

A presentation from the 2009 Topical Symposium:

***Energy Security: A Global Challenge***

Hosted by:  
The Institute for National Strategic Studies  
of  
The National Defense University

29-30 September 2009

By  
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INSTITUTE FOR NATIONAL  
STRATEGIC STUDIES

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## Report Documentation Page

*Form Approved*  
*OMB No. 0704-0188*

Public reporting burden for the collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington VA 22202-4302. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to a penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number.

1. REPORT DATE <b>30 SEP 2009</b>	2. REPORT TYPE	3. DATES COVERED <b>00-00-2009 to 00-00-2009</b>			
4. TITLE AND SUBTITLE <b>The Emerging Petroleum and Natural Gas Economy</b>		5a. CONTRACT NUMBER			
		5b. GRANT NUMBER			
		5c. PROGRAM ELEMENT NUMBER			
6. AUTHOR(S)		5d. PROJECT NUMBER			
		5e. TASK NUMBER			
		5f. WORK UNIT NUMBER			
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) <b>National Defense University, Center for Strategic &amp; International Studies, Energy &amp; National Security Program, Washington, DC, 20319</b>		8. PERFORMING ORGANIZATION REPORT NUMBER			
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)		10. SPONSOR/MONITOR'S ACRONYM(S)			
		11. SPONSOR/MONITOR'S REPORT NUMBER(S)			
12. DISTRIBUTION/AVAILABILITY STATEMENT <b>Approved for public release; distribution unlimited</b>					
13. SUPPLEMENTARY NOTES <b>2009 Topical Symposium: Energy Security: A Global Challenge, 29-30 Sep 2009, Washington DC.</b>					
14. ABSTRACT					
15. SUBJECT TERMS					
16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT <b>Same as Report (SAR)</b>	18. NUMBER OF PAGES <b>26</b>	19a. NAME OF RESPONSIBLE PERSON
a. REPORT <b>unclassified</b>	b. ABSTRACT <b>unclassified</b>	c. THIS PAGE <b>unclassified</b>			



# The Emerging Petroleum and Natural Gas Economy

Ft. McNair, Washington, D.C.

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Sept 30, 2009

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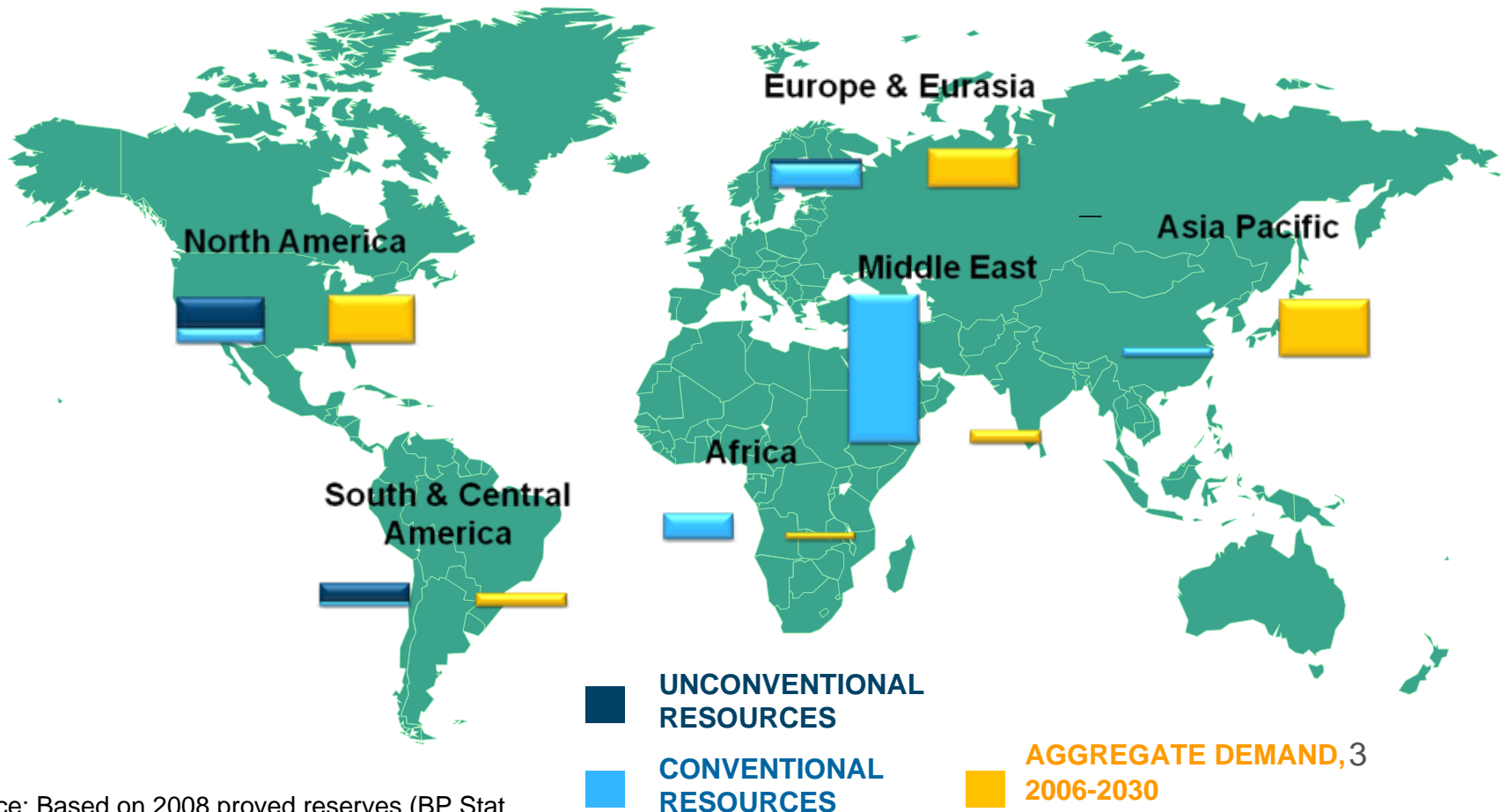
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## Topical Focus

- Peak Oil
- Technology Developments
- NOCs & IOCs
- Game Changers
  - **Climate**
  - **Natural Gas**

# Beyond Peak Oil: Global Resource Endowment is enormous, but conventional distribution is uneven and unconventional have environmental challenges



