

*“Oilfield Conformance Problems
and Methods of Control”
and
“An Industry Call to Action
for Technology Development”*



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Impact Technologies LLC

- Founded in 2003 (Tulsa, OK)
- Technology Research & Development Company
- Multiple universities, national labs, industry partners
- 27 Patents & Patents Pending, US and International
- 20 products focused in Specialized Drilling and Sealing
- Spin-offs for Commercialization



What is Conformance?

**Reducing unwanted fluid production
to lower operating costs
that can cause
premature well/field abandonment.**



Why be Concerned?

- Poor Conformance reduces profits
- Major stripper well states: KS, TX, OK, LA
- Major water producing states: TX, WY, CA, OK, KS, LA
- Waterfloods up to 200:1 (water:oil)
- Recycled: \$0.25/bbl, Disposed: \$3.00/bbl
- Biggest impact for mature/ near end-of-life fields & wells
- Higher environmental risks



Mostly in the WATER business!



Once it starts it can grow fast.



Step #1 – Symptom Identification

‘Excess water is the symptom of a problem...know the problem before treating’

-David Smith, OXY

Historical production data, reservoir and well configuration data and any testing performed

Know where the water is coming into the wellbore. Know the source of the water.



Step #2 – Potential Causes

- Well Completion
 - Damaged casing, bad cement job, hydraulic fracturing
- Reservoir
 - Coning, high permeability streaks, natural fractures, depletion
- Man-Made
 - Hydraulic fracturing, acidizing, EOR rock dissolution, aging/ worn wells, viscous fingering (waterfloods & EOR)



Step #3- Diagnosis

- Plots of historical data
 - Hall, cumulative oil plots, offset wells
- Well Tests
 - Spinner surveys, temperature surveys, RA surveys
 - Pressure buildup/drawdown, interference tests
 - Other tests
- Water Analyses
- **Treatment Goal:** Decrease excess/bad water production without damaging the oil/gas production.



Step #4 – Design & Implementation

Mechanical

- Cement/fillers, plugs, new liners
- Easiest and sometimes cheapest
- Only in/near wellbore



Chemical

- Gelled/linear polymers & SPI gels, foams
- More expensive (10K bbls)
- Deeper into Reservoir
- Larger volumes show higher success

Combination

- Mechanical and Chemical
- Treat injectors and/or producer



Chemical Treatments

'Oilfield polymer-gel treatments have been used to:

- 1) profitably generate relatively large volumes of incremental oil production,*
- 2) substantially reduce operating costs,*
- 3) extend the economic lives of marginal wells/ fields, and*
- 4) mitigate environmental concerns and liabilities'*

- Robert Syndask



Chemical Treatments

- Mostly chrome-based, some organic initiated
- Mostly internal initiated (time), some external (position) initiated
- Volume & placement critical
- Other factors:
 - Water salinity, temperature, pressure
 - Gellation timing and strength for the problem type
 - Rock heterogeneity level (high perm or fractures)
- Risk mitigation strategies



SPI Gels



- Patent Pending
- Silicate based, multi-component gel, not precipitate
- Initiator- **internal** (time set) or **external** (position set)
- Multiple formulations for targeted application
- 3X Stronger & significantly lower cost than Cr^{+6} gelled PAM systems
- Environmentally Friendly



SPI Gels Development Milestones To Date

- Oilfield Waterflooding (SWC projects)
 - 9 small batch treatments in 2 OK Bartlesville fields,
- Casing Repair (OCAST project)
 - Production wells only
 - OK and KS, 14 small 50 bbl treatments, 52% success
 - 4 started but not completed due to well problems
- Sewer & Low Pressure Pipe Repair (shop tested)
- Basement Leaks
 - 4 houses, 100% success



