# Tight/Shale Oil Outlook: Third IEA-IEF-OPEC Symposium on Energy Outlooks

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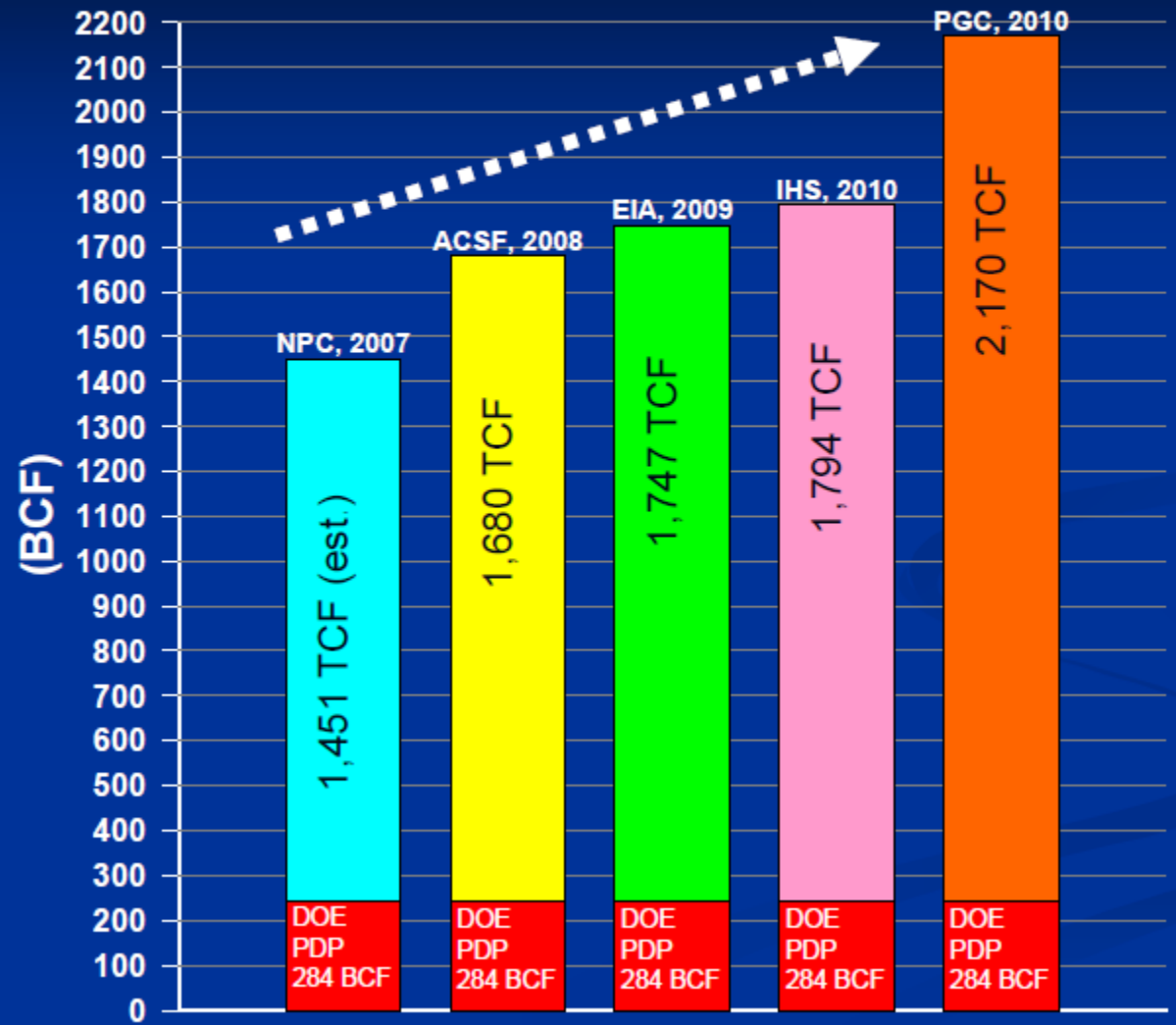
- Michael Warren, Executive Senior VP Upstream Research, Hart Energy
- David Hobbs, Head of Research, King Abdullah Petroleum Studies and Research Center, Chief Energy Strategist IHS
- Paul Stevens, Senior Research Fellow, Chatham House, Emeritus Professor University of Dundee
- Barbara Shook, Houston Bureau Chief, Energy Intelligence Group, Recent articles on natural gas revitalization

Thanks to USGS Colleagues; Gary Stewart, Melange International, Thomasson Partners Associates; Ivan Sandrea, David Knapp-Energy Intelligence Group, OPEC, IEA, IEF

# Topics

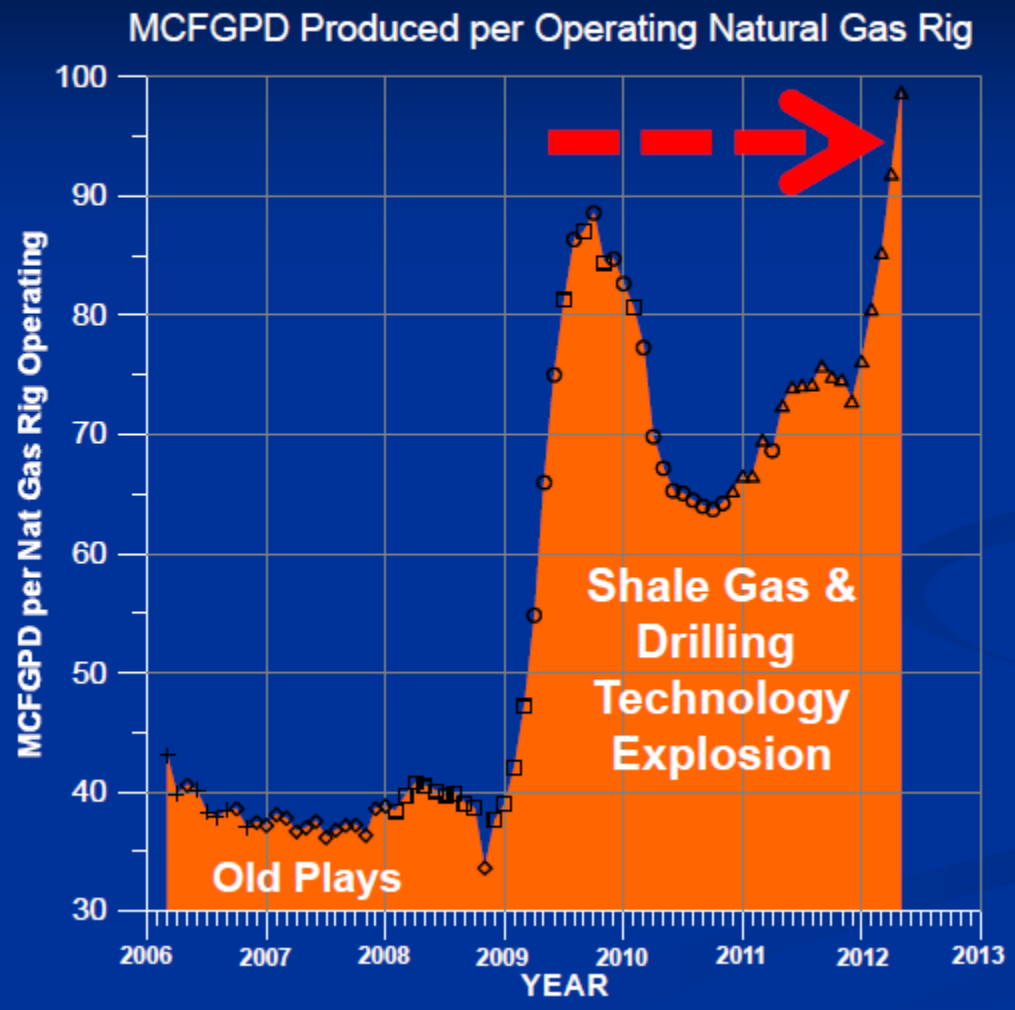
- Is the rapid expansion of shale oil production in the US sustainable/challenges?
- Is US experience repeatable globally, where and to what extent?
- How is shale oil technology evolving?
- What is the outlook for other streams related to shale oil and gas, oil demand, GTL, environmental concerns?

