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Implications of North American Oil and Gas Boom on Geopolitics and Energy Security

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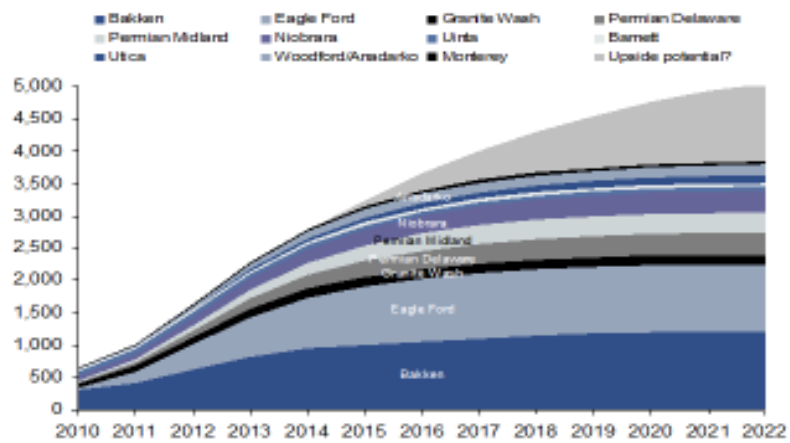
The Shale Revolution is Real

- *Investment in Tight Oil Prospects in North America Has Quadrupled Since 2010; Expected to Reach $80 Billion by 2015*
- *Producing from source rock is a new game changing paradigm*

US 2020: Shale and tight oil

The shale revolution which has driven massive gains in natural gas production is now doing the same for oil, with potential shale liquids production growth of +3.8-m b/d by 2020

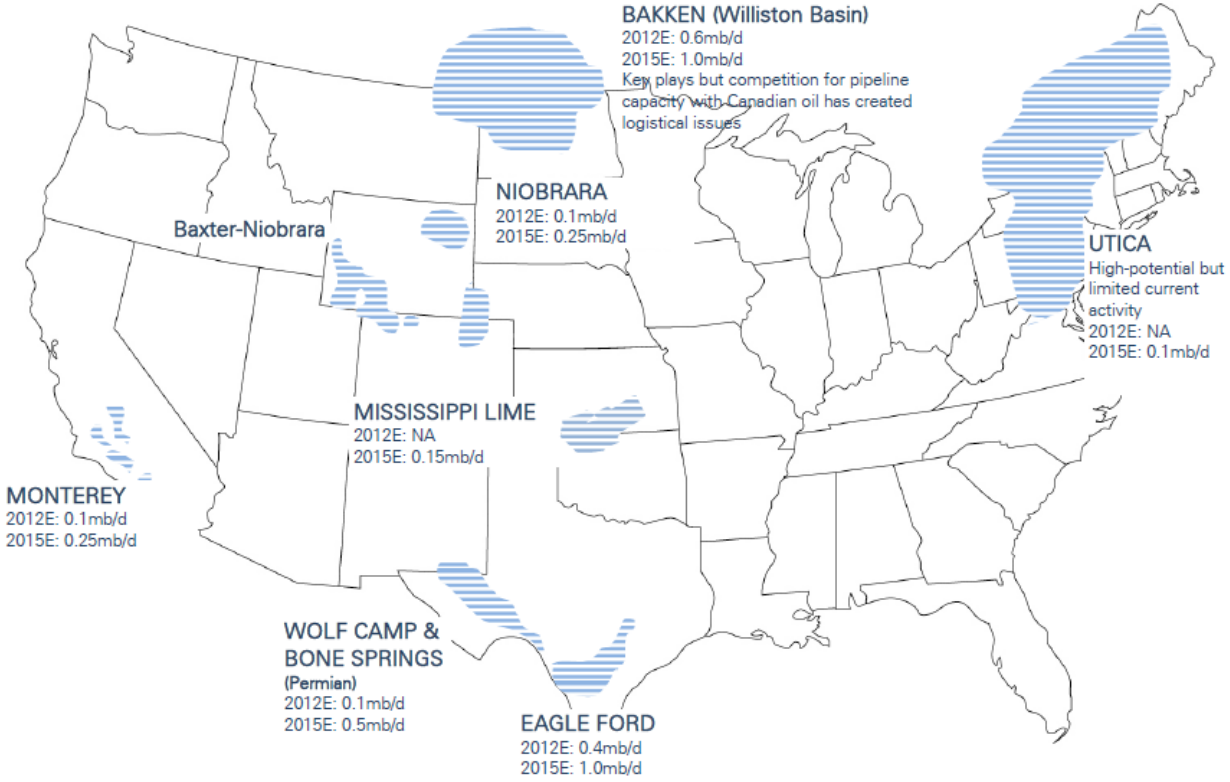
US shale liquids projections could see +3.8-m b/d of growth by 2020



