SHALE PLAYS GO INTERNATIONAL

Presentation by

G. Warfield Hobbs IV

Ammonite Resources Company
New Canaan, Connecticut

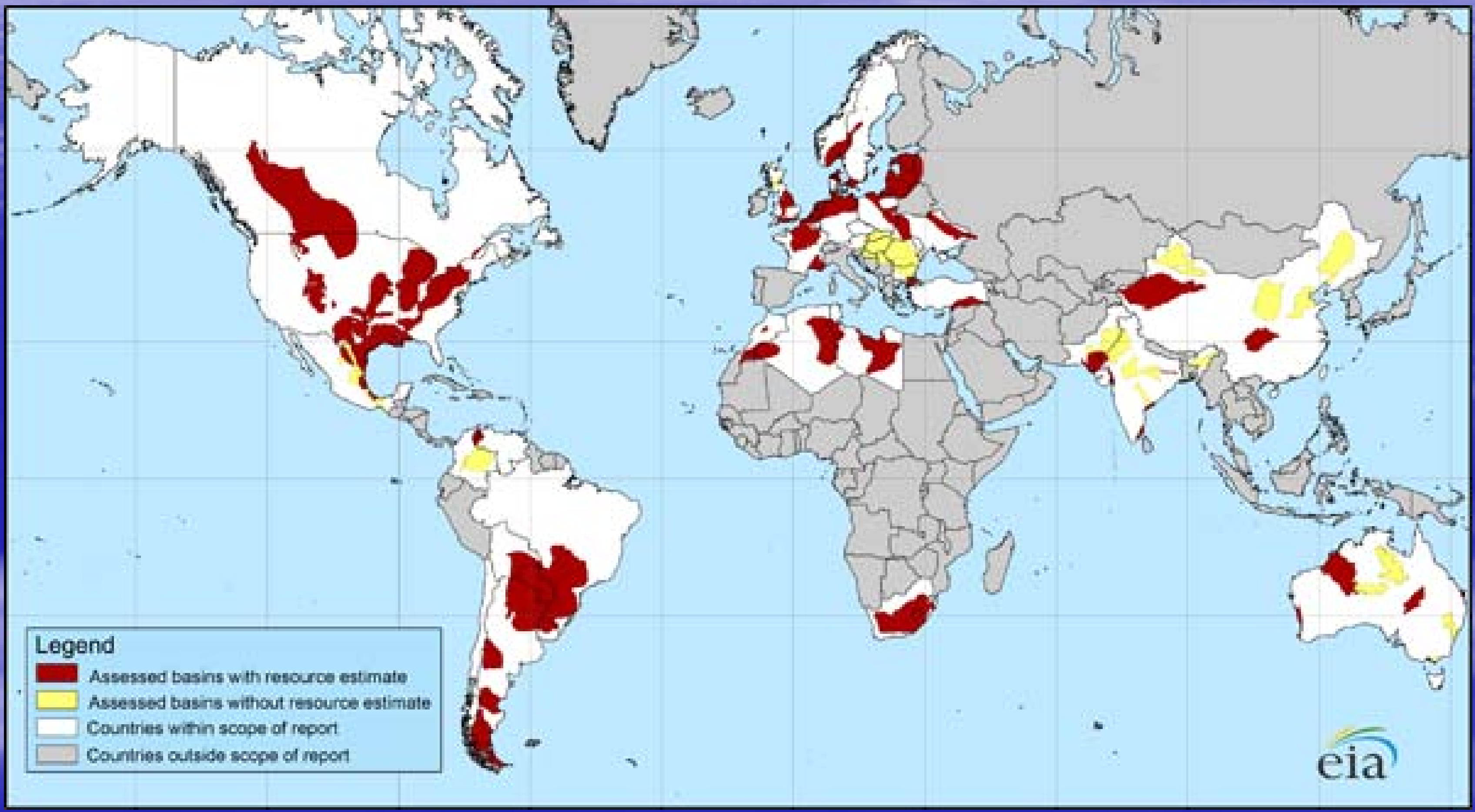
Yale Alumni In Energy Conference
New Haven, CT

March 23, 2012

INTERNATIONAL SHALE PLAYS

- ***Where are they?***
- ***The resource potential (Natural Gas and Liquids)***
- ***How are they different from typical North American operations?***
- ***Shale Plays = Gas from shales***
  Shales with liquids
  Oil Shales
- ***Scale of Resource and future impact***
  (Unconventional vs. Conventional)

GLOBAL SHALE BASINS ASSESSED BY EIA



48 Basins in 32 Countries exclusive of FSU and Middle East

Source: Advanced Resources Int'l for the EIA , April 2011

International Shale Plays
Some Representative Examples

COUNTRY	SHALE FORMATION	AGE	%TOC	Thickness (m)
Argentina	Los Molles & Vacas Muerta	Jur-K	1.6-5.0	up to 1,200
Brazil	Pimenteiras	Dev.	2.5-6.0	400
Colombia	La Luna	K	3.1	800
China	Ordos Basin / Permian Basin	Permian	2.0-5.0	250
Indonesia	Lahat	Eocene	1.7-16.0	150
Australia	Carynginia	Permian	2.0-11.0	15-350
Oman, UAE	Qusaiba Hot Shale	Silurian		
Saudi Arabia	Rub Al Khali Basin		4.0-12.0	20-70
Jordan	Mudawwara	Ord-Sil.	4.0-7.0	50-1,500
Syria	Tanf	Silurian	2.0-8.0	up to 530
Algeria	Frasnian Shale	Dev.	8.0 -14.0	120-200
South Africa & Botswana	Ecca	Permian	0.7-1.3	46
Turkey	Hamitabat	Eocene	1.0-7.0	50-350

Source: Hart Energy March 2011, others

GLOBAL SHALE GAS

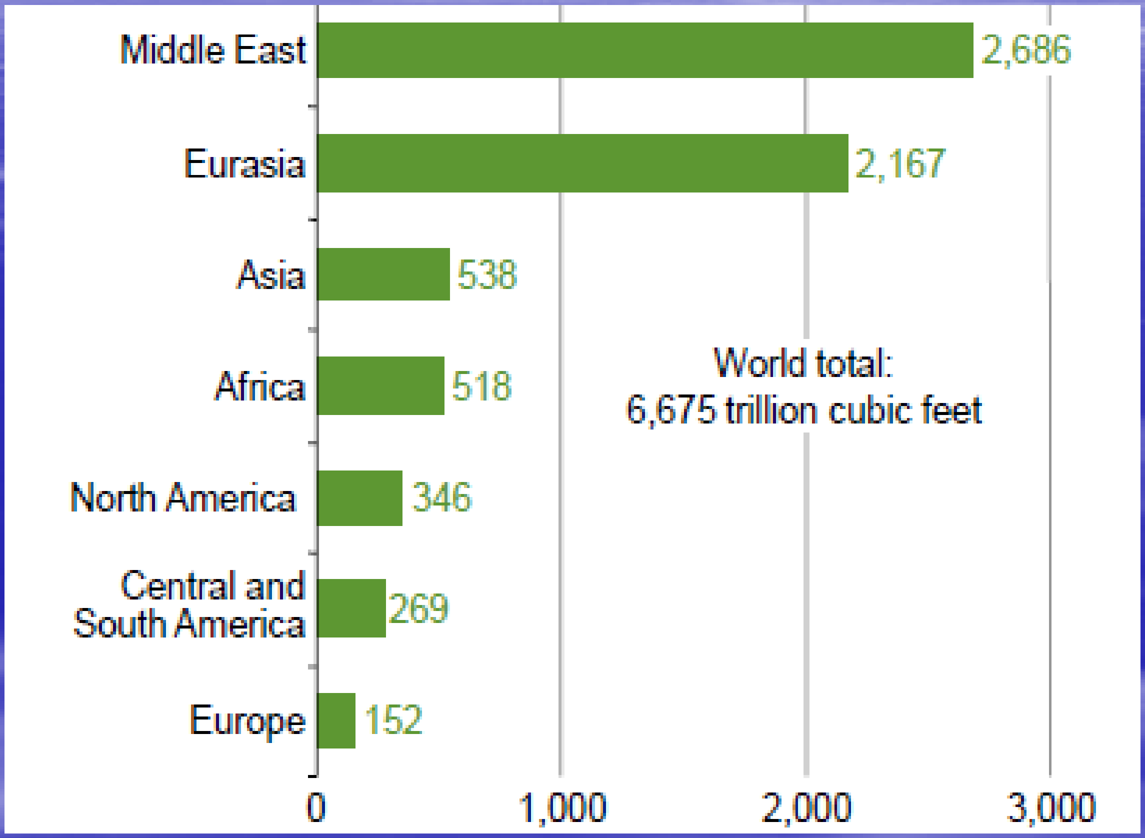
Technically recoverable shale gas resource in 48 basins outside Russia and Middle East @ 5,760 TCF *

