Oil-Prone Shale Plays:
The Illusion of Energy Independence

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Shale Magical Thinking

"I know not any thing more pleasant, or more instructive, than to compare experience with expectation, or to register from time to time the difference between idea and reality. It is by this kind of observation that we grow daily less liable to be disappointed."
--Samuel Johnson: Letter to Bennet Langton

What few people realize:

- While oil production has increased, the U.S. is not going to become energy independent.
- Resources are not reserves, and reserves are not supply.
- Shale oil wells have high decline rates and require substantial capital expenditure to keep production flat much less increasing.
- Oil production from the Eagle Ford and Bakken shales will probably increase U.S. supply by 1-2 million barrels per day by 2020 depending on oil price.

The Good News Propaganda Campaign About Oil

THE WALL STREET JOURNAL.
WSJ.com

OPINION | March 19, 2012, 7:24 p.m. ET

Move Over, OPEC—Here We Come

In energy, North America is becoming the new Middle East. The only thing that can stop it is domestic politics.

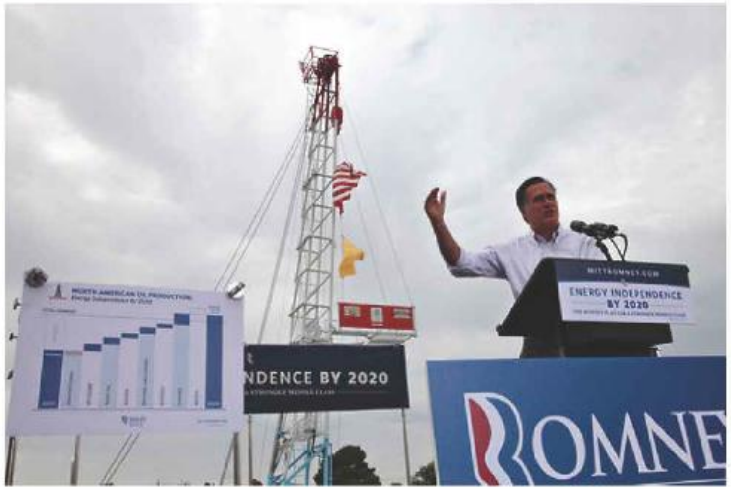
By ED MORSE

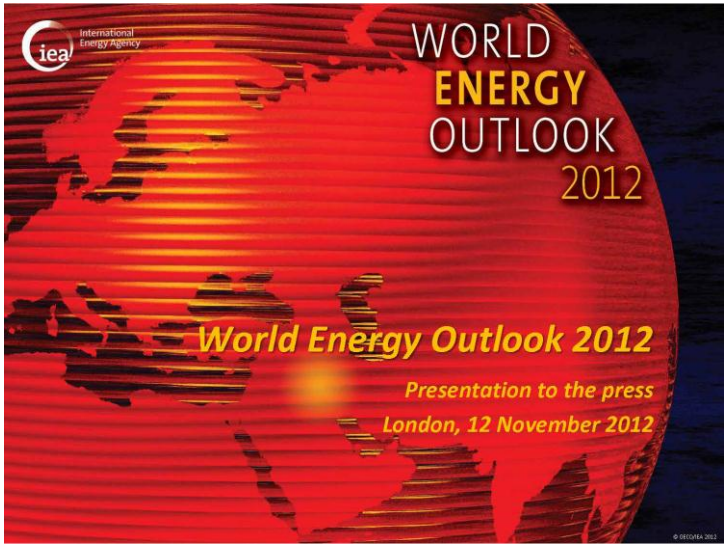
Bloomberg

Americans Gaining Energy Independence With U.S. as Top Producer

By Rich Miller, Asjylyn Loder and Jim Polson - Feb 6, 2012

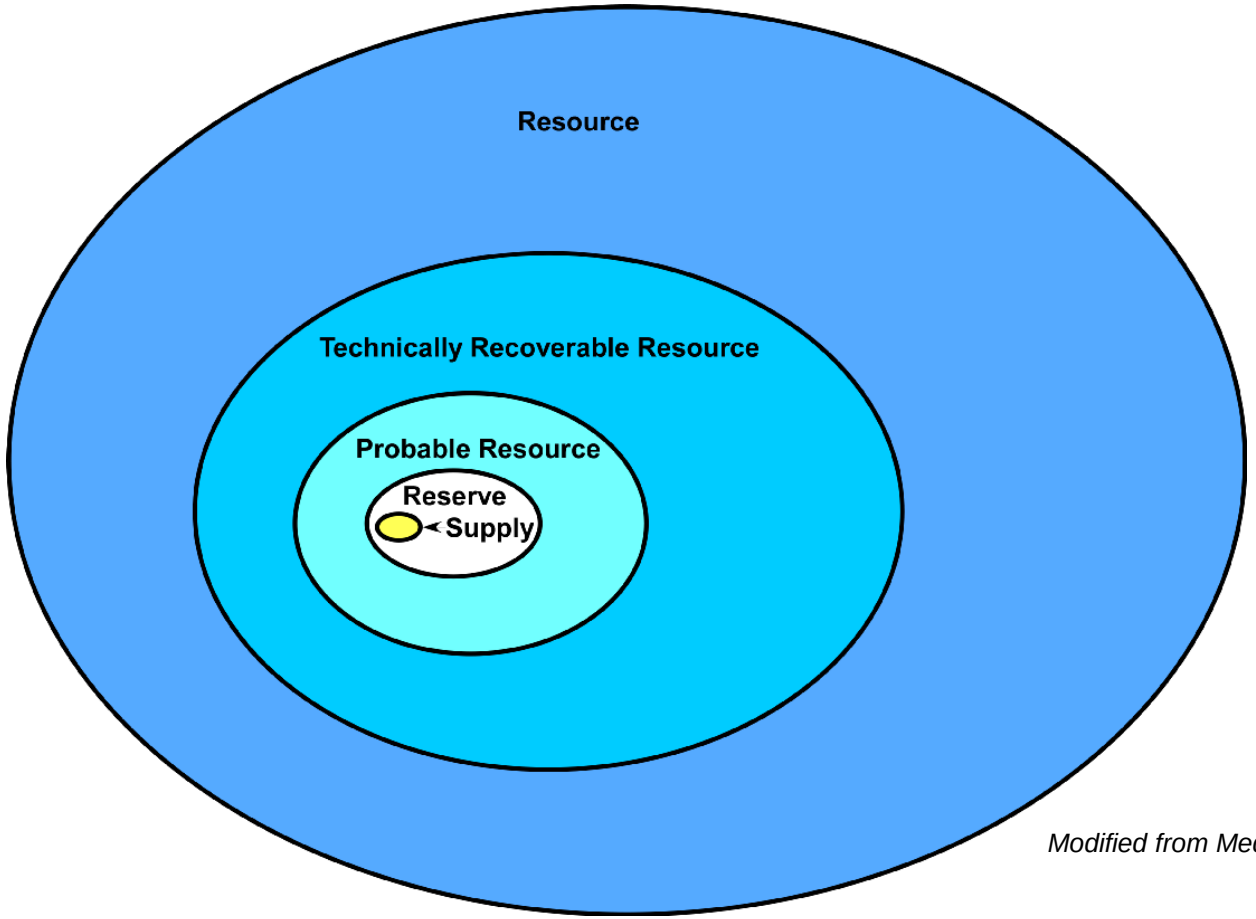
Romney Unveils Plan for Energy Independence





"Why not?
Price, cost, and returns. None are really dealt with by the IEA."
--Rune Likvern

Resources ≠ Reserves ≠ Supply

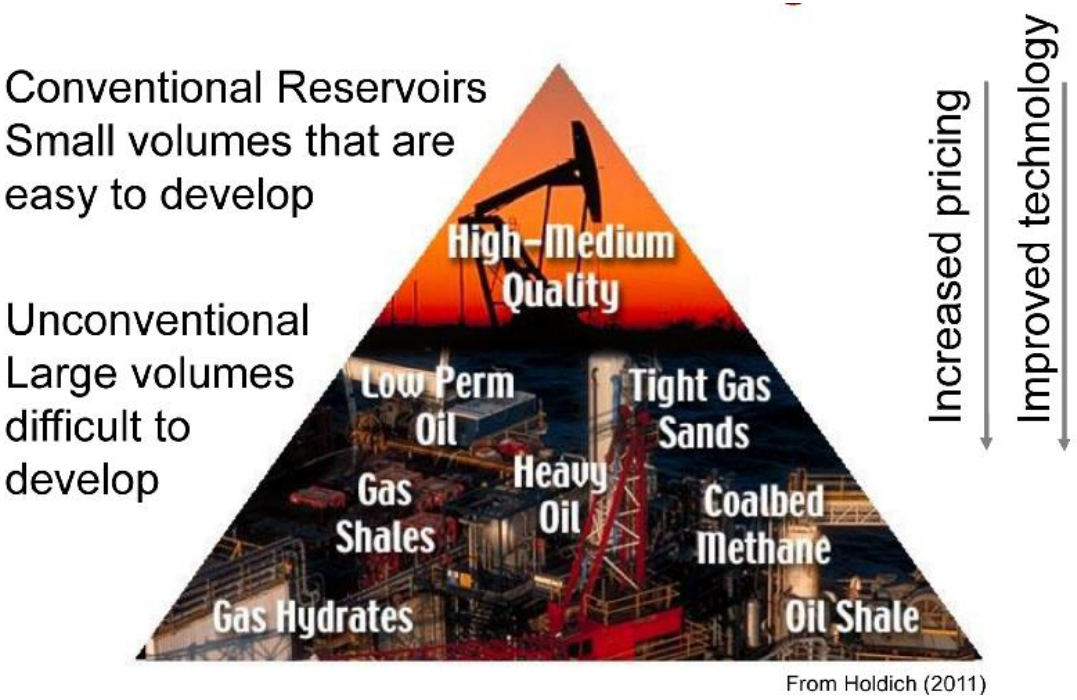


Modified from Medlock (2010)

- Reserves are a very small sub-set of resources.
- Reserves take years of development drilling to become supply.
- Proved undeveloped reserves may never be developed.