Source: CIRA

- *Forecasts vary but mainly on size of supply bubble*

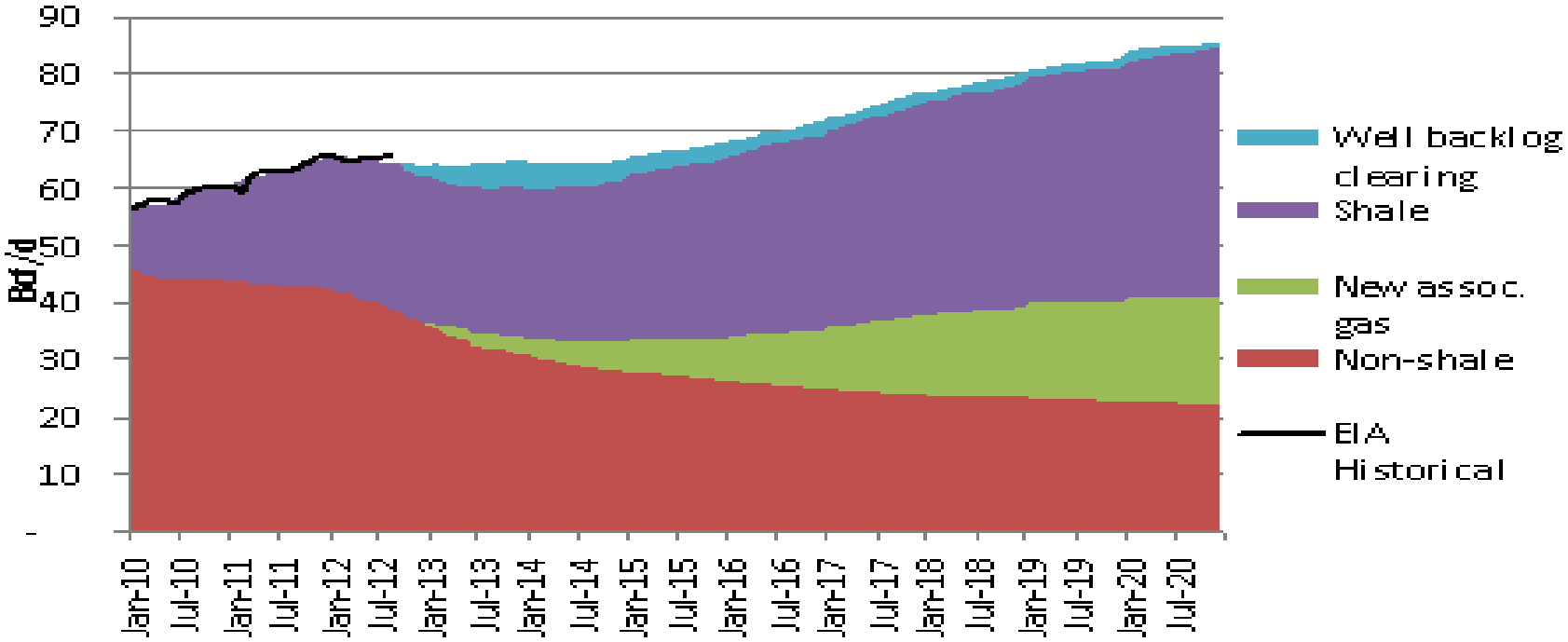
Over ten U.S. shale plays have high liquids potential



Source: Deutsche Bank, Integrated Oils: Oil & Gas for Beginners

- U.S. shale oil and gas potential is widely distributed geographically
- Technical and cost challenges rapidly being overcome through experience and innovation; Production increases can be expected for the next several years

U.S. Natural Gas Production Profile Remains Robust through 2020 and beyond



Source: Citi

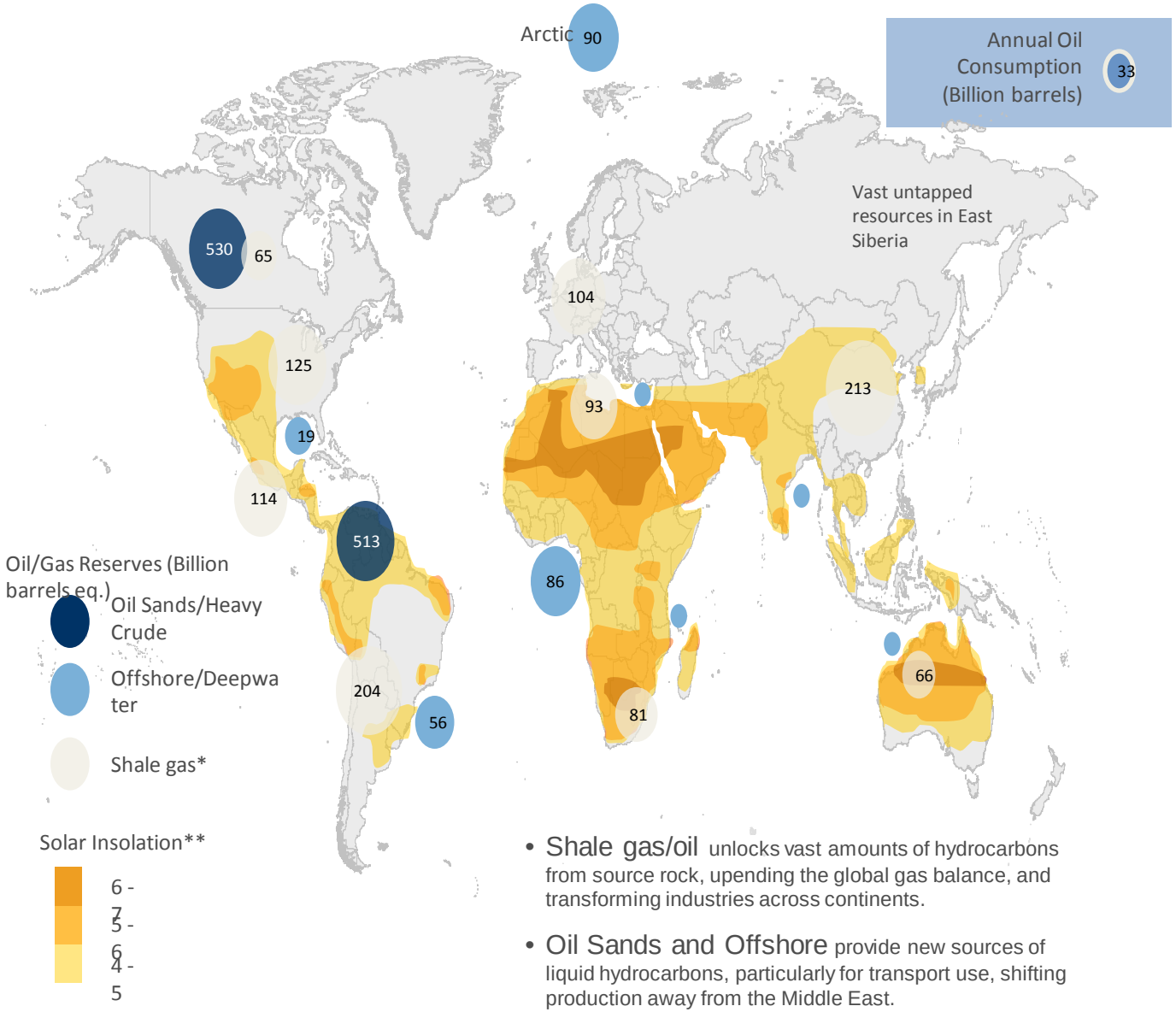
- Large resources available at breakeven costs between $2 per mcf to $3.50 per mcf in 2013-2014 time frame given a backlog of drilled wells and rising Marcellus output
- Longer term, modeling simulations indicate U.S. domestic supplies can keep up with rising demand and limited US LNG exports without pulling prices out of the $4 to $6 range, drawing on higher cost dry gas reserves