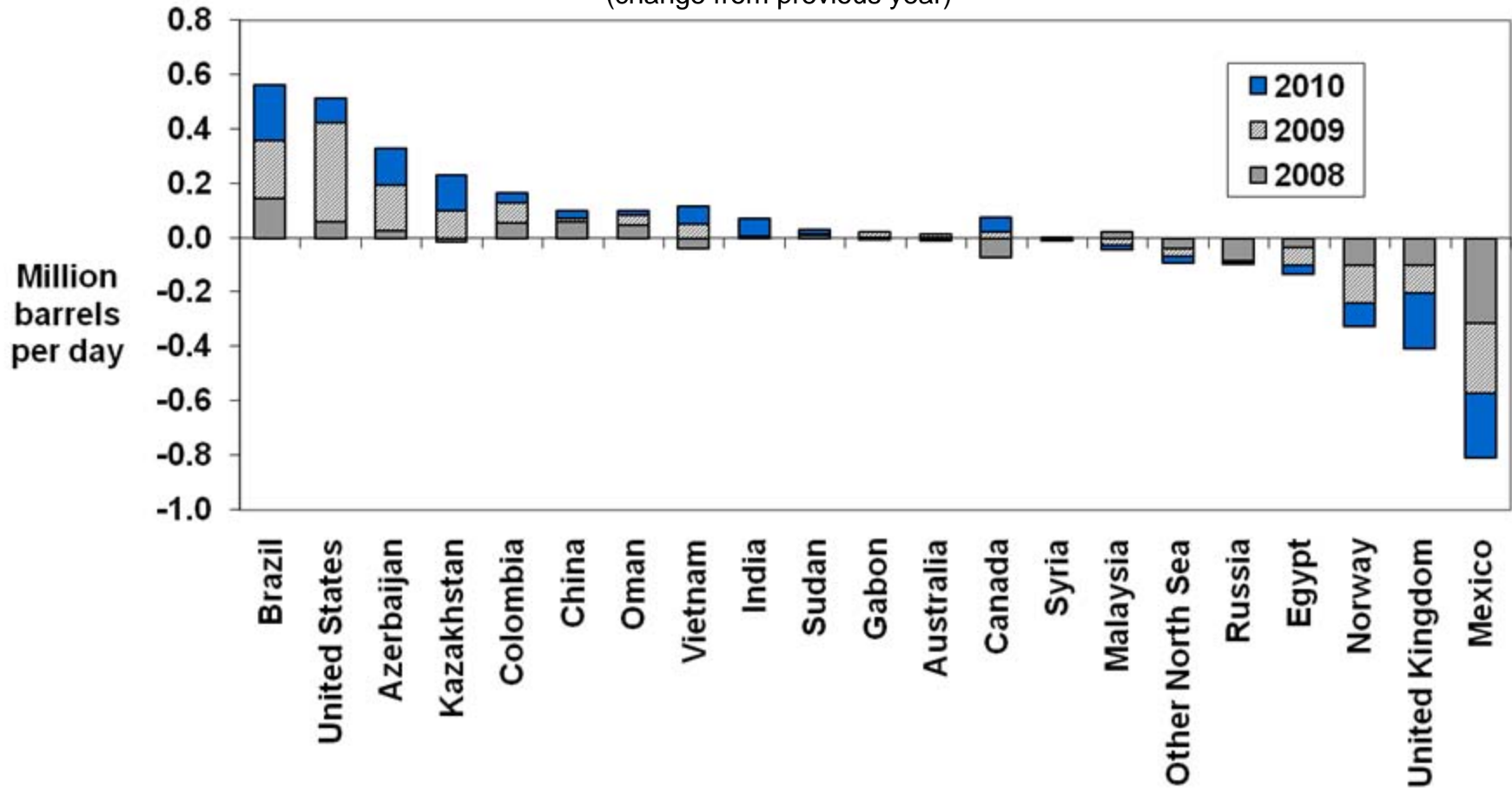
Source: Based on 2008 proved reserves (BP Stat Review) and 2006-2030 demand trends (EIA)

# Geopolitical & governance risks are accumulating

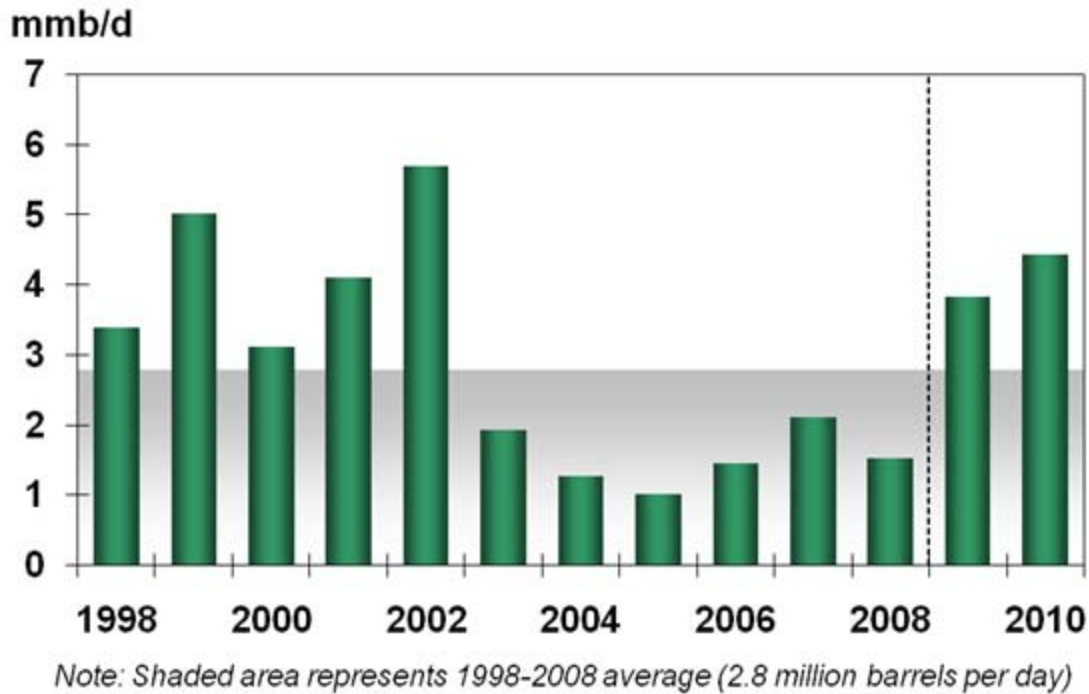


# Non-OPEC Oil Production Looks Flat

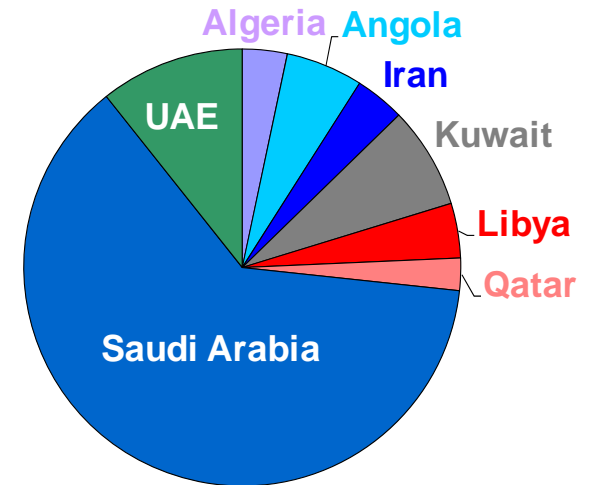
(change from previous year)



