Natural Gas Outlook and Other Things

Presentation to:
2014 Phosphate Spring Conference
Boca Grande, Florida

By:
John Harpole

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May 9-10, 2014

Fertilizer Industry vs. Natural Gas Industry

Source: http://www.search.com/reference/Lucy_van_Pelt

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The New York Times

April 1, 2014

Worst Is Yet to Come

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Los Angeles Times

April 1, 2014

Crop Yields Are Down, Deaths From Heat Are Up

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SIERRA CLUB

FOUNDED 1892

April 2014

“By having a child, an American woman increases her carbon legacy sixfold.”

- Sierraclub.org

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The Daily Telegraph

January 22, 2013

David Attenborough: Humans Are Plague on Earth

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Prince Philip

Husband of Queen Elizabeth II

"…I am tempted to ask for reincarnation as a particularly deadly virus."

Forward to "If I Were an Animal"

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Worst Earth Day Predictions

Made in 1970

"CIVILIZATION WILL END WITHIN 15 OR 30 YEARS UNLESS IMMEDIATE ACTION IS TAKEN AGAINST PROBLEMS FACING MANKIND."

- Source: George Wald Harvard Biologist

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Worst Earth Day Predictions

Made in 1970

"IN A DECADE, URBAN DWELLERS WILL HAVE TO WEAR GAS MASKS TO SURVIVE AIR POLLUTION… BY 1985 AIR POLLUTION WILL HAVE REDUCED THE AMOUNT OF SUNLIGHT REACHING EARTH BY ONE HALF."

- Source: Life Magazine

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Worst Earth Day Predictions

Made in 1970

"AIR POLLUTION…IS CERTAINLY GOING TO TAKE HUNDREDS OF THOUSANDS OF LIVES IN THE NEXT FEW YEARS ALONE."

- Source: Paul Ehrlich,
Stanford University Biologist

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Worst Earth Day Predictions

Made in 1970

"BY THE YEAR 2000, IF PRESENT TRENDS CONTINUE, WE WILL BE USING UP CRUDE OIL AT SUCH A RATE…THAT THERE WON'T BE ANY MORE CRUDE OIL. YOU'LL DRIVE UP TO THE PUMP AND SAY, 'FILL 'ER UP, BUDDY,' AND HE'LL SAY, 'I AM VERY SORRY, THERE ISN'T ANY.'"

- Source: Kenneth Watt, Ecologist

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Worst Earth Day Predictions

Made in 1970

"POPULATION WILL INEVITABLY AND COMPLETELY OUTSTRIP WHATEVER SMALL INCREASES IN FOOD SUPPLIES WE MAKE. THE DEATH RATE WILL INCREASE UNTIL AT LEAST 100-200 MILLION PEOPLE PER YEAR WILL BE STARVING TO DEATH DURING THE NEXT TEN YEARS."

- Source: Paul Ehrlich,
Stanford University Biologist

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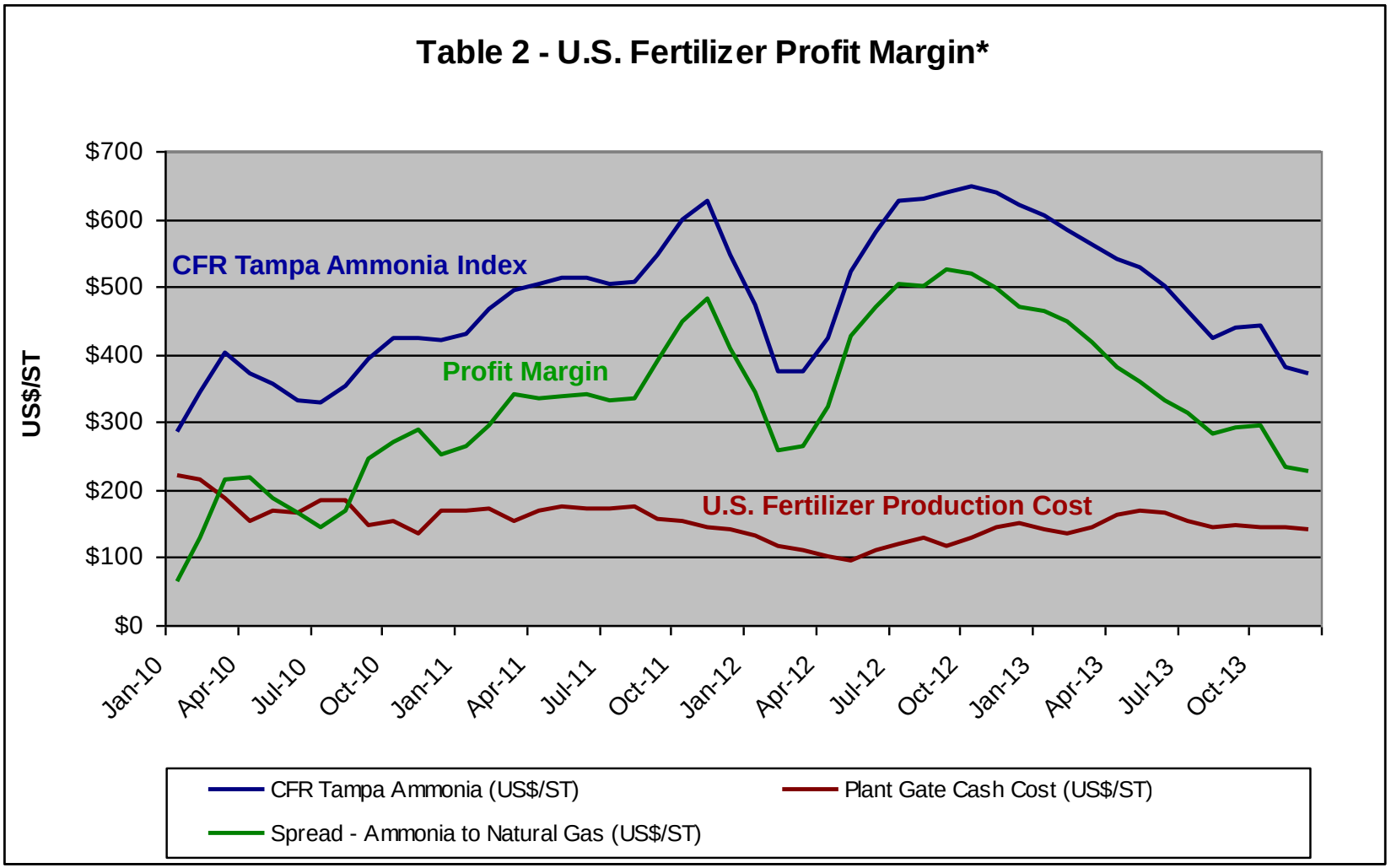
Natural gas – fertilizer - food

- "If we all ate simple vegetarian diets and farmed every acre of arable land as wisely as possible using the best techniques of the late 1800s, the earth could support a population of around 4 billion people. In theory, the other 2 billion-plus inhabitants should be starving, the natural result of population out-stripping food supply, as doomsayers from Thomas Malthus to Paul Ehrlich have long predicted."

- Thomas Hager

This U.S. energy breakthrough has positive implications for the cost of food.

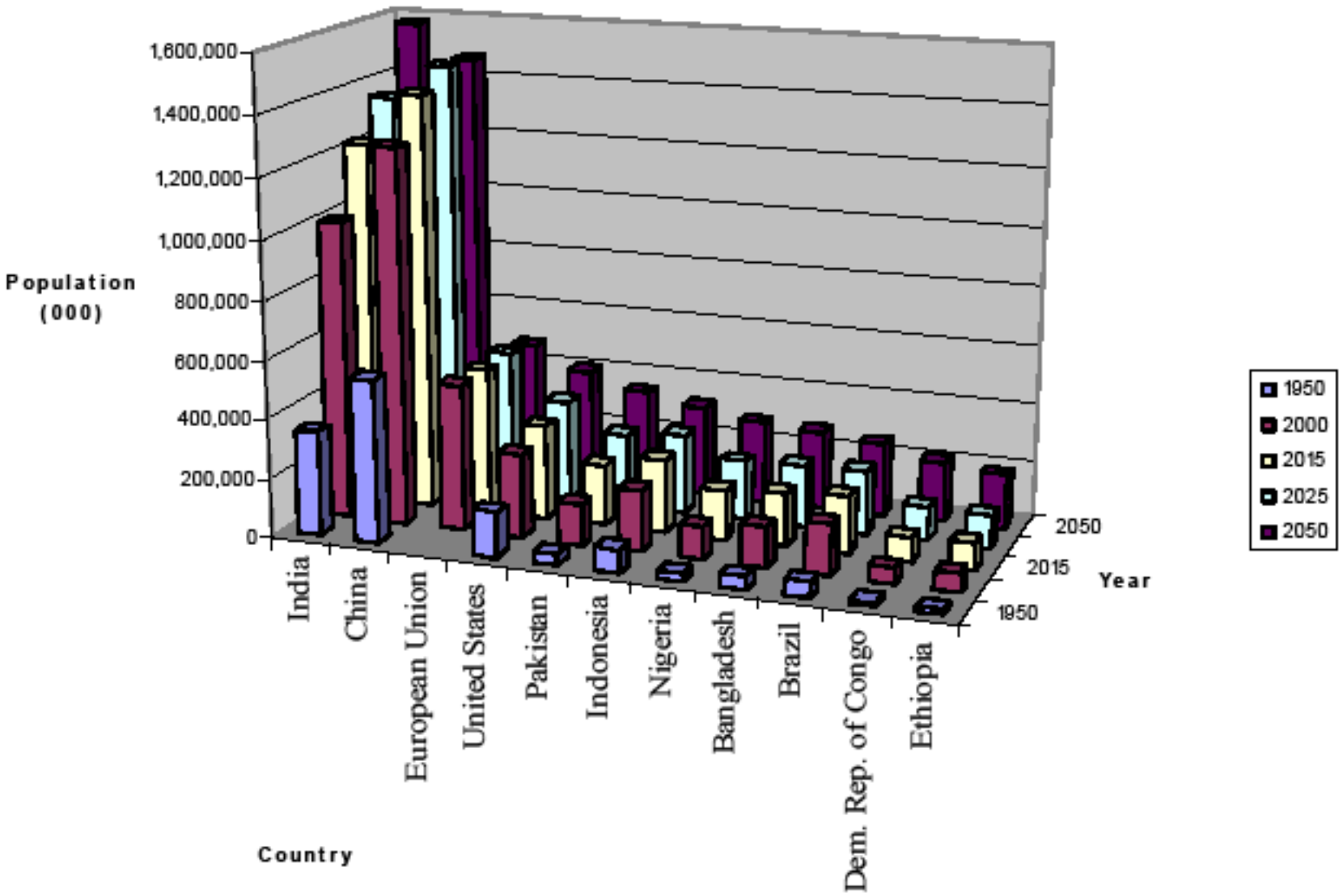
Table 2 - U.S. Fertilizer Profit Margin*



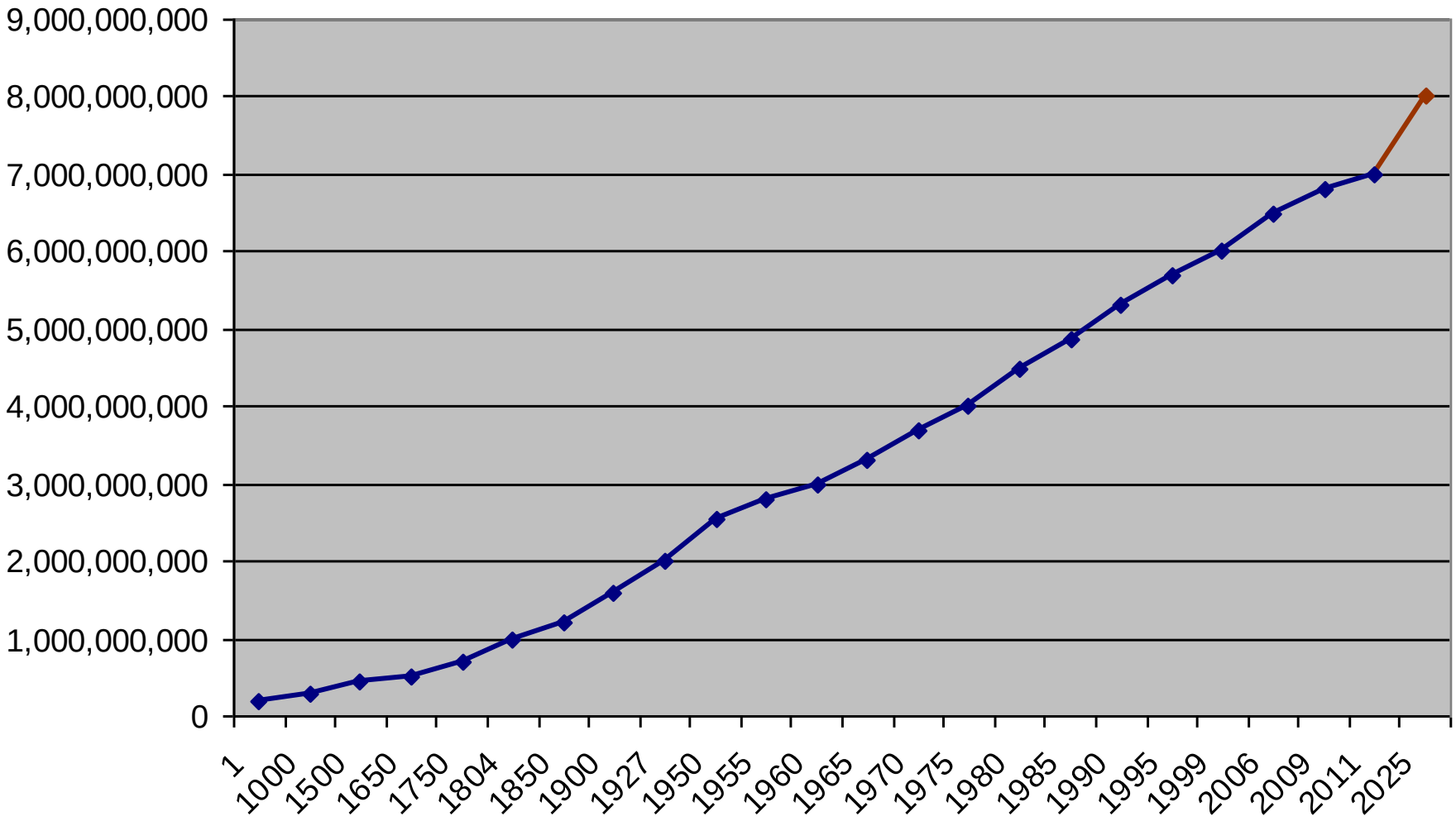
*CFR Tampa Ammonia Index less Plant Gate Cash Cost

Source: Published index information and U.S. fertilizer industry experts

Population Growth from 1950-2050

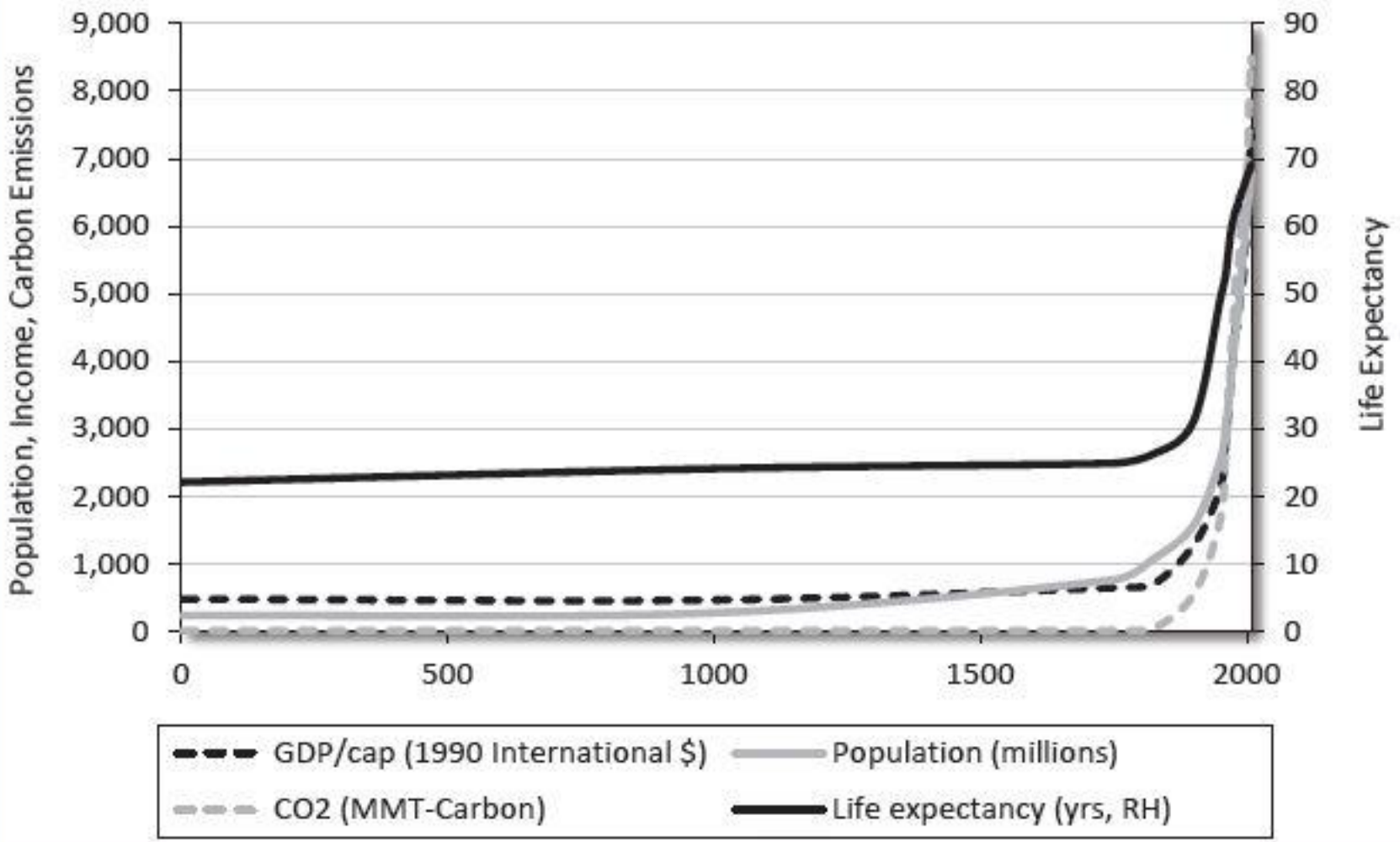


World Population Growth



Source: About.com; http://geography.about.com/od/obtainpopulationdata/a/worldpopulation.htm

Global Progress, 1 A.D.–2009 A.D. (as indicated by trends in world population, gross domestic product per capita, life expectancy, and carbon dioxide [CO_2] emissions from fossil fuels)



Source: Policy Analysis: *Humanity Unbound: How Fossil Fuels Dave Humanity from Nature and Nature from Humanity,* Indur M. Goklany, December 20, 2012