The Shale Revolution is Real But…

- *Local communities increasingly objecting to fracking-related Activities*
- *Local ordinances, limited bans among new trends…*
- *Financing also slowing*
- *Social acceptance*

for fracking will be related to industry best or worst practices;

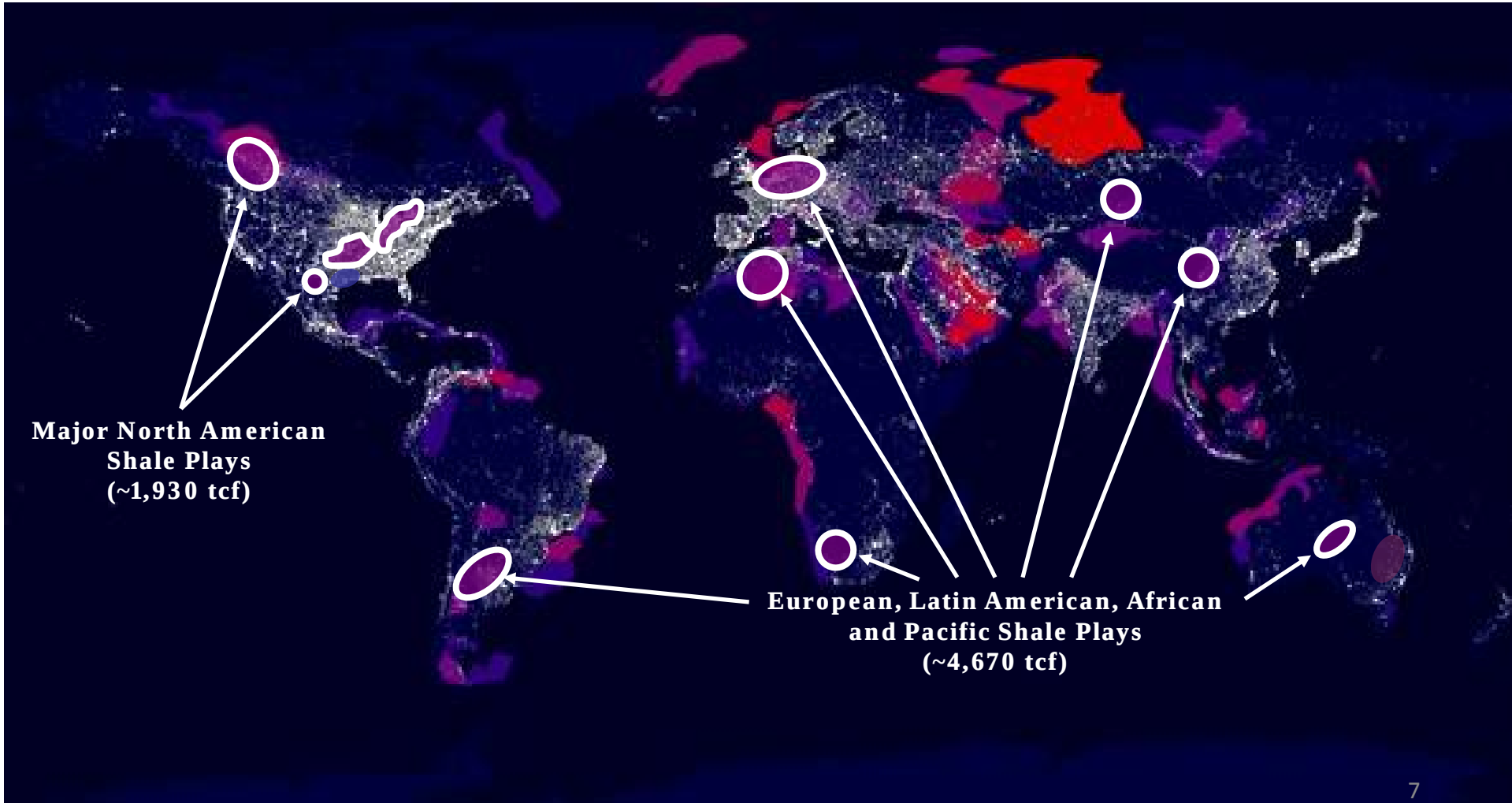
Map of future global energy (and the reserves keep growing)



- **Shale gas/oil** unlocks vast amounts of hydrocarbons from source rock, upending the global gas balance, and transforming industries across continents.
- **Oil Sands and Offshore** provide new sources of liquid hydrocarbons, particularly for transport use, shifting production away from the Middle East.

* From EIA's studies on World and U.S. Shale Gas Resources (2011)
** Amount of solar energy in hours/day during the worst month of the year
Source: EIA, Wood Mackenzie, USGS, Citi Research

New World: Shale will have a transformational impact on energy supply and pricing, energy trade patterns and oil geopolitics, and industry structure



*Over 6,600 tcf of shale according to ARI/EIA report, 2011

North America is poised to become one of the largest LNG suppliers globally

- North American LNG poised to supply 10- to 13-Bcf/d (78-100-mtpa): Could be as much as 20% of the 2020 market
- North America joins Qatar and Australia as a top LNG exporter region
  - Qatar has 77-mtpa (10.3-Bcf/d) of export capacity; debottlenecking could add another 20%.
  - Australian investments could expand export capacity to 88-mtpa (11.7-Bcf/d) by 2018
  - Canada is also pursuing LNG export projects to Asia

List of US LNG export projects grouped by DOE and FERC application status

Terminal	Company	Location	mtpa	Bcf/d
US				
Sabine Pass	Cheniere	Cameron	16.9	2.2
Freeport	Freeport/Macquarie	Freeport/Macquarie	10.5	1.4
Lake Charles	Energy Transfer Partners	Lake Charles, LA	15.0	2.0
Cove Point	Dominion	Lusby, MD	7.3	1.0
Group 1				
Freeport expansion	Freeport/Macquarie	Freeport/Macquarie	3.0	0.4
Cameron	Sempra	Hackberry, LA	12.0	1.6
Jordan Cove	Jordan Cove	Coos Bay, OR	5.8	0.8
Oregon	LNG Dev Co.		9.1	1.2
Corpus Christi	Cheniere	Corpus Christi, TX	15.3	2.0
Lavaca Bay	Exelerate	Port Lavaca, TX	10.0	1.3
Group 2				
Gulf Coast	Gulf Coast LNG	Brownsville, TX	20.4	2.7
Southern LNG	Southern LNG	Savannah, GA	4.0	0.5
Gulf LNG	Gulf Coast LNG Export	Pascagoula, MS	11.0	1.5
CE FLNG	CE FLNG	Plaquemine, LA	7.8	1.0
Golden Pass	Golden Pass Products	Port Arthur, TX	19.0	2.5