# OPEC Surplus Production Capacity

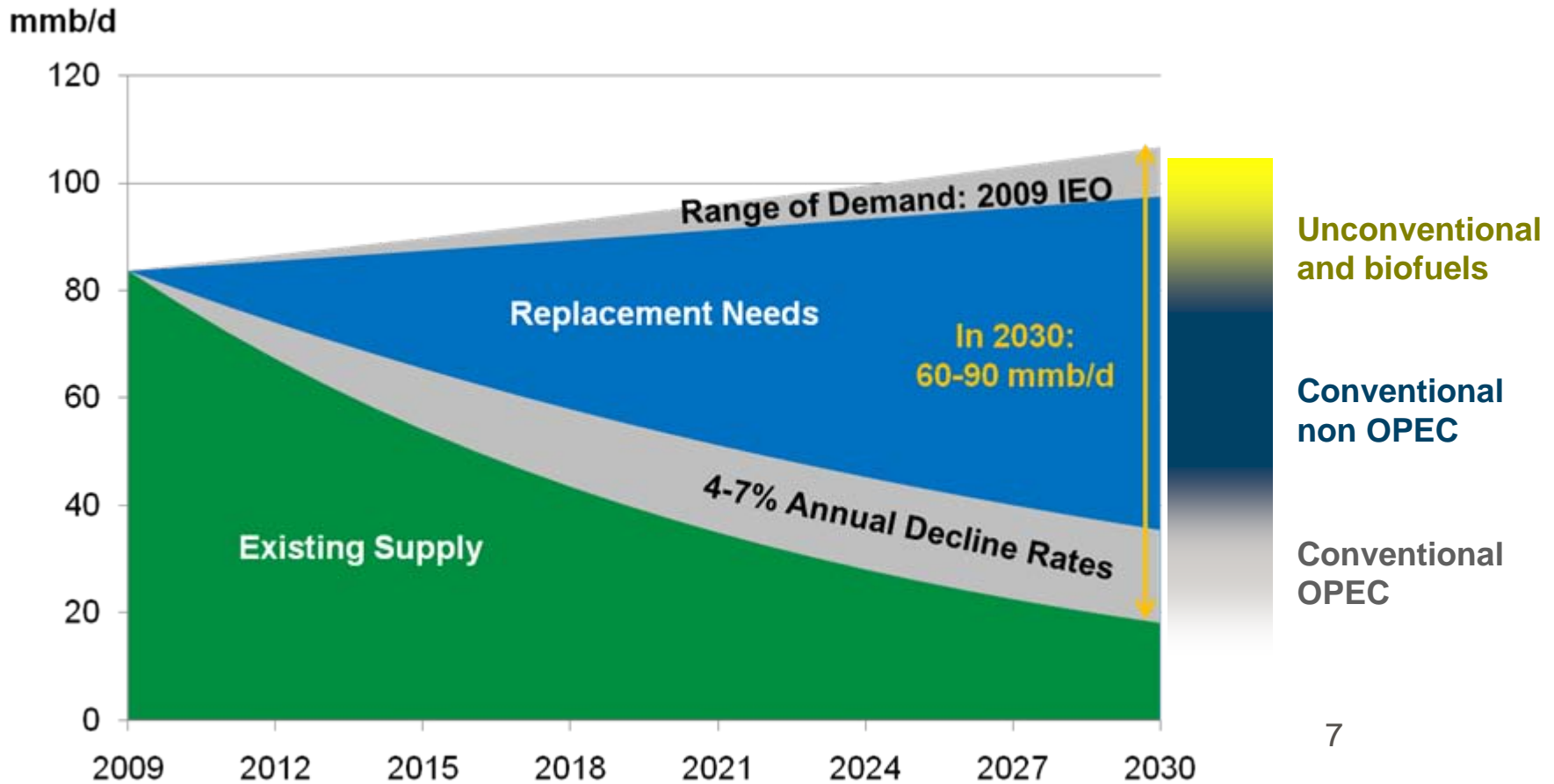


Surplus Capacity, by Country  
Total Current (est.): 5.5 mmb/d

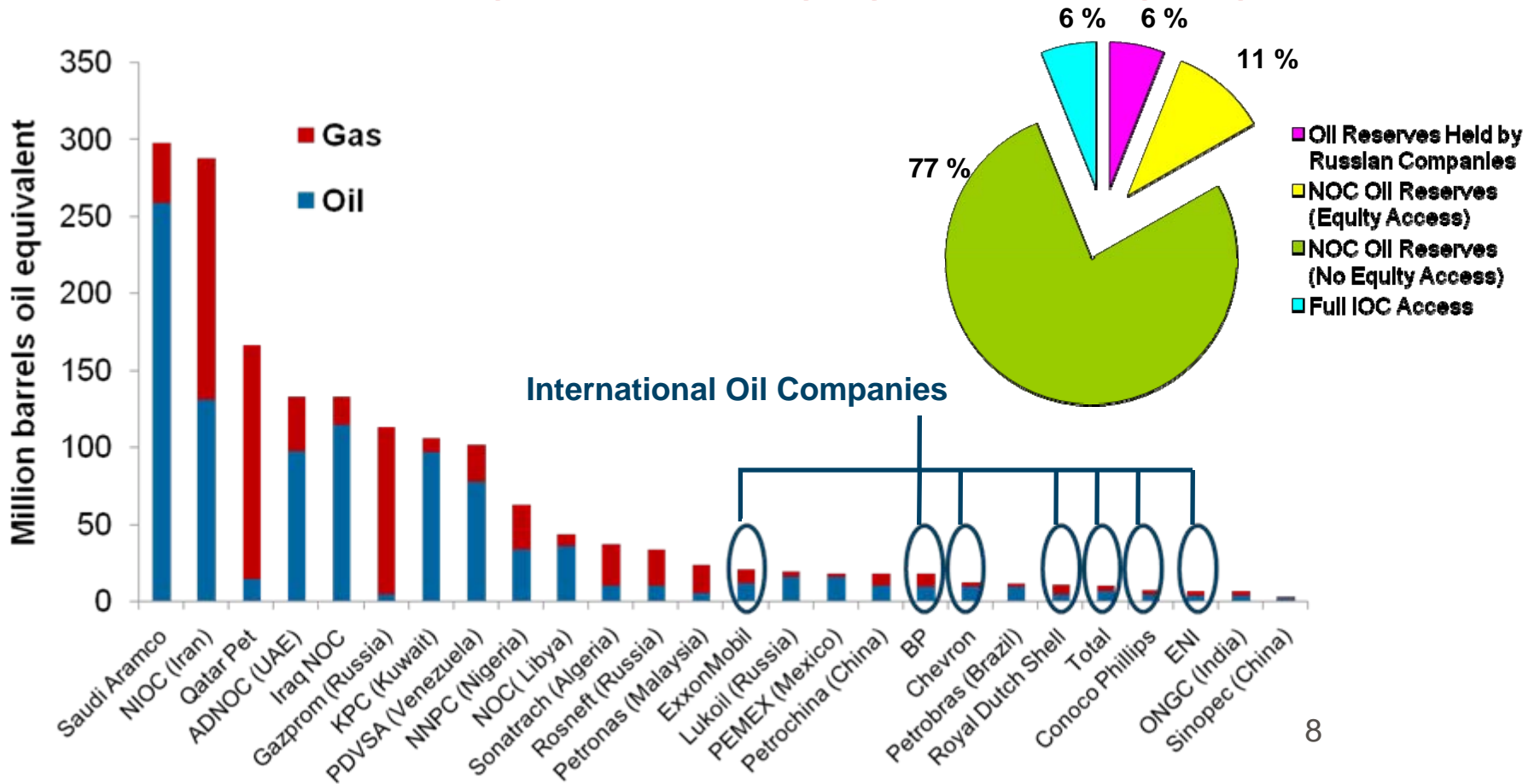




# Replacing Global Liquids Supply Will Be Challenging



**15 of the Top 20 Largest Oil Companies are NOCs;  
NOCs control 80-90% of conventional oil and gas reserves;  
Will play an increasing role in managing resources going forward**



## All NOCs are NOT alike, but they share certain priorities and objectives:

- Agents of host governments
- Protectors of the National Resource Patrimony
- Source of Revenues needed to fund other programs