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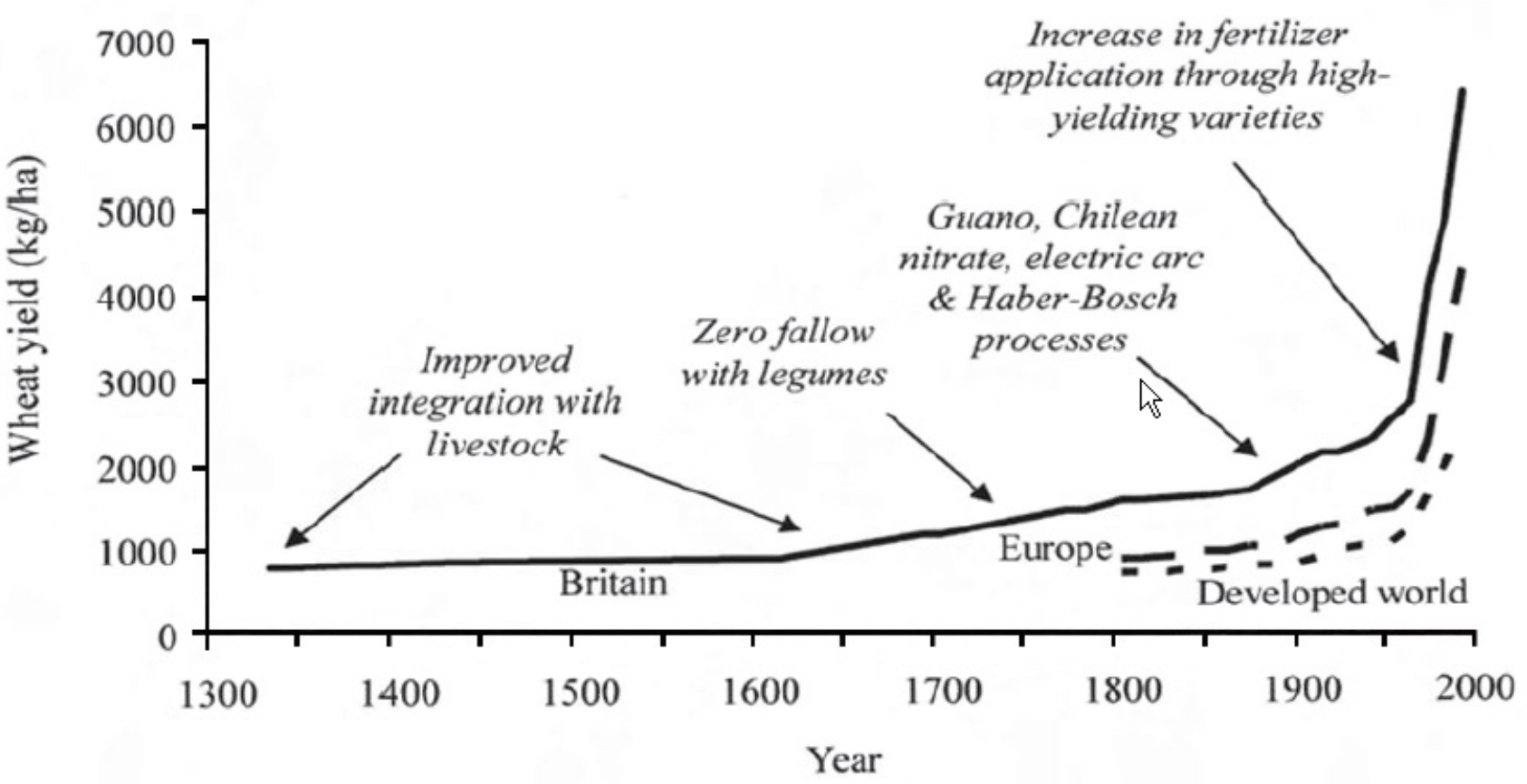
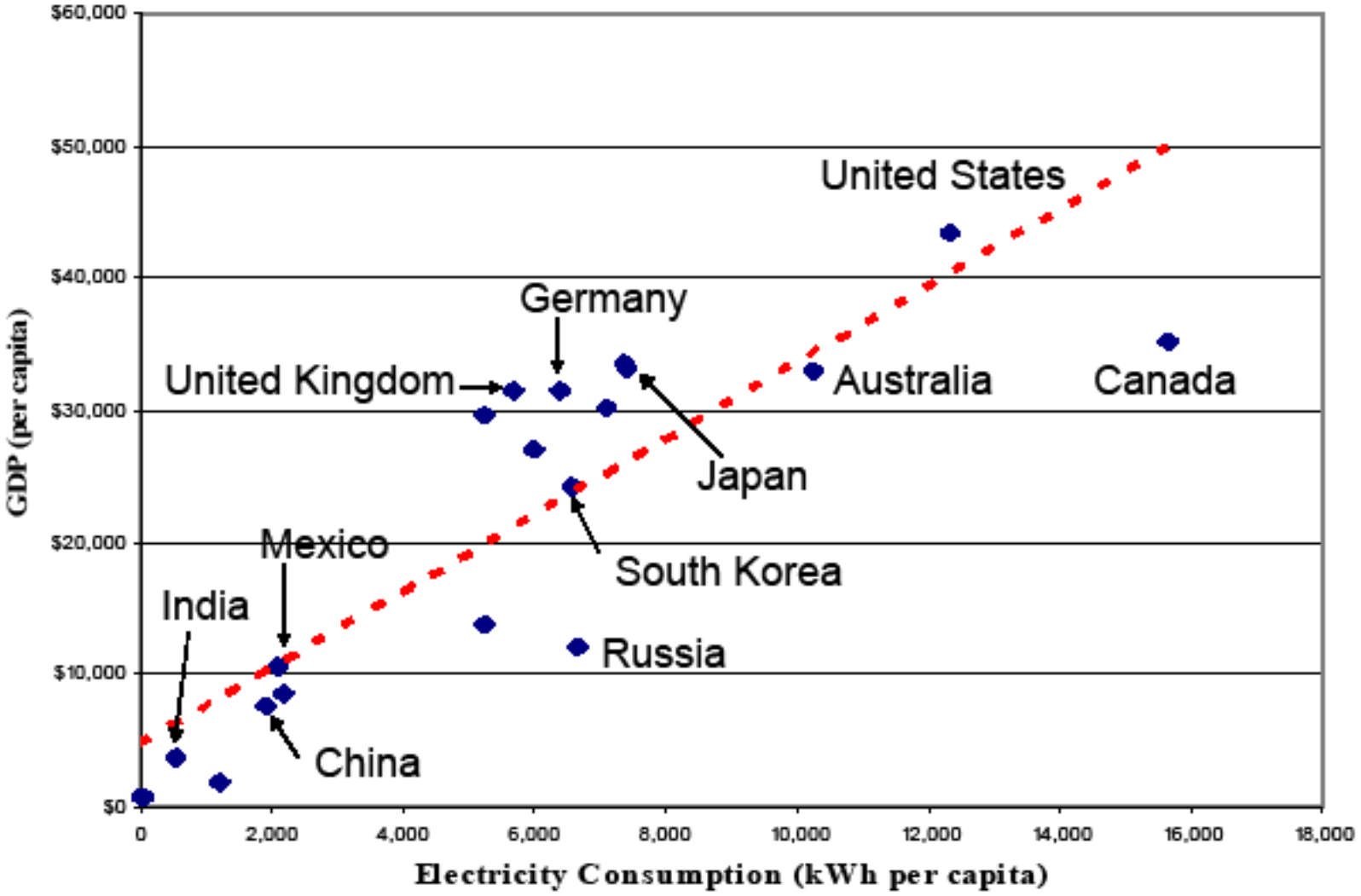
Figure 3
Wheat Yield in Britain, Europe, and the Developed World, 1300–1990



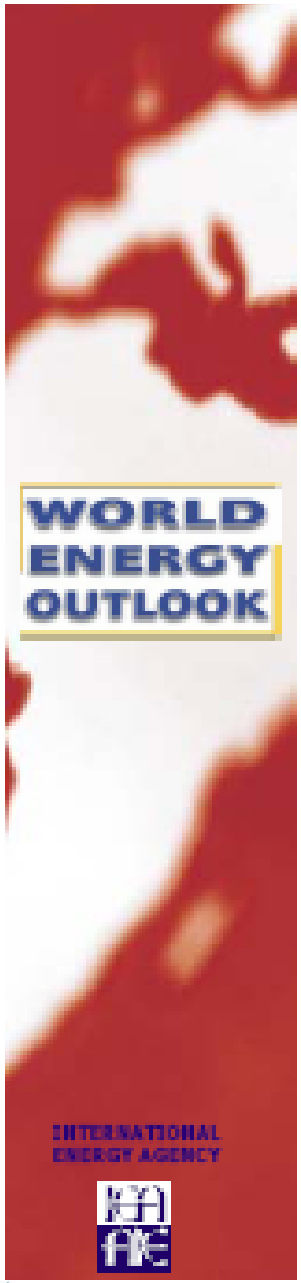
Source: N. B. J. Koning, et al., "Long-term global availability of food: continued abundance or new scarcity?" *NJAS Wageningen Journal of Life Sciences* 55 (2008): 229–292.
*Britain: Until 1800, England; since 1800, the United Kingdom.
**Europe, excluding Russia.
***The developed world, excluding Japan and South Africa.

Source: Policy Analysis: *Humanity Unbound: How Fossil Fuels Dave Humanity from Nature and Nature from Humanity,* Indur M. Goklany, December 20, 2012

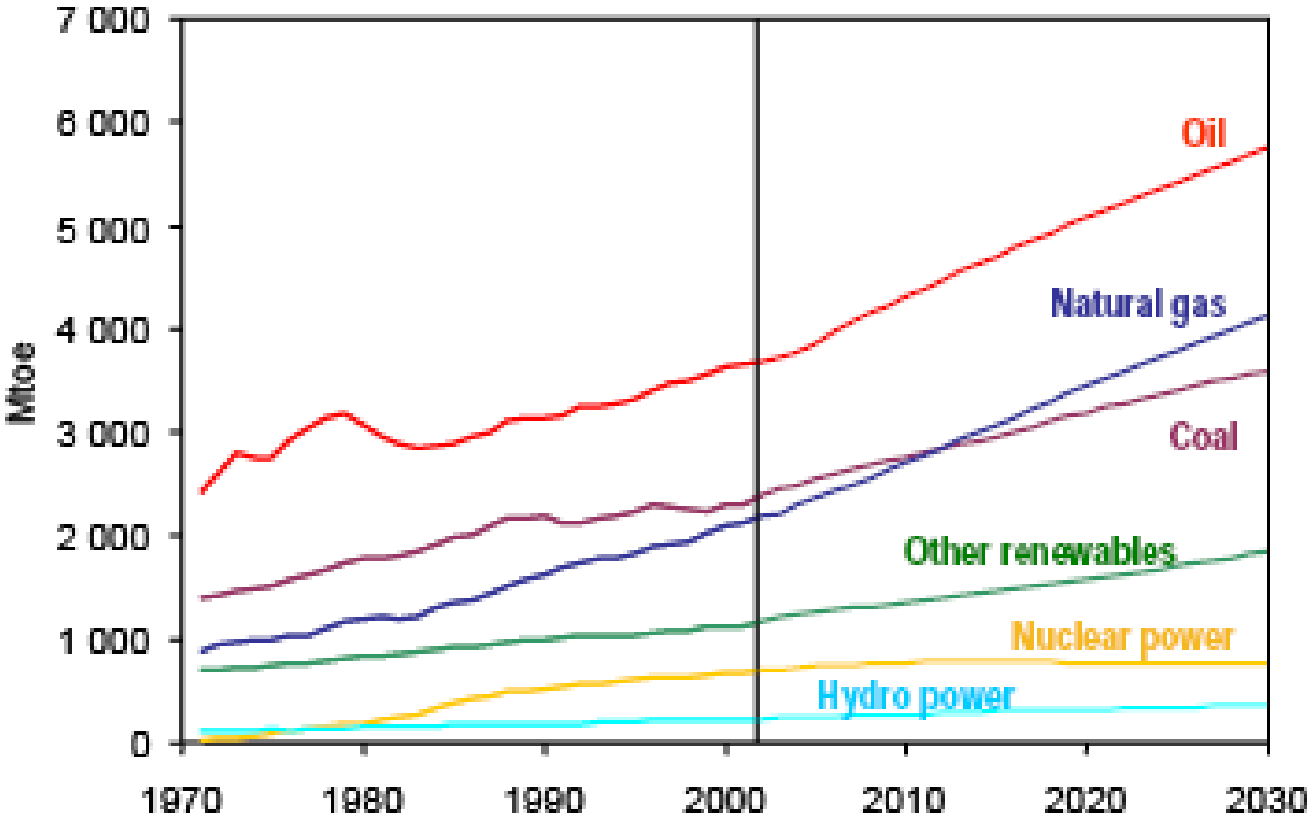
Quality of Life is Strongly Correlated with Electricity Consumption



Source: CIA World Factbook, 2007



World Primary Energy Demand



Fossil fuels account for almost 90% of the growth in energy demand between now and 2030

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Sustainability?

- Sustainability is the balance between “too many people and too few resources”
- It is the fundamental presumption by the UN in any population growth model for the world, and also in climate change arguments.
- “Fighting Climate Change With Family Planning”
- What if energy became “super-abundant”?
- The case for natural gas.

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Natural Gas 101

Patience please…

Natural Gas Conversions

1 CF = 1 cubic foot

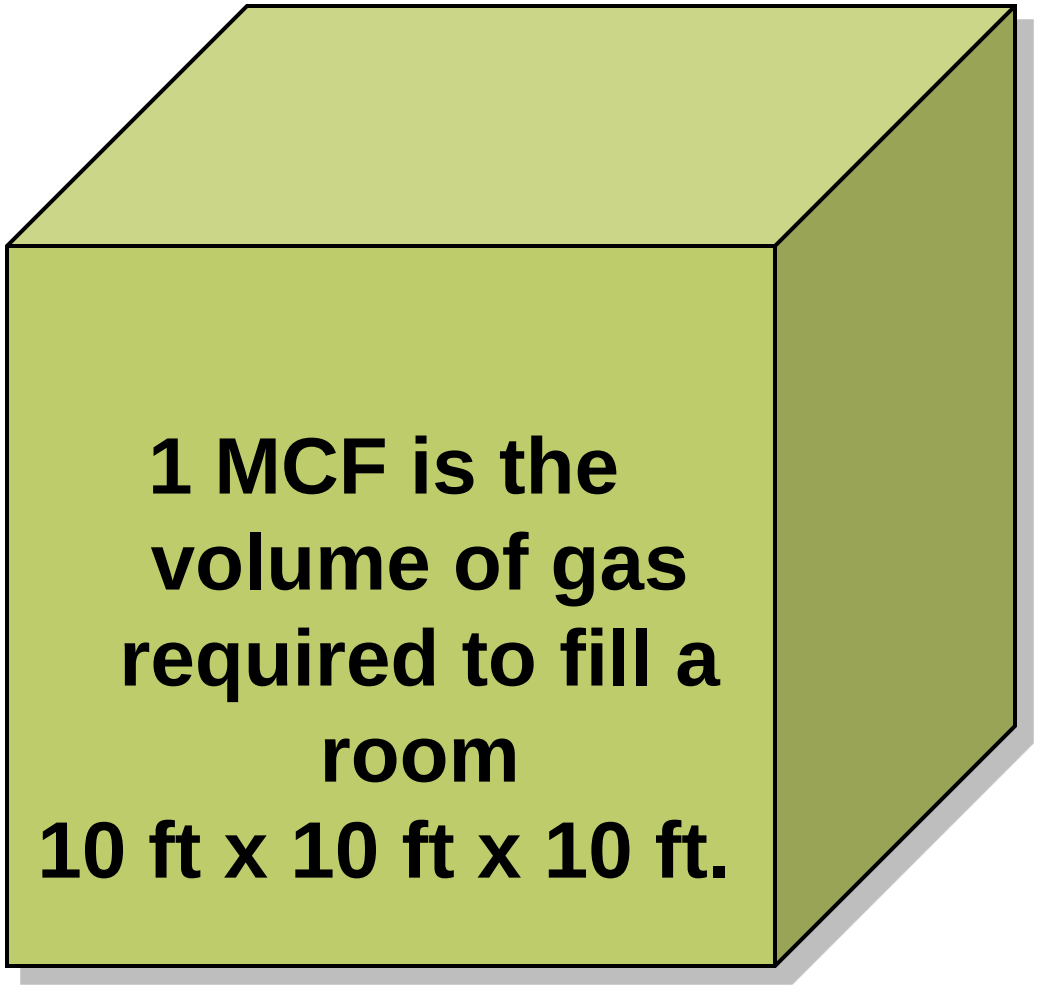
1000 cubic feet = 1 MCF

1 dekatherm = 10 therms

1 MCF = 1 MMBTU = 1 dekatherm

(roughly)

Volume in Reality



Perspective: Residential Gas Usage

In a single year, the average US home uses 84 MCF of natural gas.

Source: Natural Gas Supply Association

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Natural Gas Volumes: A Perspective

- 1 MCF is the volume of gas required to fill a 10’x10’x10’ room
- 1 MCF = 1 Dekatherm, 1 Dekatherm = 10 Therms = 1MMBtu
- 84 MCF is the volume of gas the avg. US home uses per year
- 2.1 BCF/Day is the peak-day demand along the front range of Colorado

Natural Gas Volumes: A Perspective (cont'd)

- 1 BCF is the volume of gas an average Western Colorado well will produce over its lifetime (In heat content, 1 BCF is equal to the amount of energy found in a swath of wooded natural forest 800 feet wide by 120 miles long.)

- 3 BCF is the volume of gas contained in 1 LNG Tanker, which is enough to heat approximately 35,000 homes for one year.