(Global gas consumption currently @ 115 TCF)

Liquids Resource estimate @ ?

Source: Advanced Resources International study for EIA – April 5, 2011

WORLD PROVED NATURAL GAS RESERVES TRILLION CUBIC FEET @ January 1, 2011



Shale Gas could double global gas reserves

Source: Oil & Gas Journal
EIA International Energy Outlook 2011

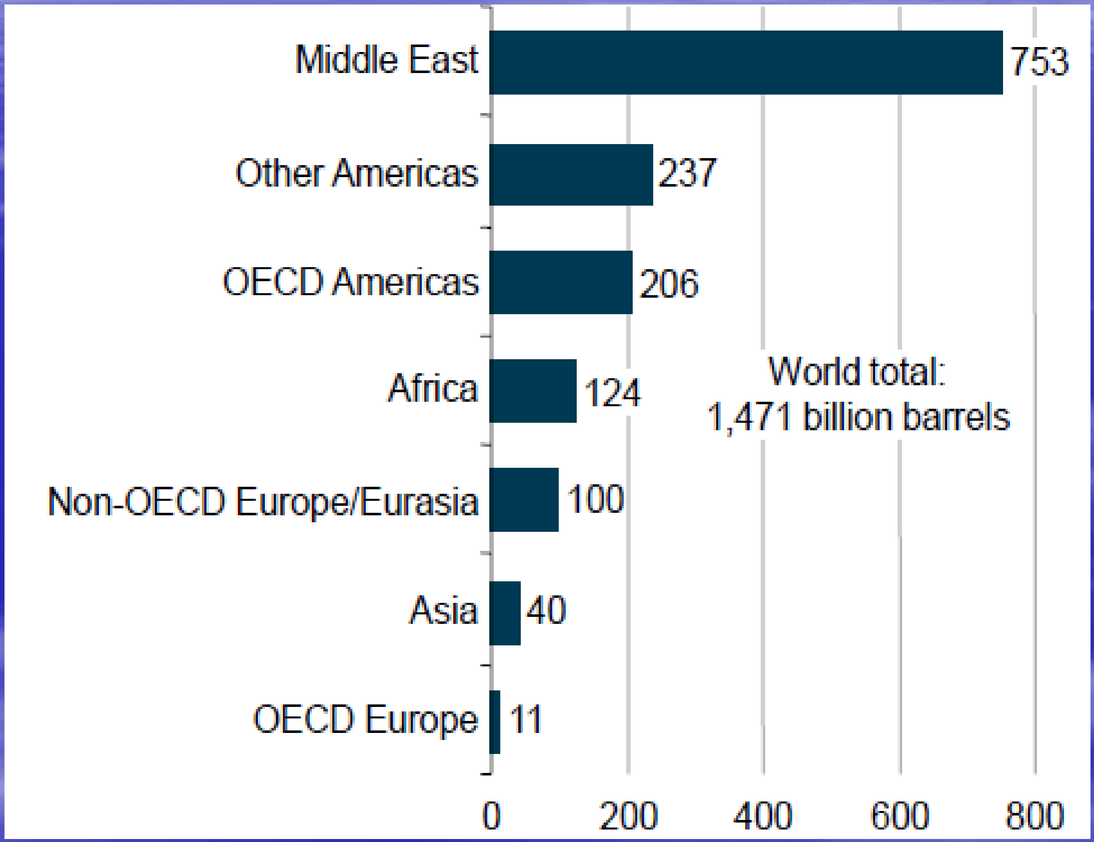
OIL SHALE

Global resource estimate of approximately
3 Trillion barrels of shale oil in place
with 1 Trillion barrels technically recoverable.
(commercial shales @100-200 litres oil/tonne)

USA (Green River Basin)
and Brazil = 87% total resource
= Kerogen (not crude oil)

Sources: NPC 2007, USGS 2005, DOE 2004,

WORLD PROVED OIL RESERVES
Billion BO @ January 1, 2011



Shale oil and oil from shales could double global oil reserves

Source: Oil and Gas Journal (quoted by EIA)

INTERNATIONAL vs. DOMESTIC OPERATIONS

Shale Plays outside North America
Are Emerging in a Totally Different Macro-Environment

- ***Mineral ownership***
- ***Regulatory Environment***
- ***Infrastructure***
- ***Competition with Conventional Resources***
- ***Commodity price structure for natural gas***

INTERNATIONAL RESOURCE PLAYS

Regulatory Environment

Resource plays are different vs. Conventional
- **i.e. - area of a typical petroleum license.**
- **regional vs. structural controls …**
- **(How define production license area and relinquishments?)**

Hydraulic fracturing requirements
- **(public resistance –Quebec, France, Bulgaria)**

Production profile (80% decline)

Reserves (more complex to define for a production license)

Petroleum laws must be revised (i.e. Colombia)

Result: plays are slower to permit and develop

INTERNATIONAL SHALE PLAYS

Natural Gas commodity Price

< $20/mmbtu (as LNG) internationally

Vs.

$2.30-$2.50/mmbtu in USA

Ergo: shale gas plays are very important.

(…and gas shales produce liquids!)