Source: BP, company reports, Citi Research

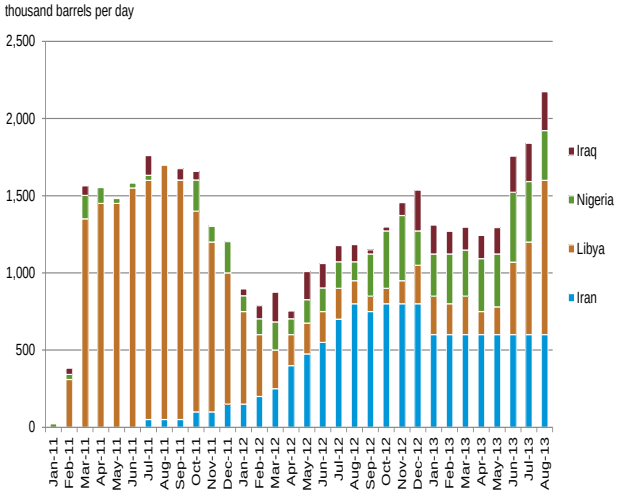
2013 Review: If North America Shale is Real: Why were prices so high globally?

Fukushima tightened LNG markets just as the US domestic surplus was displacing LNG to rest of the world; Libya added to record oil disruptions last year, just as new US tight oil knocks African crude out of US market

Fukushima Dai-ichi nuclear plant, March 2011

- **…absorbed 15 mtpa of spare capacity of global natural gas**

Crude supply disruptions in Iraq, Nigeria, Libya, Iran (2011-13)



- **…absorbed over 1 mb/d North American oil production growth**

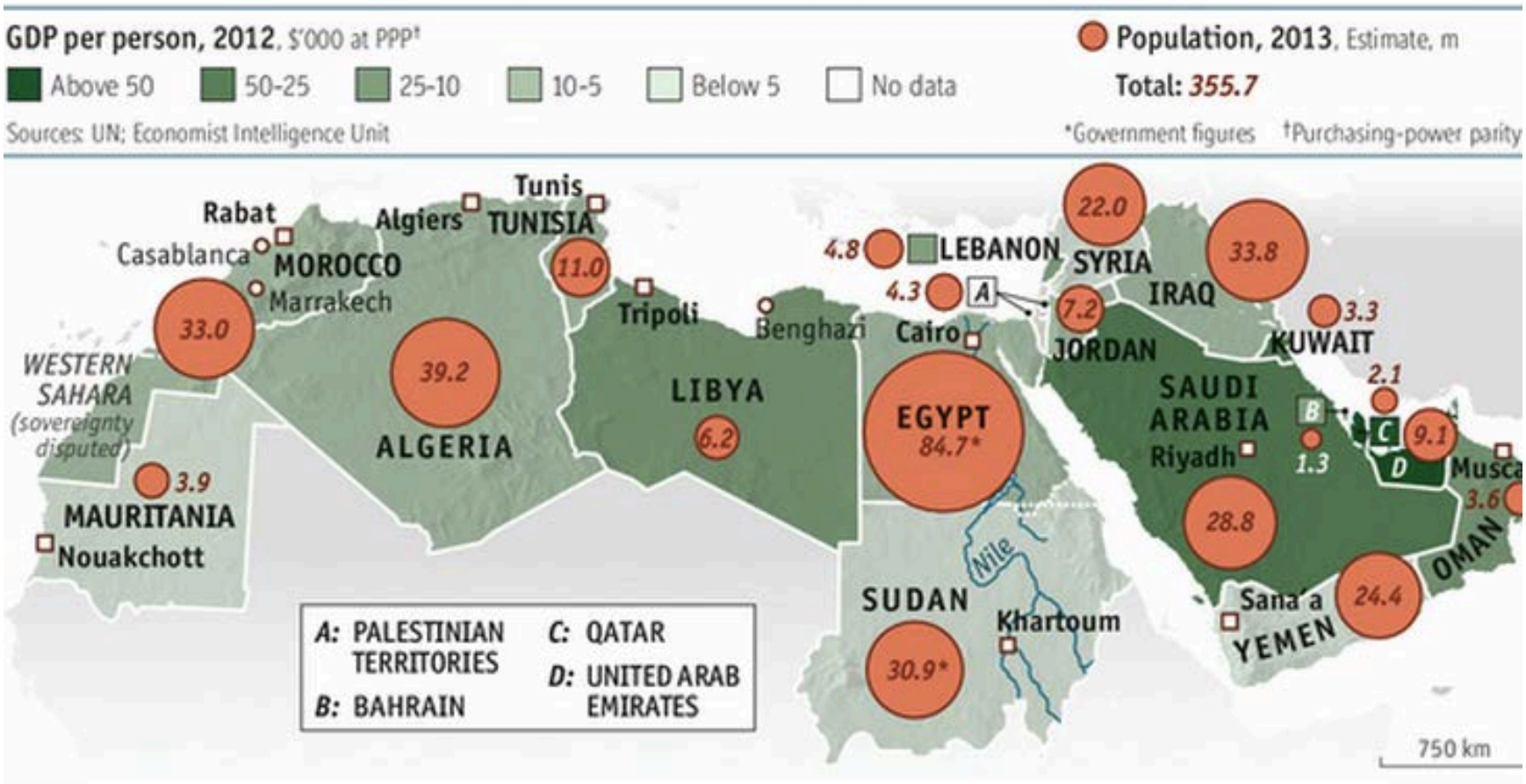
Source: NTV/NNN Japan/AP, EIA

Welcome to the New Millennium:
Which of these two black swans is the largest risk to energy security?