Natural Gas Volumes: A Perspective (cont'd)

- 8 BCF is the avg. daily amt. of natural gas consumed in California
- 2.6 BCF is the peak day demand in New York City
- 4.09 BCF per day production from 3 Pennsylvania counties (Marcellus)
- 7 BCF per day potential incremental fertilizer and chemical plant demand in U.S.
- 2008 U.S. Shale gas resource: 347 TCF
- 2013 U.S. Shale gas resource: 1,073 TCF

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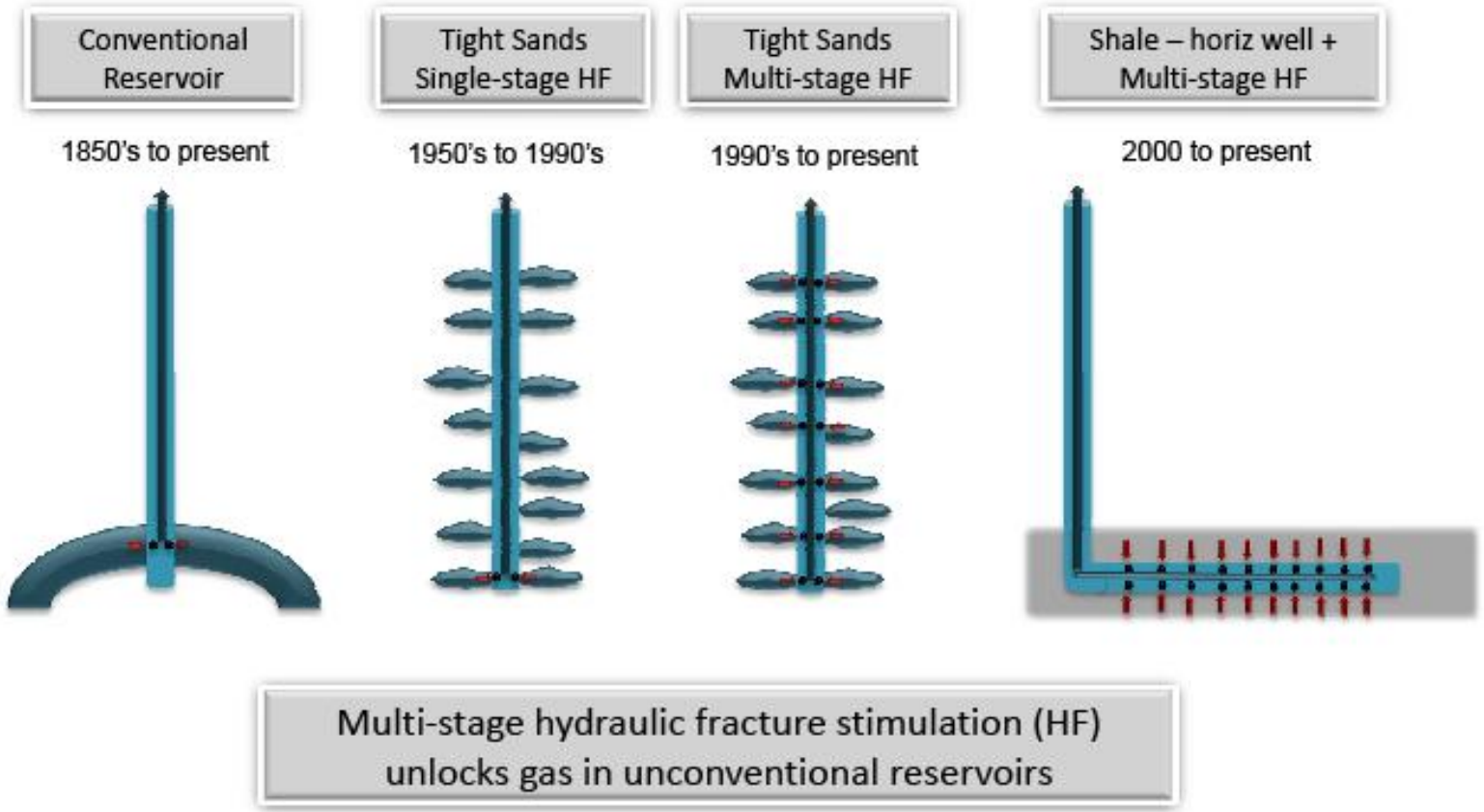
Natural Gas Volumes: A Perspective (cont'd)

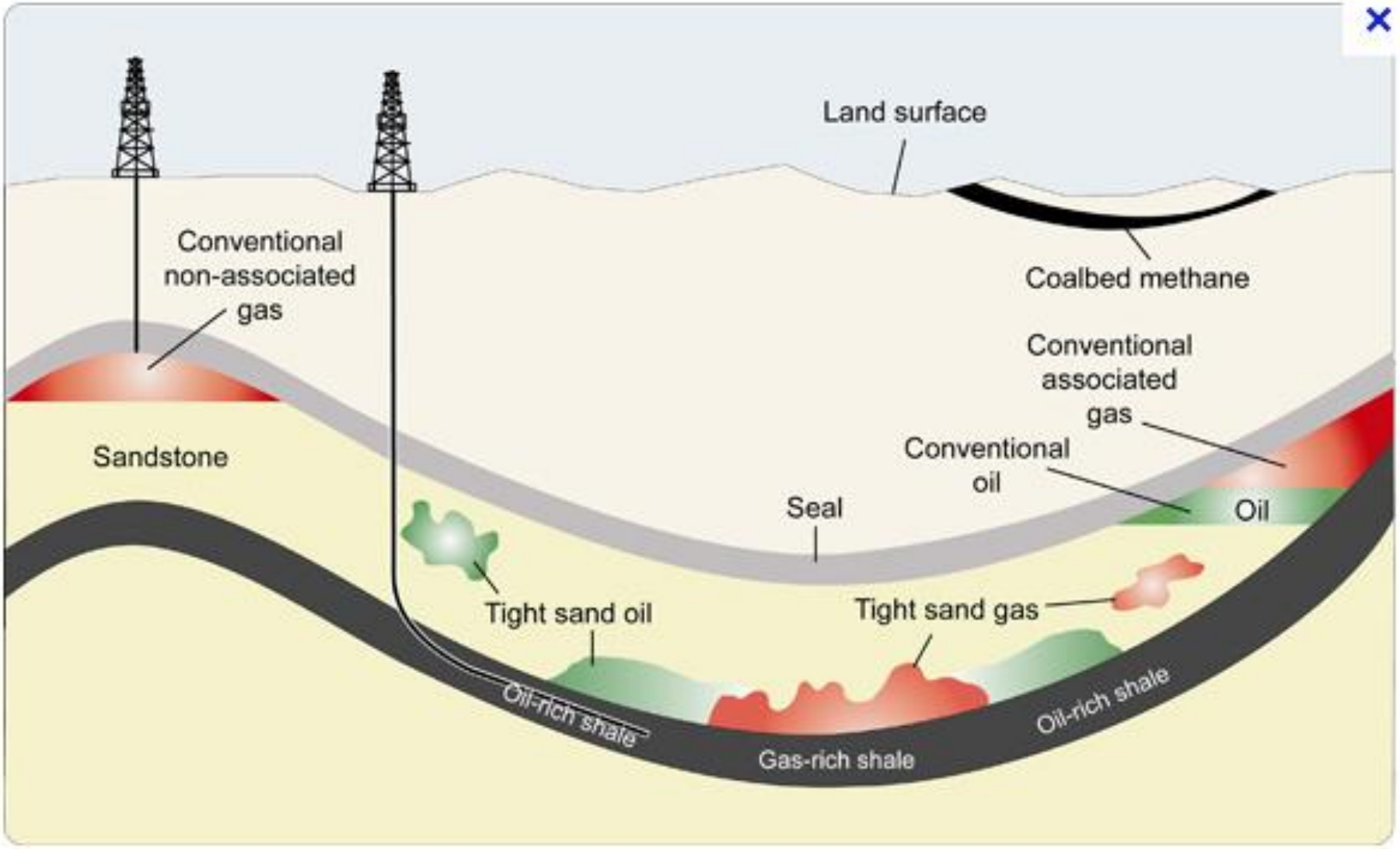
- 18.7 TCF EU's 28 member countries natural gas consumption in 2013
- 23 TCF Annual U.S. natural gas usage
- 29 TCF Noble Energy natural gas reserves, offshore Israel
- 70 TCF Anadarko natural gas reserves, offshore Mozambique
- 2,688 TCF Future U.S. gas supply estimate (48 year record) 2013 estimate

EVOLUTION IN GAS WELL COMPLETEION TECHNOLOGY - THE KEY TO TODAY'S NATURAL GAS REVOLUTION



Source: *America's New Natural Gas,* America's Natural Gas Alliance

Conventional vs Unconventional Reservoirs



Source: Chris Wright, Liberty Resources Tuesday Lunch Club Presentation, 3/5/13

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Fracture Treatment in 1949

12 Miles East of Duncan, OK

Source: Platts Gas Daily, April 15, 2013

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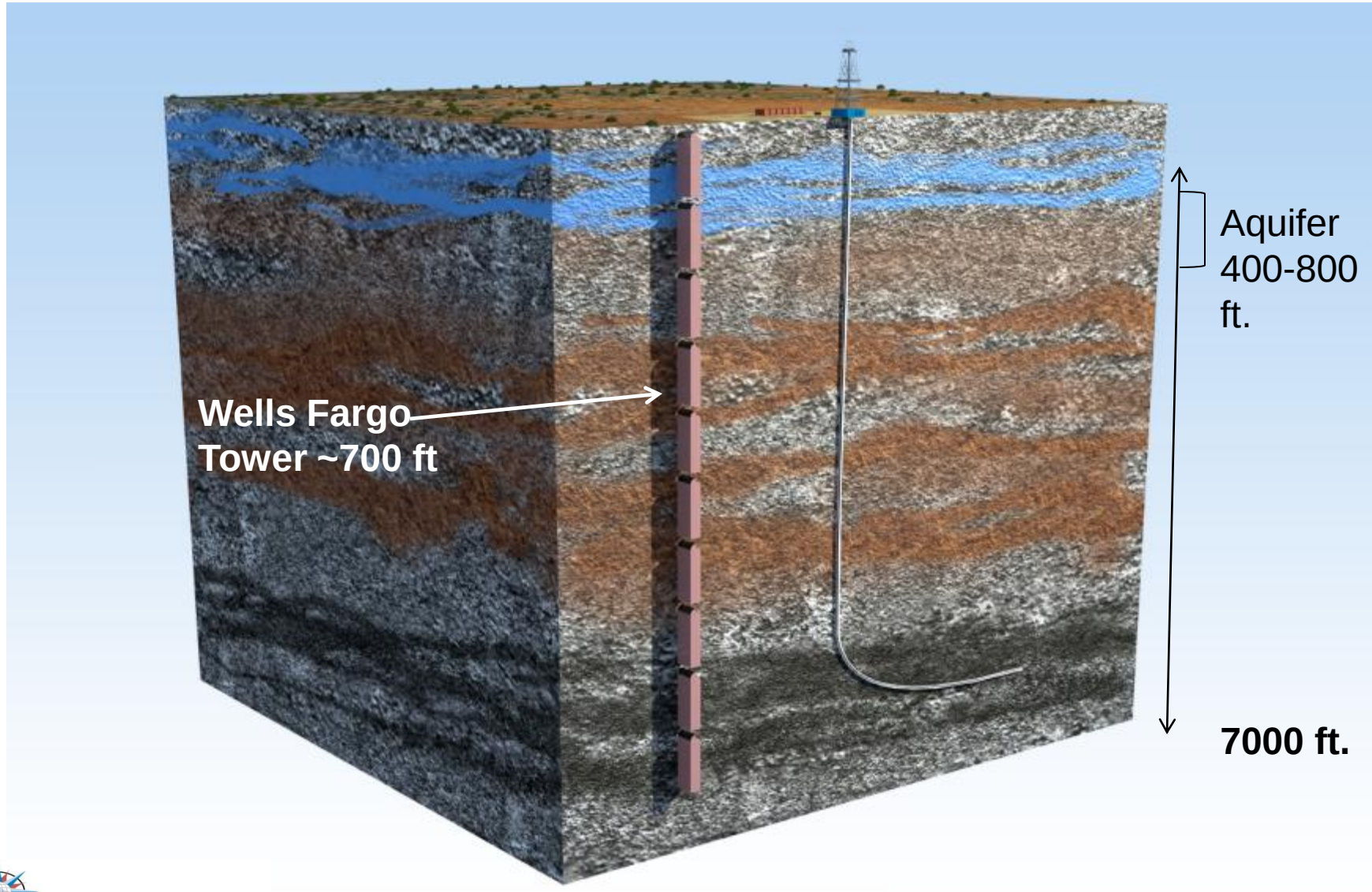
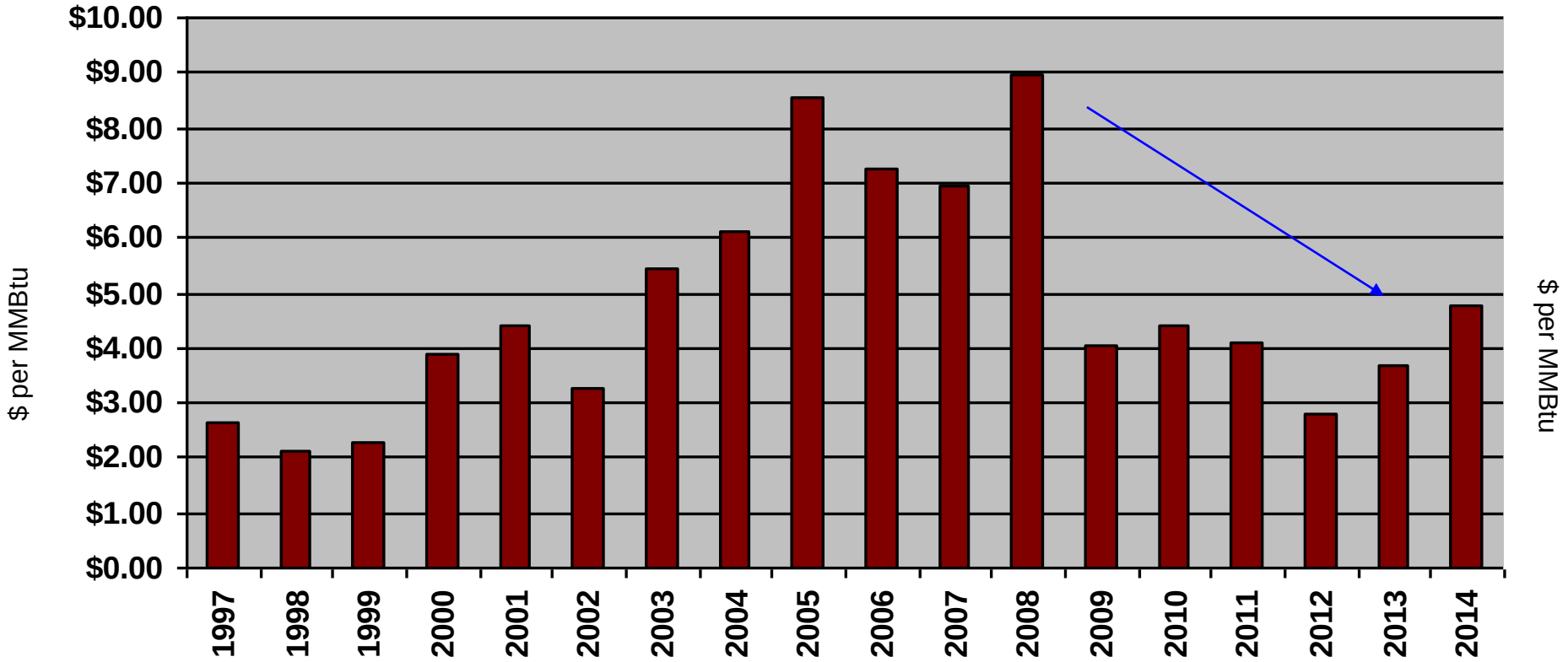
Drilling Distance



Source: Colorado Oil & Gas Association, *Hydraulic Fracturing and Water*

NYMEX Henry Hub Natural Gas Price*
1996 - 2014 Actual



Source: *Average of last three days of trading as published in the Platts Gas Daily Report

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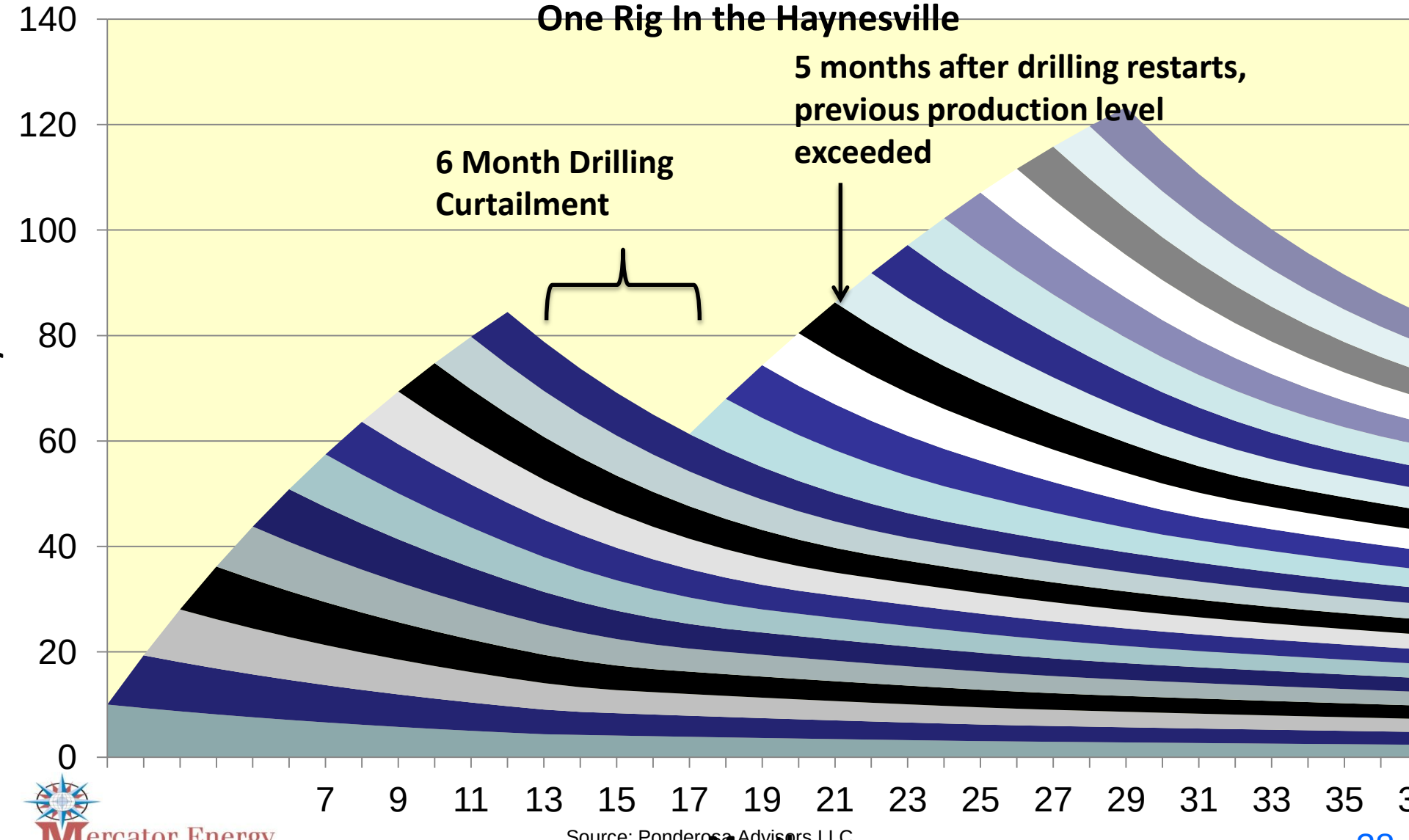
The "Ferrari" Affect Substantially Reduces The Likelihood Of Price Spikes



Source: Ponderosa Advisors LLC

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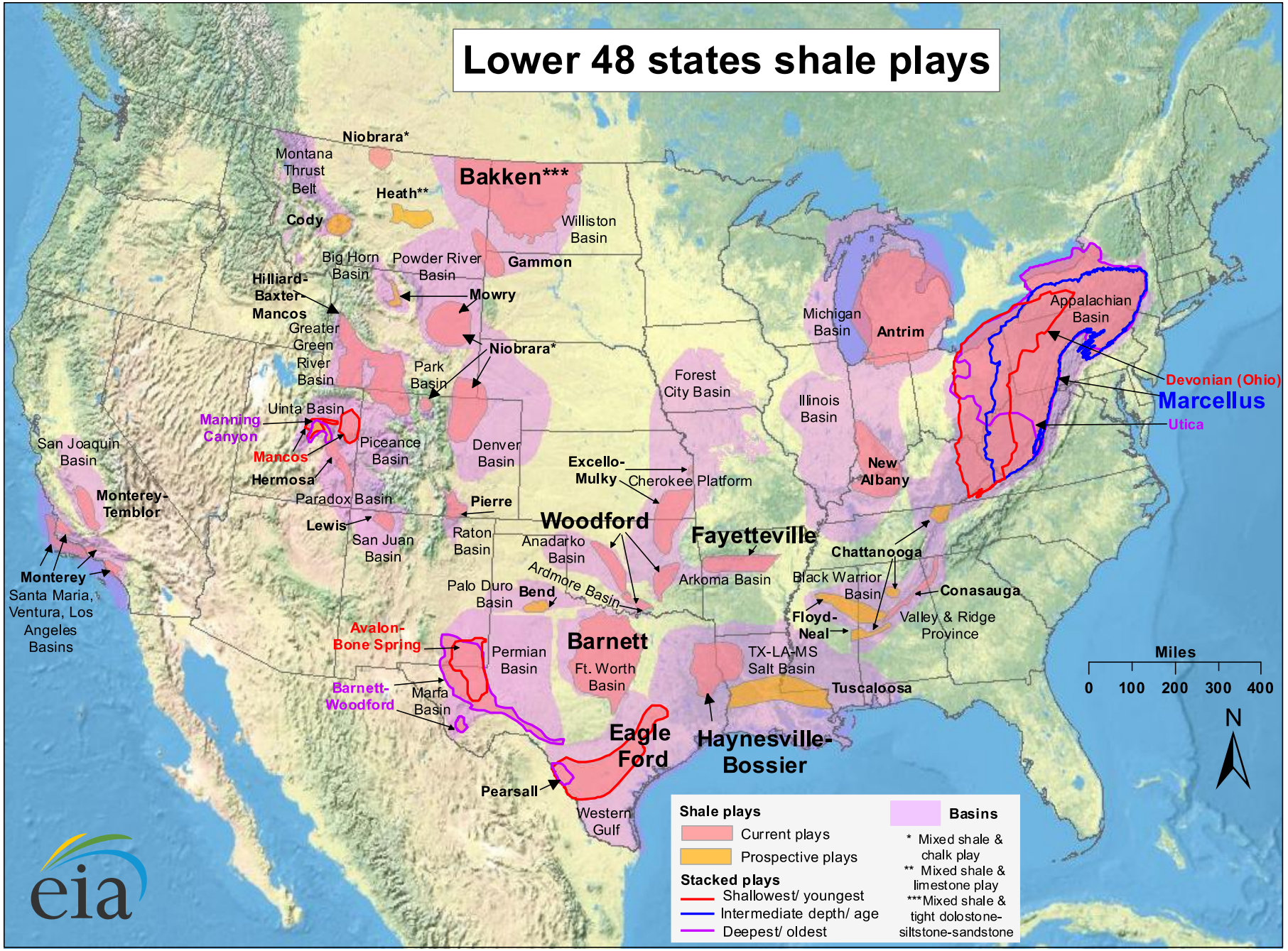

Source: Energy Information Administration based on data from various published studies.
Updated: May 9, 2011

Forecasts for Shale Gas Resource?

