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

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• **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

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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 Bcf/gpd

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

4.5 Bcf/d Alaskan NG?

30 years of 10 MM boed

Replace ~ 10 MM bopd of Imports

244 TCF

(900 TCF)

~ 1,000 TCF
NG Model Is Holding Up, but we have a problem! Oversupply!

700 – 800 Rigs can Maintain Production @ ~ 60 Bcfpd

Reserves: 284 TCF (EIA, 2010)
Baker Hughes Natural Gas Rig Count

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

The current 500 operating NG rigs can not maintain 66 Bcf/gpd 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?

High Price Volatility

NG should Compete in Transportation

Displacing Coal Pushes Low NG Pricing

Data EIA, 2011
World Oil Consumption Has Grown at a Rate of 1.21 MMBOPD per Year for the Past 18 Years.

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)
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
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.
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*

[Timeline graph with production data from 1970 to 2006, showing peak production years and key events such as D&J Sands, Sussex, Codell, Codell Refrac, Niobrara, and 20 Acre Density.]
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 9th; 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

Massive Potential
Estimated global natural gas reserves, in trillions of cubic meters

Source: BGR, 2009

North America:
- Conventional: 31.2 trillion cubic meters
- Unconventional: 372.4 trillion cubic meters

Europe:
- Conventional: 6.3 trillion cubic meters
- Unconventional: 84.4 trillion cubic meters

CIS (former Soviet republics):
- Conventional: 117.1 trillion cubic meters
- Unconventional: 248.8 trillion cubic meters

Middle East:
- Conventional: 35.4 trillion cubic meters
- Unconventional: 147.7 trillion cubic meters

Latin America:
- Conventional: 9.4 trillion cubic meters
- Unconventional: 233.2 trillion cubic meters

Africa:
- Conventional: 16.2 trillion cubic meters
- Unconventional: 153.2 trillion cubic meters

Asia/Australia:
- Conventional: 25.1 trillion cubic meters
- Unconventional: 480.1 trillion cubic meters

Worldwide:
- Conventional: 240.6 trillion cubic meters
- Unconventional: 1719.8 trillion cubic meters

Total: 60,734 TCF

For comparison: Global natural gas consumption in 2009 was 2.9 trillion cubic meters.