Tehran, Iran 1979 – Qatif, Saudi 2013

Unpredictable forces at work that might take years,
if not decades, to resolve

Decades After OPEC's First Big Success Raising Oil and Gas Prices, Economic and Social Pressures Remain and are Worsening!



Five Issues to Watch in the Next Twelve Months

- Continued Civil War in Syria
- Strain in US-Saudi, Qatari-US Relations Over Syria: An Energy Coalition Opening for Russia?
- Possible Increase in Saudi fragility
- Iranian Nuclear Dialogue Stays in News
- Increasing Domestic U.S. Pressure to Further Disengage from the Middle East
- China Air Pollution Emergency Changes Primary Energy Demand

What Would A Crisis in the Middle East Look Like? What Would It Mean?

*Expect A Sharp Reversal in Economic Recovery

*Guard Against A Renewed Financial and Banking Crisis (Saudi, Qatari SWF funds previously stabilized IMF and private banks)

*Bet on Alternative Fuels, Especially Natural Gas and NGLs in Transportation

*Adjust Business Models to Adapt to "Millennial" Trends Such as Urban Density/Living Local, Community Choice Aggregation (CCA), Telecommuting

*Look For Accelerated Investment in North America Shale

What Would A Resolution of Crises in the Middle East Look Like? What Would It Mean?

*Expect A Sharp Reversal in Oil Prices

*But This Time Around, Hard To Knock Out Alternative Energy

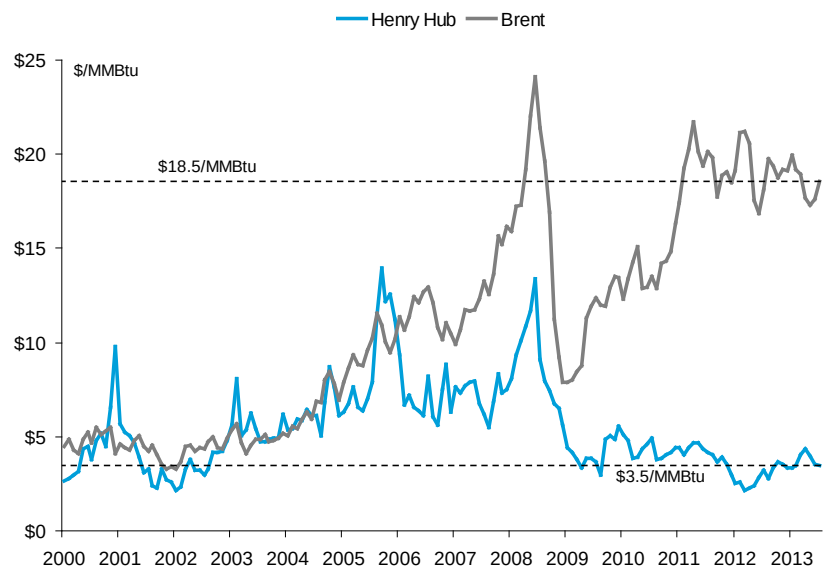
*Failed State Risks Will Keep US Involved

*Lack of Oil Import Need Might Embolden the US to Encourage Democracy

*China's Worst Nightmare – China, Japan Will Have Energy Rivalry Previously Expected for US-China

Citibank estimates that as much as 20-m b/d of global oil demand could be substituted by natural gas

Brent and Henry Hub natural gas prices were around $5/MMBtu levels until the mid-2000s, but in 2012, Henry Hub prices fell to below $2 while Brent was above $20/MMBtu at times



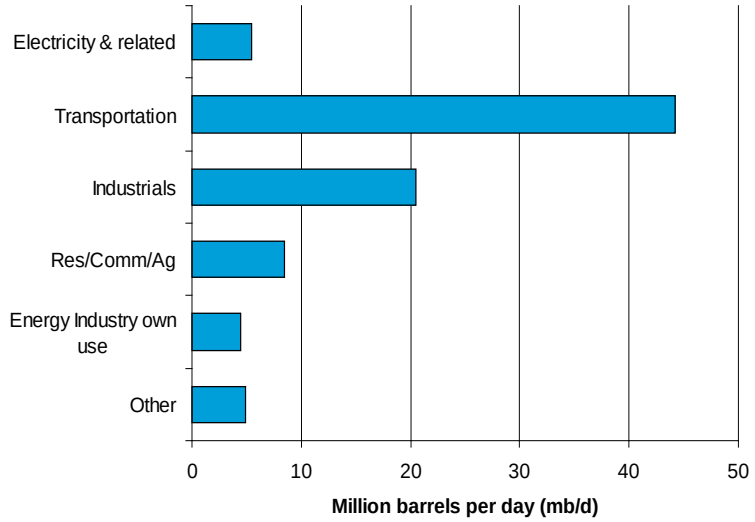
In US, nat gas supply grew over 20% from 2009 to 2012, pushing out LNG imports, coal use. Higher demand expected in power generation, industrial demand, LNG exports, as well as passenger and delivery transportation

- .
- **Do low natural gas prices mean eroding demand for coal in power generation and an end to oil's domination of transportation.**
- **What's at stake: 20 million barrels per day of oil demand (of 90-m b/d global market) and, combined with renewables, another 150-mtpa of coal.**
  - **9-m b/d of trucking diesel demand**
  - **3-m b/d of marine bunker fuel oil demand**
  - **2-m b/d of oil-fired power generation**
  - **5-m b/d of petrochemical demand for naphtha**
  - **Rail transport use, drilling equipment and oil use for space heating**
  - **…and this does not include gasoline demand that could be eroded in light vehicles.**