- Responsible for Social development & infrastructure
- Role in International relations
- Stakeholders are Political
- Management practices, operating standards and agendas different from IOCs

## A Word on Technology Advancements

- Better diagnostics, intelligent wells
- GeoSteering
- Improved reservoir simulation
- Pre-salt experience
- Maximum Reservoir Contact Wells
- Sub-sea completions
- Rez “Bots”
- Horizontal drilling (shales)

**Bottom Line: Significant new discoveries (BB fields), improved accessibility & increased recovery rates**

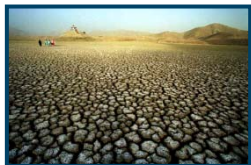
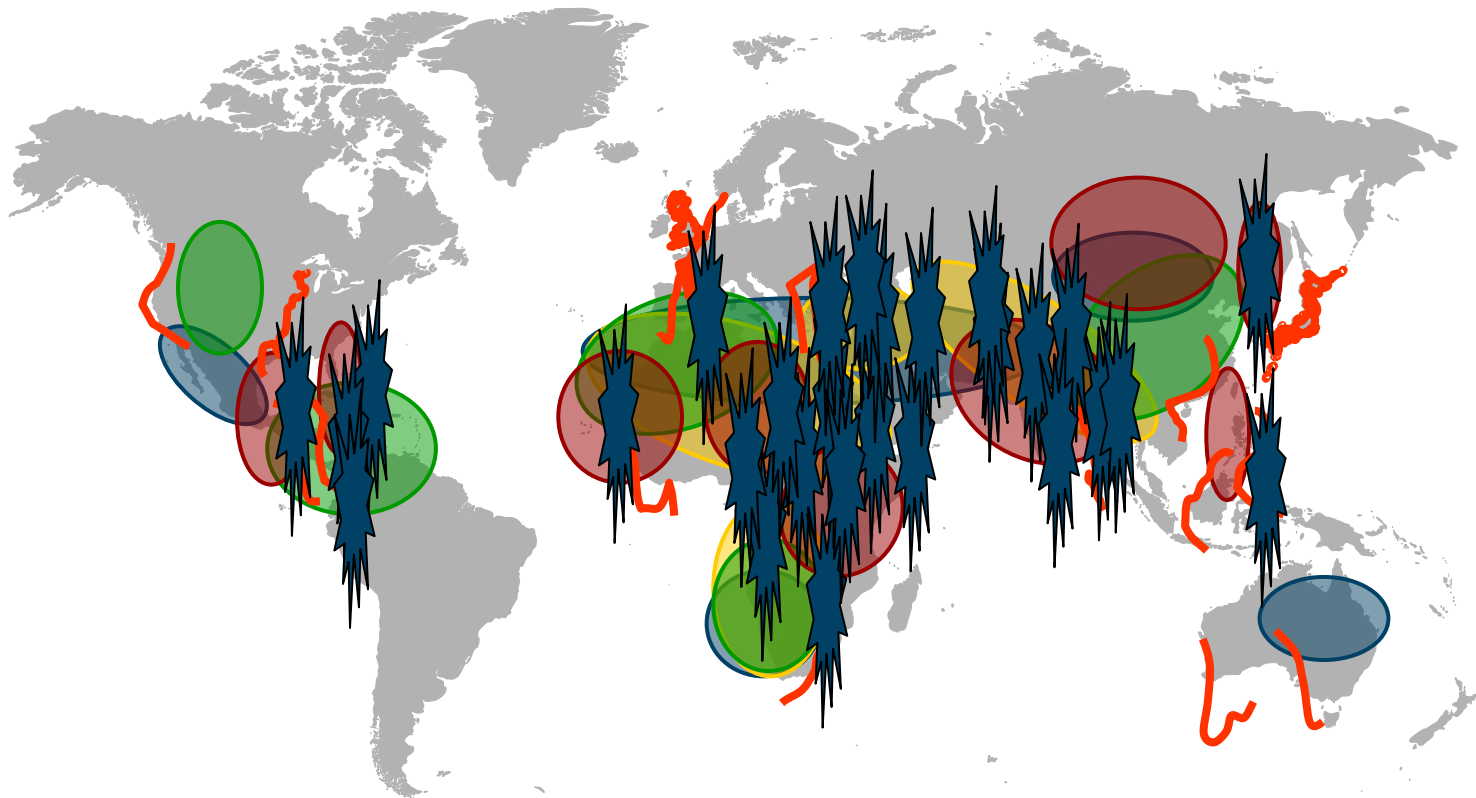
## Game Changers