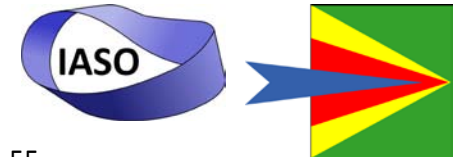
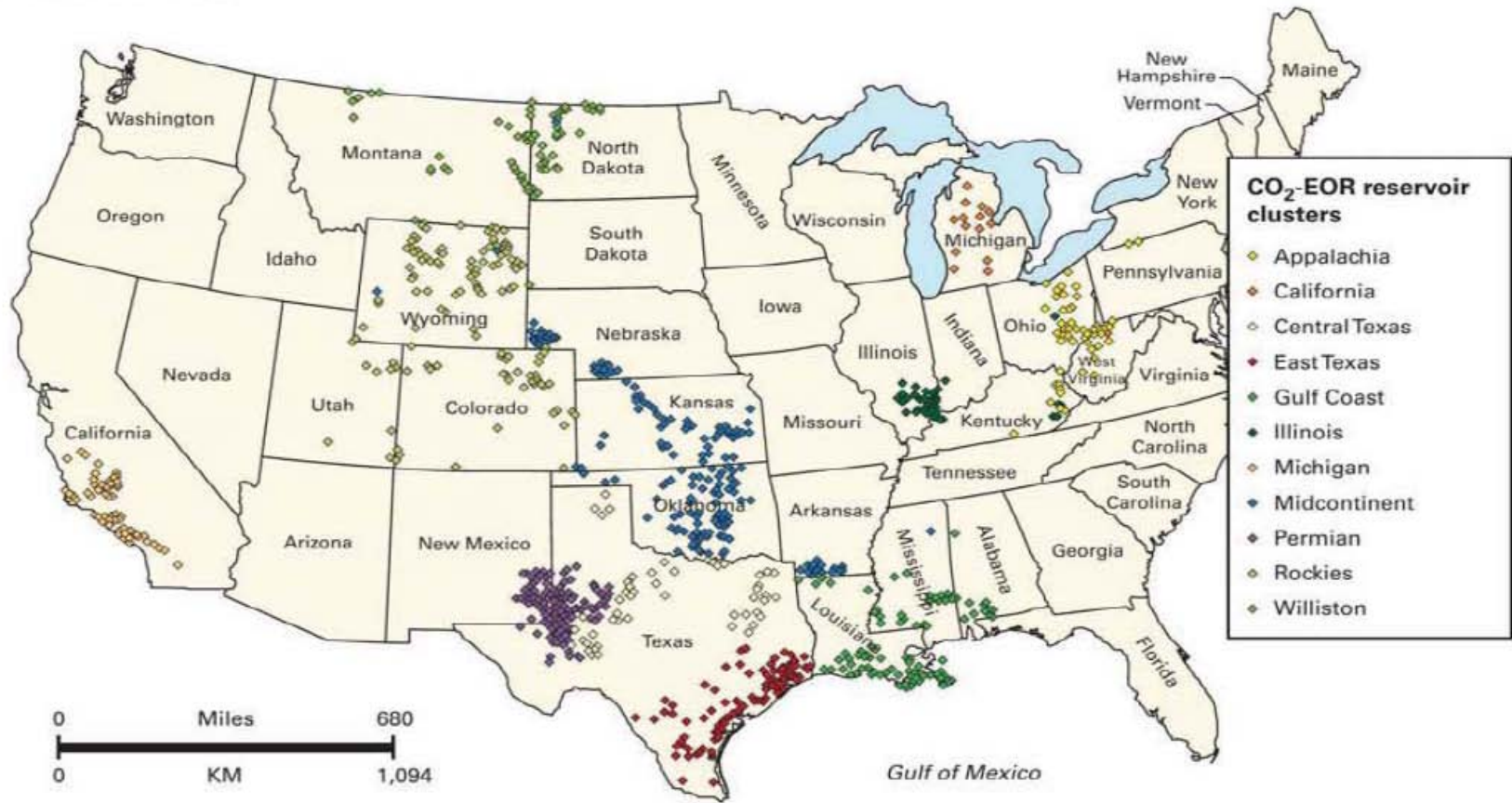
Future SPI Gel Milestones

- Now fabricating In-Line Mixing Skid for Continuous Mixing & Pumping
- CO₂ Flood Field Treatments (DOE project)
- Waterfloods- larger volume treatments
- Well Drilling treatments
 - Influx Control (air) & Lost Circulation (mud)
- Spin-off for Commercialization