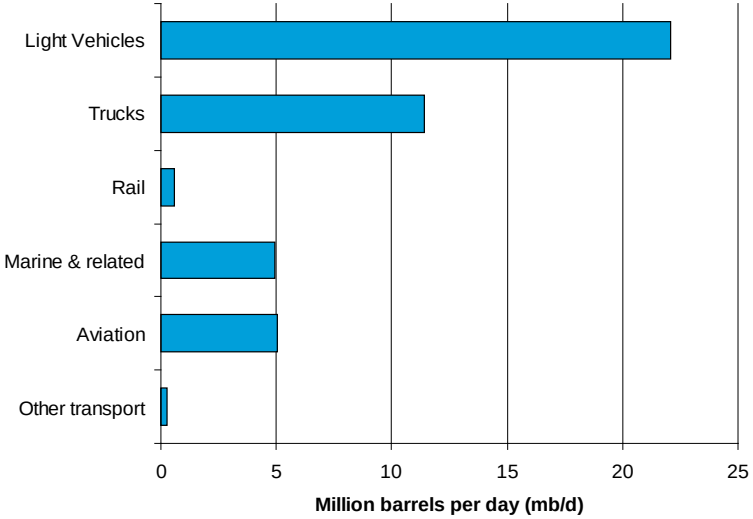
Source: Bloomberg, Citi Research

Potential global oil-to-gas substitution market in transportation is sizeable

World Oil Demand by Sector (2010)



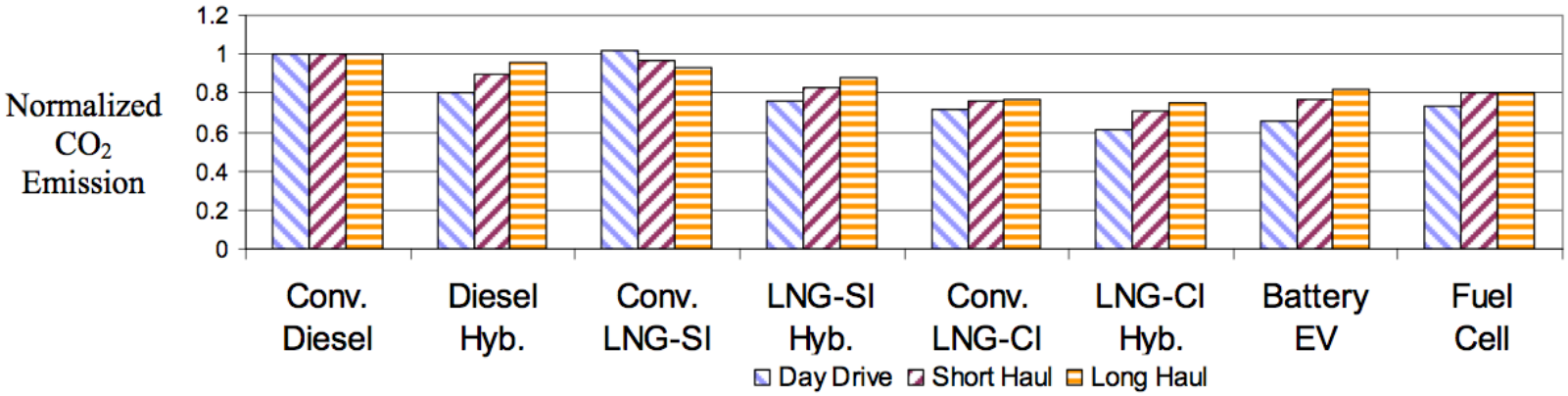
World Oil Demand for Transportation (2010)



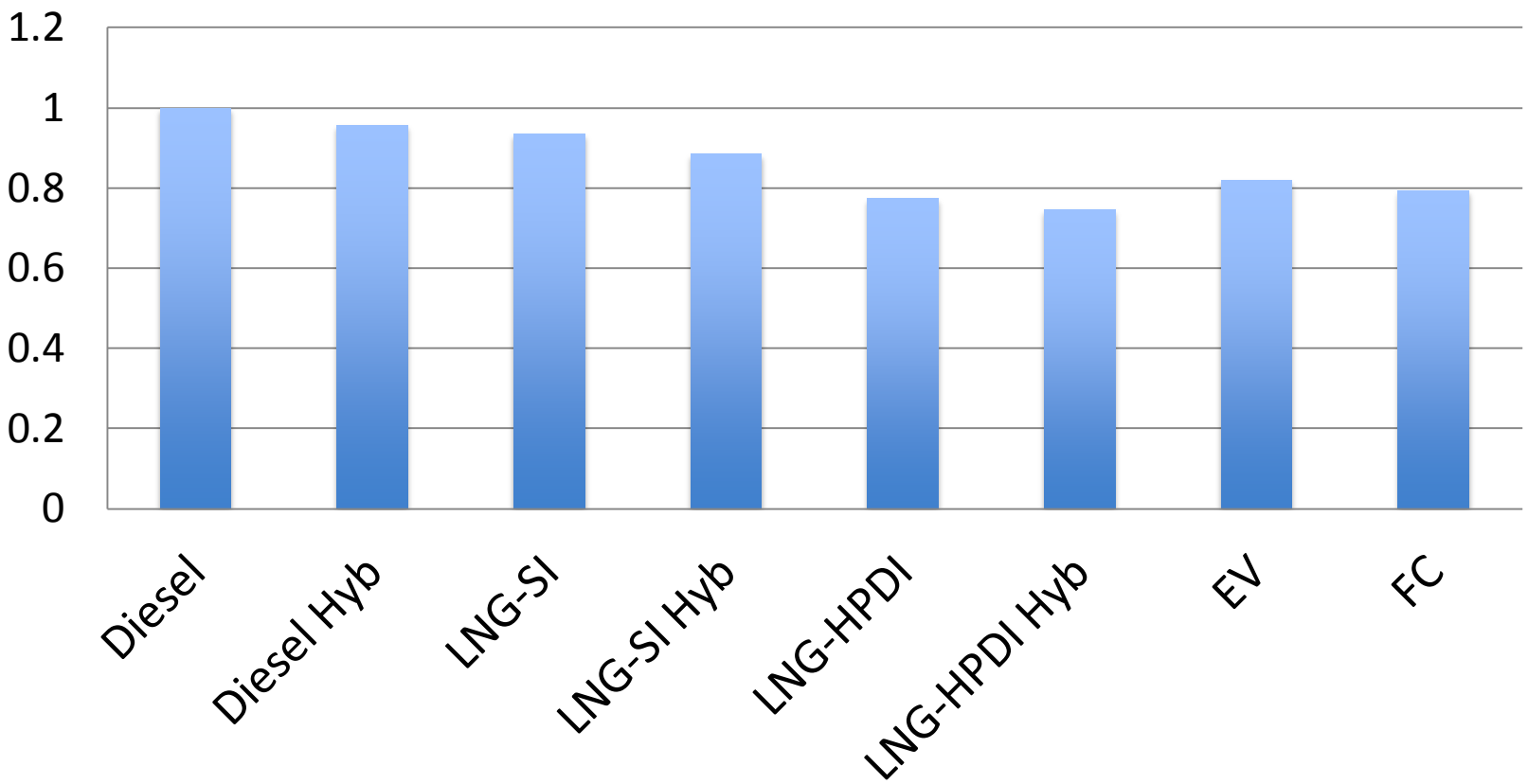
- **Transportation accounts for 44-mb/d of global oil demand, almost 50% of the total.**
- Within transportation, oil demand for light vehicles accounts for over 20-mb/d, trucks for more than 10-mb/d, marine and aviation each uses about 5-mb/d, and the rest is in rail and other transportation.
- Most regions worldwide, other than Africa, already have some presence of NGVs
- **The trucking, marine and rail sectors, as well as certain light vehicle markets, could be sizeable market opportunities for natural gas.**