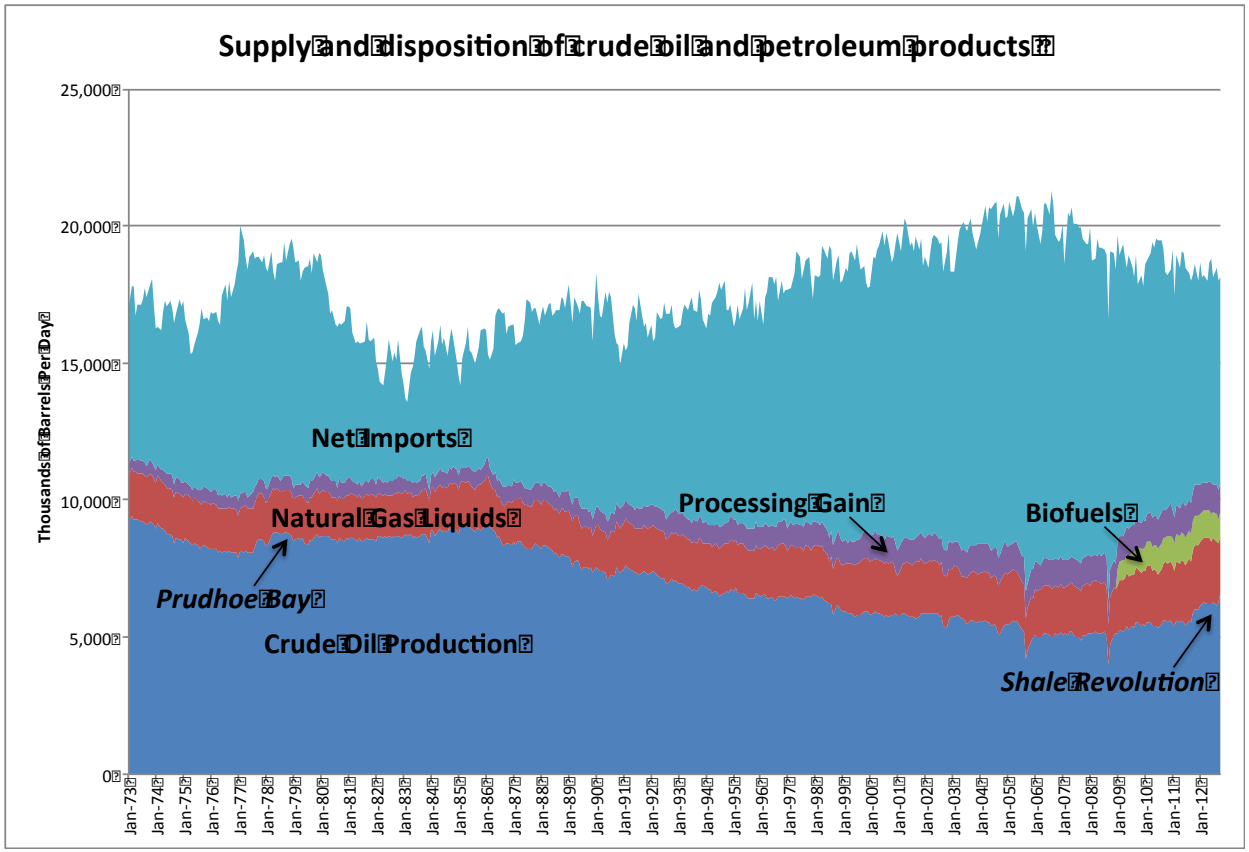
A view from the bottom of the resource pyramid

- Unconventional plays became important as better plays were exhausted.
- There is no technological revolution, just improvement through extensive & expensive trial-and-error.
- Shale reservoirs will not perform as well as conventional reservoirs.
- Economics depend on high oil prices.
- And the drilling treadmill never ends because of high decline rates.
- Demand destruction will limit oil price and, therefore, the long end of the unconventional production curve.