CO₂ Potential

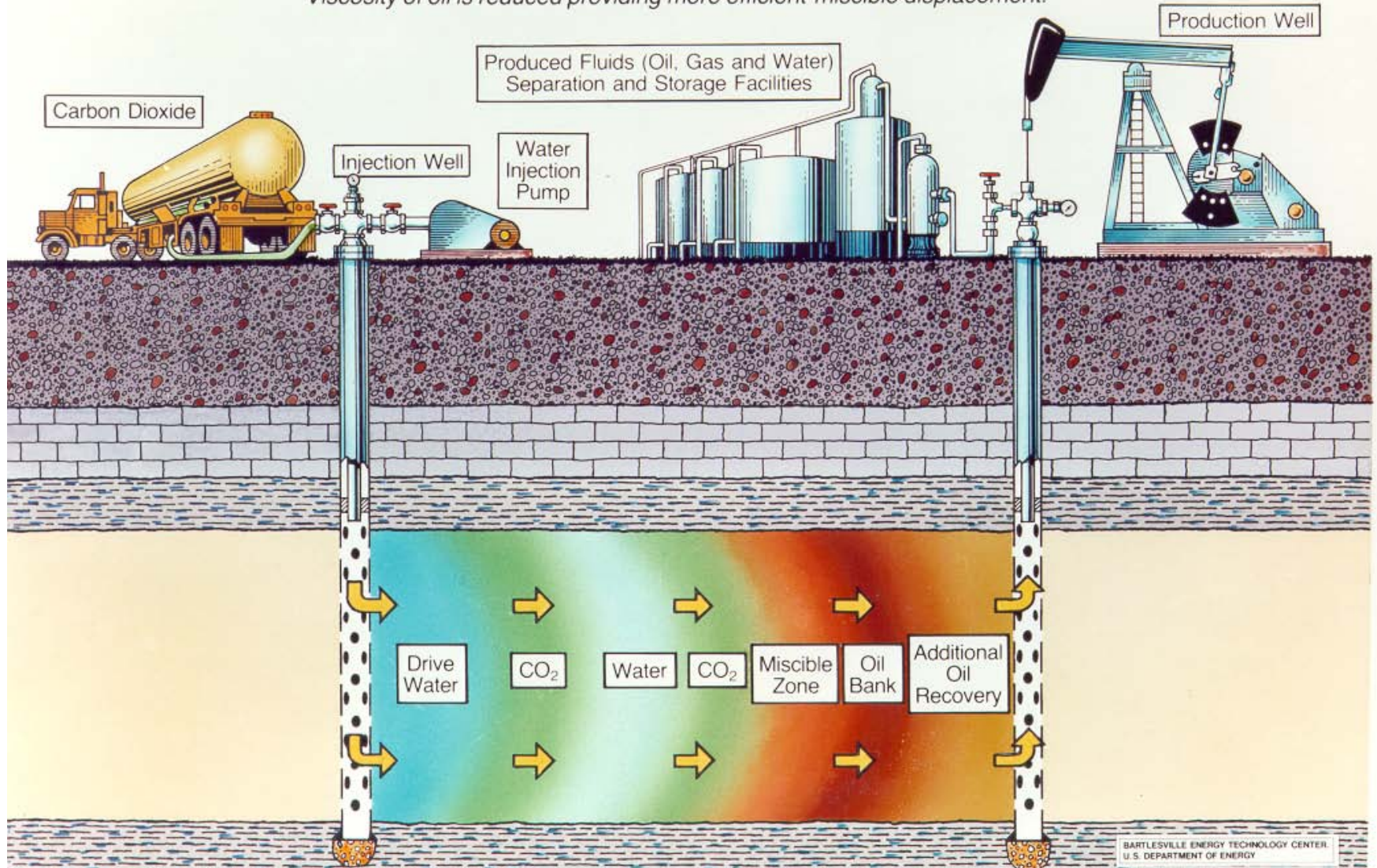
US CO₂-EOR POTENTIAL



CARBON DIOXIDE FLOODING

This method is a miscible displacement process applicable to many reservoirs. A CO₂ slug followed by alternate water and CO₂ injections (WAG) is usually the most feasible method.