- 2008 - **347 TCF** - Energy Information Administration (EIA)
- 2008 - **840 TCF** - Navigant for Clean Skies Foundation
- 2009 - **616 TCF** - Potential Gas Committee (PGC)
- 2011 - **827 TCF** - Energy Information Administration (EIA)
- 2013 – **1,073 TCF** - Potential Gas Committee (PGC)

Source: Various resource estimates

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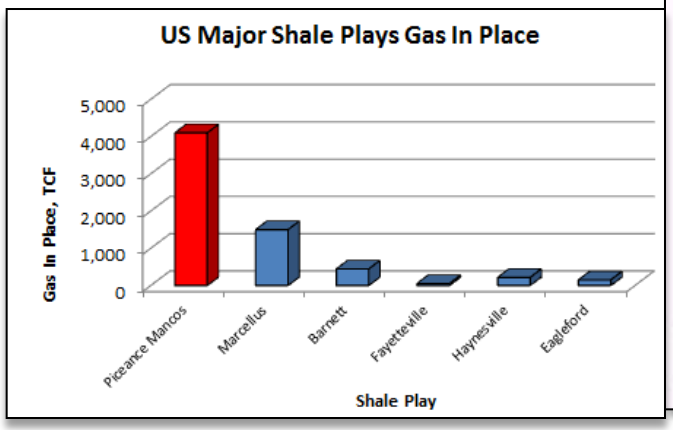
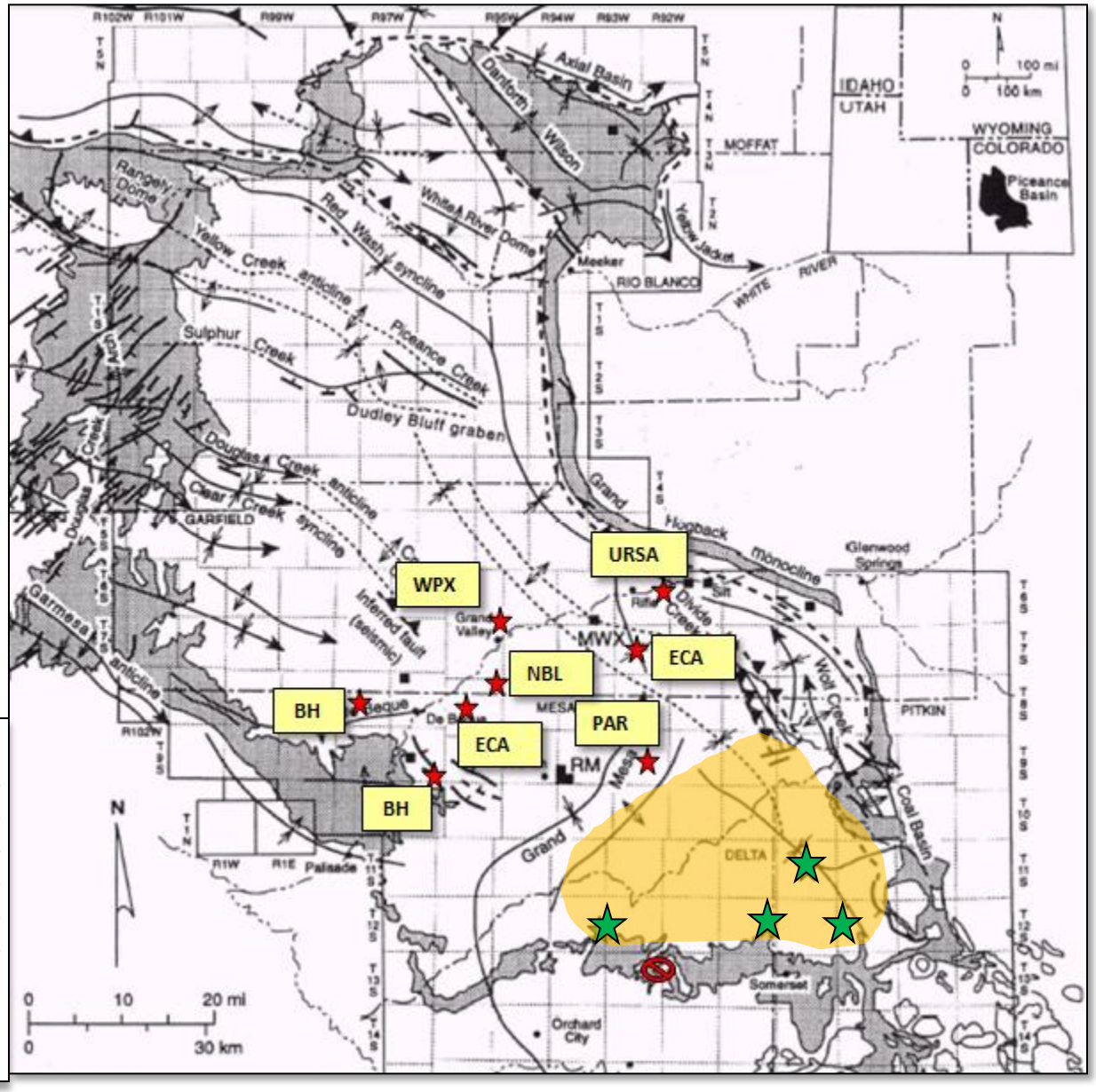
Mancos Shale Gas Resource Play

An Emerging Giant:

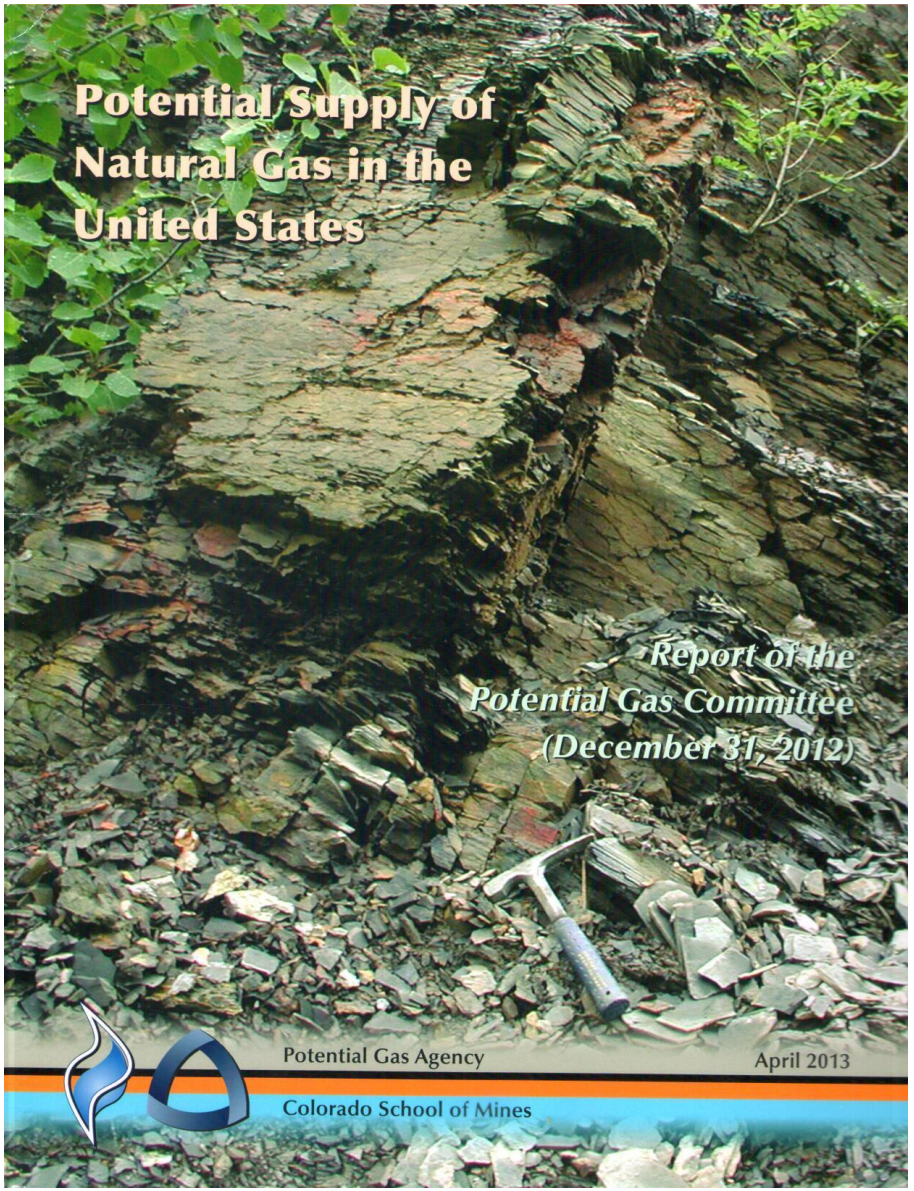
- **~3X larger than the Marcellus shale deposit**
- **Thickness of 2,200 to 4,000ft vs. Marcellus ~ 200ft.**
- **Massive GIP - > 4,000 TCF vs. Marcellus - > 1,000 TCF**
- **Very thick, gas-saturated shale deposit**
- **Deposited across a large area, >3.9 Million acres**
- **Proven productive across the Piceance Basin**





PGC Report Released April 2013

The Mancos Shale play was not included in the PGC Report



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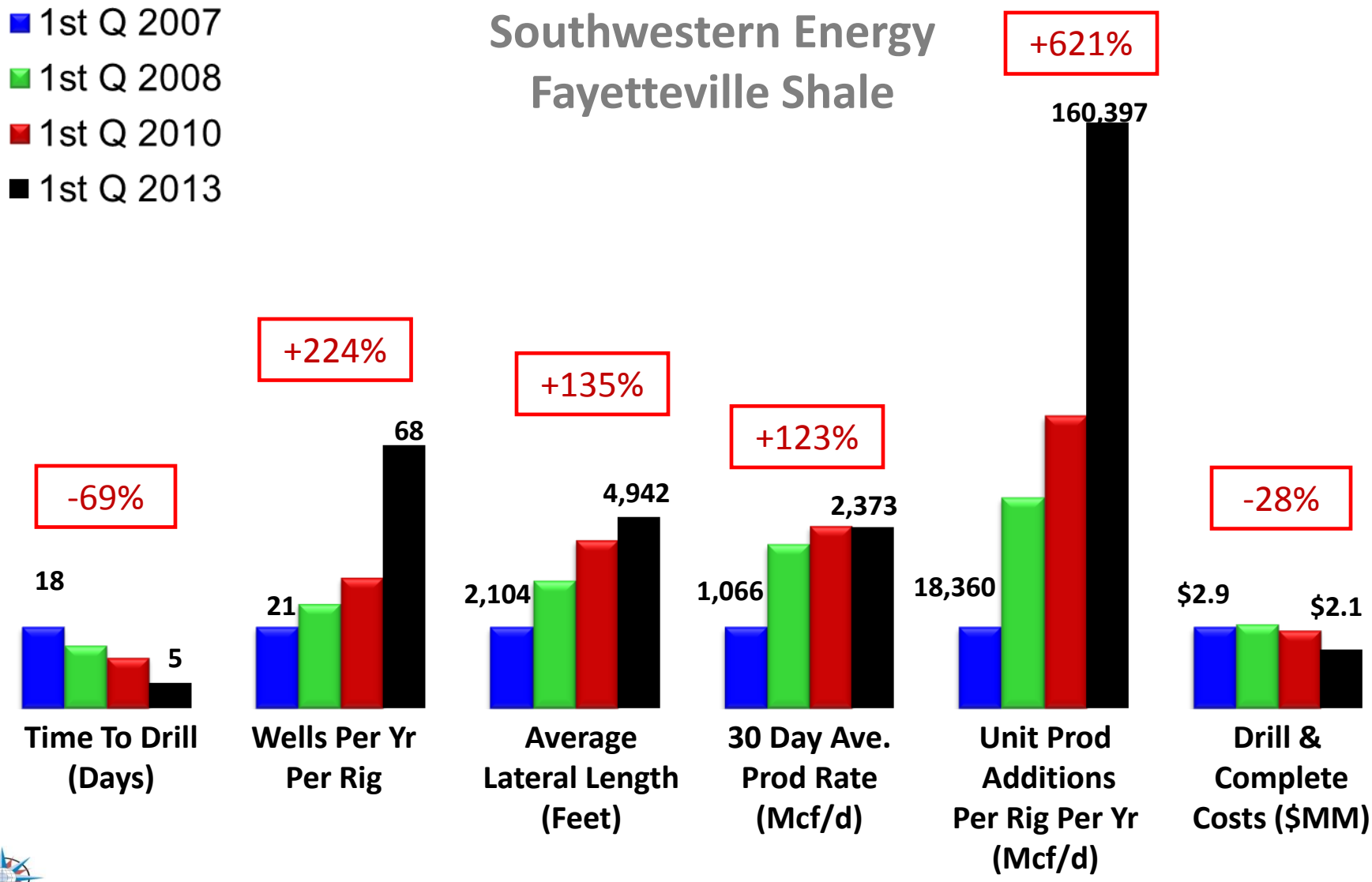
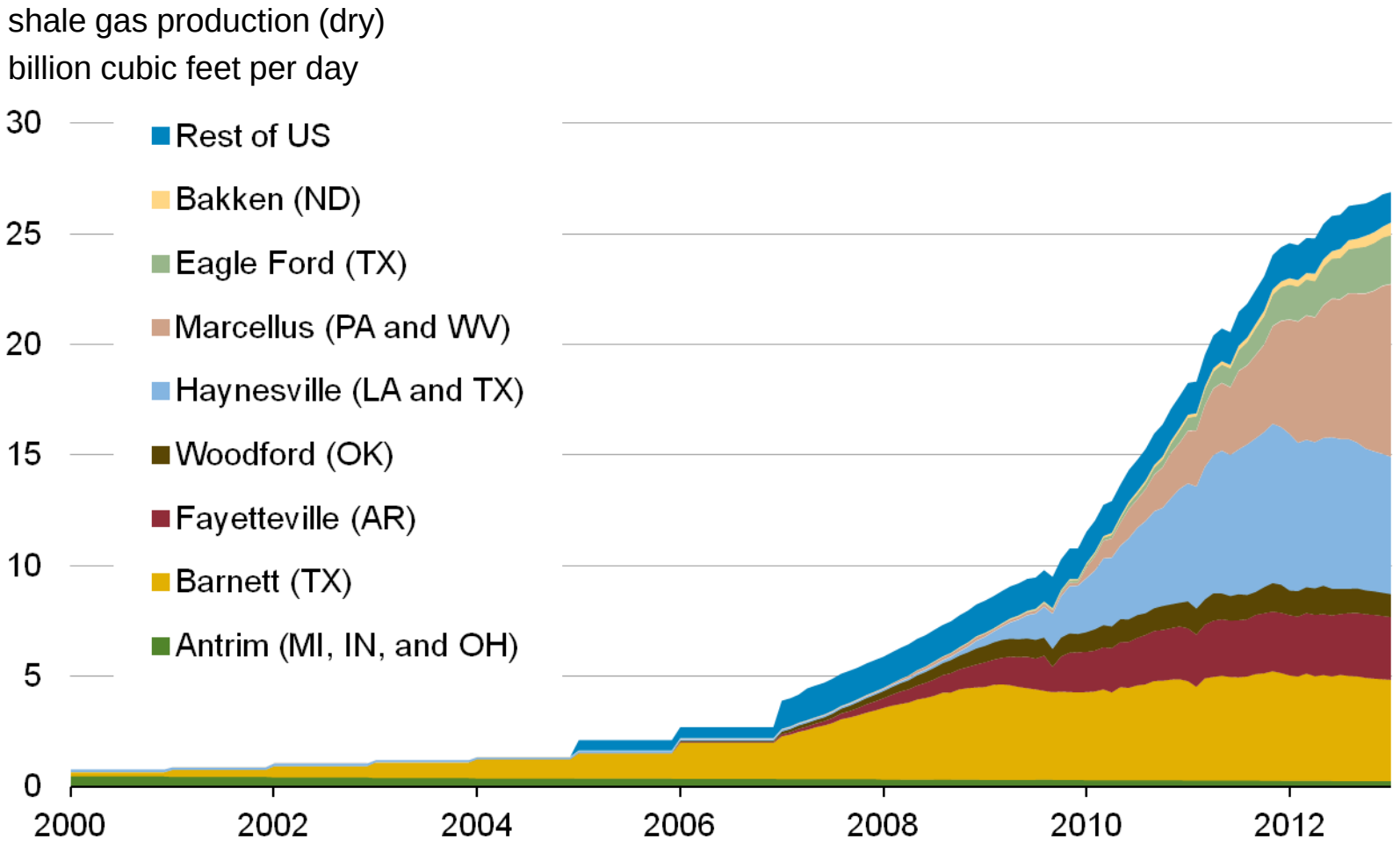
Drilling Rig Productivity Continues To Improve



Source: Southwestern Energy Financials

Domestic production of shale gas has grown dramatically over the past few years



Sources: LCI Energy Insight gross withdrawal estimates as of January 2013 and converted to dry production estimates with EIA-calculated average gross-to-dry shrinkage factors by state and/or shale play.