INTERNATIONAL SHALE PLAYS

Every Source Rock

= a Resource play with horizontal drilling and Hydro-fracturing technologies

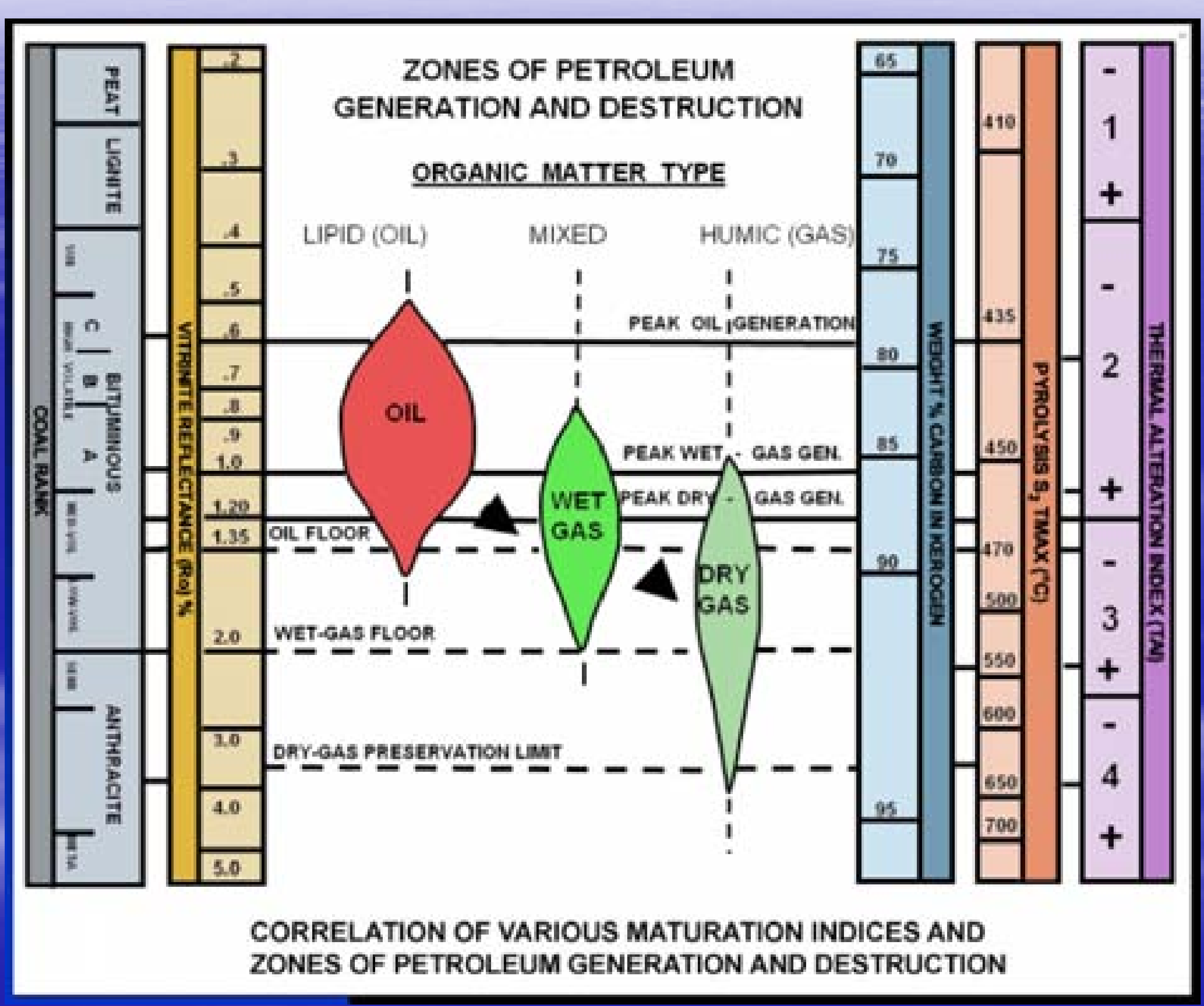
Barrier: Fracking technology not available

Halliburton there….. But where are:

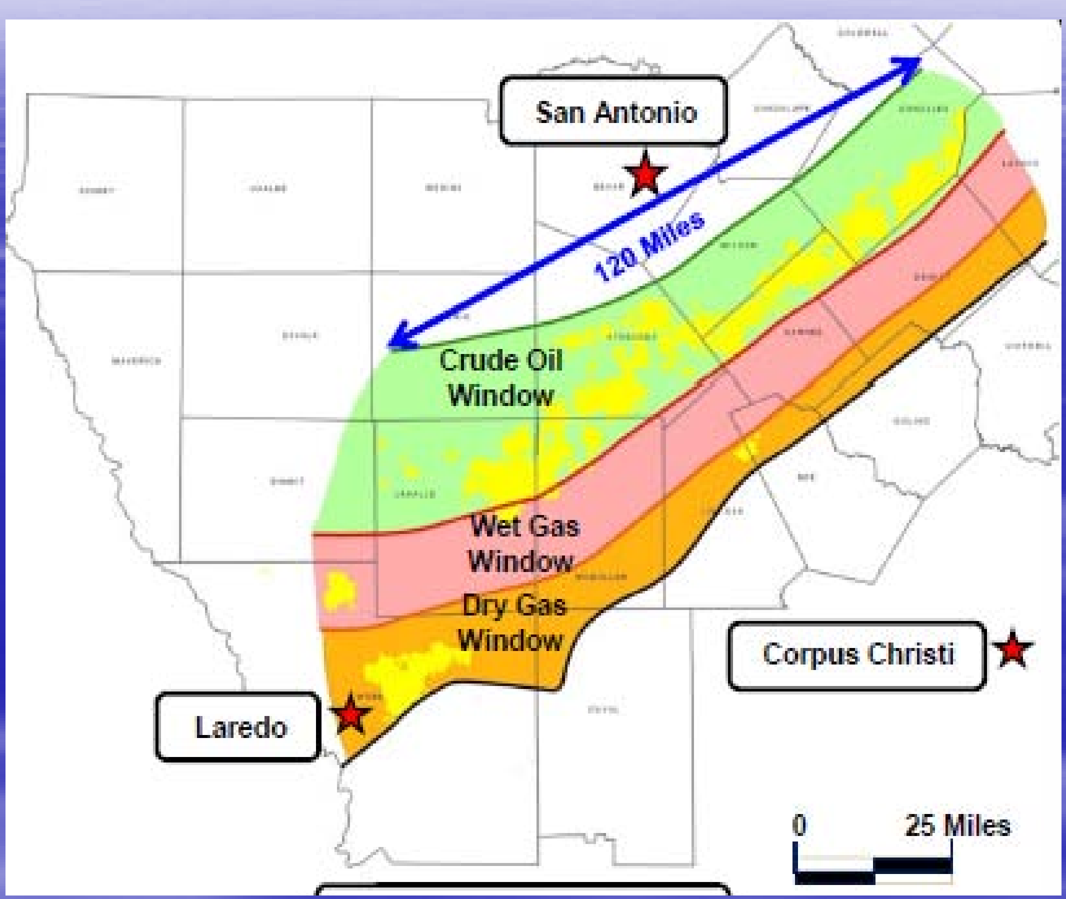
Suppliers and infrastructure (trucks, compression, et cetera) for millions of gallons of Water, millions of pounds of Frac Sand? Trained hands?

= A slower pace than in the USA

When Exploring for Liquids – Keep this Chart in Mind!