Source: IEA, Citi Research

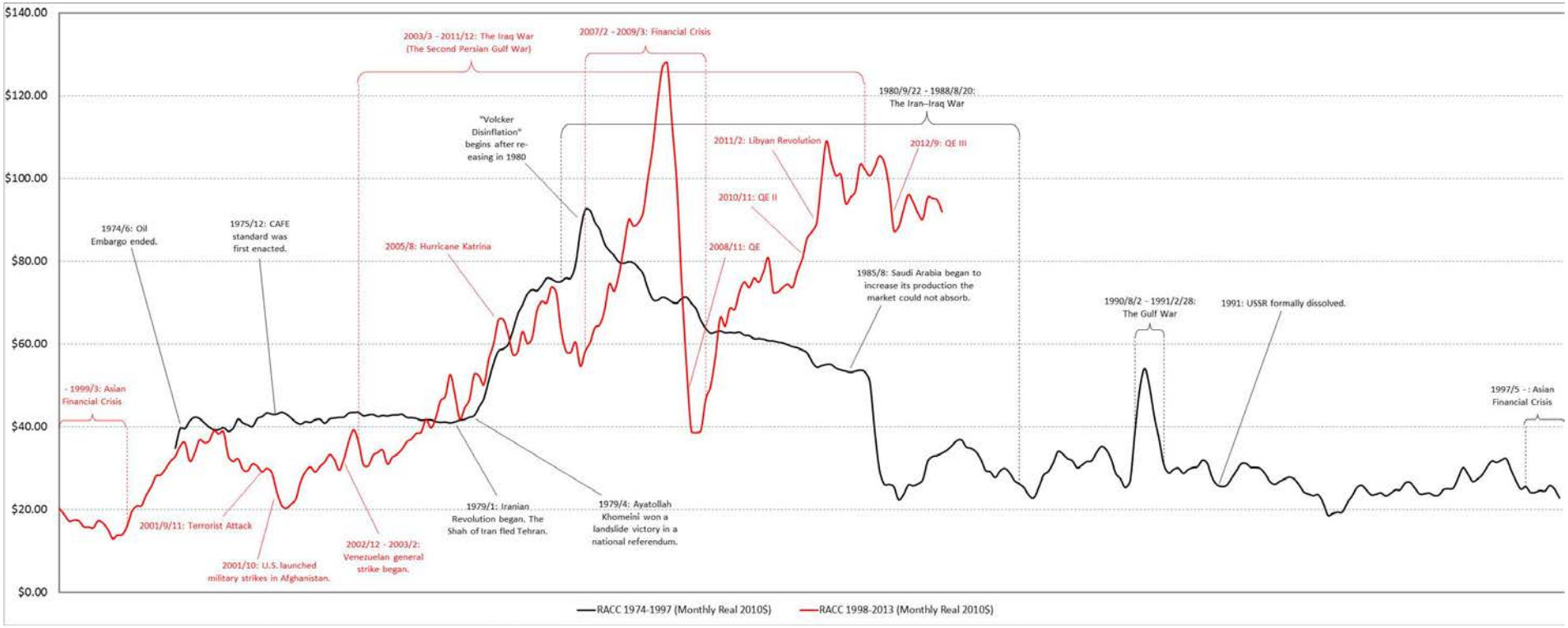
Class 8 truck ADVISOR Model (Andy Burke) exhaust CO2 emission comparison (Based on g/dge- energy content)



Class 8 truck
ADVISOR Model (Andy Burke)
exhaust CO2 emission comparison
(Based on g/mile- engine efficiency factored in)