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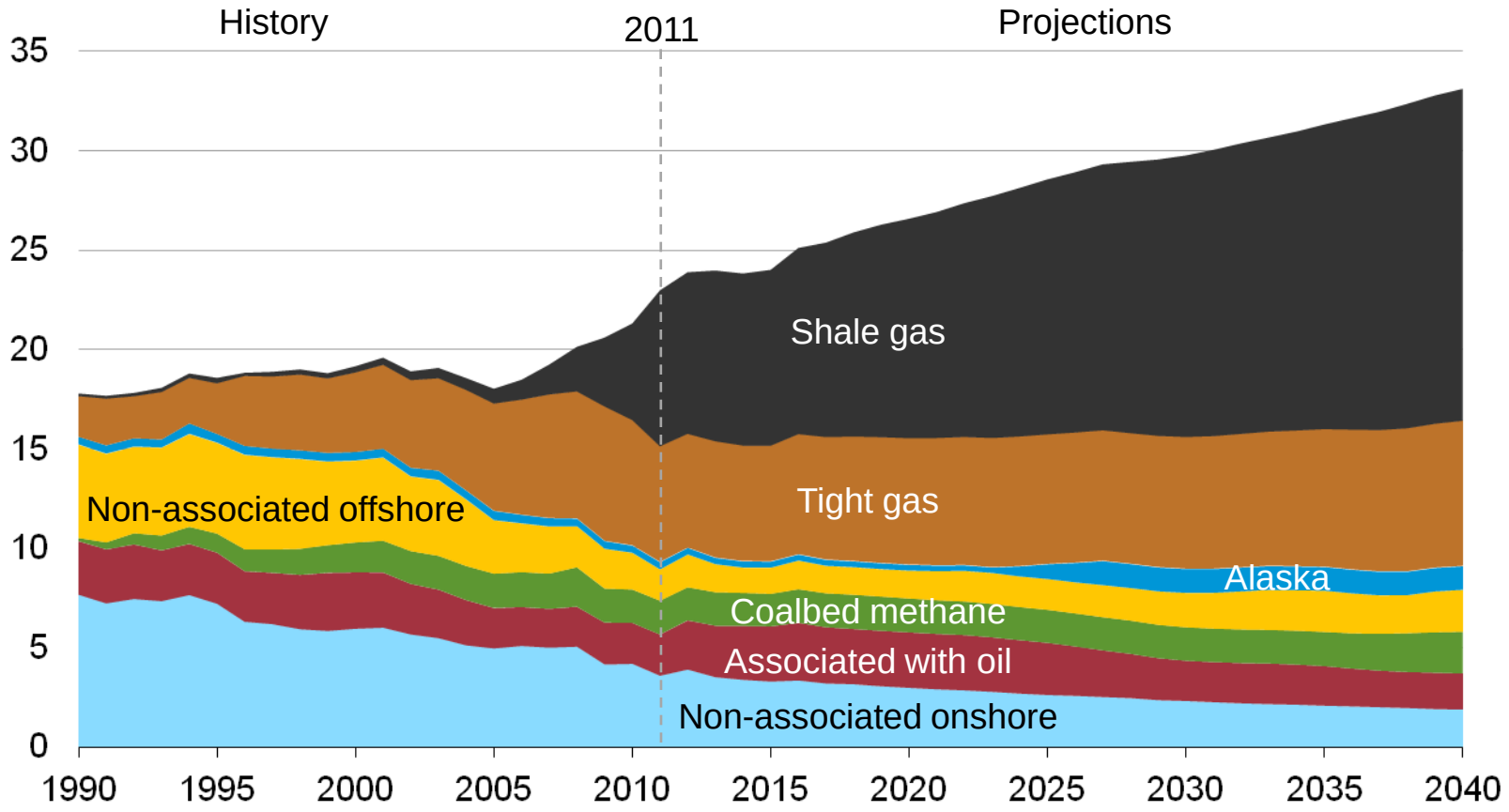
Shale gas leads growth in total gas production through 2040

U.S. dry natural gas production
trillion cubic feet



Source: EIA, Annual Energy Outlook 2013 Early Release

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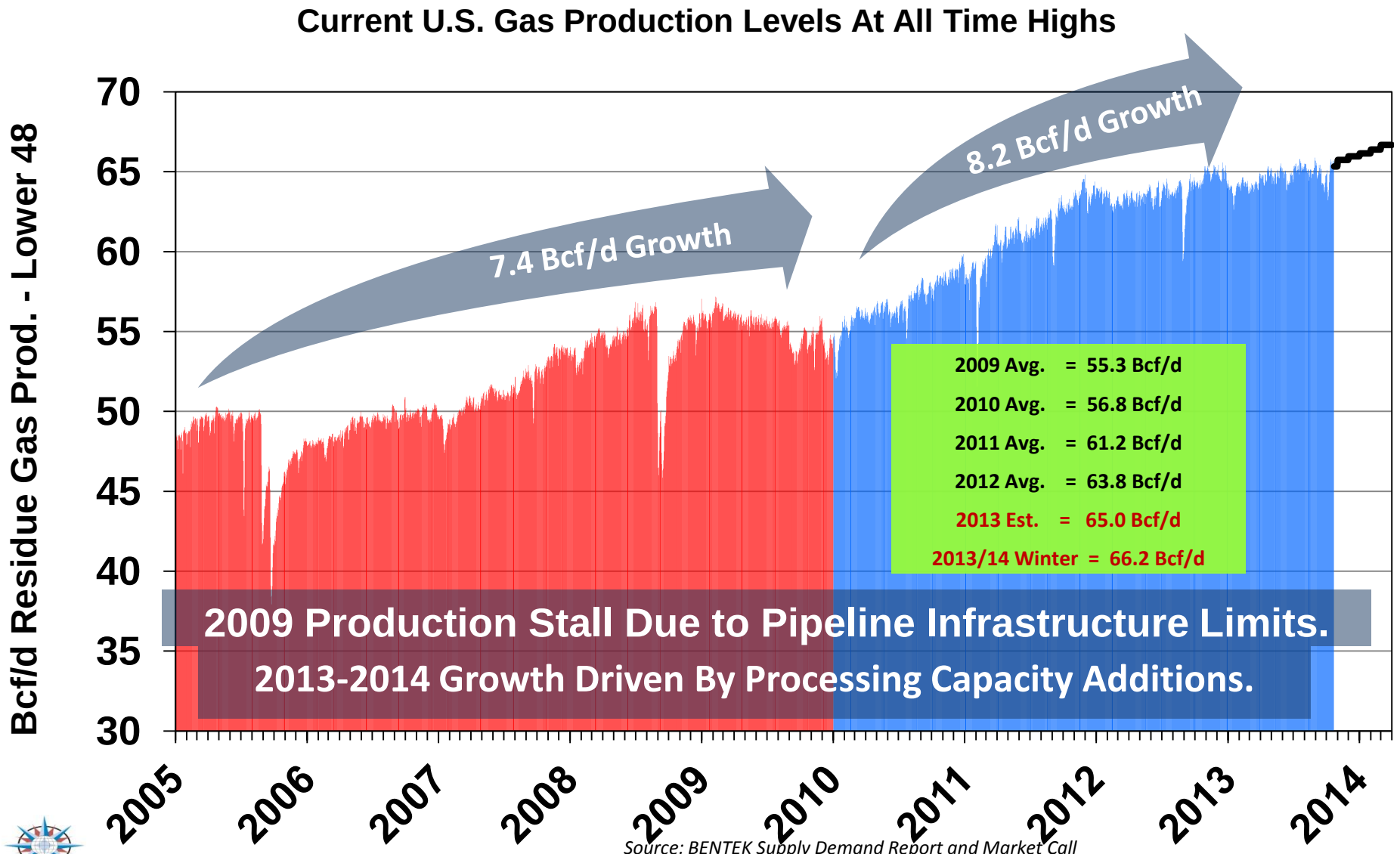
Growth Spurts in U.S. Natural Gas Production



Source: BENTEK Supply Demand Report and Market Call

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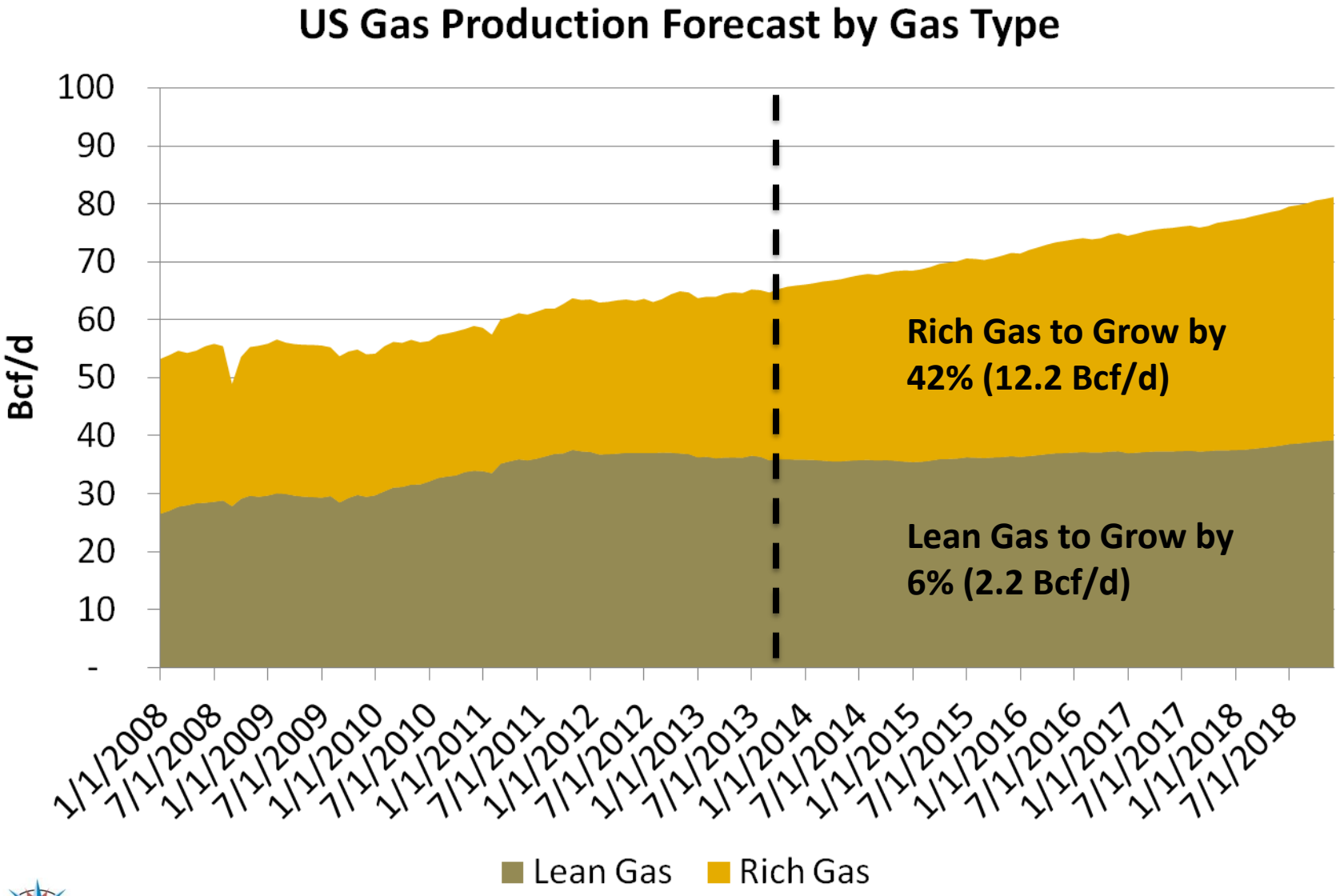
Rich Gas Production Leading Growth Expectations



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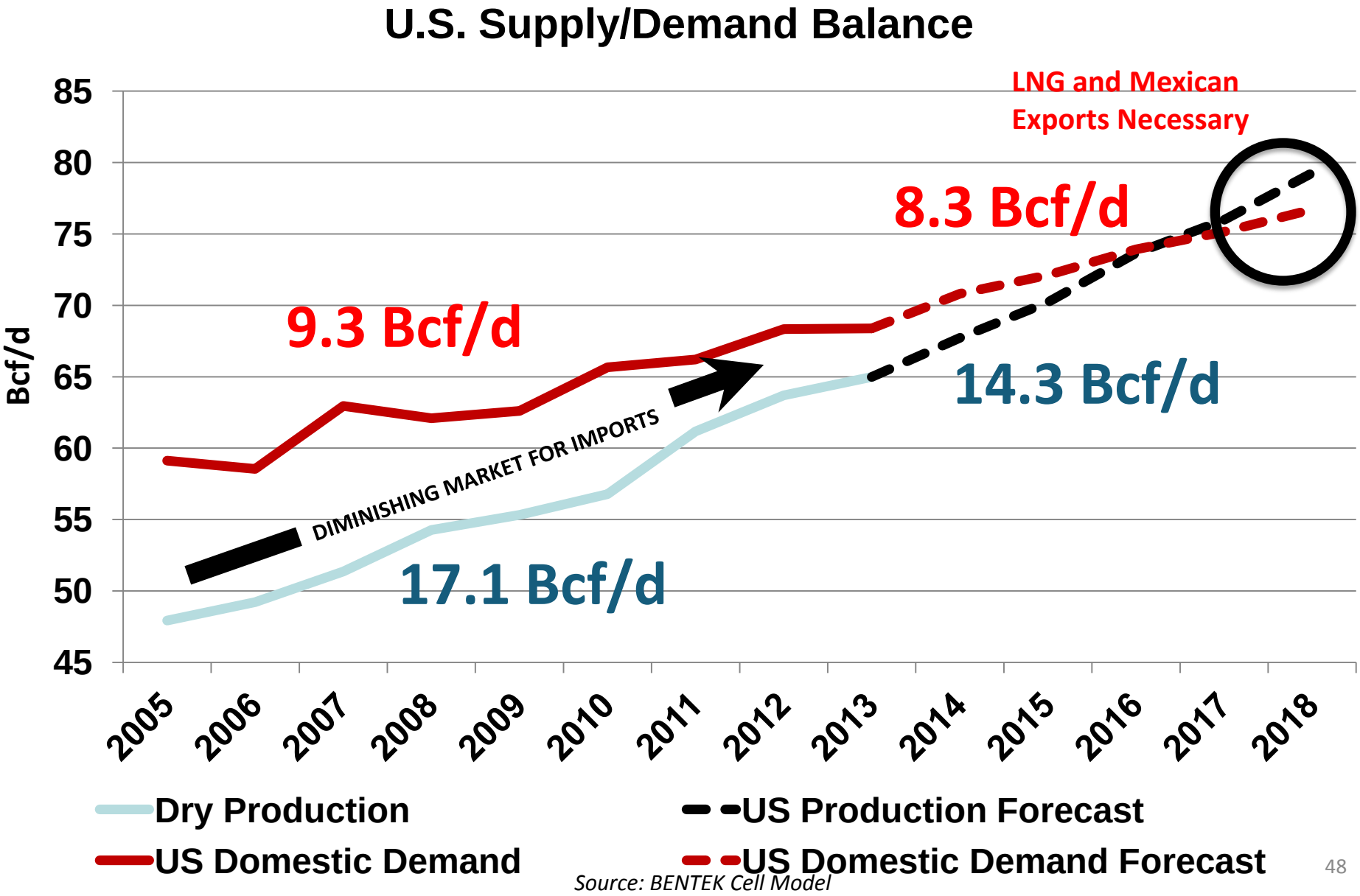
Source: Bentek

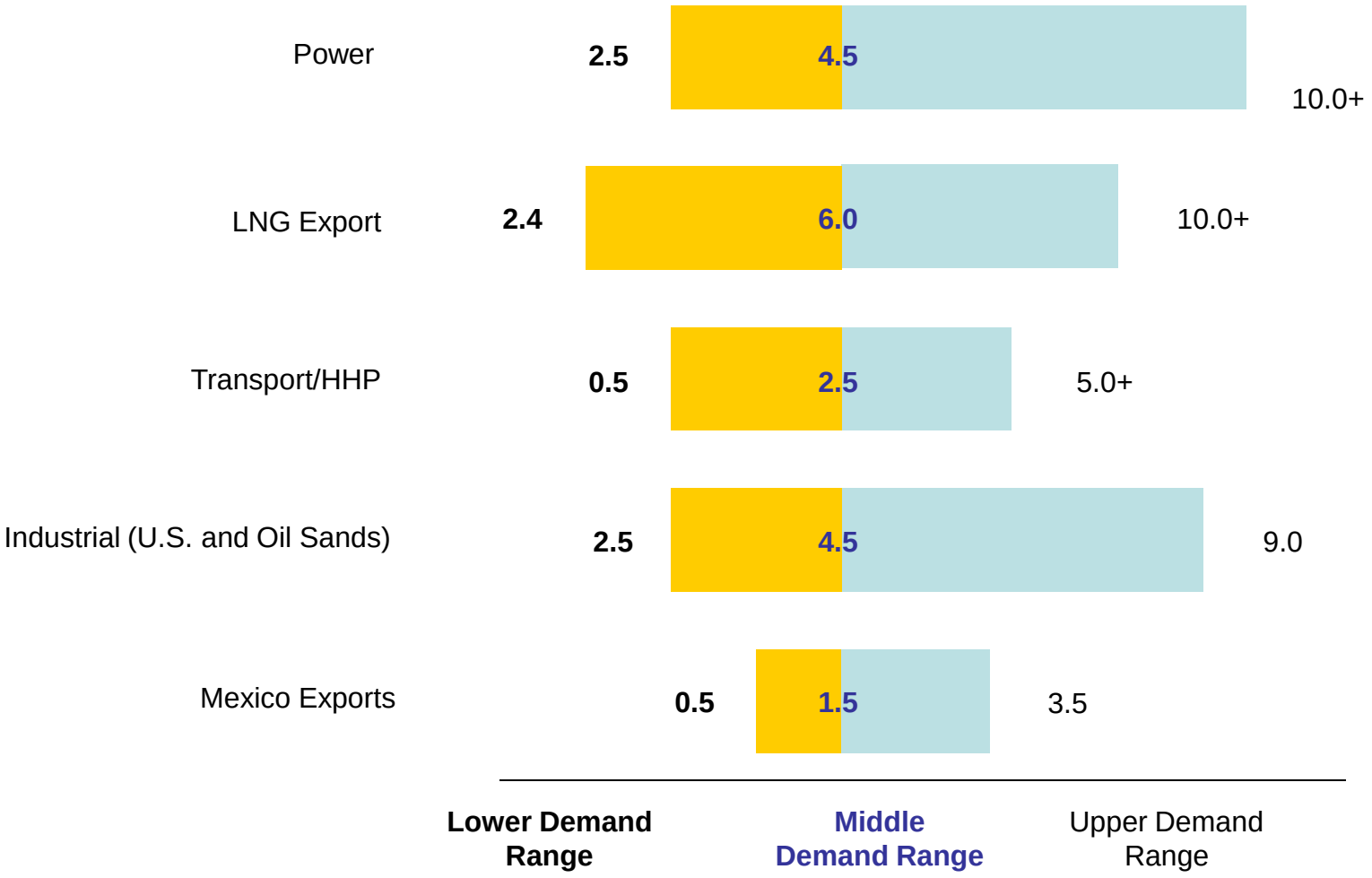
Growth in Domestic Demand Not Enough: Exports Needed



Source: BENTEK Cell Model

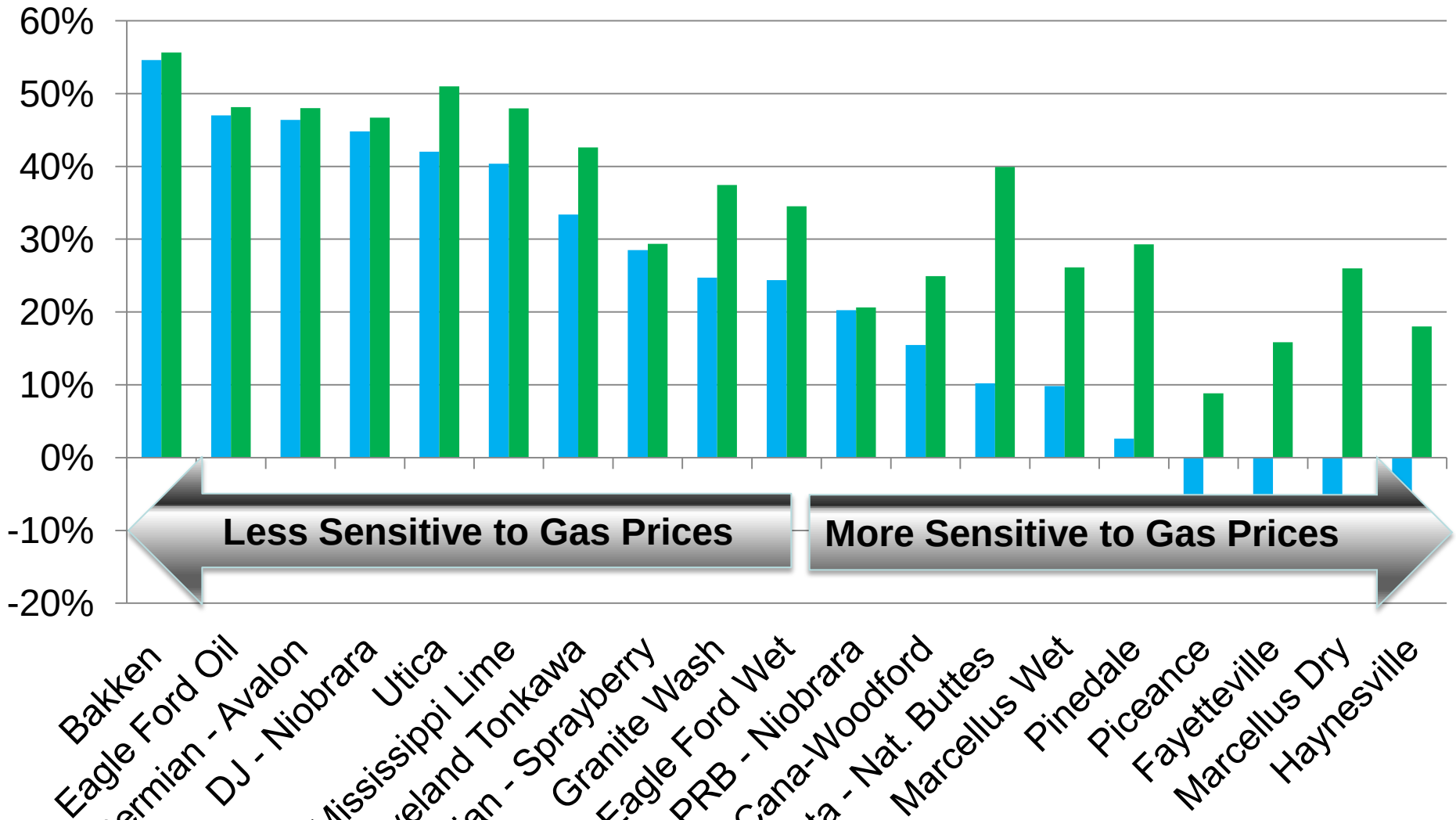
North American Natural Gas
Demand Ranges by Selected Sector

Significant demand growth is possible in the LNG, transportation/HHP and power sectors through 2020.