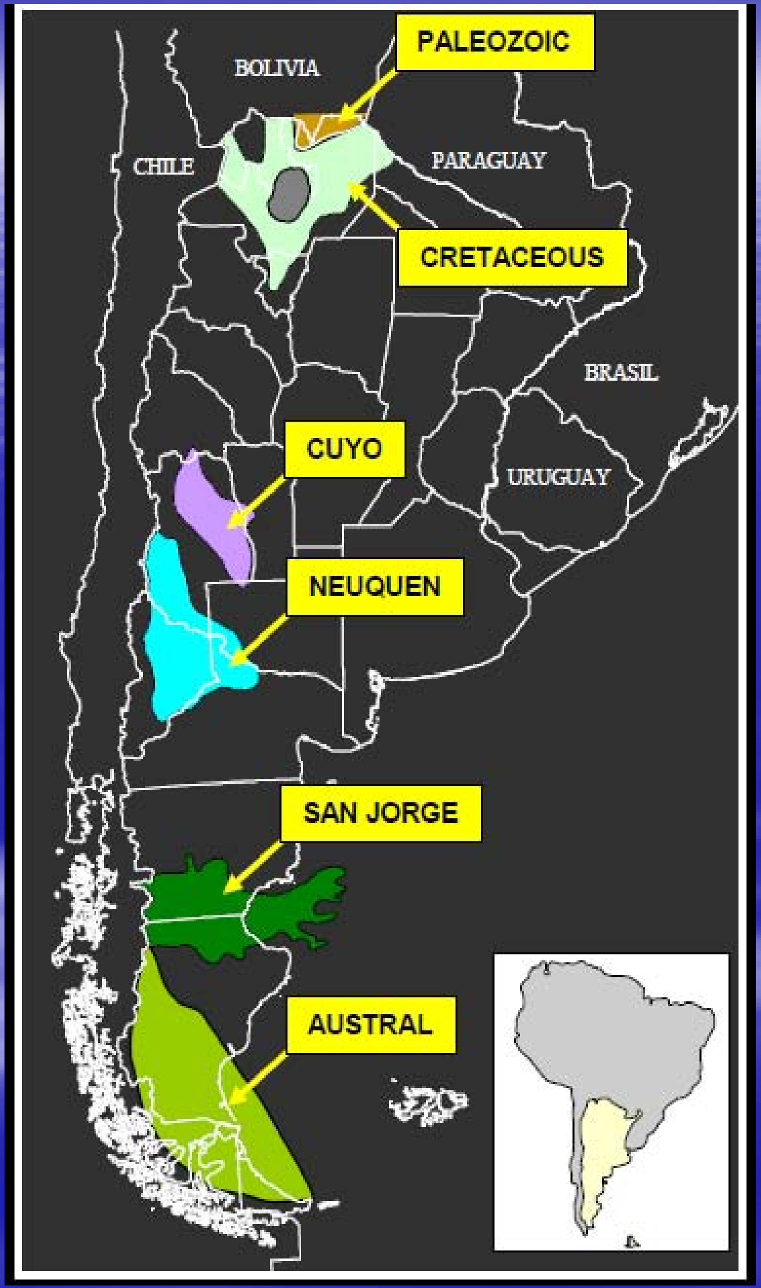
South Texas Eagle Ford Play



Same approach internationally to define gas prone vs liquid prone areas

SHALE PLAYS IN LATIN AMERICA

Source: Hart Energy, March 2011



ARGENTINA

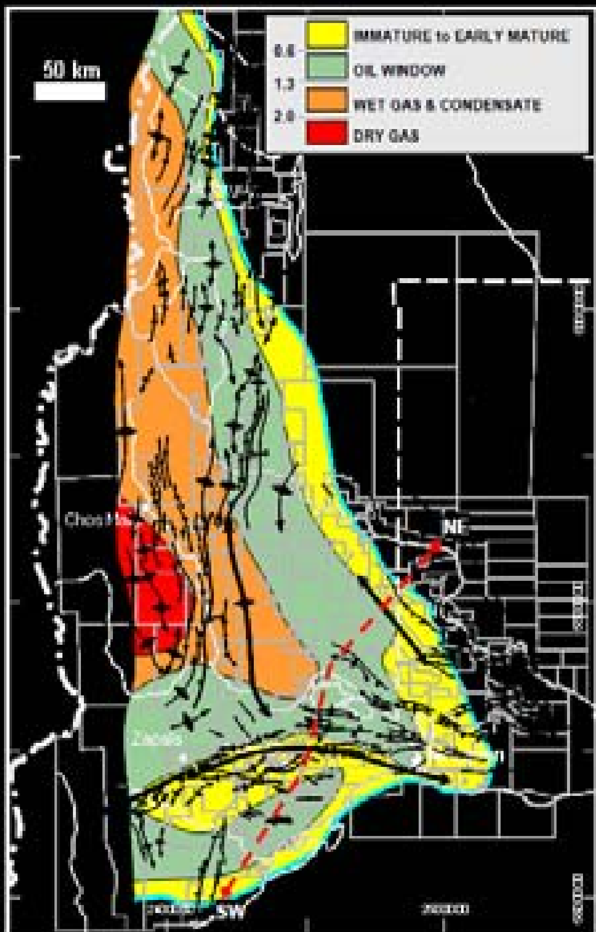
Companies Active in Argentine Shale Plays include:
Repsol YPF, Total, ExxonMobil, EOG Resources, Apache, Andes Energy and other local independents

NEUQUEN BASIN

Best wells in Neuquen Basin @ 300-400 BOPD 35-45º API (These are vertical wells to date.)
Resource estimate of 22.8 billion barrels in place in Vaca Muerta Fm. of which 150 MMBO est. proved to date.

Neuquén Basin

Vaca Muerta Fm (Late Jurassic)



Organic-rich facies developed in a backarc marine embayment, under anoxic conditions, in tune with the Jurassic-Cretaceous ups and downs of eustasy

TOC: 3-8%

Kerogen Type: I/II; locally restricted type II-S facies in marginal areas

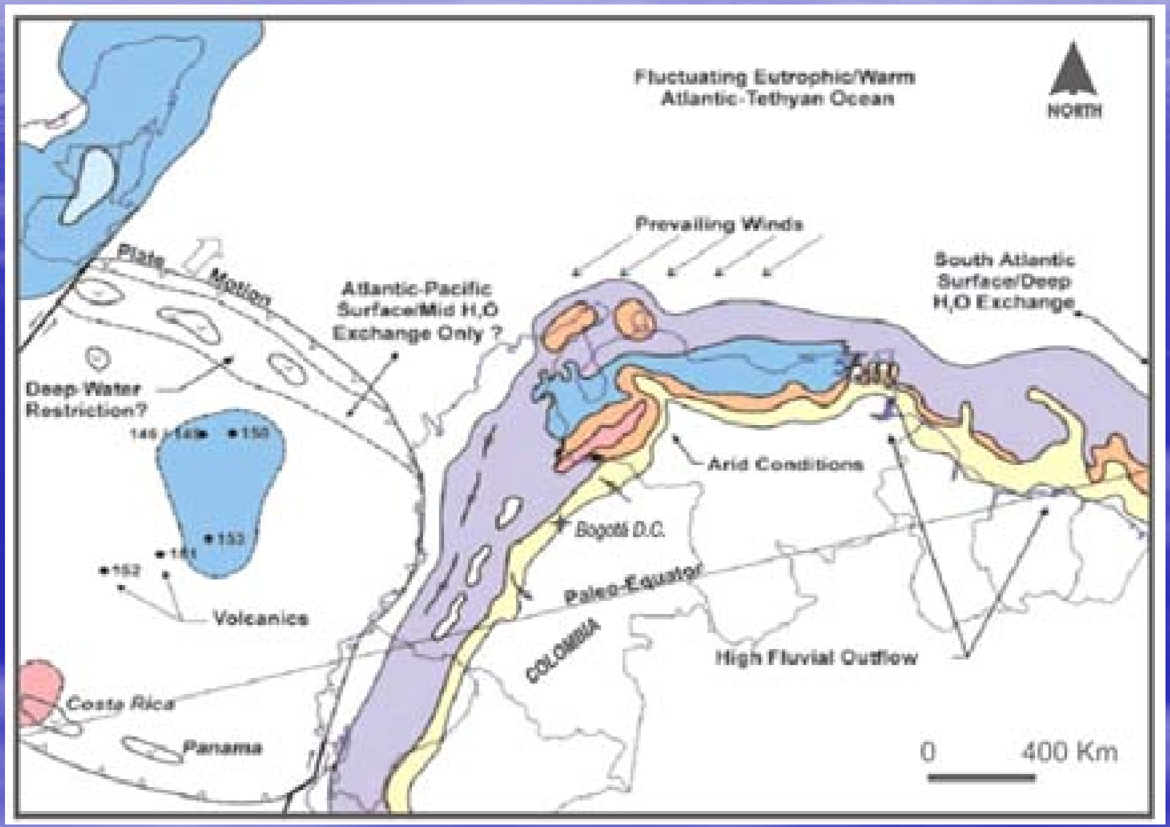
VKA: high-quality amorphous

Source Quality/Maturity: extremely prolific, world-class source rock for liquid hydrocarbons; gas and condensate accumulations related to a well developed hydrocarbon kitchen