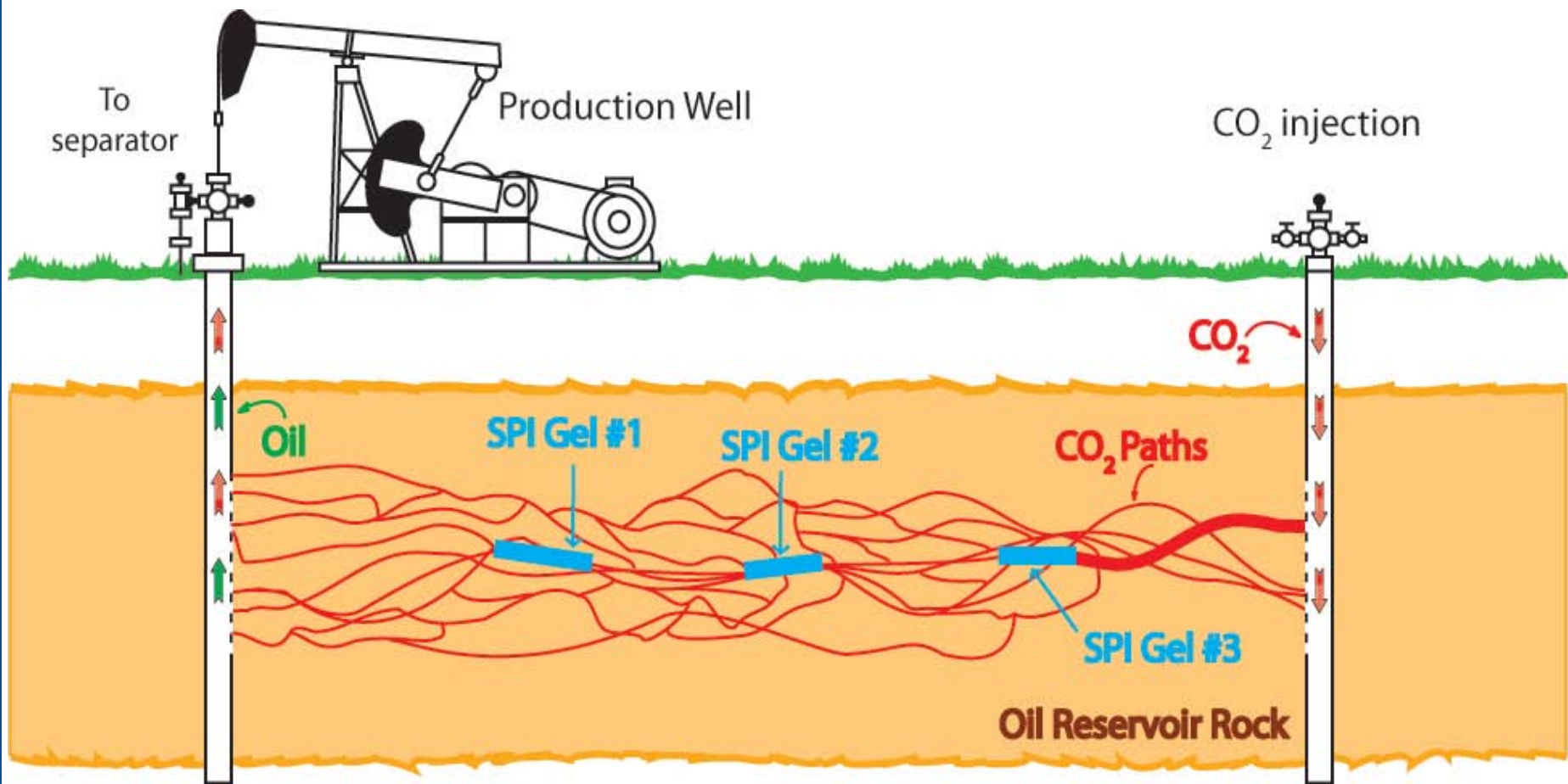
Viscosity of oil is reduced providing more efficient miscible displacement.



CO₂ Floods have Severe Conformance Problems

- Low CO₂ density & viscosity >> high mobility
- High mobility >> 'viscous fingering' >>
poor conformance & early CO₂ breakthrough
- Less oil recovered per injected CO₂ volume
- Higher costs from multiple cycles of CO₂





Improved Mobility Control for Carbon Dioxide (CO₂) Enhanced Oil Recovery Using Silica Polymer Initiator (SPI) Gels

- DOE Project (2011-2013), \$1.5MM, Field Test SPI Gels in CO₂ Floods
- **Seeking Operators of CO₂ Floods to:**
 - Provide well / field information and oil /water samples for lab testing
 - Provide well site for treatments
 - Provide Geologist/Engineers in treatment design, field implementation
 - Provide post-treatment well and field data
 - Allowing sharing of treatment data for publication
 - Cost Share only by in-kind time and effort
- **Impact will:**
 - Run laboratory tests on well samples
 - Design a SPI field treatment plan for operator/DOE approval
 - Perform treatment in field & monitor and report results
 - Perform all DOE reporting





Impact Technologies LLC needs industry help

- Operators of CO₂ floods for DOE Field Tests
- Operators of waterfloods
- Air Drilling Contractors w/water influx problems
- Resources to commercialize to next level