# U.S. TECHNICALLY RECOVERABLE RESOURCE




Assuming U.S. NG Consumption remains flat, the US has ~ 97 Years Of NG "Reserves"

# New Wells Are Better Than the Old Plays



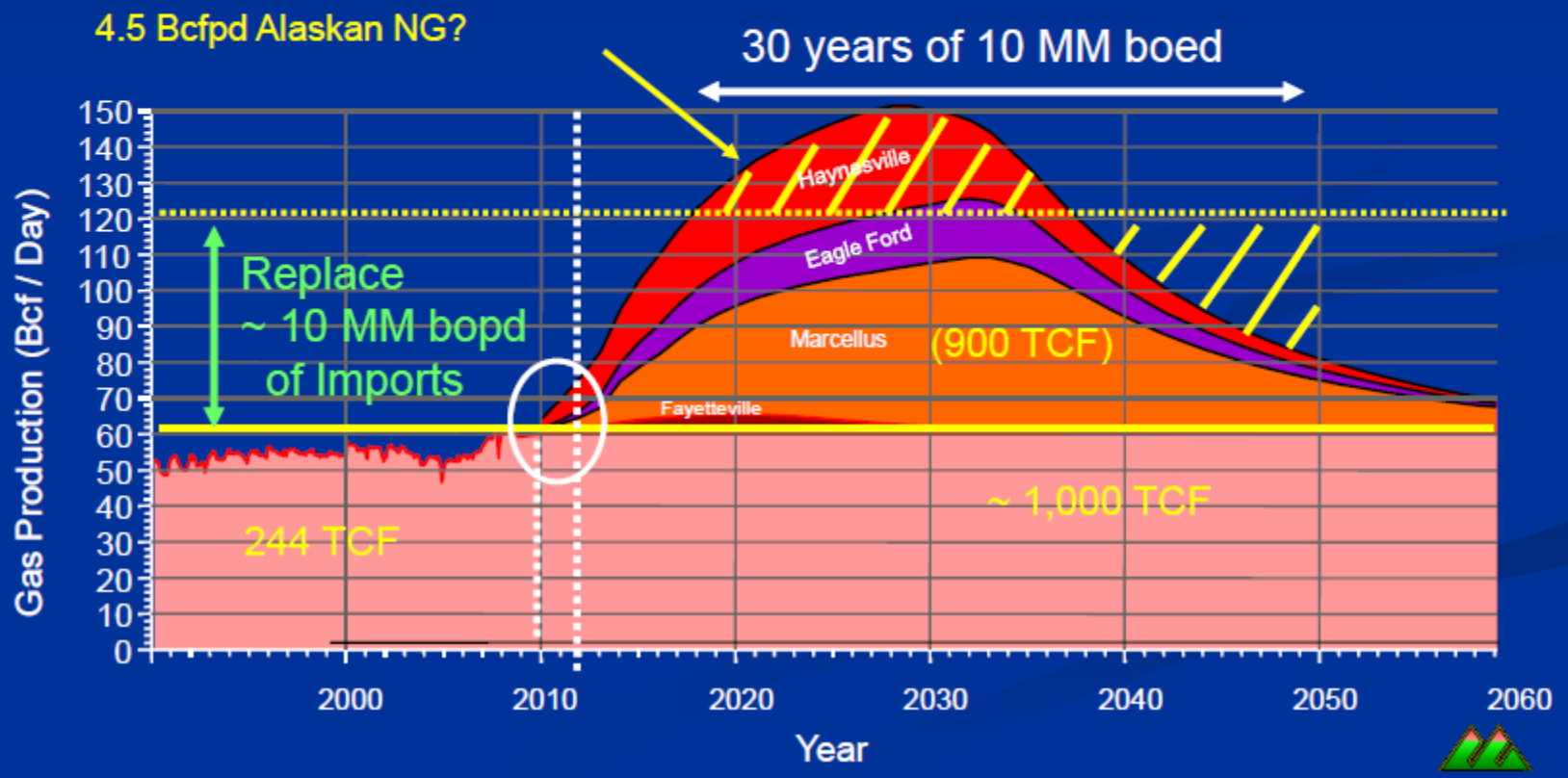

~ 750 NG Rigs are needed to maintain U.S. Natural Gas Production at 60 Bcfgpd

**We have more NG reserves, & it takes less rigs to extract it. These Resource Plays are for real!**

**This Blessing is now our new Challenge:**
**Too much Gas, Not enough Markets**

# U.S. Natural Gas Production Projection

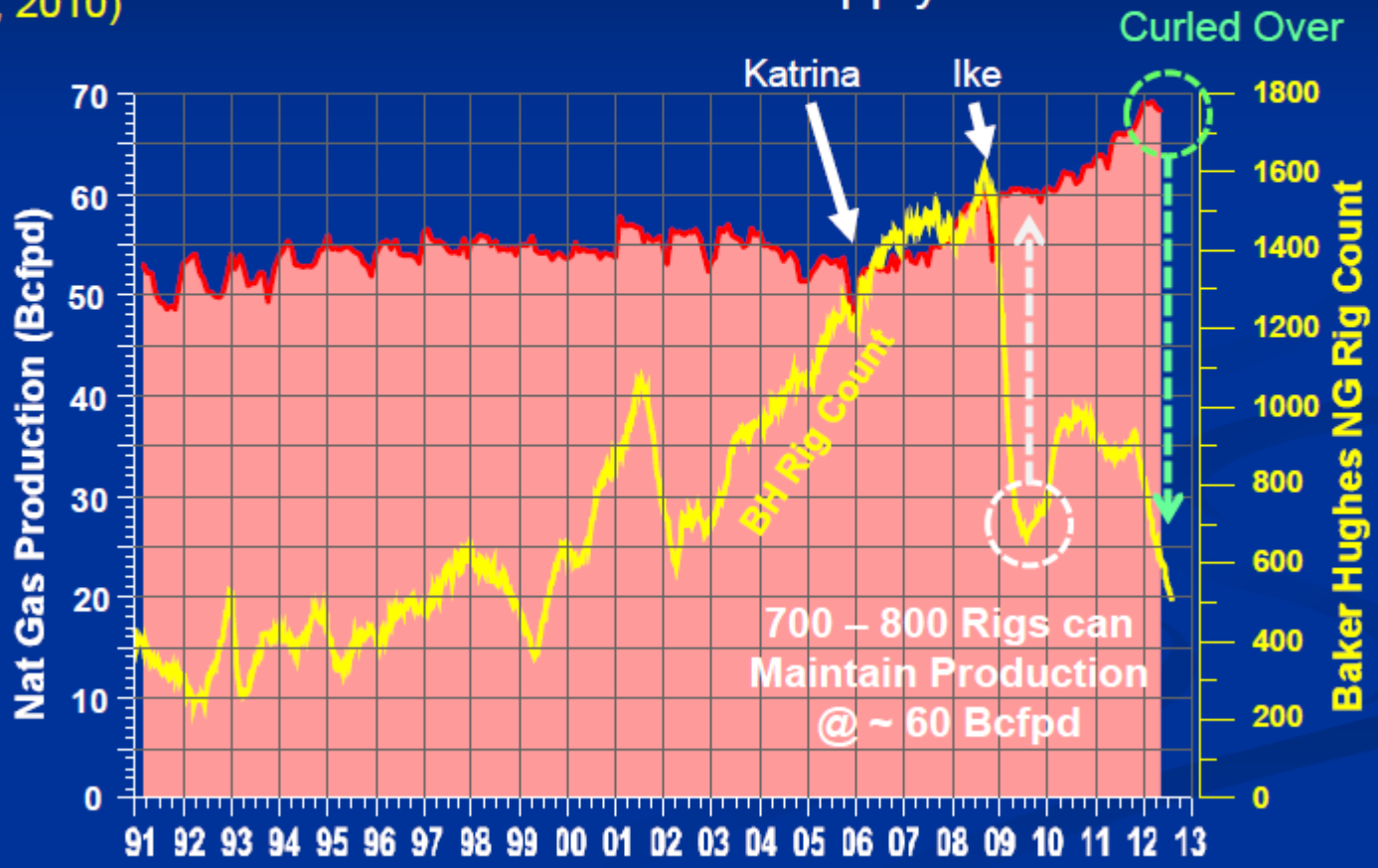
- As Modeled, 4 Shales can provide an additional 90 Bcf/day
- 900 TCF of Shale Gas Reserves can offset 2/3rds of our oil imports for 30 years



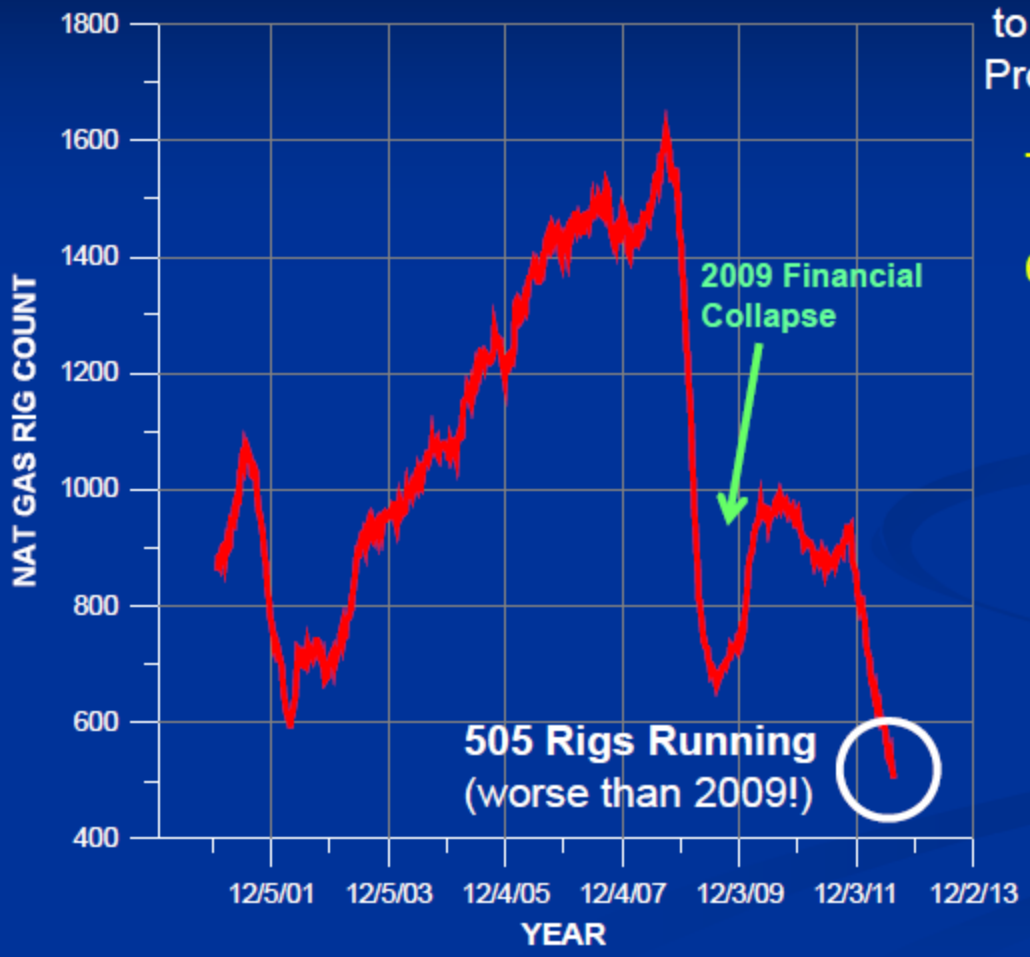
# UNITED STATES

Reserves:
284 TCF
(EIA, 2010)

NG Model Is Holding Up, but we have a problem!
Oversupply!