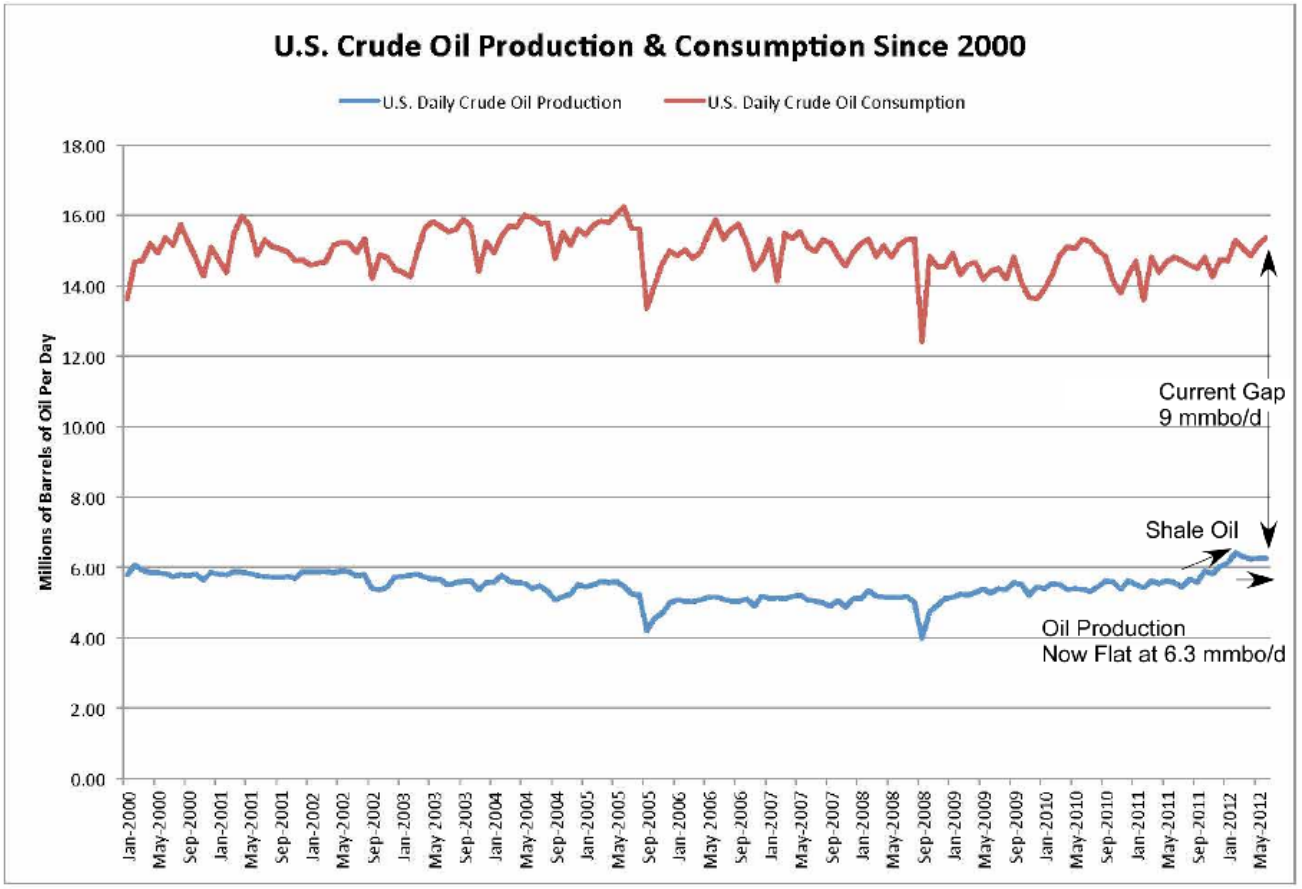
From Holdich (2011)

Crude Oil vs. Liquids



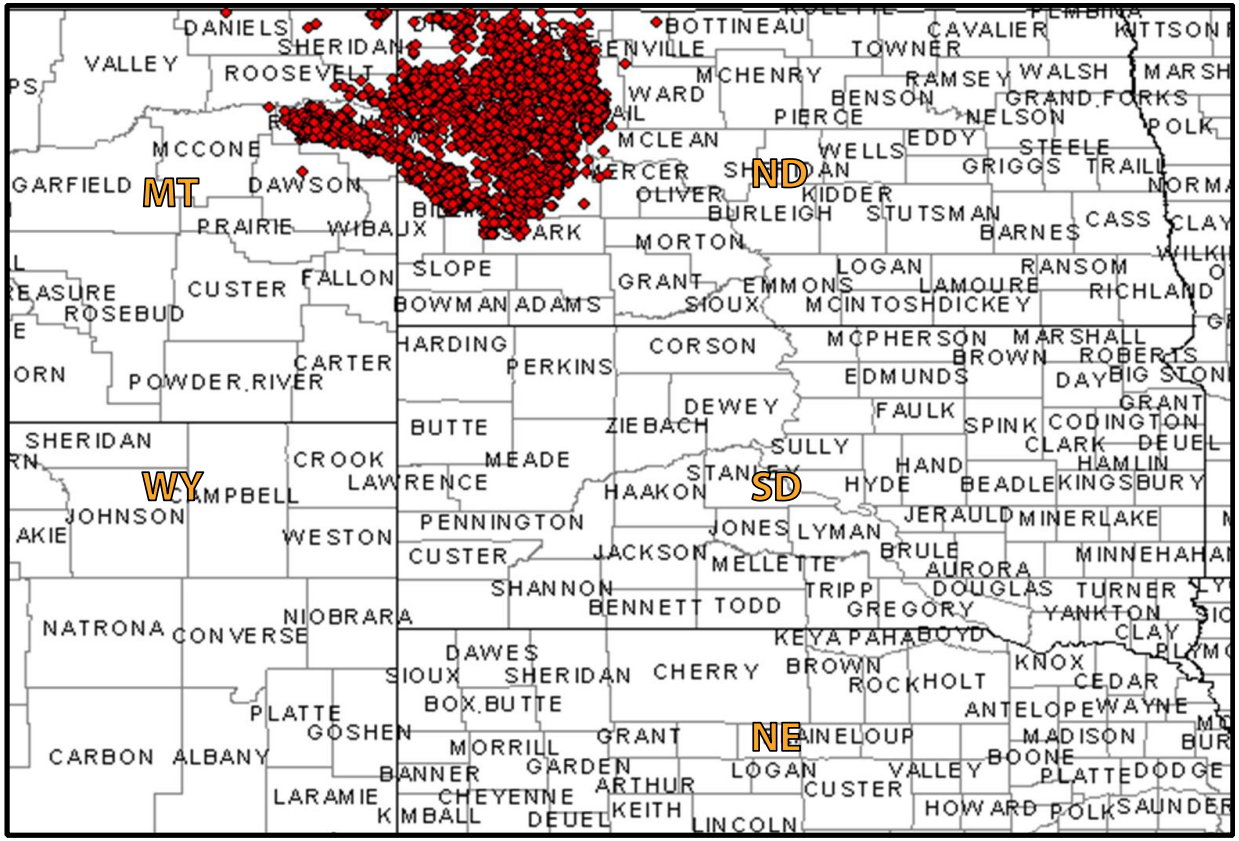
- Crude oil, petroleum products & petroleum liquids are commonly grouped together.
- They are not the same.
- Natural gas liquids have lower heat content than oil, and are not used for transport. NGLs must be distilled from natural gas.
- Refinery processing gain results from refining crude oil into products with lower specific gravity.
- Biofuels are not made from petroleum & have lower heat content.