Thickness: 25 to 450 m

Legarreta, L, and Villar, H.,
AAPG Search & Discovery, Nov., 2011

Colombia has World-Class Source Rock!
La Luna / Cansonna Formation



Late Cenomanian-Turonian paleogeography of NW South America. La Luna / Cansonna deposition in purple and blue.

From Villamil, 2003, AAPG

EUROPEAN SHALE BASINS

Source: Hart Energy, March 2011

PLAYING THE SHALES IN POLAND

Potential Shale Gas Resource @ 1 Trillion m^3
(Reduced from original EIA estimate of 5.3 Tcm)

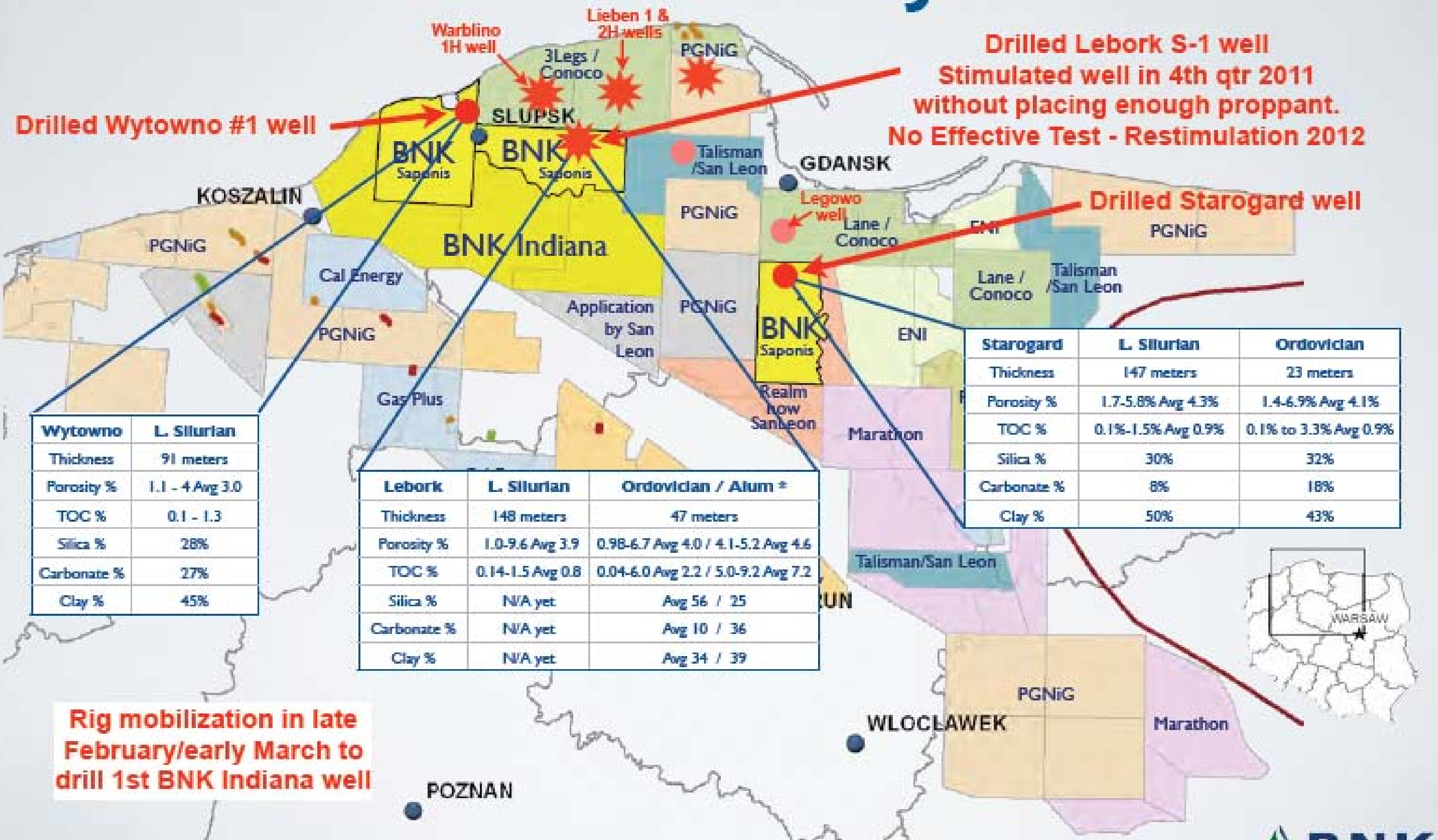
Why strategically important for Poland?

Gas from Russia @ $14.16/mmbtu in February!
Poland must reduce its GHG emissions

Active Players:

Polish Petroleum and Gas Mining Co. (PGNiG)
PNK Orlen, ExxonMobil, Chevron, ConocoPhillips
Marathon, BNK Petroleum, San Leon
Talisman Energy

POLAND PROJECTS



Wytowno	L. Silurian
Thickness	91 meters
Porosity %	1.1 - 4 Avg 3.0
TOC %	0.1 - 1.3
Silica %	28%
Carbonate %	27%
Clay %	45%

Lebork	L. Silurian	Ordovician / Alum *
Thickness	148 meters	47 meters
Porosity %	1.0-9.6 Avg 3.9	0.98-6.7 Avg 4.0 / 4.1-5.2 Avg 4.6
TOC %	0.14-1.5 Avg 0.8	0.04-6.0 Avg 2.2 / 5.0-9.2 Avg 7.2
Silica %	N/A yet	Avg 56 / 25
Carbonate %	N/A yet	Avg 10 / 36
Clay %	N/A yet	Avg 34 / 39

Starogard	L. Silurian	Ordovician
Thickness	147 meters	23 meters
Porosity %	1.7-5.8% Avg 4.3%	1.4-6.9% Avg 4.1%
TOC %	0.1%-1.5% Avg 0.9%	0.1% to 3.3% Avg 0.9%
Silica %	30%	32%
Carbonate %	8%	18%
Clay %	50%	43%