# Baker Hughes Natural Gas Rig Count




If ~ 750 NG Rigs are needed to maintain U.S. Natural Gas Production at 60 Bcfgpd, then:

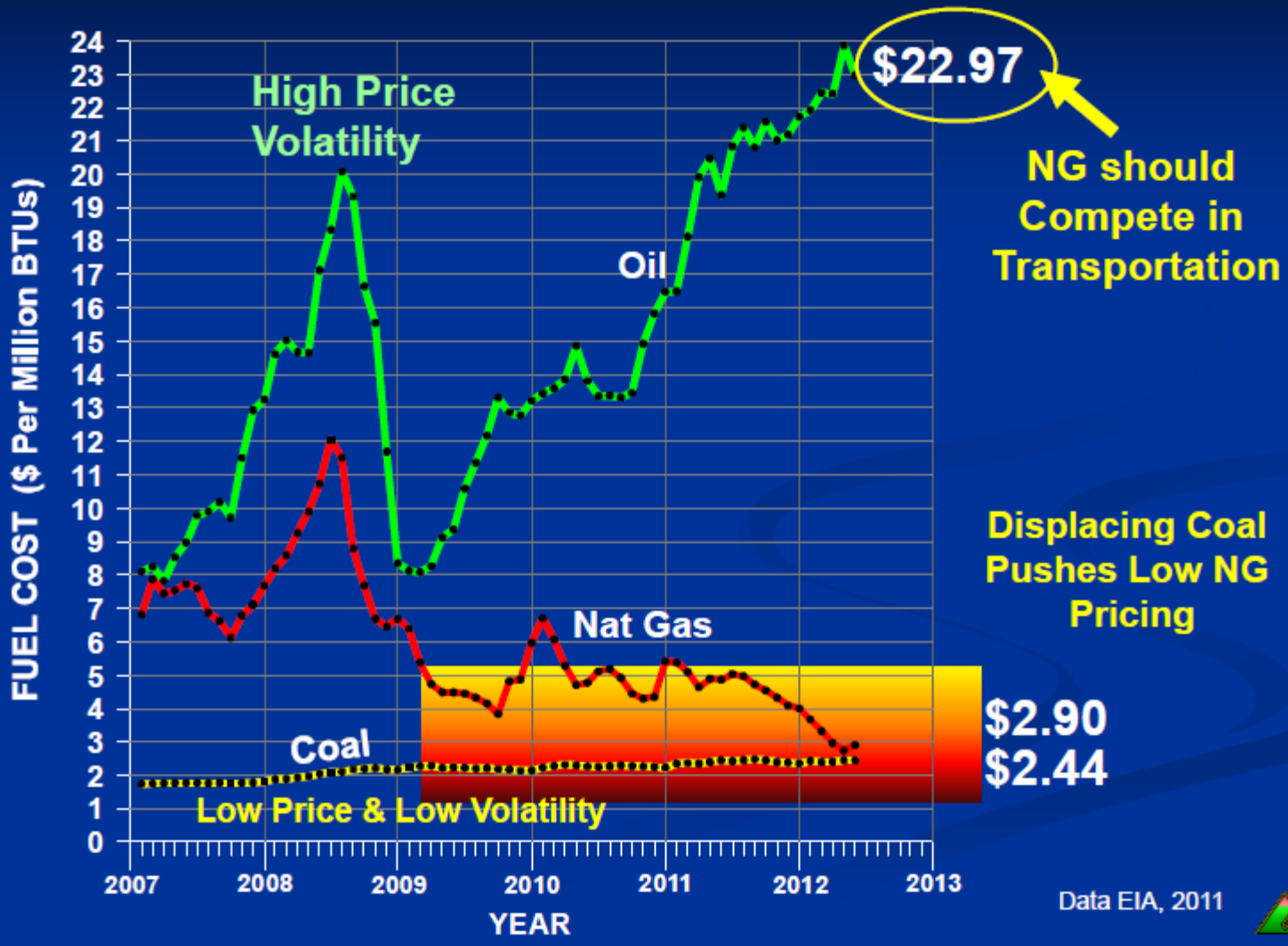
The current 500 operating NG rigs can not maintain 66 Bcfgpd production. NG Production has already started to curl over.

**Here's the Challenge:**

- If we run just 950 Rigs, NG prices will crater;
- If we lay down rigs, production plummets.

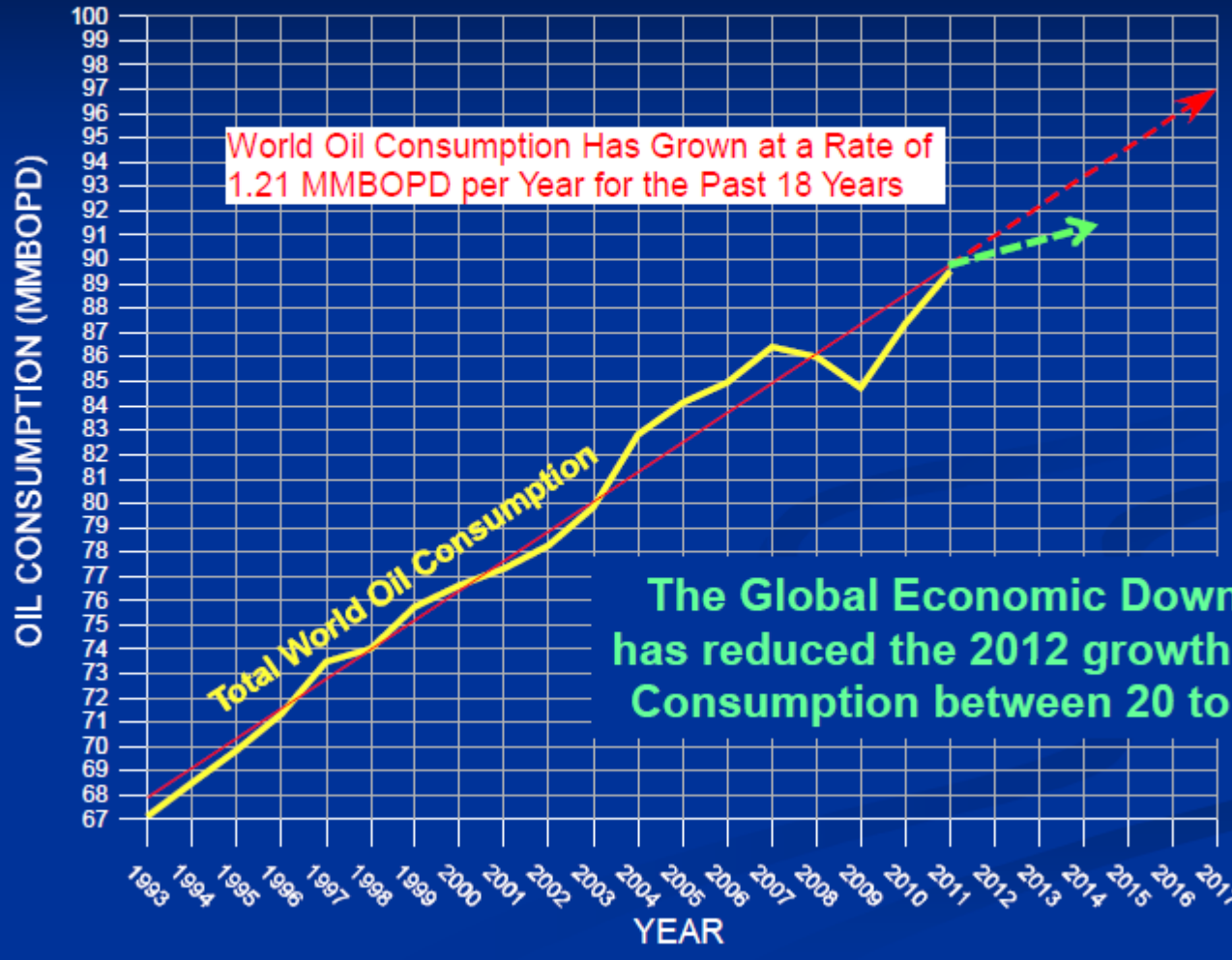
**How do we keep NG Consistently above $4 Mcf ??**