Source: Encana Corporate Presentation, August 2013; Industrial Energy Consumers of America; Bentek Energy; Raymond James; Michael Smith, Chairman & CEO Freeport LNG, Industry Sources

Diverse Hydrocarbon Mix Maintains Gas Production



Note: Oil $80
NGL 30% of Crude

Source: Bentek

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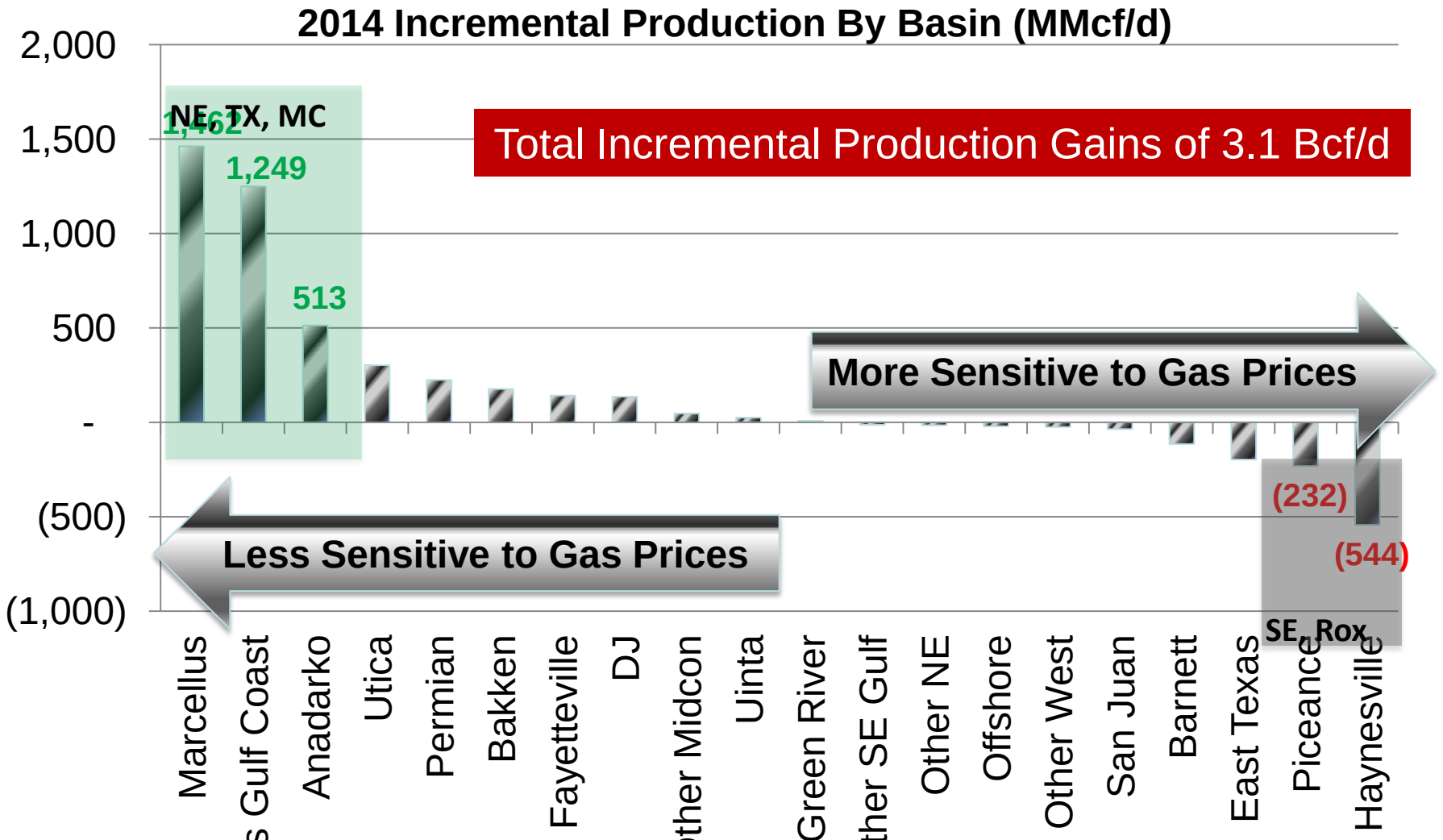
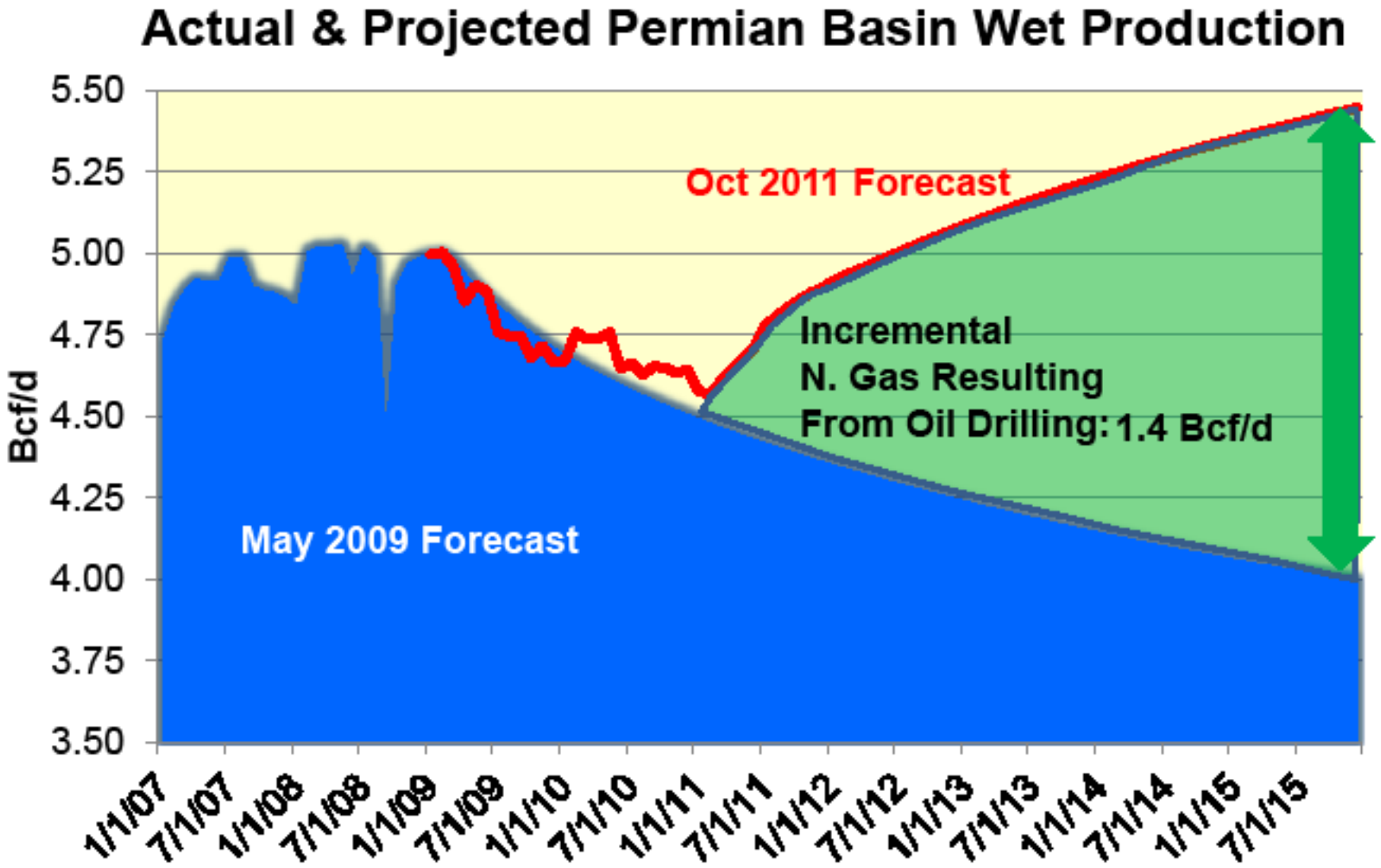
Diverse Hydrocarbon Mix Maintains Gas Production

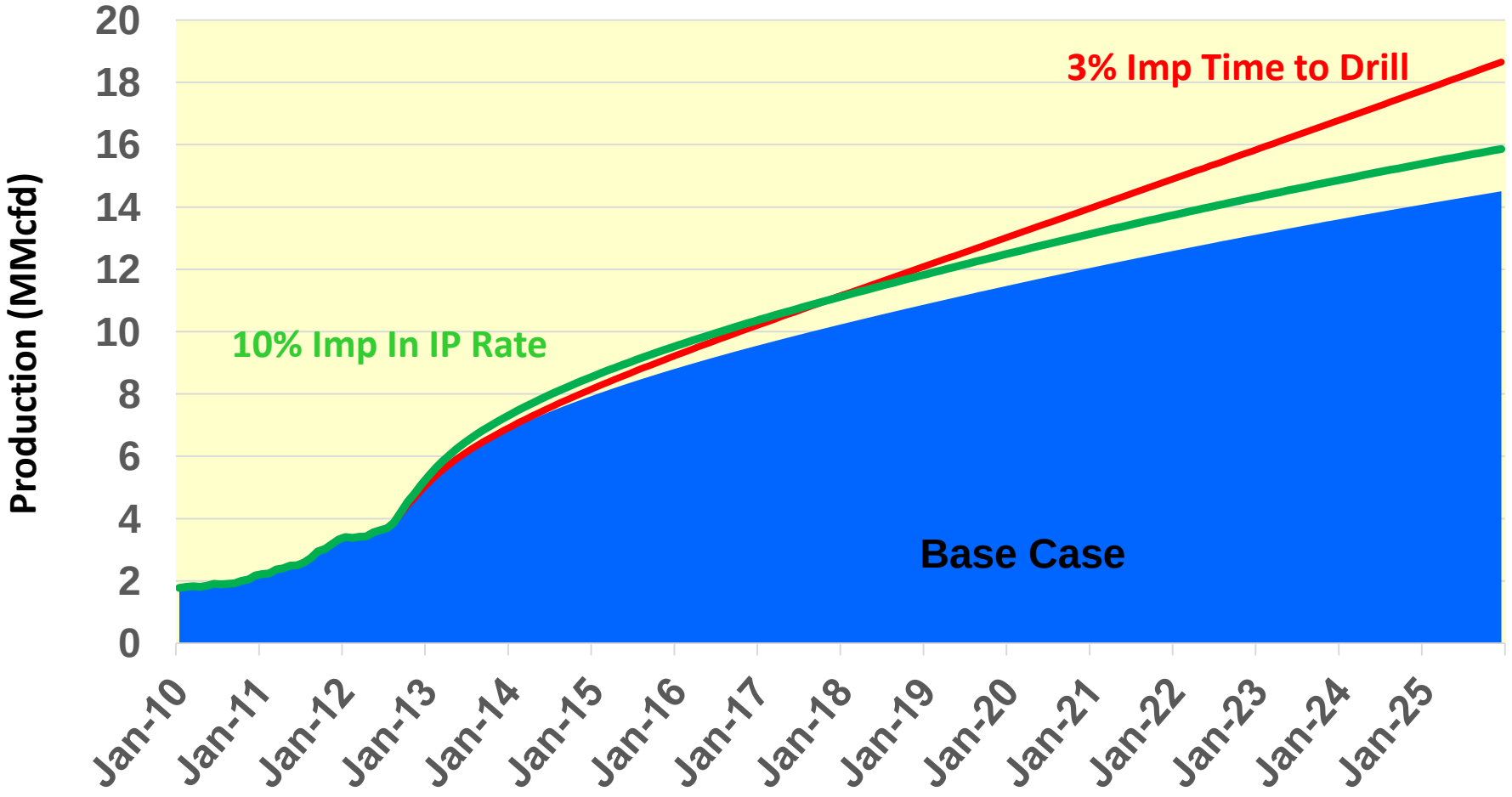


Source: Bentek

Ironically, Oil & Liquids Exploration Drives Gas Production

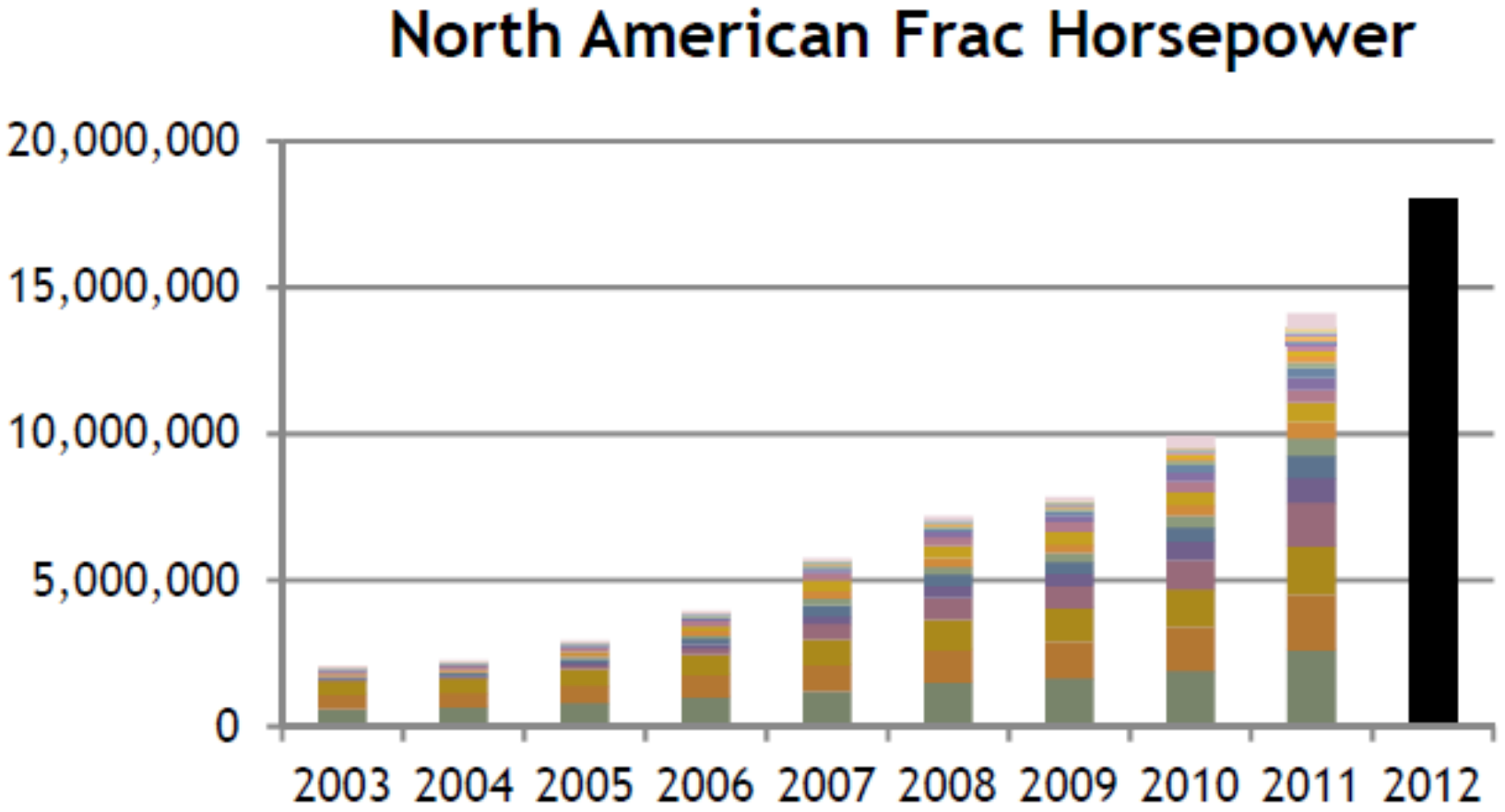


Faster Drilling Times Yield More Wells, More Production



Source: Ponderosa Advisors LLC

Fracturing Application Exploded



Source: Chris Wright, Liberty Resources Tuesday Lunch Club Presentation, 3/5/13

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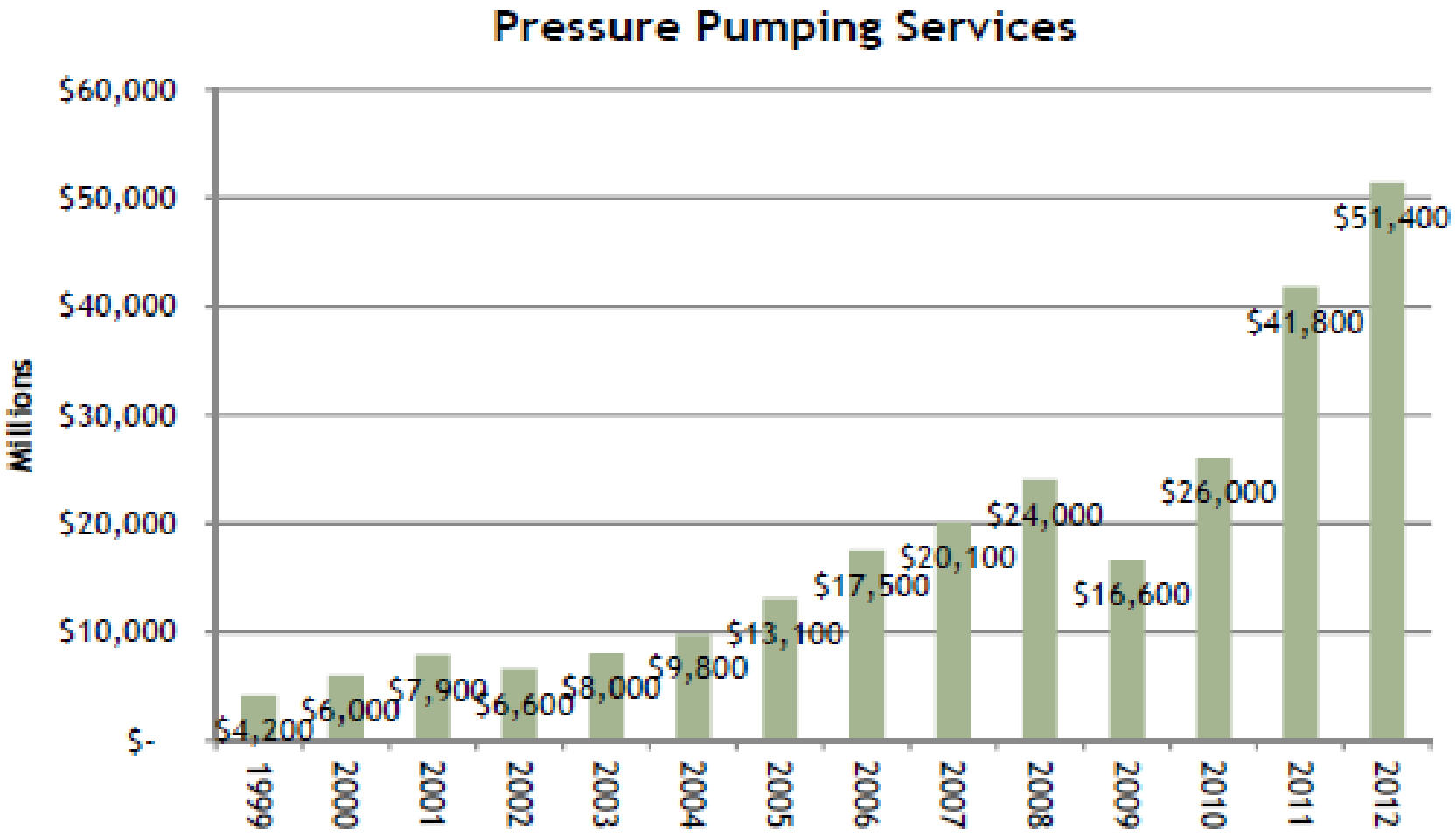
10-fold growth in 10 years



Source: Chris Wright, Liberty Resources Tuesday Lunch Club Presentation, 3/5/13

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This U.S. energy breakthrough has international implications.