Rig mobilization in late February/early March to drill 1st BNK Indiana well

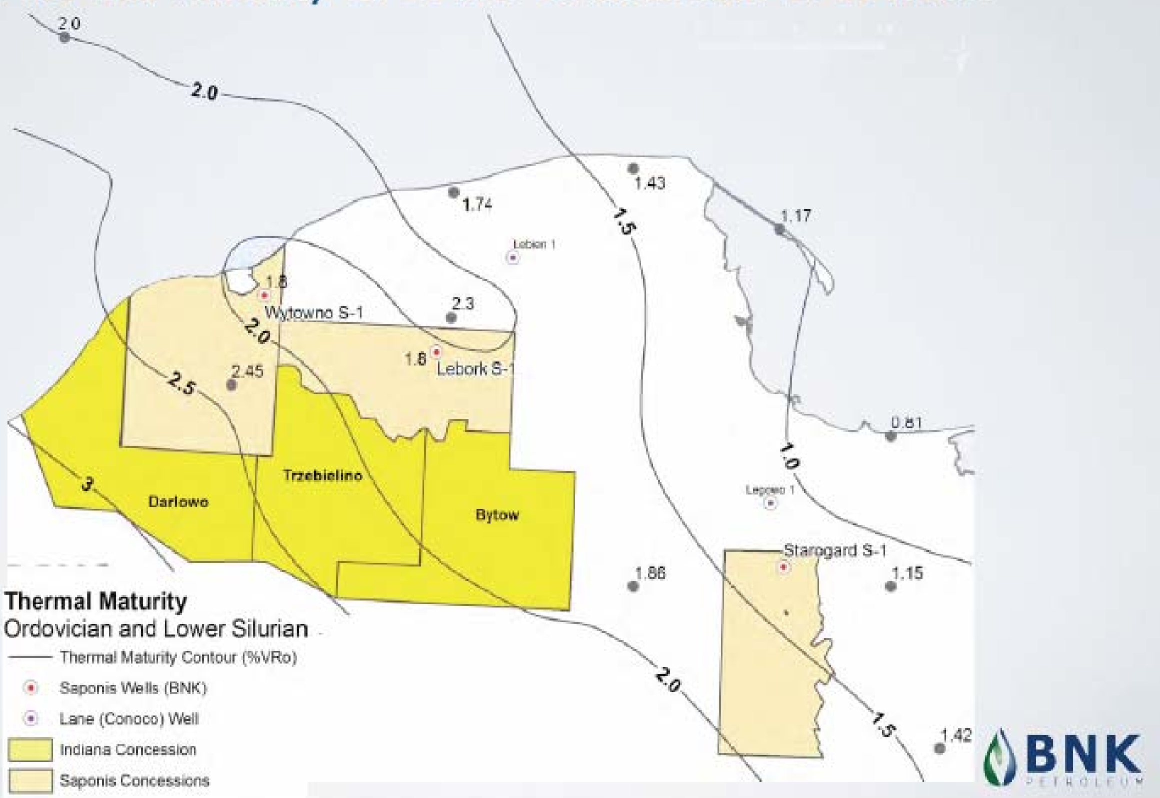
* Alum is the shale interval in the Cambrian formation