# FUEL COST: Want to Compete Against Coal?




Data EIA, 2011

# World Oil Consumption




**The Global Economic Downturn has reduced the 2012 growth of oil Consumption between 20 to 40%.**

# U.S. and Regional Resource Comparisons

- U. S. Shale Overview—55 active resource plays—22 proven oil, 17 natural gas, 16 unproven
- US Self Sufficiency by 2017 due to resource plays (IEA 2012)
- US is now the 2nd largest hydrocarbon producer (11 MMBOE) only behind Saudi Arabia largely due to resource plays
- Three plays , the Bakken (North Dakota) and Eagleford and Barnett (Texas) now produce as much oil as the offshore Gulf of Mexico
- Comparison with Bakken (North Dakota)
- The Bakken has moved North Dakota to the 2nd largest oil producing state and globally from a 58th oil production ranking to 13th in 5 years
- The Niobrara- a 40 year growth story

# North American Shale Resource Plays

(red=gas, green=oil, light blue=biogenic gas, yellow-unproven to date)

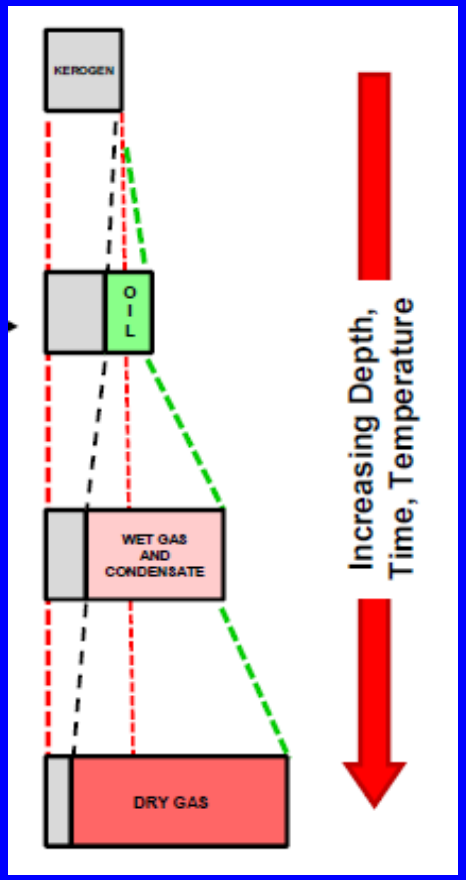

Jarvie, 2012, AAPG Memoir 97

# Shale Oil Historical Back Drop

- *Same concept as Shale Gas except the organic material is only partially cooked*

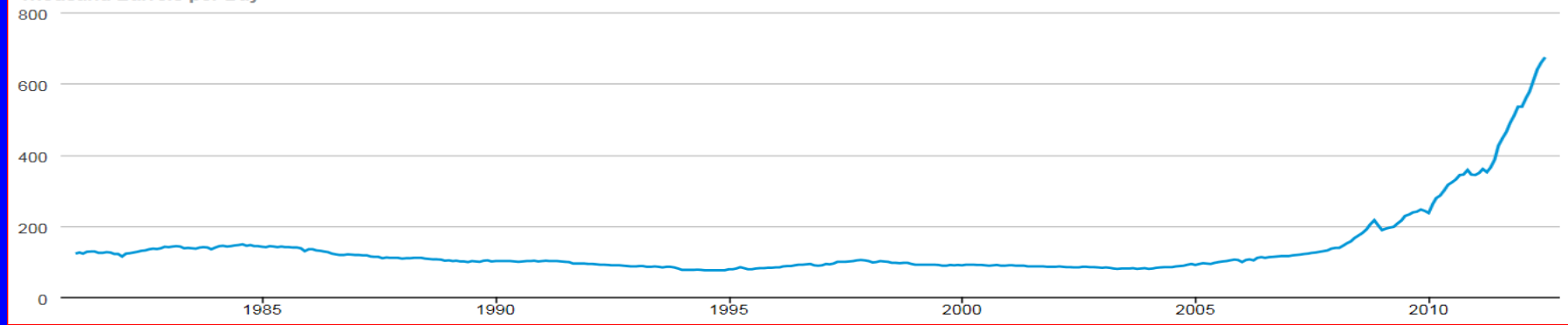
- *Same drilling and completion concept*
  - *Rubbalize the rock to increase rock volume connected to the wellbore*
  - *Very low permeability can be produced economically*

