinberg/19/177/131>