U.S. Oil Production



- U.S. oil production is now flat at 6.3 mmbo/day.
- U.S. crude oil consumption is 15.4 mmbo/day.
- The gap between production and consumption is 9 mmbo/day.
- It is unlikely that the U.S. will become energy independent.

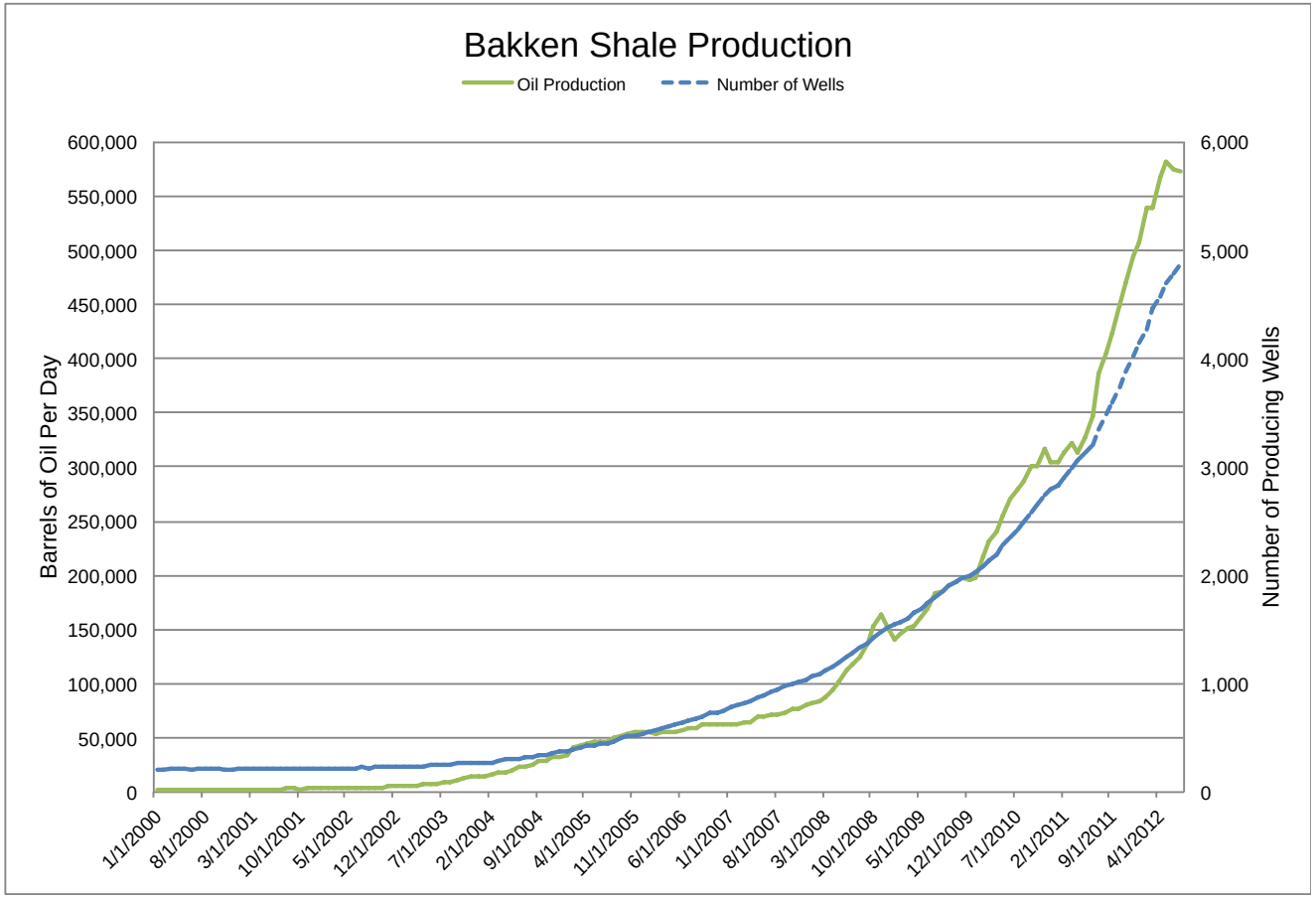
Bakken Shale Location Map



Data from DI

- 236 rigs drilling in the Bakken.
- Second highest rig count.