- *75% of generated oil is still located in the source rock*

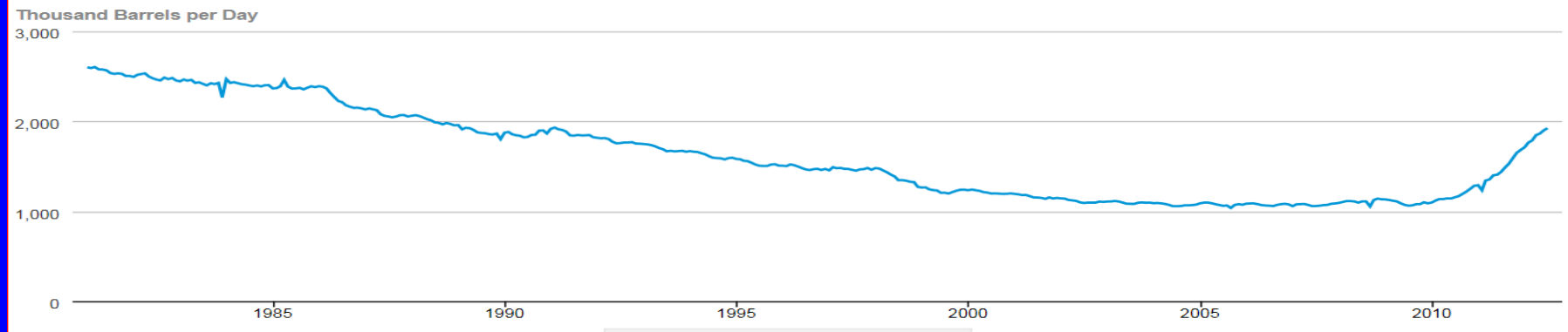



EOG, 2009

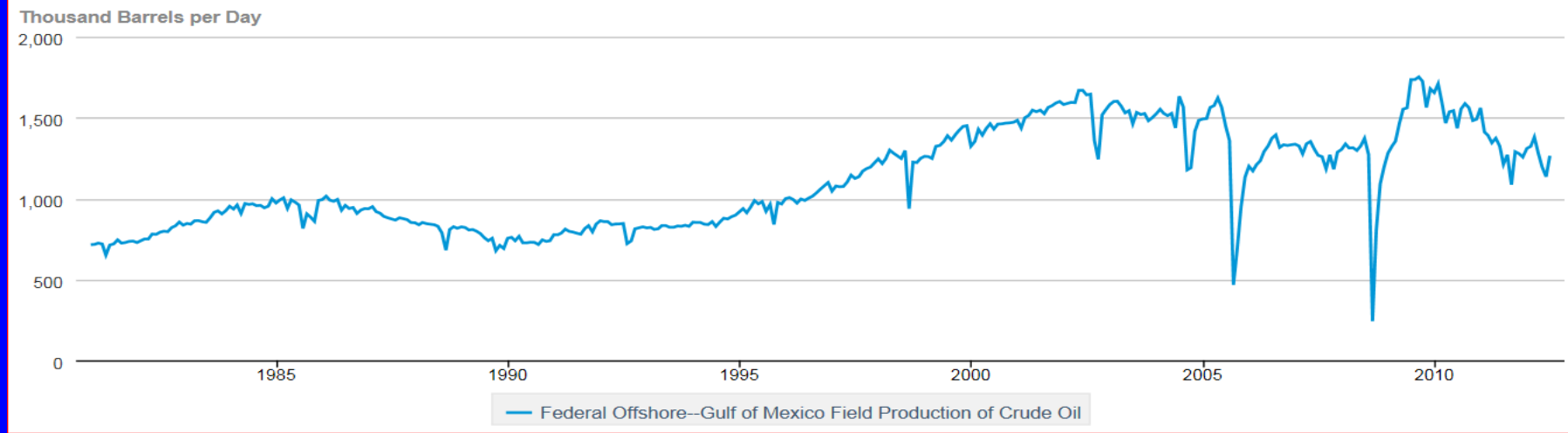
## North Dakota Field Production of Crude Oil