BNK PETROLEUM

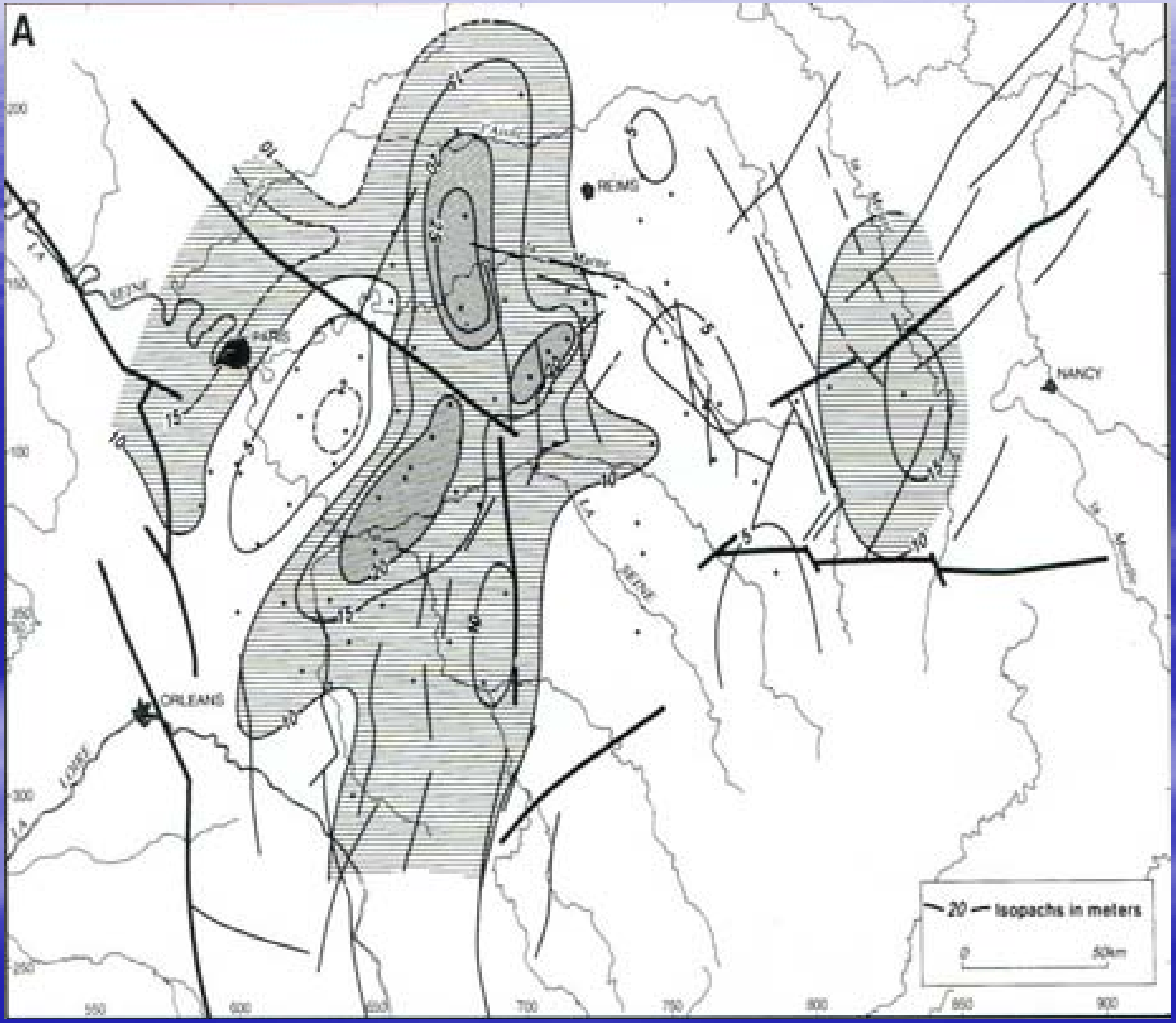
SHALE PLAYS IN POLAND

POLISH THERMAL MATURITY

Thermal Maturity of Lower Silurian and Ordovician



PARIS BASIN



Bessereau et al, 1996

Paris Basin
Up to 20m Jurassic Age Shale with 3.0-5.5% TOC

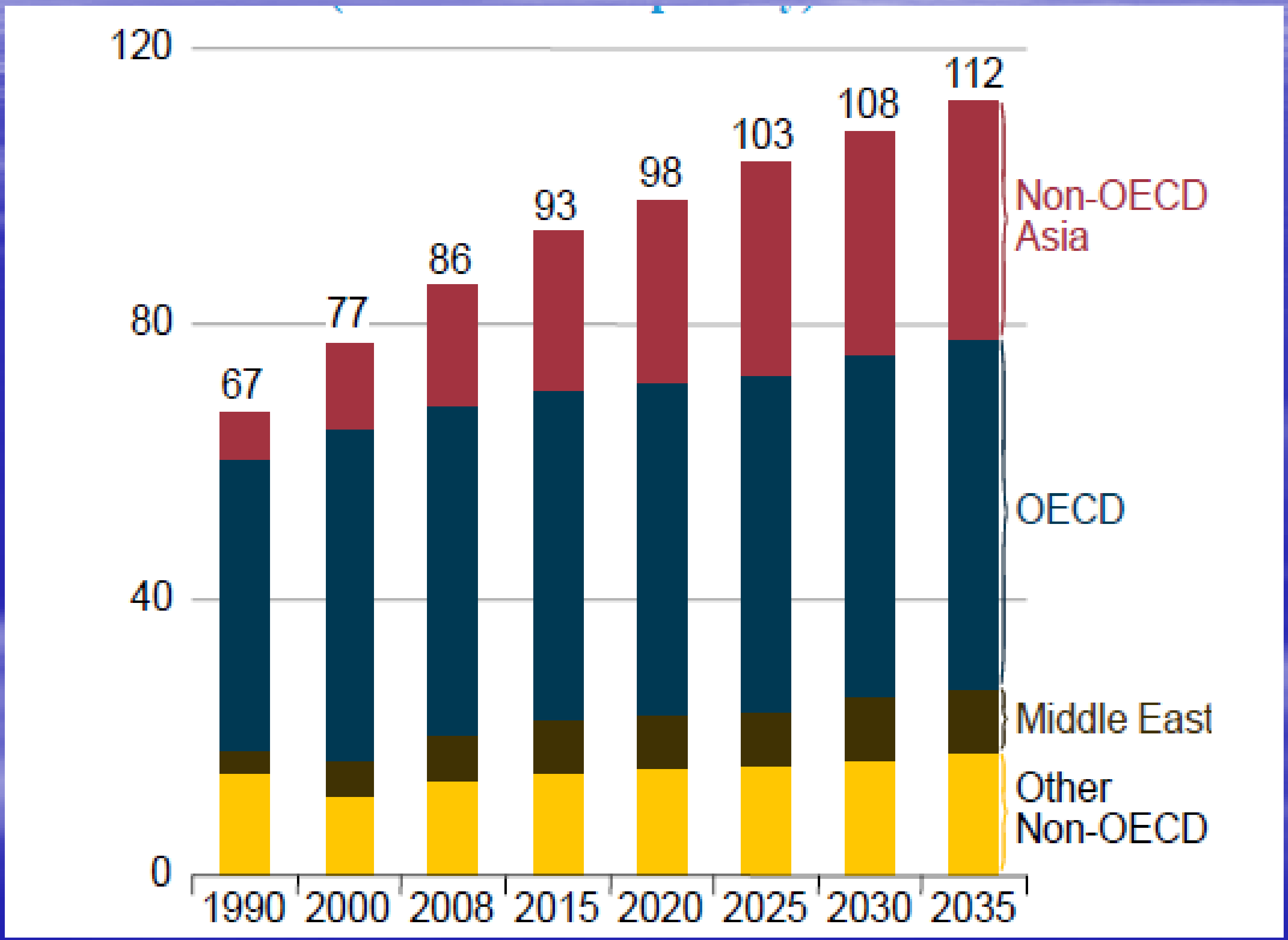
Active Companies
Total, Toreador, Hess, Vermillion Energy, Continental Resources

Moratorium on Hydraulic Fracturing!