- **Climate Change and Regulation of Carbon & GHG Emissions**
- **Exploitation of Unconventional Shale Gas Reserves**

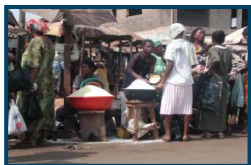
## Climate Change as a Game Changer

- Affects supply & demand
- Alters fuels choices, increases prices
- In the extreme, raises security concerns
- New investment & technologies applied on a global scale
- Implications of a fractured vs. unified response
- Concept of “Sustainable Development” challenges traditional view of economic prosperity
- Requires long-term global policy solutions and trade-off balances

# Climate Change as a Threat Multiplier



Water Scarcity



Demography



Crop Decline



Hunger



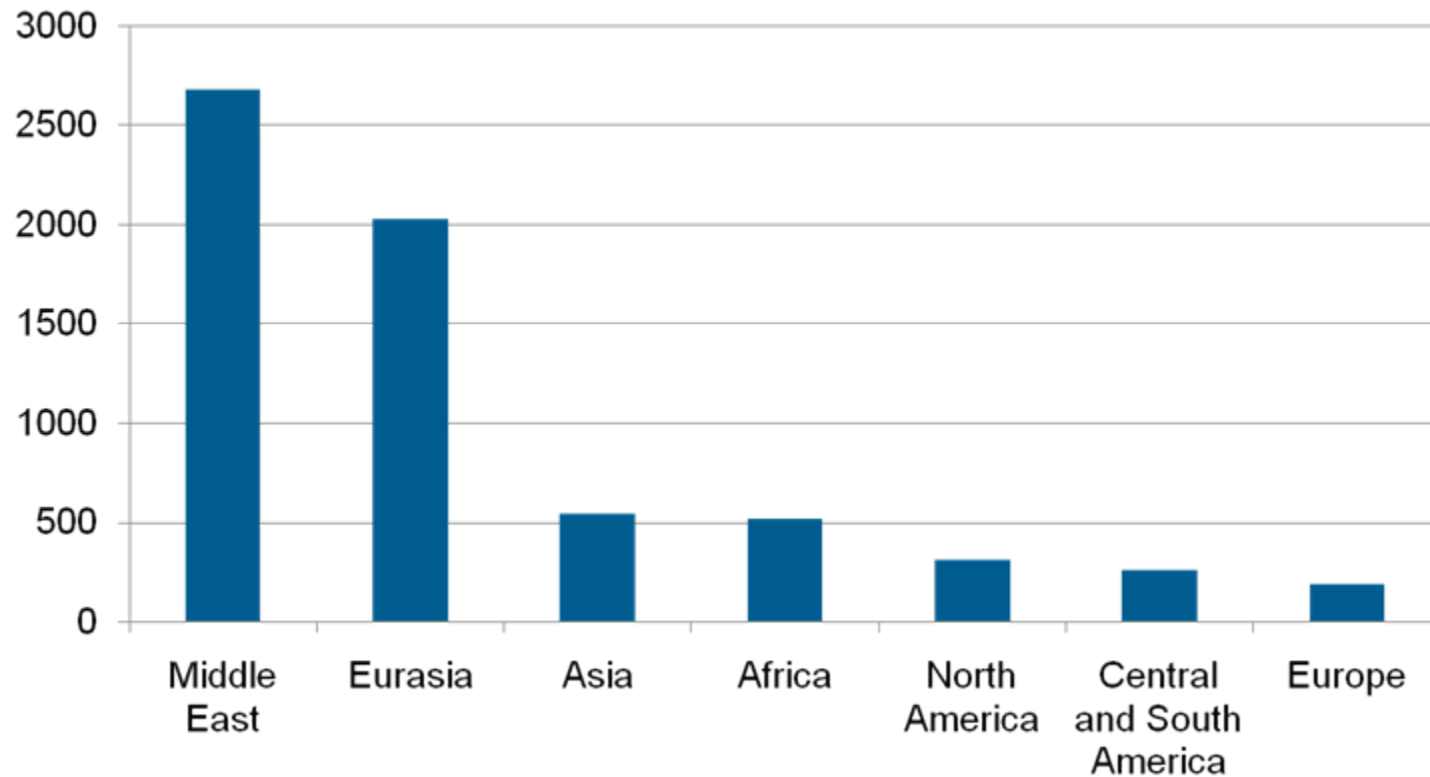
Coastal Risks



Recent Conflicts

## Conventional Global Natural Gas Reserves

trillion cubic feet



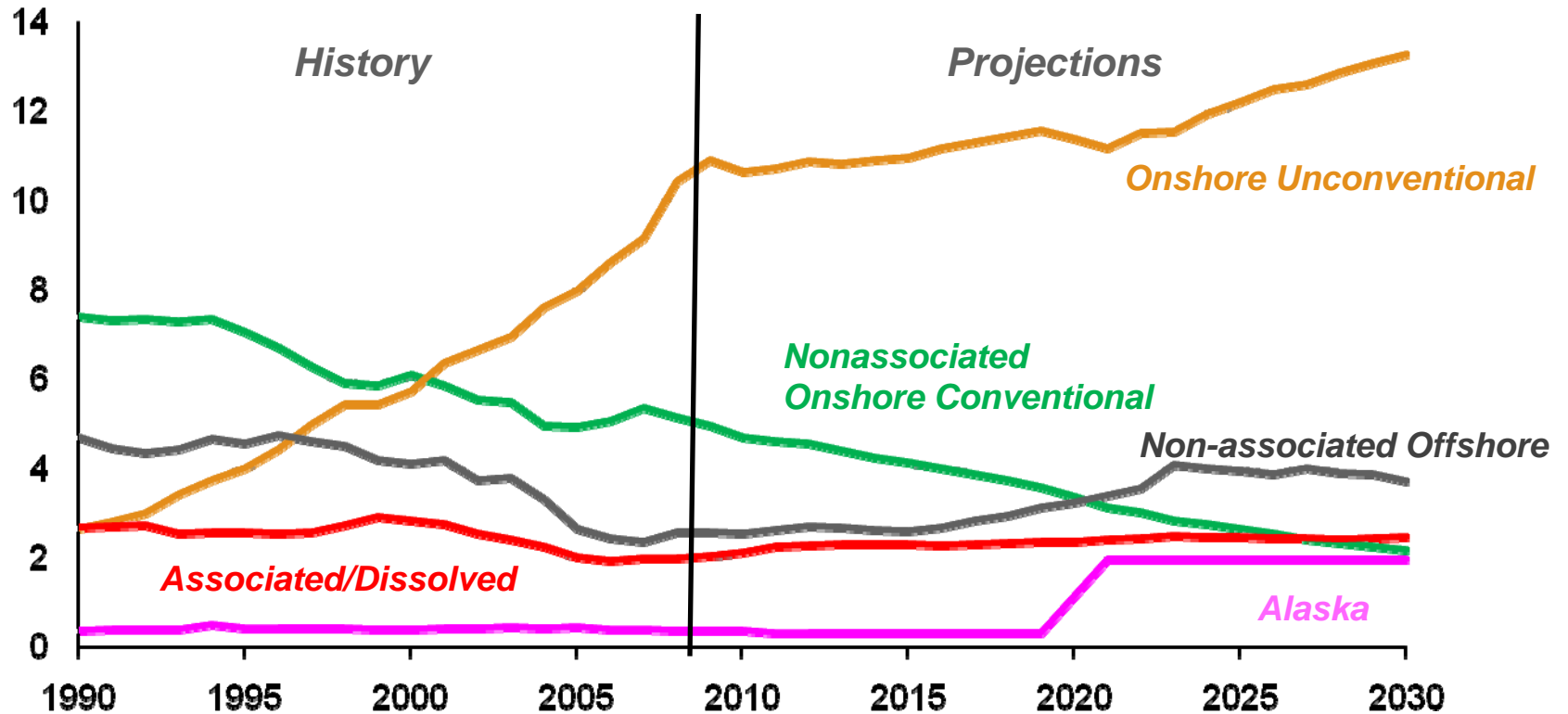


## Global Gas Supply Dilemma

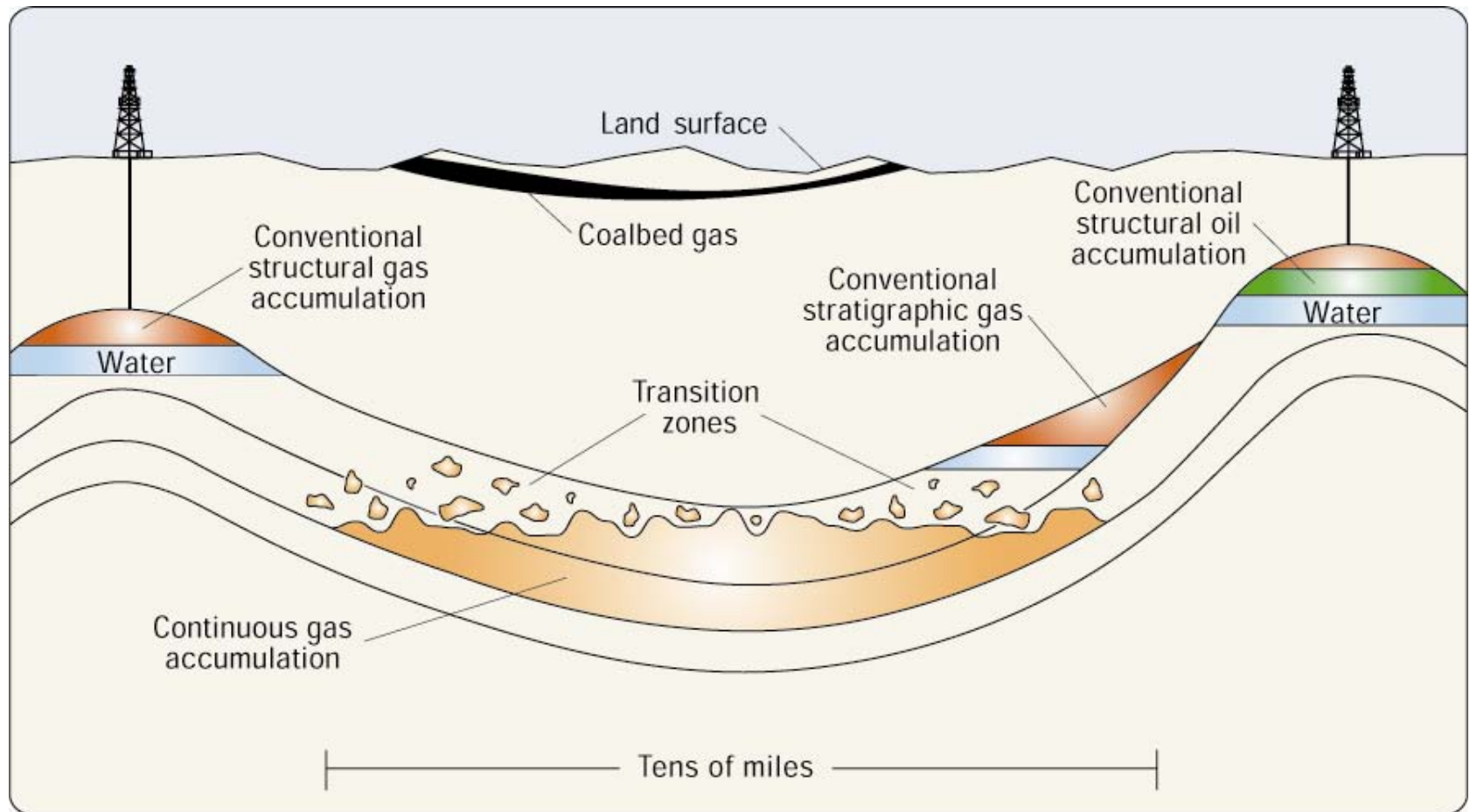
- Global gas demand to grow, especially in a carbon constrained world
- Conventional supply sources become more concentrated geographically
- Concentration can affect leverage, supply and prices, geopolitics, etc.
- Delivery system under greater stress
- Price rise + increased import dependence recreates balance of payments concerns

# What's New?: Substantial growth in U.S. natural gas production through 2030 led by unconventional...

trillion cubic feet



## Conventional vs. Continuous Resources



## Game-Changing Potential: Estimates of US Shale Gas Resources

EIA Annual Energy Outlook 2009: **267 tcf** undiscovered technically recoverable shale gas resources (mean)

- Based on 2007 U.S. Geological Survey assessment and 2006 Mineral Management Service data

Navigant Consulting Inc. 2008: **274 tcf** undiscovered technically recoverable shale gas resources (mean)