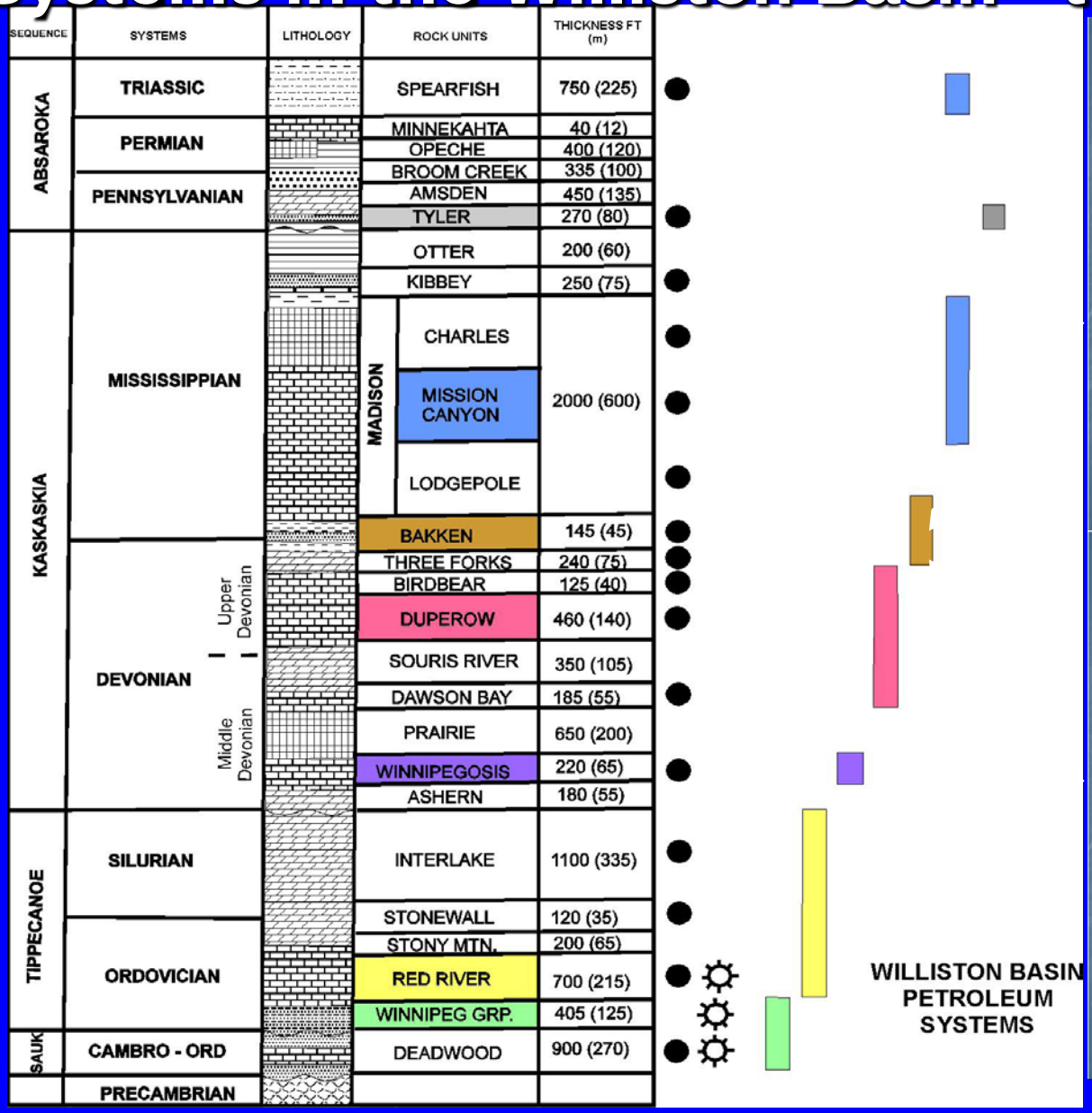

## Texas Field Production of Crude Oil

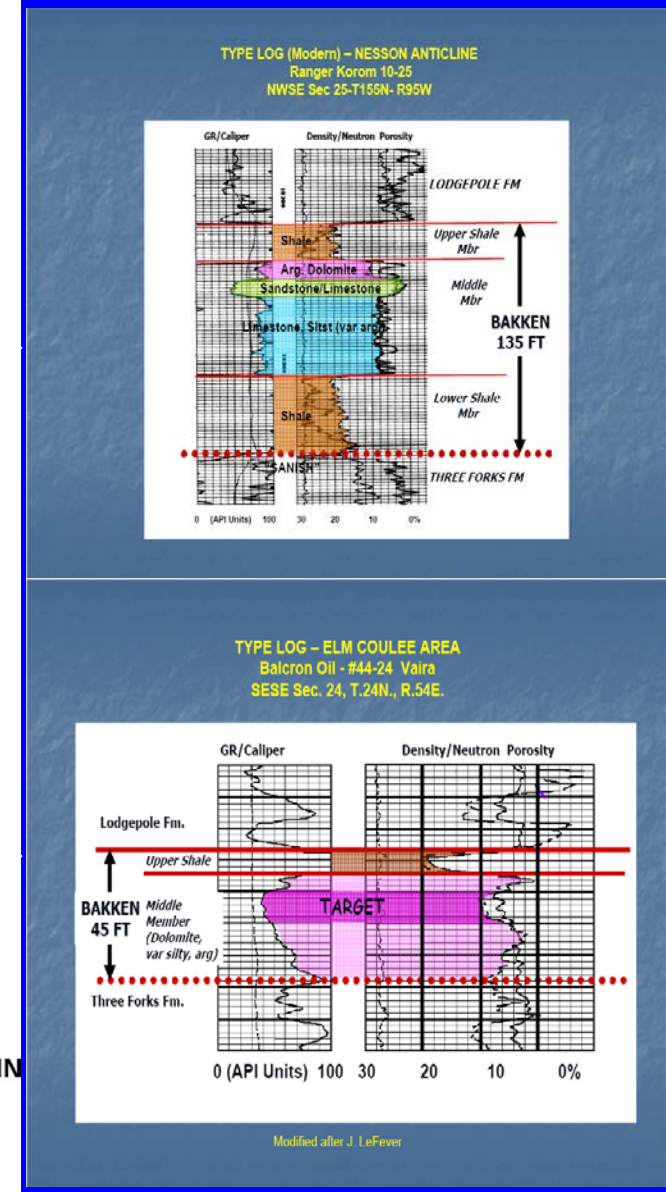



## Federal Offshore--Gulf of Mexico Field Production of Crude Oil



# The Bakken is One of Eight (12?) Petroleum Systems in the Williston Basin—the thinnest one

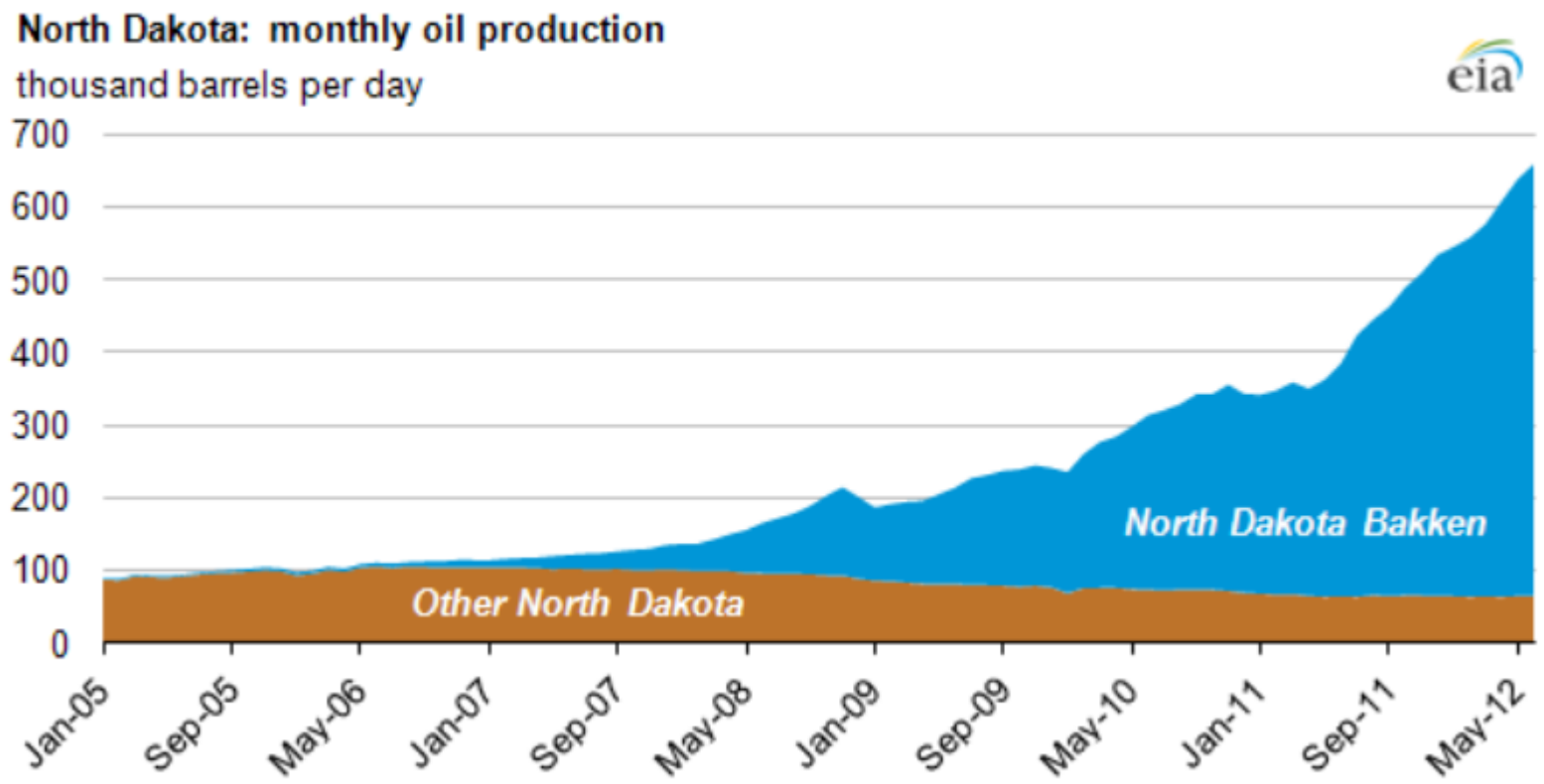



Sonnenberg et al., 2011

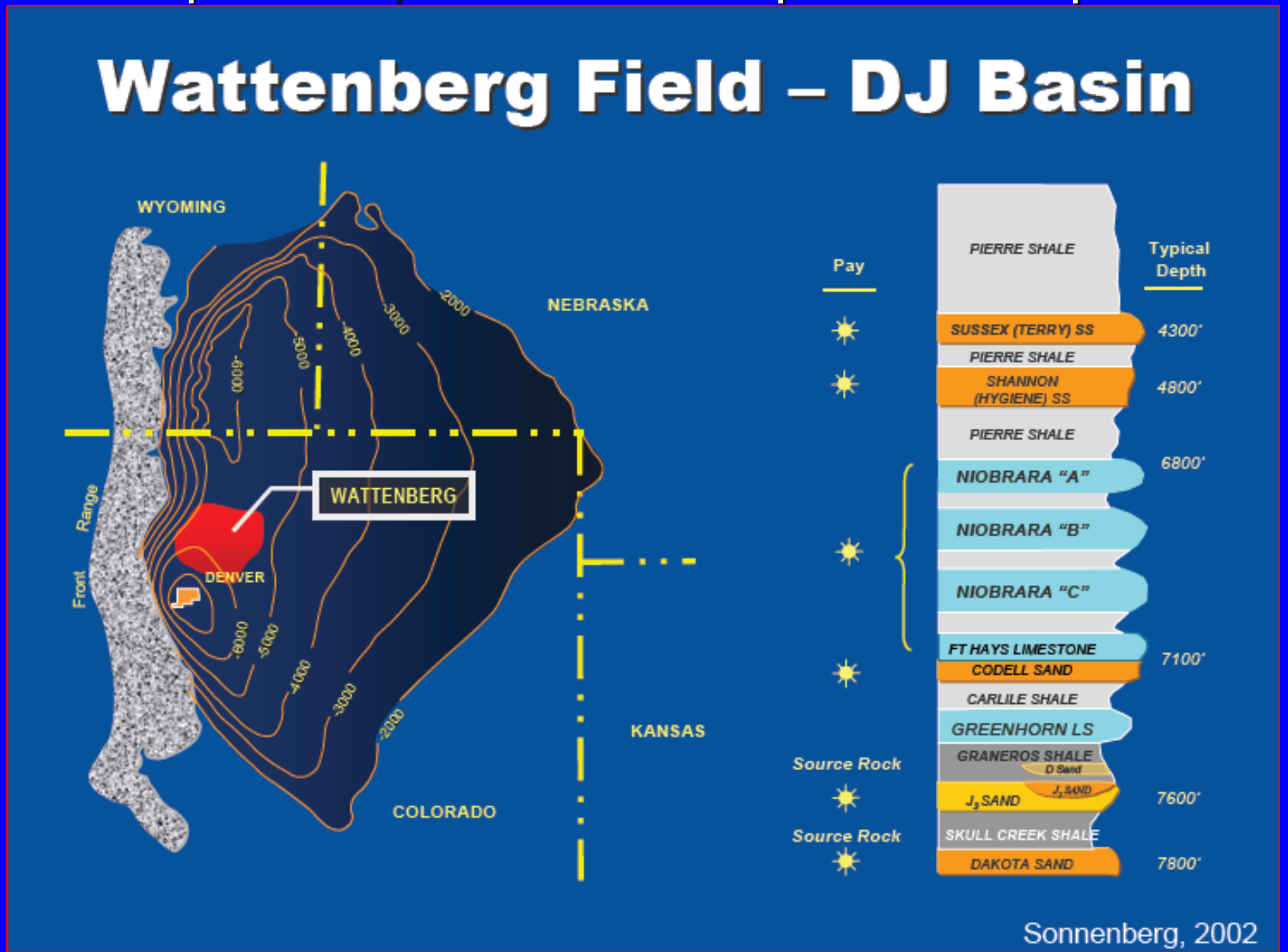
# The Williston Basin was 98th Oil Province in the World, Now it is the 50th ( in 5 years) due to the Bakken Oil Resource Play and is estimated to go to 1 million barrels of oil per day soon, 13th in