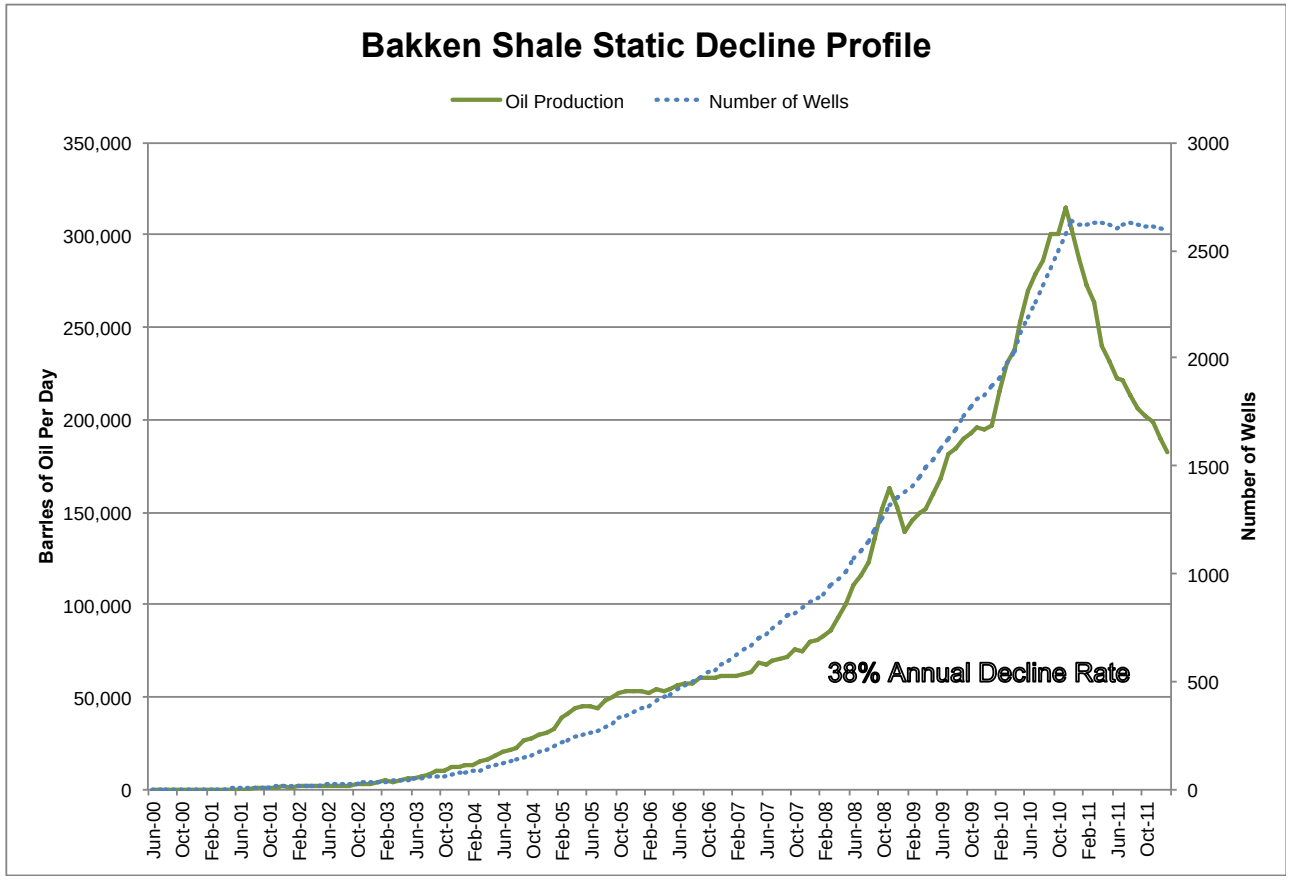
Bakken Shale Total Production



Data from DI

- Oil production has increased to 573,000 barrels per day from 4874 producing wells.
- Average well is 118 barrels of oil per day. Well cost is $11.5 million.