- Based on aggregated data from numerous studies

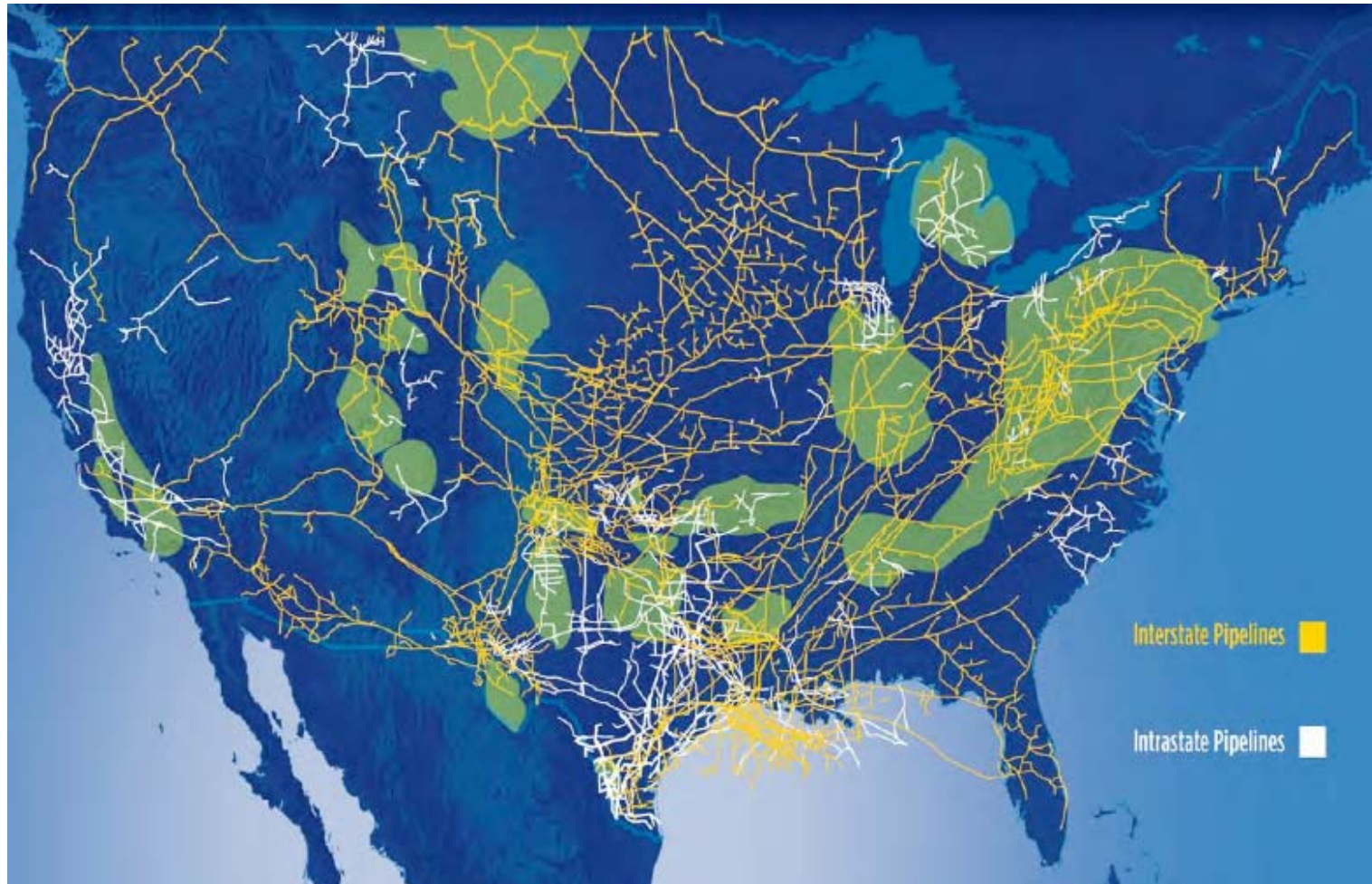
Navigant Producer Reports 2008: **up to 842 tcf** undiscovered technically recoverable shale gas resources (max reported)

- Ascertained by Navigant in 2008 study (accounts for Marcellus and Haynesville)

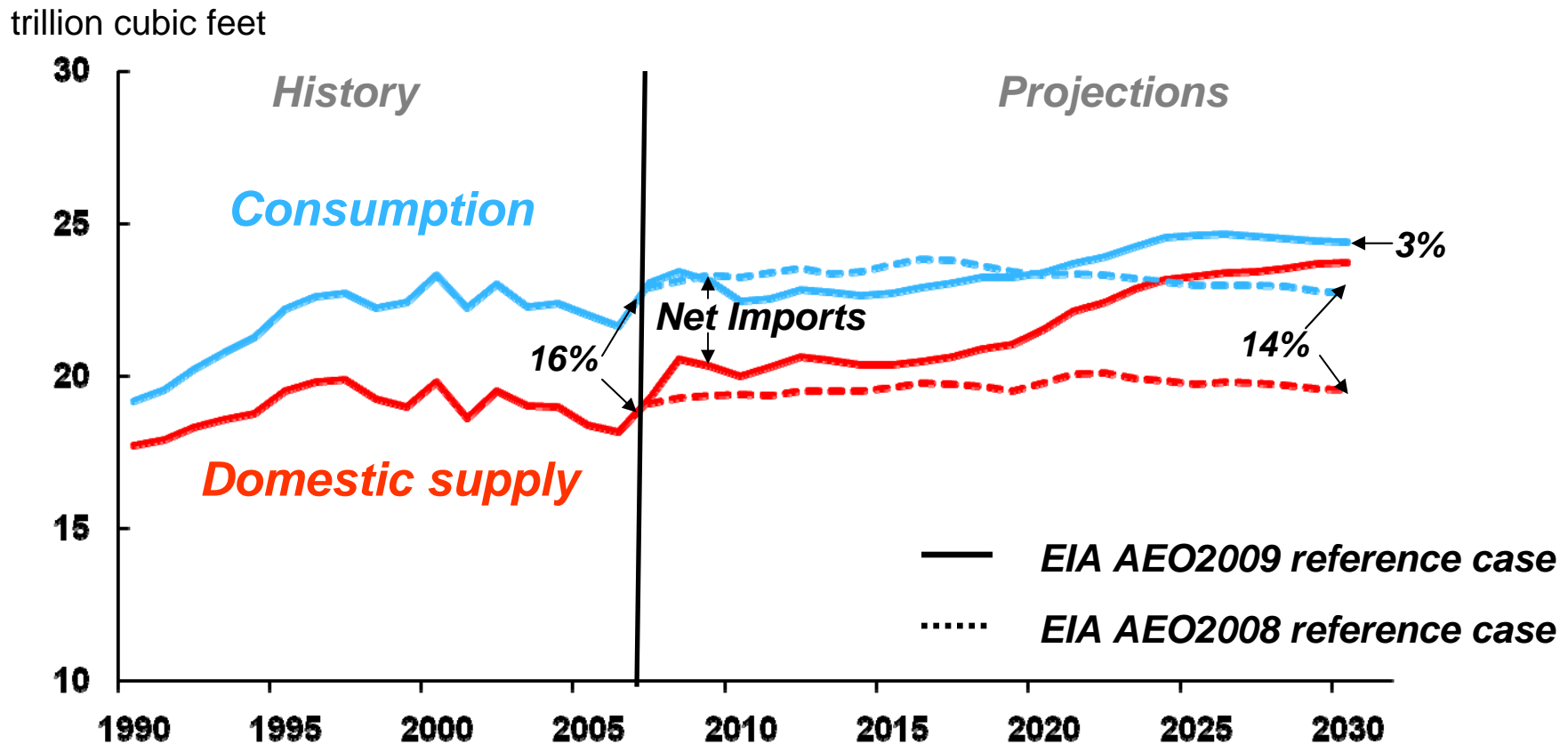
Potential Gas Committee 2009: **616 tcf** undiscovered technically recoverable shale gas resources (mean)