Reducing Greenhouse Gas Emissions

	Natural Gas	Coal
Carbon Dioxide	117,000	208,000
Carbon Monoxide	40	208
Nitrogen Oxide	92	457
Sulfur Dioxide	0.6	2,591
Particulates	7	2,744
Formaldehyde	0.750	0.221
Mercury	0.000	0.016

Source: EIA – Natural Gas Issues and Trends

Pounds of air pollutants produced per billion Btu energy

Harpoles In China: 2010 & 2012

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ENVIRONMENTAL IMPACTS OF COAL

2008 **2013**

Dr. Mike Slattery *Texas Christian University*

Photo: www.marketplace.org

Kyoto Protocol

US Energy Information Agency reports that America's greenhouse gas emissions have **fallen 7 percent to 1992 levels**. US, a non participant in Kyoto Protocol Treaty, is the only nation to meet 1999 forecasted reduction

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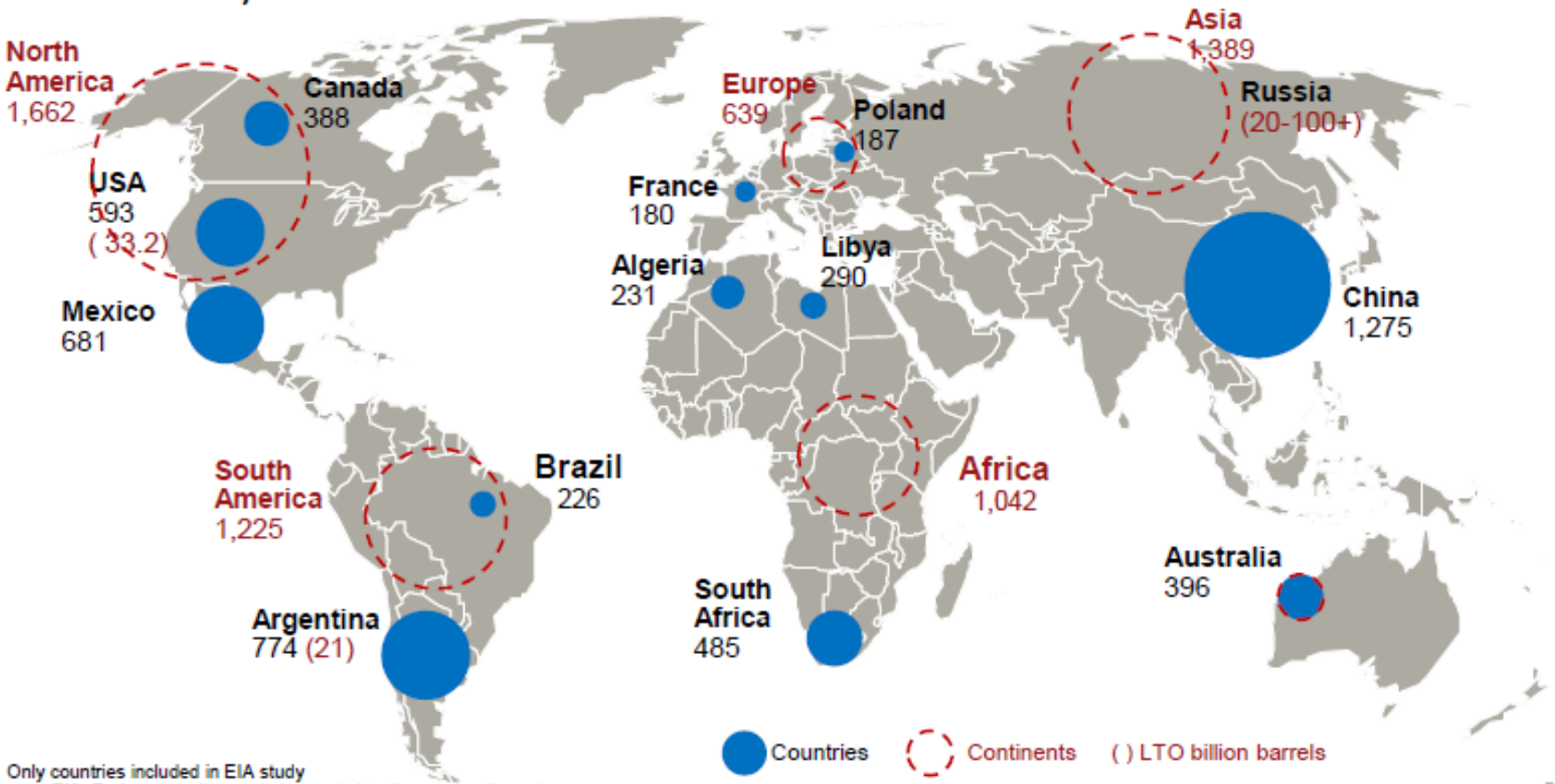
Source: Colorado Oil & Gas Association, *Hydraulic Fracturing and Water*

Resource potential in North America is massive – with the Rockies accounting for a significant fraction

Major global shale gas and LTO opportunities[1]

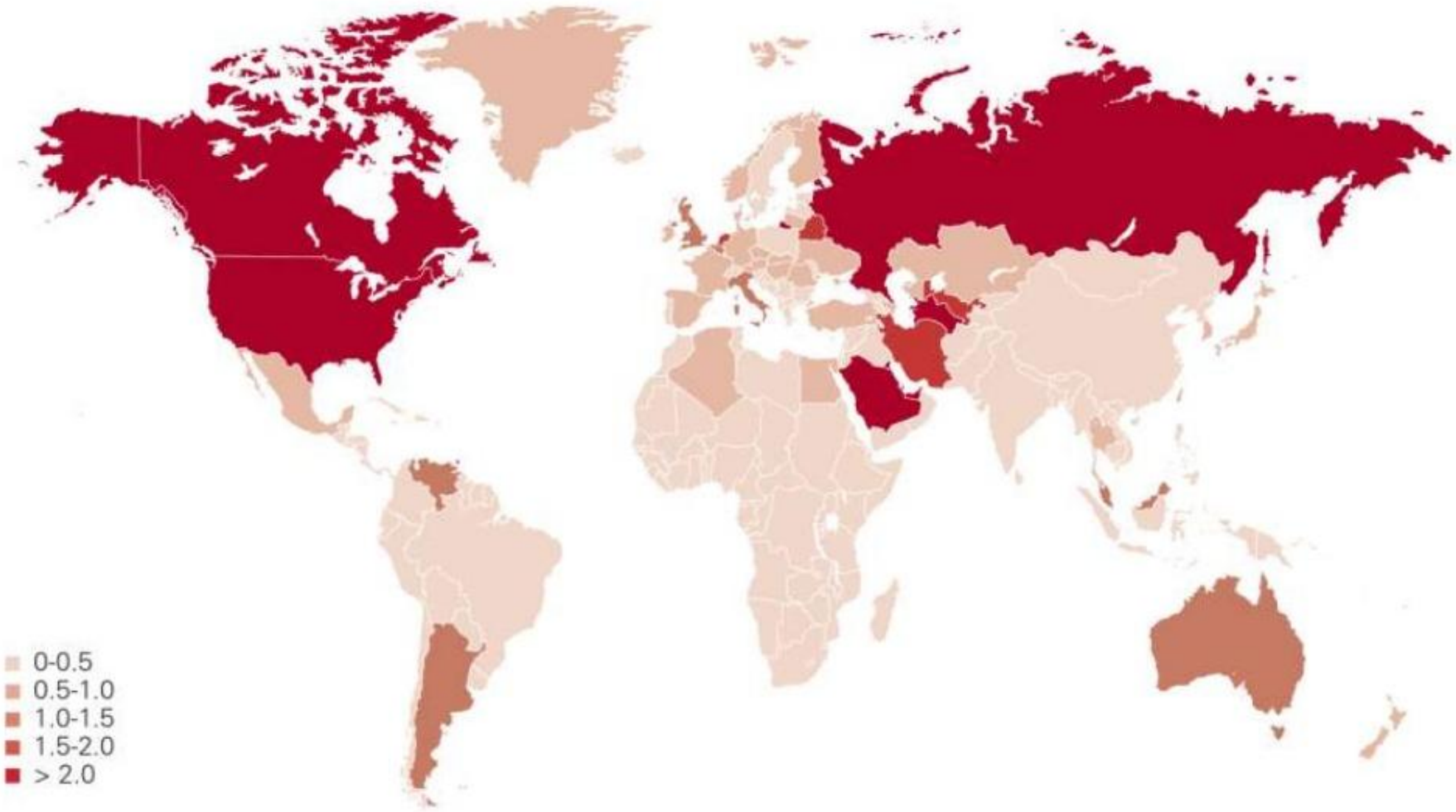
Technically recoverable shale gas (trillion cubic feet) and LTO (Billion barrels) resources



1. Only countries included in EIA study
Source: EIA, Forbes, http://www.shale-gas-tight-oil-argentina-ii.com/

Gas consumption per capita 2012

Tonnes oil equivalent

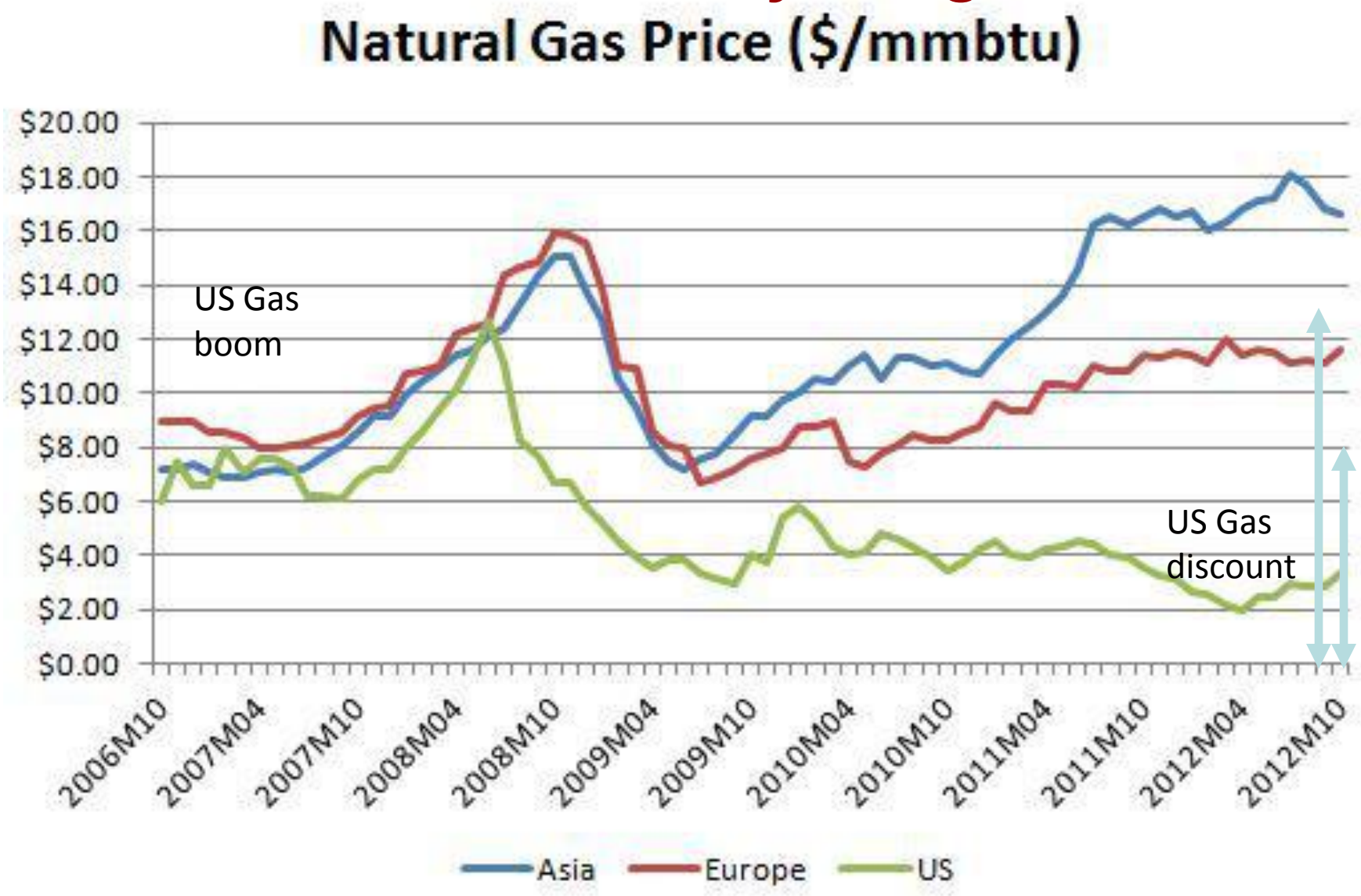


Source: Includes data from Cedigaz.

BP Statistical Review of World Energy 2013

Source: BP Statistical Review of World Energy 2013

Gas Prices by Region



Source: Chris Wright, Liberty Resources Tuesday Lunch Club Presentation, 3/5/13

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World LNG Estimated November 2013 Landed Prices

Source: *Waterborne Energy, Inc.* Data in $US/MMBtu

Updated October 7, 2013

2169

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Industry Investing Over $100B in Manufacturing Renaissance

- 123 projects… and more are being announced regularly
- 9 energy intensive sectors (chemicals, fertilizer, steel, aluminum, glass, gas-to-liquids, tires, machinery, plastics)
- **7-9 Bcf/d gas demand growth by 2020**
- 5 million manufacturing jobs (Boston Consulting Group)
- 16 different states

Industrial Energy Consumers of America (IECA)
The Energy Voice of Industrial Energy Consumers

Source: *Industrial Natural Gas Demand* presentation, Paul N. Cicio, June 2013

Conclusions

- Since 1949, **1,400,000 wells** have been hydraulically fractured in the US…No one has ever been able to demonstrate that it is harmful to human health

- Low natural gas prices will **significantly** advance the general public health and welfare
  - Conversion coal to gas, reduced air emissions
  - Energy security, job creation & lower energy costs for low income households

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Conclusions

- The sustainability argument essentially implies keeping poor people poor.
- The breakthrough on hydraulic fracturing and horizontal drilling has created a super-abundant energy commodity (natural gas) that should improve the quality of life as it is disseminated throughout the world.
- The world should embrace this breakthrough and not attempt to vilify it.

Conclusions

- Inexpensive energy translates to:
  - Jobs
  - Affordable heat
  - Affordable light
  - Affordable food
- All of those conditions can significantly contribute to an environment conducive to a higher quality of life.

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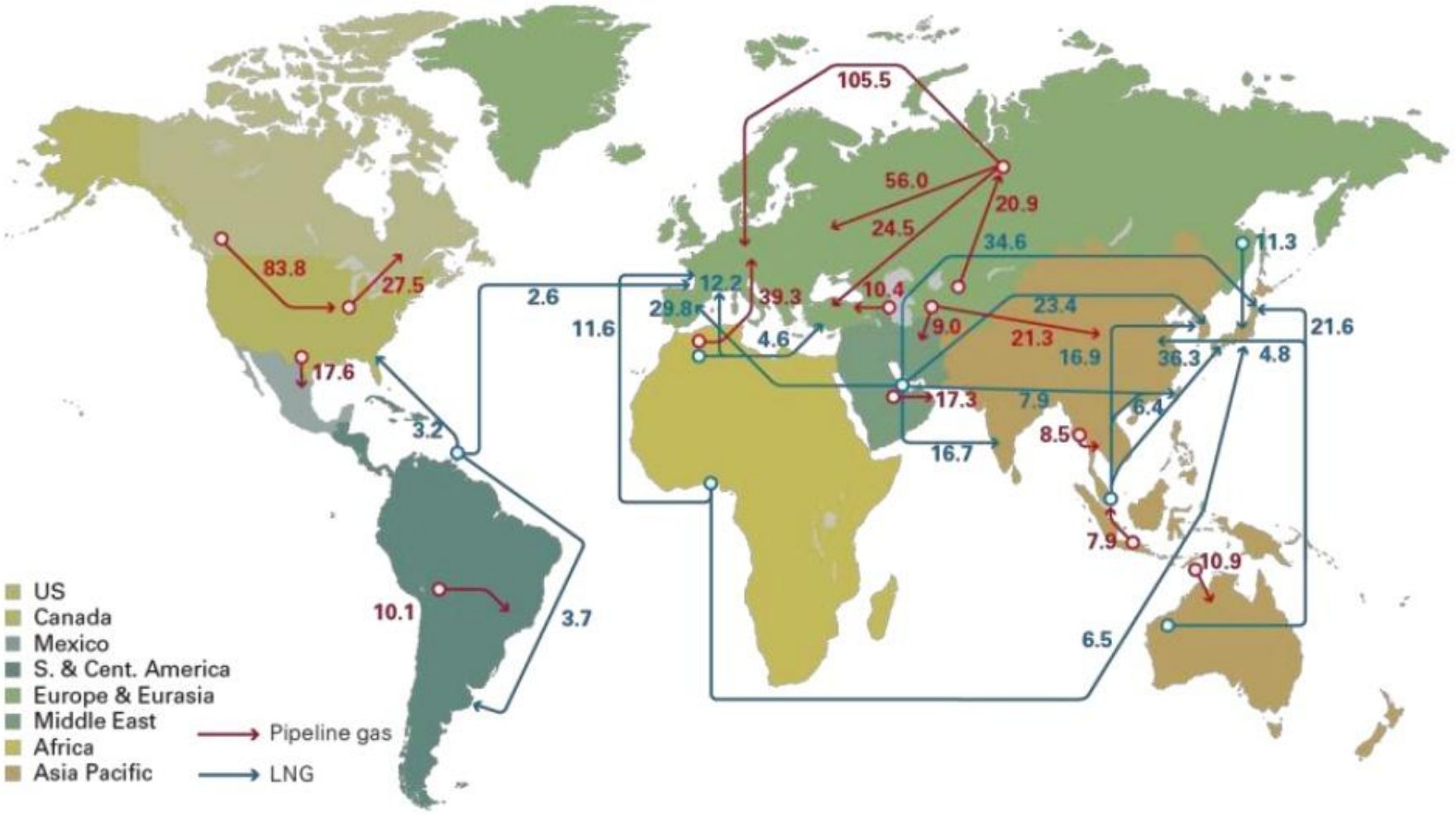
Citations for Report

All of the information utilized for this report is a compilation of information pulled from the following data sources:

Ponderosa Advisors LLC
Blue, Johnson Associates, Inc.
Chris Wright, Liberty Resources
Office of Fossil Energy
Office of Oil Gas Global Security Supply
U.S. Department of Energy
Raymond James and Associates, Inc.
Charif Souki, Cheniere Energy Inc.; Cheniere Research
U.S. Federal Energy Regulatory Commission
Institute for Energy Research (IER)
Energy Information Administration (EIA)
Bernstein Research
Western Energy Alliance
Sutherland LNG Blog
Platts Gas Daily Report, A McGraw Hill Publication
Colorado Oil and Gas Association
Fox News

Major gas trade movements 2012

Trade flows worldwide (billion cubic metres)



Source: Includes data from Cedigaz, CISStat, GIIGNL, IHS CERA, Poten, Waterborne.