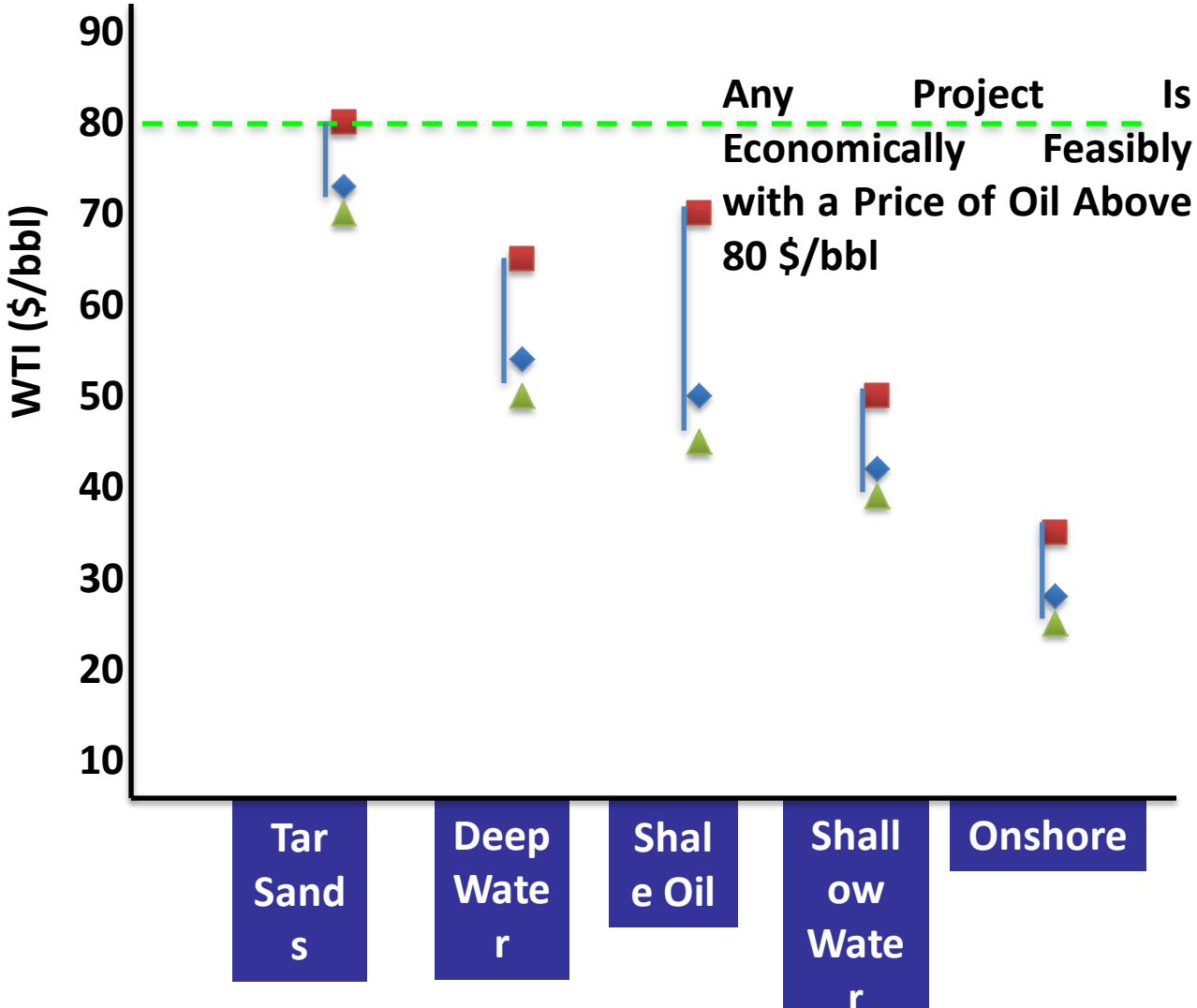
Repeating Boom and Bust Cycles Characterize Oil.



Source: Medlock, K.B., Amy Jaffe, "The price of crude oil: deja vu all over again?" (2013), EIA

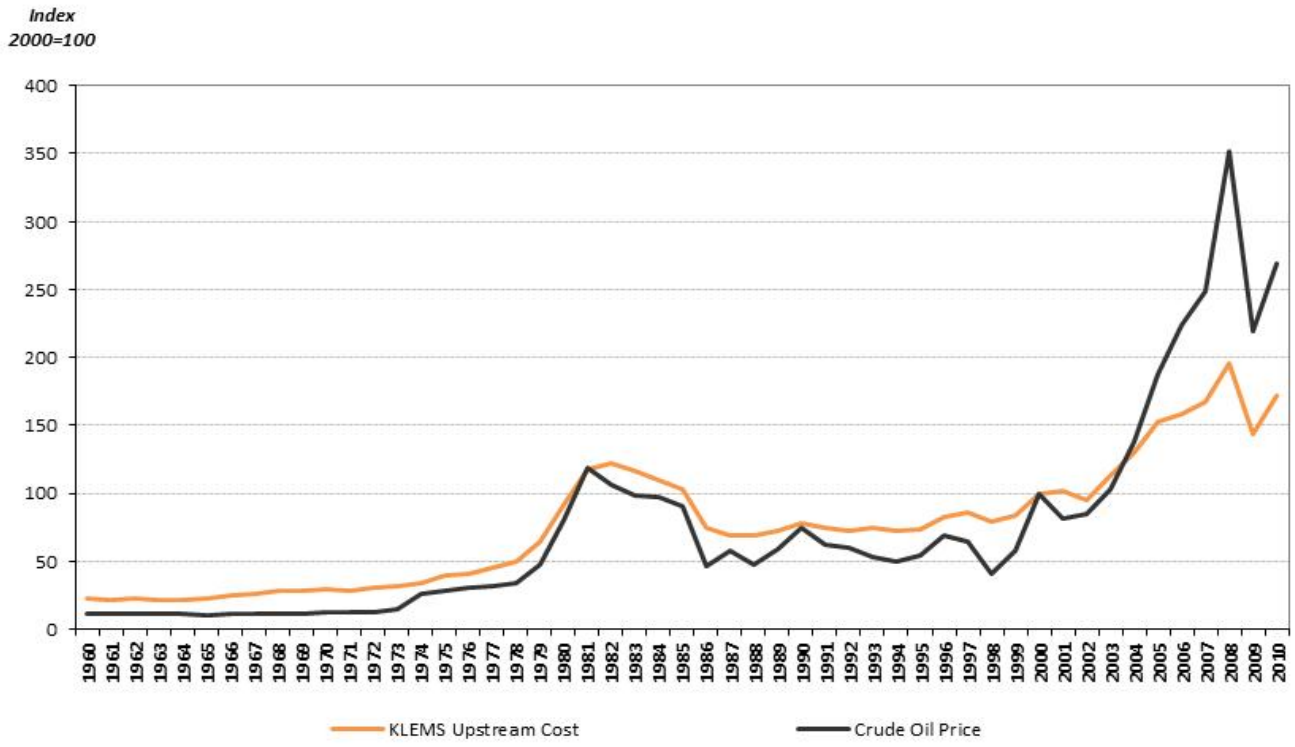
- High oil prices usher in demand destruction through conservation, efficiency gains, and substitution
- High oil prices stimulate drilling innovations, which over time can lead to supply bubbles.

Range of the Breakeven Oil Price by Play Type



Costs and Oil Prices Move Together

- *Chicken egg effect: As prices rise, more drillers expand activity, increasing demand for equipment and rigs and raising costs. Equal and opposite effect seen when prices fall.*
- *It is not correct that cost increases will be permanently rising based on complexity. Cost management-technology improvement, accelerated development cycle times, and improved well productivity can all reduce costs.*



C0nclusions

- In the medium to longer term, oil scarcity unlikely to be the force driving a shift to alternative energy
- Climate and energy policy initiatives will have to take into consideration the possibility of oil and gas surpluses and lower fossil fuel prices

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