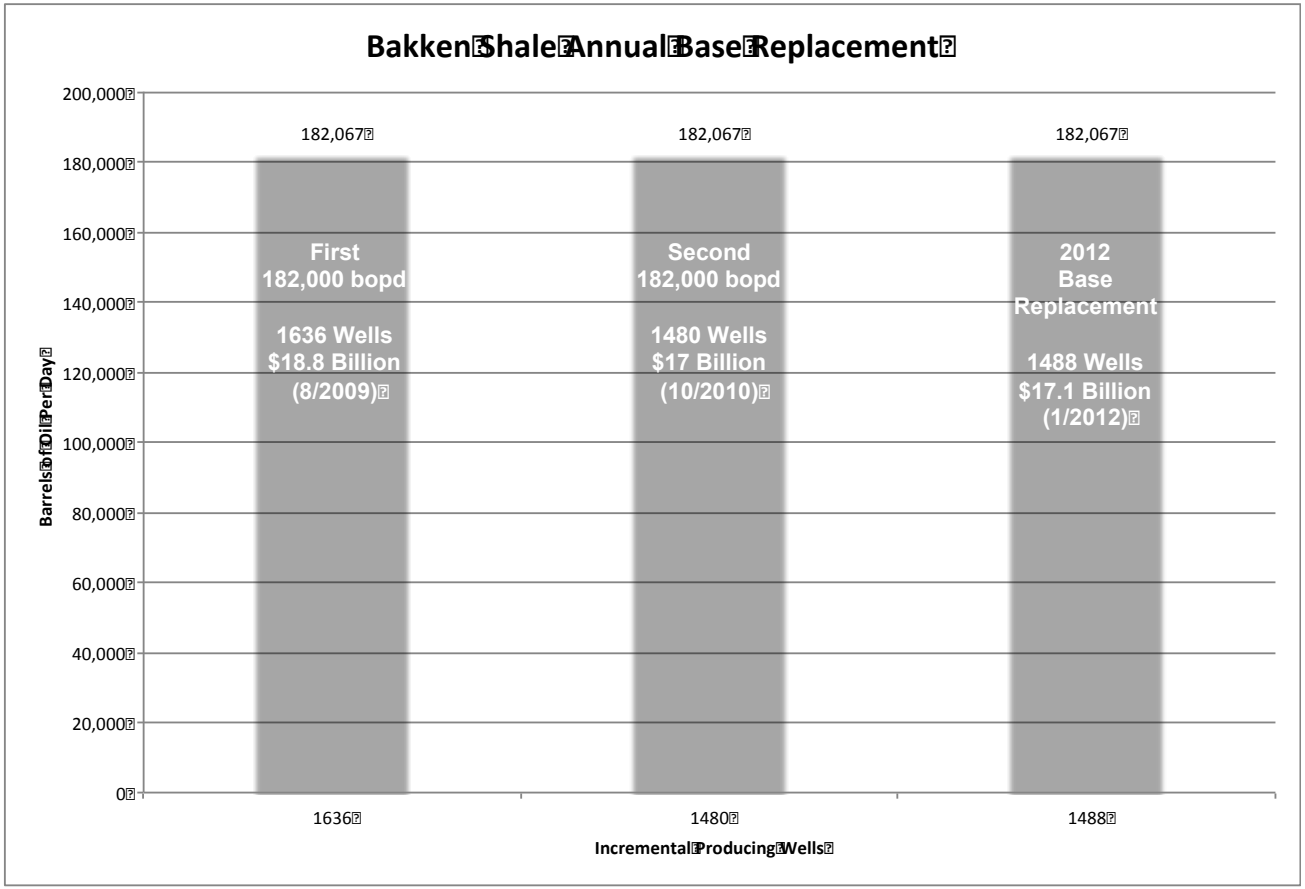
Bakken Shale Annual Base Replacement



Data from DI

- 38% annual decline rate.
- Must replace 182,000 bo/d each year to maintain supply.
- That means approximately 1,488 new producing wells/year at a cost of ~ $17 billion.
- 1130 new producing wells were added in last 12 months ($13 billion).