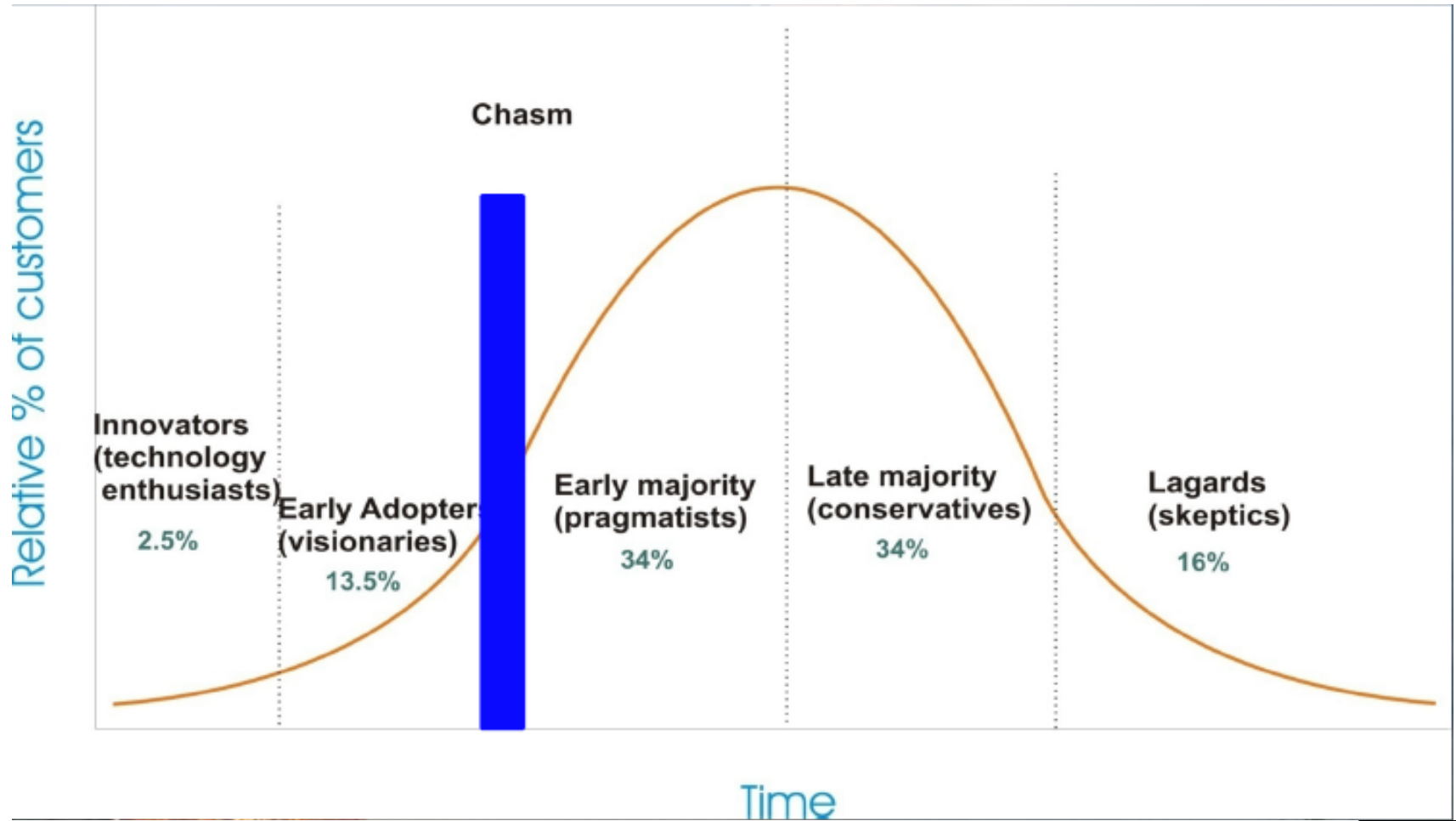


Industry Call to Action for Technology Development

- US O&G 20 year technology adaption cycle
- Williston Basin (Horizontal well)
Development halted at the US-Canadian
- Coiled tubing drilling in Canada and in the
Alaskan Prudhoe Bay



Industry Call to Action for Technology Development



Source: Geoffrey Moore





Industry Call to Action for Technology Development

- Smaller companies (OIPA independents?) should be faster adopters of new technologies
- Seek out, find and try new technologies
- Do not give up the first field try
- Reduce O&G technology adaptation timeline
- Do it to save your domestic industry
- Do it to save your own business!



Thank you. Questions?