- **Estimated total U.S. gas resources of 2,074 tcf** (mean undiscovered tech recoverable + reserves)

## Shale Resources and Natural Gas Pipeline Network



# New US Domestic resources mean less imports (pipeline gas and LNG) and more supply choices for the world!



## Implications of Global Shale Gas Exploitation

- Development of US shale formations would free up LNG for use elsewhere
- Significant shale prospects likely in China, Turkey, Australia and Europe
- Development of indigenous gas sources, coupled with LNG, efficiency, renewables and interconnects could reduce EU reliance on Russian gas
- Global gas surplus could revamp price/contract structures



Source: The Economist



**BUT ...realizing the full promise of shale resources is not a certainty and US domestic policy is important!**

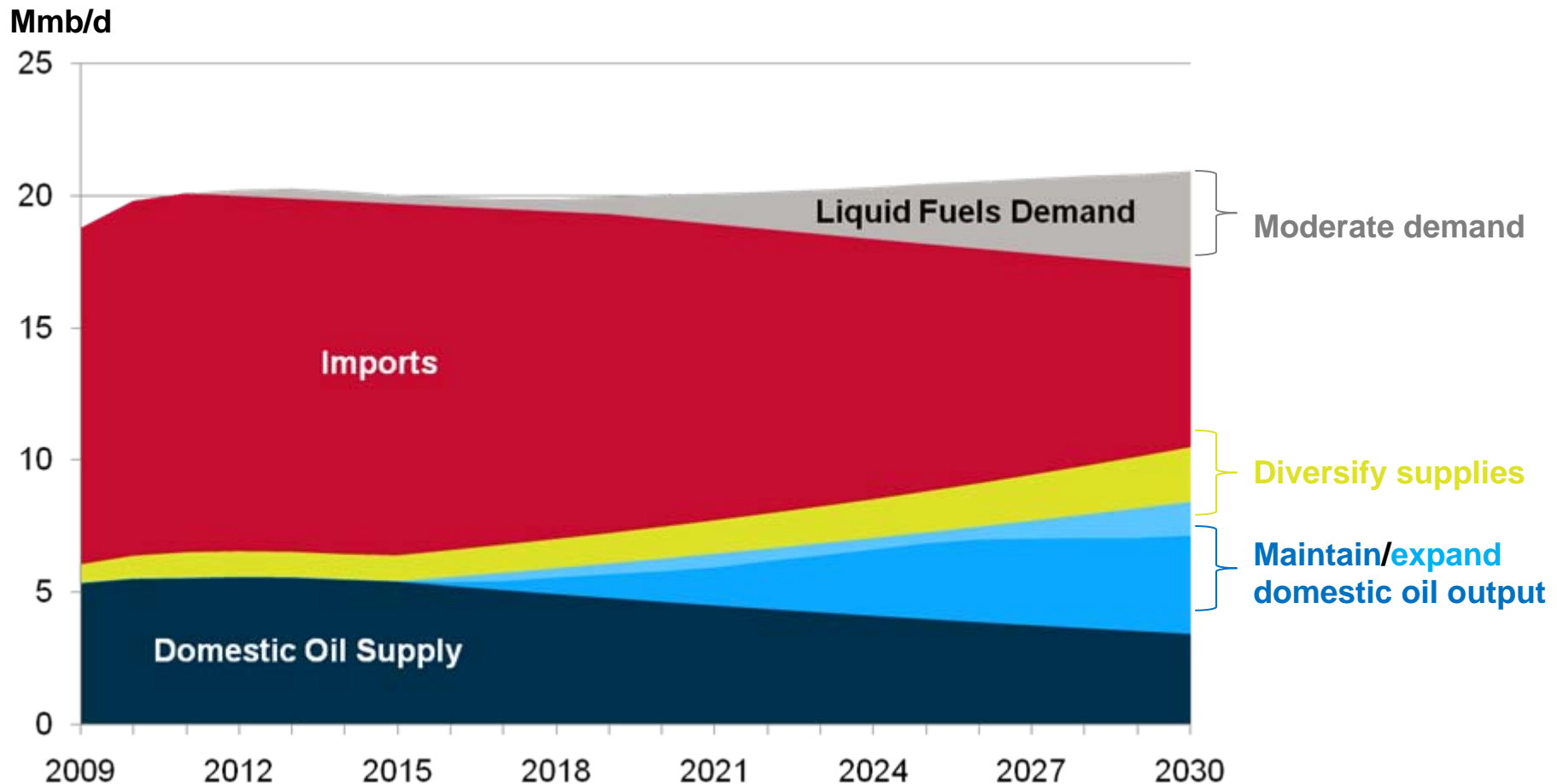
## **Technical/Economic Challenges**

- All shales are not alike; application of drilling/reservoir fracturing technology & operational experience matters
- Steep decline rates require ongoing investment and drilling; and repeated fracturing
- Up front investment (lease acreage and pilot wells) not insignificant vs. cost basis relative to commodity price/value

## **Environmental/Regulatory/Societal Challenges**

- Uncertain regulation (hydraulic fracturing, water, land use, permits), “industrialization” of areas unfamiliar with development plans and associated impacts
- Location, location, location – shale resources are, at times, proximate to and distant from delivery infrastructure and demand centers – both present problems

# Strategies to Enhance Oil U.S. Security Count



# Policy Model