the world

## North Dakota crude oil production continues to rise




**Source:** U.S. Energy Information Administration, based on North Dakota Department of Mineral Resources.
**Note:** Includes Bakken, Sanish, Three Forks, and Bakken/Three Forks pools.

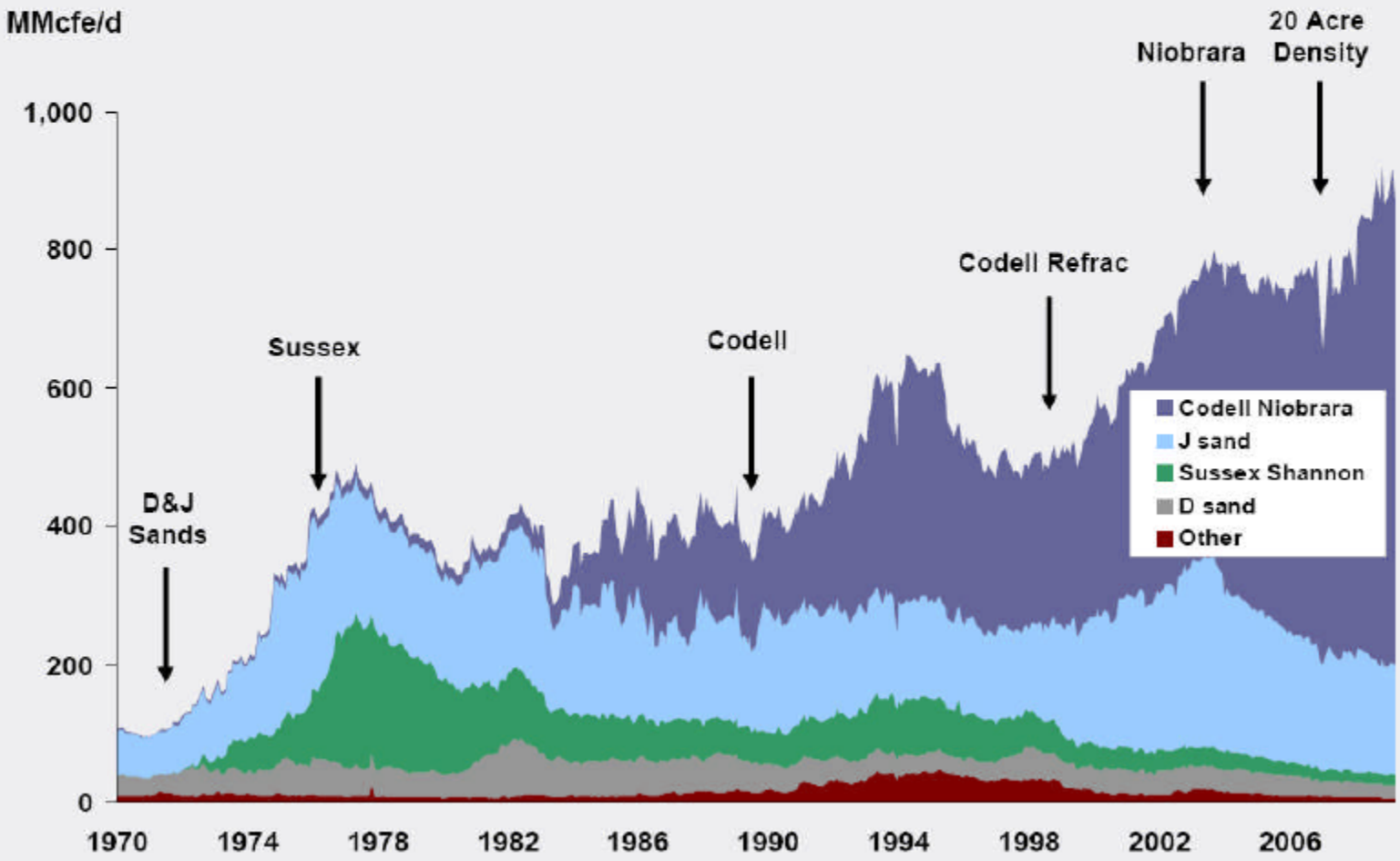
# Wattenberg Field, Weld County Colorado
# One of the largest US Natural Gas Fields
# 4 TCF produced, 1 to 1.5 BBO expected to be produced



# Wattenberg Redevelopment

## Industry Wattenberg Field Production

*Reinventing a true resource play*



# Global Perspective

- There are 2400 thermally mature source rock shales in the world's basins
- Approximately 200 of these shales are Type II kerogen (oil prone)
- In the top 20 provinces in the world, only 3 reside in the U.S., the largest ranking 9$^{th}$; i.e. the best source rocks are not in the U.S.
- Much overseas resource (unconventional) activity has not been focused on the best source rocks; e.g. Poland, Paris Basin
- Producing examples of underpressured oil shale plays (Domanik, Russia) and underpressured gas plays (Ordovician-Silurian, Jordan) have been producing for many years

# Unconventionals (Resource Plays) Dwarf Conventional Gas