INTERNATIONAL SHALE PLAYS

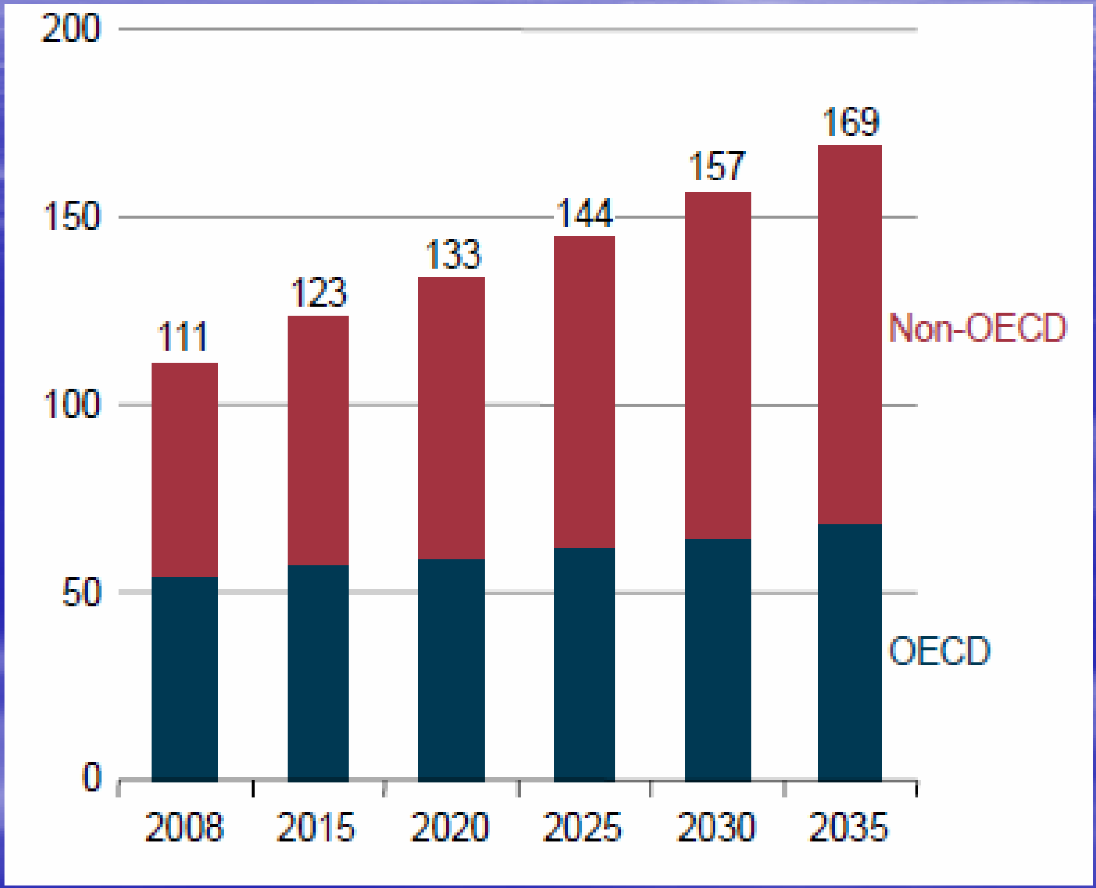
Impact on Global Supply

GLOBAL LIQUIDS GROWTH BY REGION
Million Barrels/Day



Source: EIA International Energy Outlook 2011

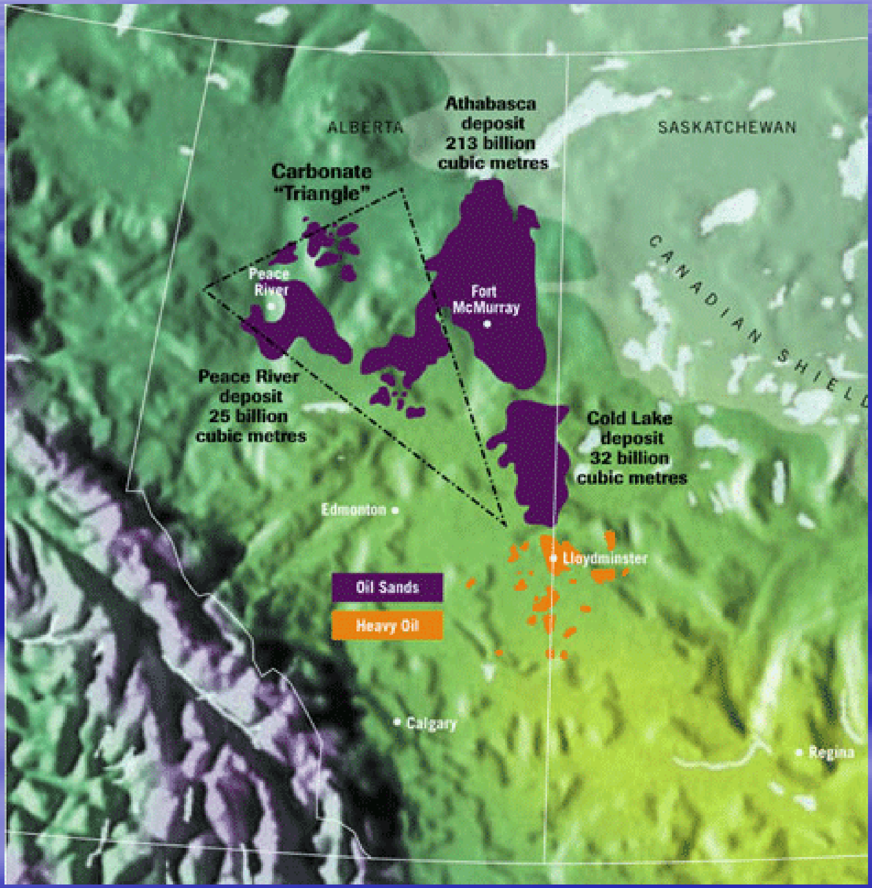
GLOBAL NATURAL GAS GROWTH BY REGION
Trillion Cubic Feet/year



Source: EIA International Energy Outlook 2011

CANADIAN OIL SANDS

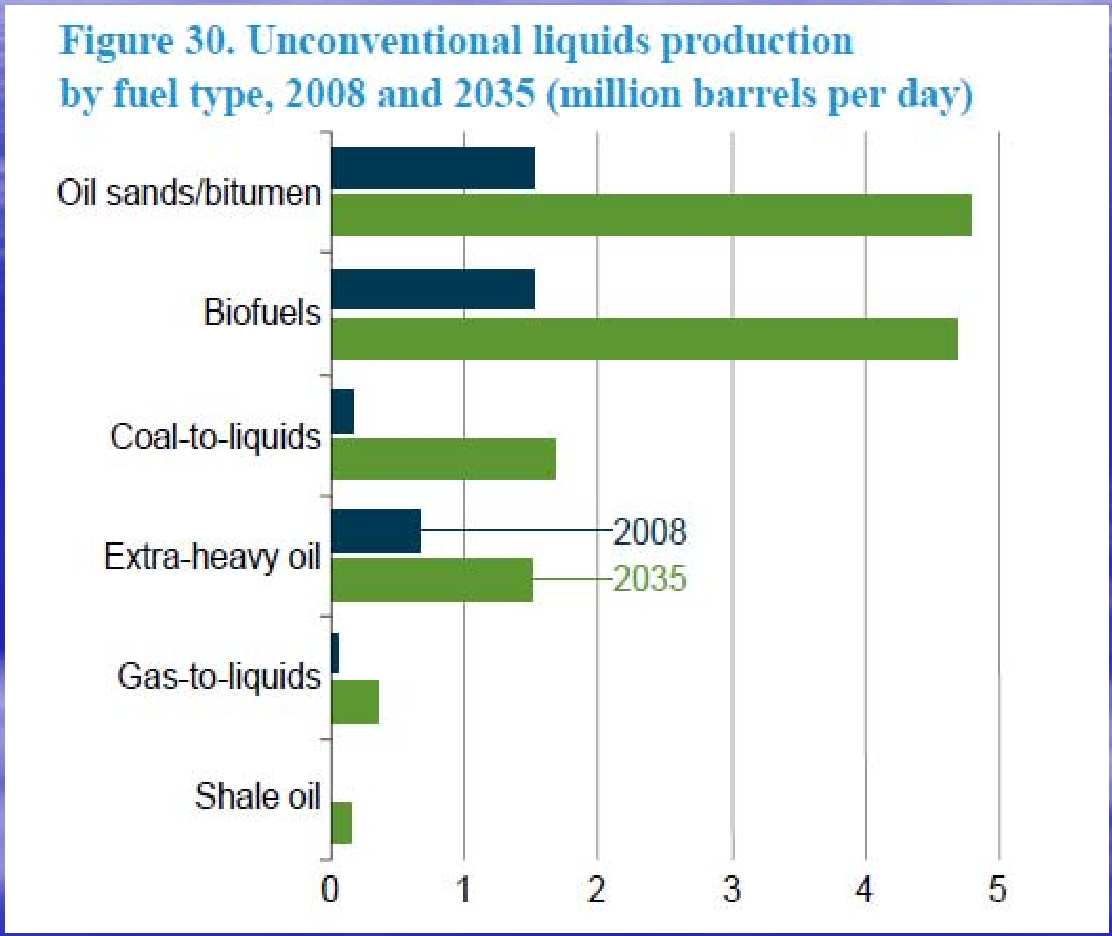
170 Billion Barrels Recoverable Reserves



Year	2008	2010	2015	2025
MMBO/day	0.1	1.5	2.2	3.7

Source: CAPP

SHALE OIL – HOW SIGNIFICANT?



Conventional oil From shales ?

IHS Projects increase in USA from 1 MMBO/day in 2011 to 3 MMBO/day by 2018

Source: EIA International Energy Outlook 2011

Unconventional Liquids
= Small % of Global Supply
= Slow Growth

BUT …….

The Incremental Barrel of Supply
Sets The Global $ Oil Price

Liquids from shales,
while not significant globally,
are, and will be, very important
for net importers like
the USA, China, and EU.

So…….

Keep Exploring!

Thank You!

About the Author

G. Warfield "Skip" Hobbs is a consulting petroleum geologist and Founder and Managing Partner of Ammonite Resources, a firm of international petroleum geotechnical consultants that is headquartered in New Canaan, Connecticut. He holds a B.S. Degree in Geology from Yale College and a M.S. Degree in Petroleum Geology from the Royal School of Mines, Imperial College, London. Prior to forming the Ammonite Corporation in 1980, and Ammonite Resources in 1982, Hobbs worked from 1970-1980 as an international exploration geologist for Texaco and Amerada Hess in Latin America, Europe, Asia, the Middle East, and lastly in New York City. Hobbs is a licensed professional geologist in Texas, Pennsylvania and Florida.

Skip is a past national Secretary (1993-1995) of the 33,000 member American Association of Petroleum Geologists, and was President of the AAPG Division of Professional Affairs in 2000-2001. He is currently the Past-President of the American Geological Institute, a federation of 50 geoscience societies representing over 250,000 members. Hobbs writes and lectures frequently on energy economics and energy policy.

Hobbs may be contacted via e-mail at <skiphobbs@ammoniteresources.com>