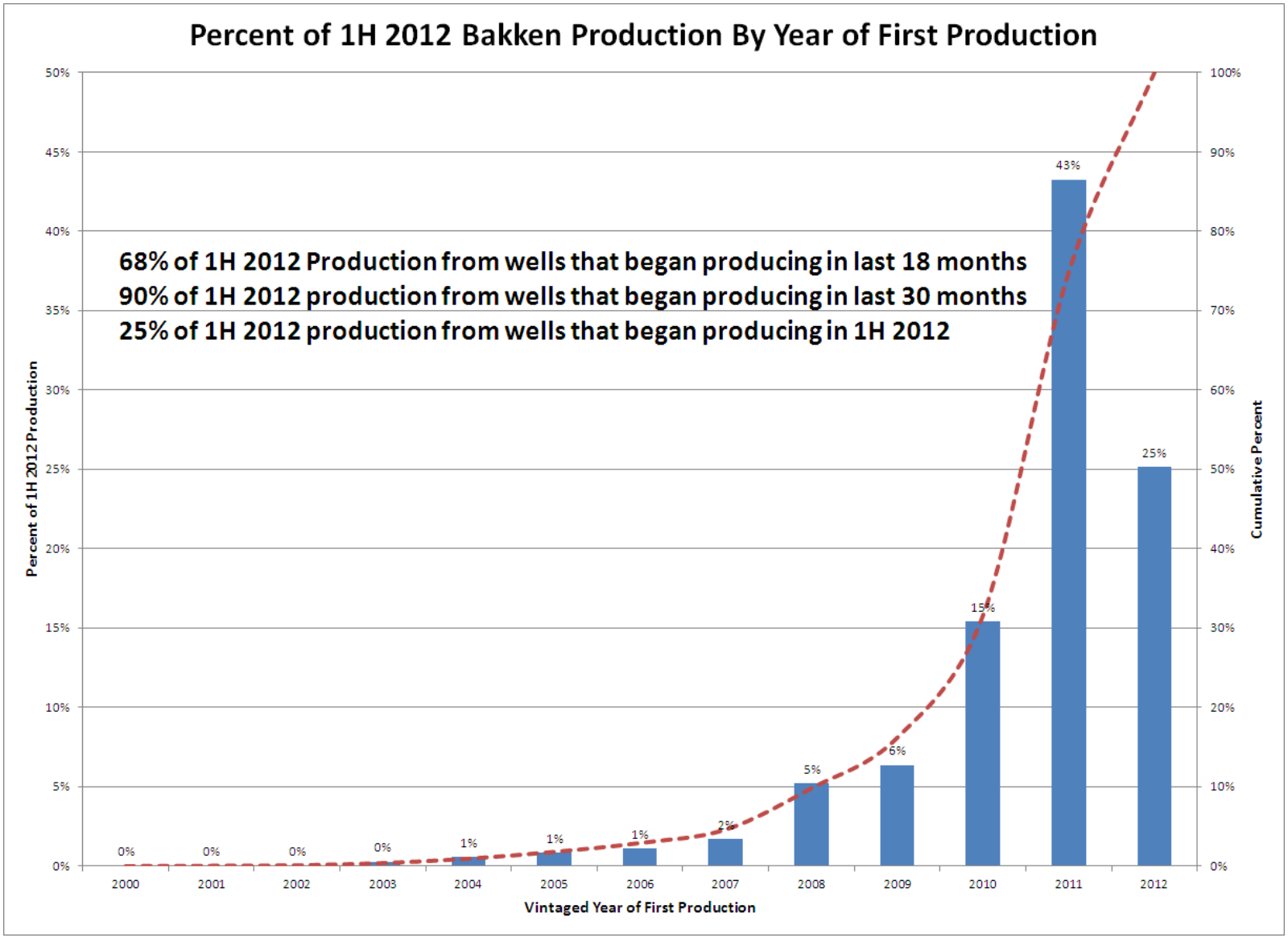
Bakken Shale Annual Base Replacement



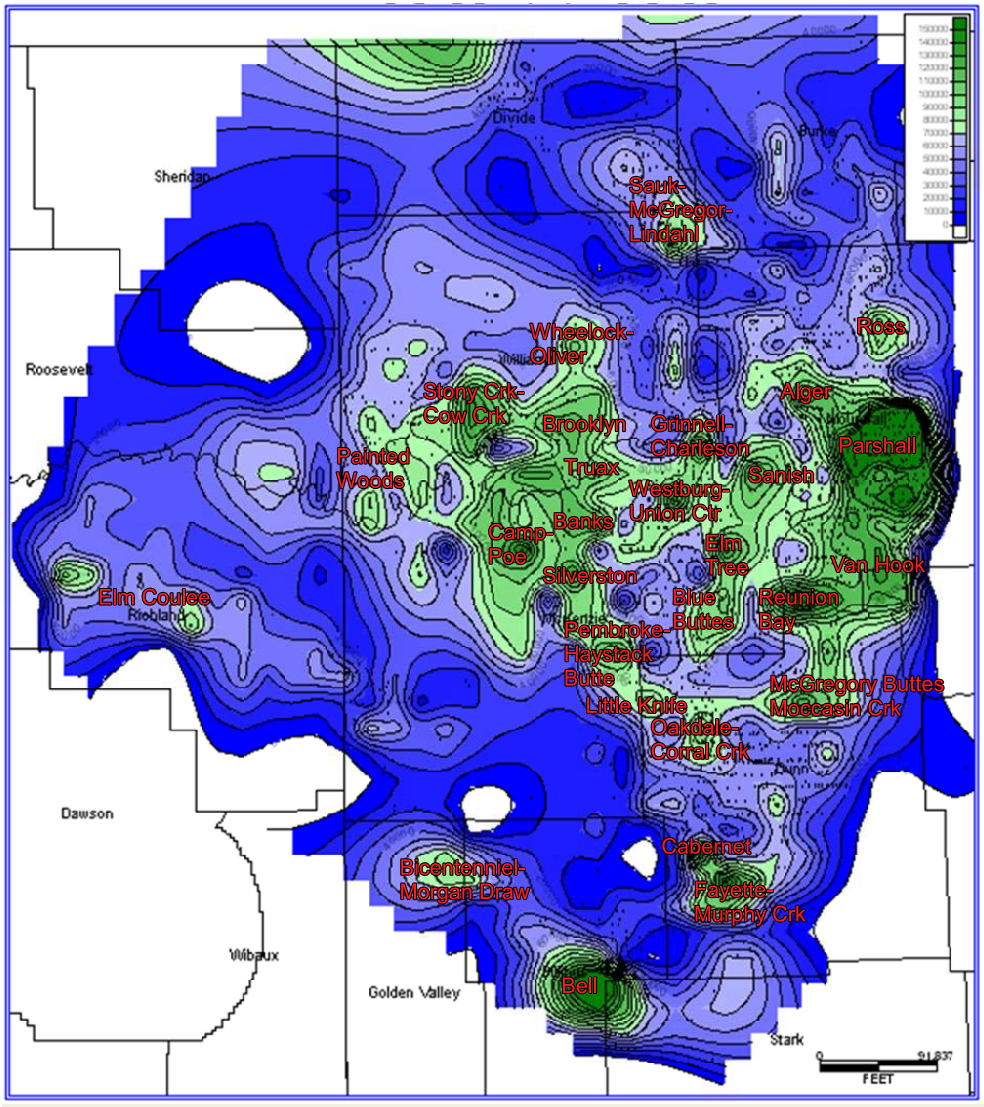
Data from DI

- Fewer wells required today to replace same volume as in 2009.
- No improvement in efficiency between 2010 and 2011.

Vintaged Bakken Shale Production



Bakken 12-month Cumulative Production Map



12-Month Bakken Cumulative Oil Production and Fields in This Study.

- Map shows wells with first production in 2006 or later.
- Green areas indicate break-even or greater production volumes
- Most production on the map is from the Three Forks reservoir.
- Indicates that production is from discreet fields.

Shale Oil Observations

- Shale oil obeys the laws of physics
  - ✓ Commercial oil is found in fields,
  - ✓ Plays are not fields,
- Shale plays depend on constant drilling and most current production is from wells drilled yesterday.
- Decline rates are breath-taking.
- Shale oil production requires infinite capital at low cost of capital.
- It is unlikely that oil from shale plays will result in energy independence.

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