BP Statistical Review of World Energy 2013

Source: BP Statistical Review of World Energy 2013

Russia, Iran and Qatar Form Natural Gas Cartel

10/21/2008 in Tehran, Iran

Qatar's Deputy Premier and Minister of Energy and Industry, Abdullah bin Hamad Al-Attiya

Iranian Oil Minister, Gholam Hossein Nozari

Alexei Miller, Chief of Russia's state gas monopoly - Gazprom

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Fig. 1: Russian gas export to Europe: On-border sales and transit arms (1)

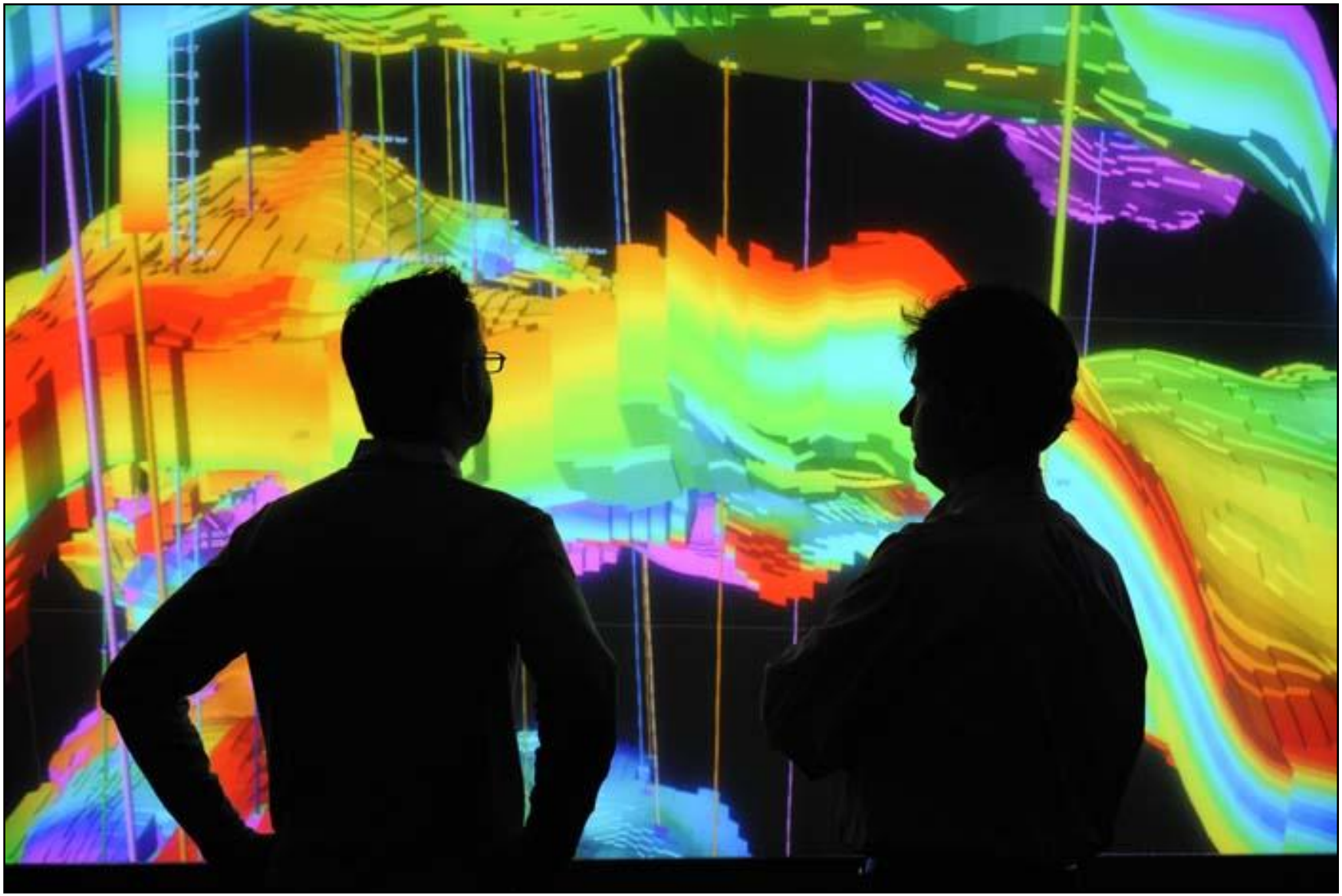

Gas pipeline
Proposed gas pipeline
Member States of the European Union
Russia
0
500 Kilometers
0
500 Miles
To Shtokman field
To Yamal fields
Barents Sea
Nadym
Teriberka
Ukhta
Punga
Yamal-Europe
Northern Lights
Finland
Norway
Sweden
Gulf of Finland
Vyborg
Volkhov
Gryazovets–Vyborg
Gryazovets
Russia
North Sea
Bacton Gas Terminal
Nord Stream
Brotherhood
BBL
Greifswald
NEL
Rehden
Moscow
JAGAL
JAMAL
Yamal-Europe
Germany
Belarus
OPAL
Olbernhau
Poland
Kazakhstan
Central Asia
Yamal-II
Soyuz
Baumgarten Gas Hub
Transgas
Soyuz
Austria
TAG
Brotherhood
Ukraine
Hungary
Subotica
South Stream
Romania
Italy
Adriatic Sea
Beregovaya Compressor Station
Caspian Sea
South Stream
Pleven
Bulgaria
Varna
Black Sea
Blue Stream
Ankara
Durusu Terminal
South Stream
Greece
Turkey

Noble in Israel and the Eastern Mediterranean

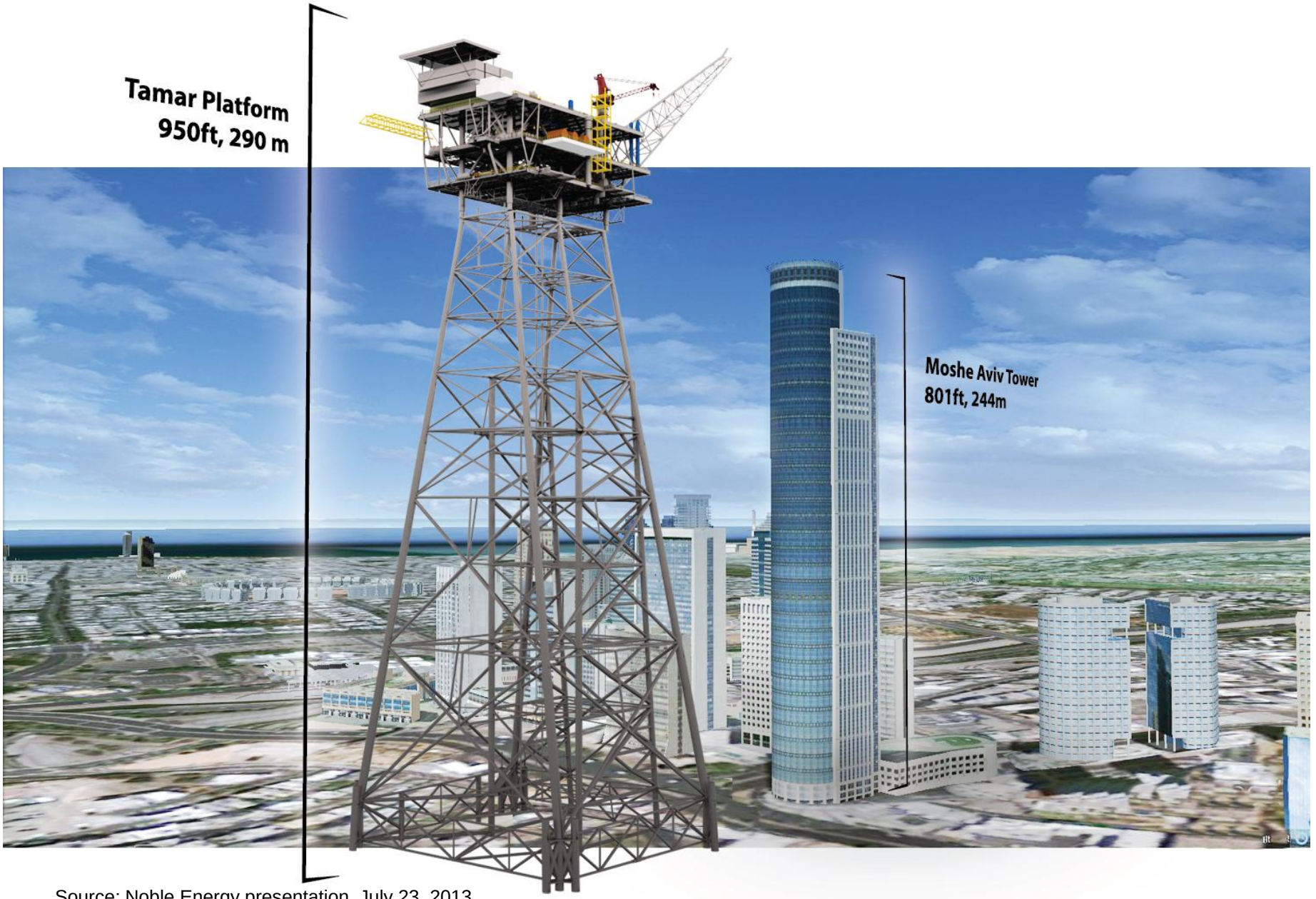
- Noa discovered 1999
- Mari-B discovered 2000
  - 28 BCM
  - Created Israel's natural gas industry
  - First gas sales 2004
- Tamar and Dalit discoveries in 2009
  - 280 BCM - 25 years supply
  - First gas sales in 2013
- Leviathan discovery in 2010
  - 535 BCM – export project
  - Potential to be online in 2016
- Cyprus A, Dolphin discoveries in 2011, Tanin in 2012

Source: Noble Energy presentation, July 23, 2013

Noble Energy 3-D Visualization Center

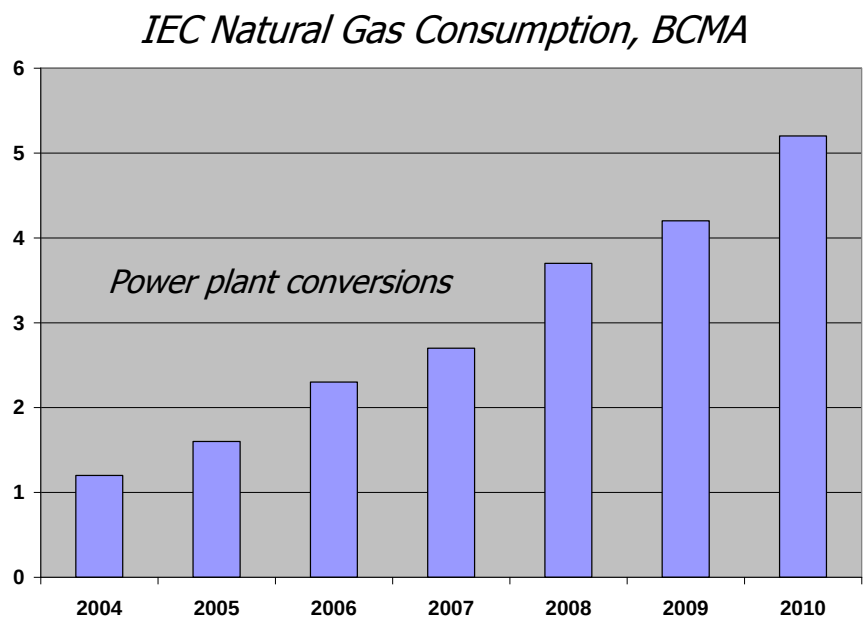


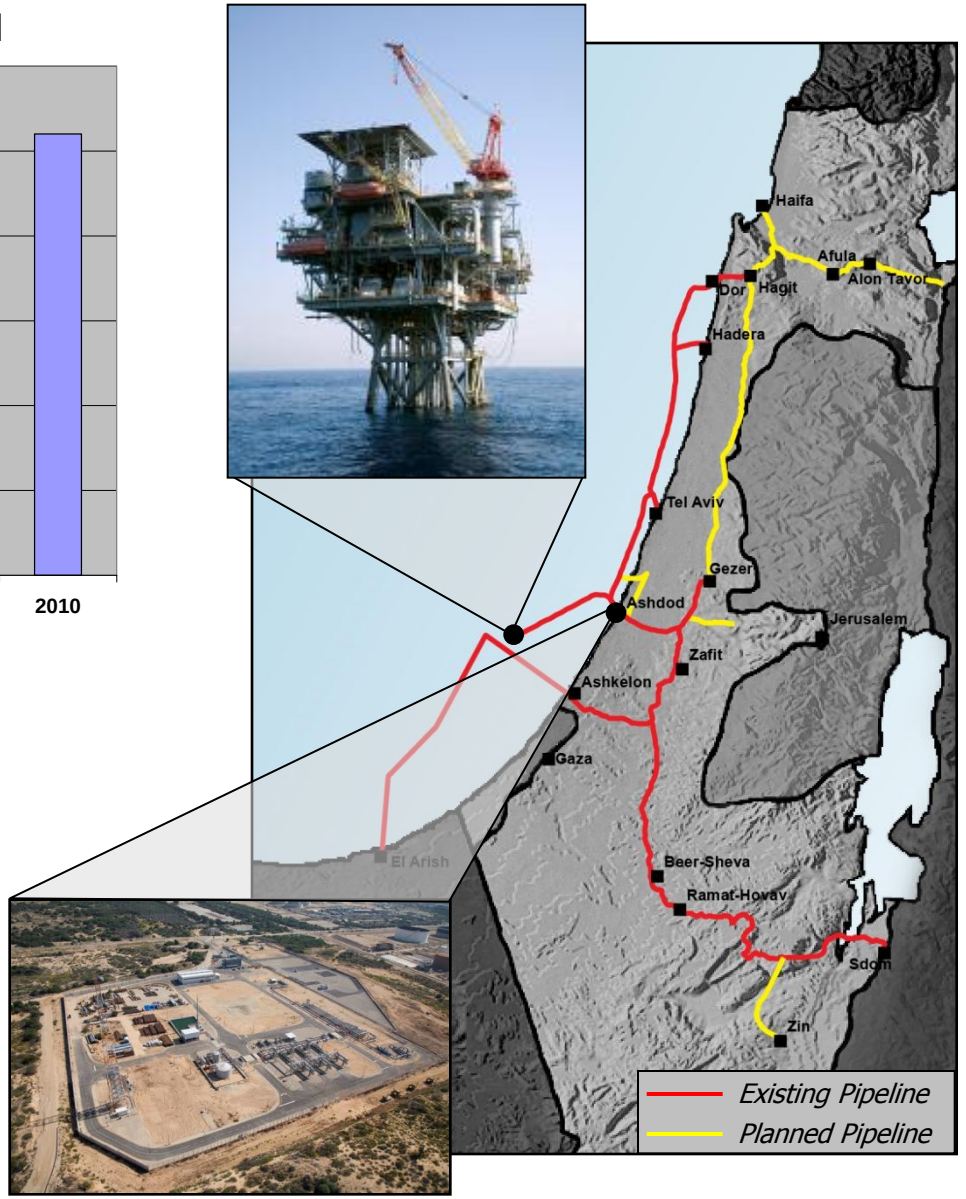
Source: Noble Energy presentation, July 23, 2013



Source: Noble Energy presentation, July 23, 2013

Mari–B Field





- Supplies fuel for one-third of Israel's electricity generation
  - Over NIS 26 Billion in total savings since 2004
  - Saved 17 million metric tons of CO2 emissions to date

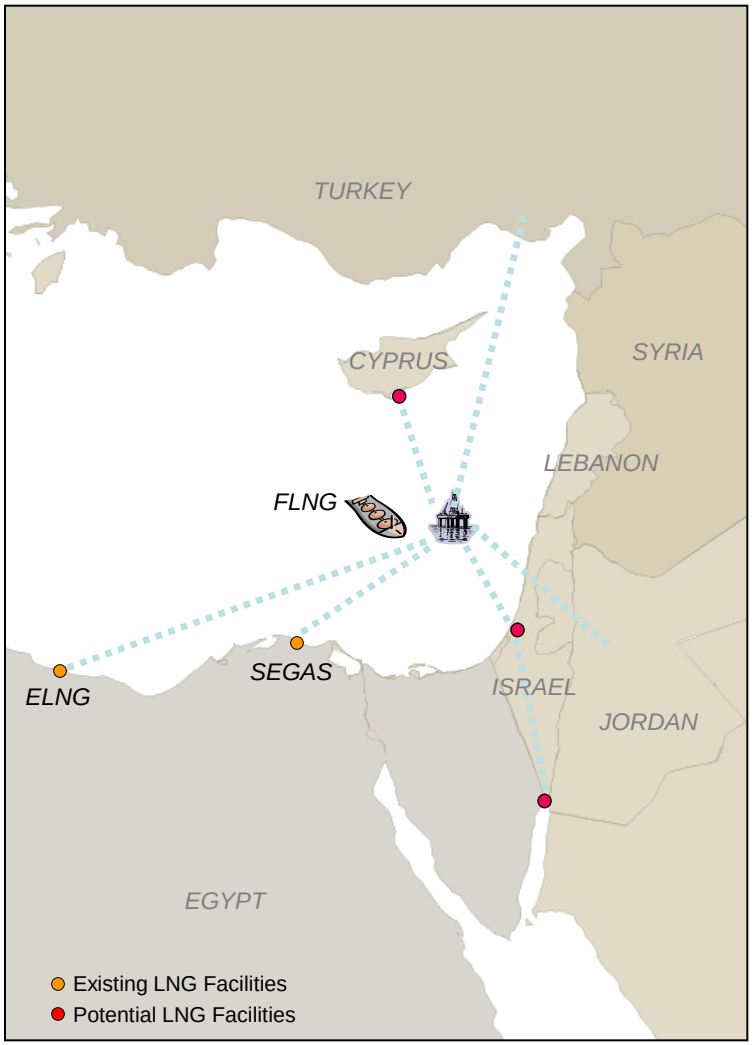
Source: Noble Energy presentation, July 23, 2013

Tamar Reservoir Size

Source: Noble Energy presentation, July 23, 2013

Leviathan Export

- Drivers for natural gas exports
  - Accelerates Leviathan sanction
  - Encourages exploration
  - Value generation
- LNG options
  - Onshore Pre-FEED studies underway for multiple sites
  - FLNG nearing FEED stage
  - Pipeline options
  - Jordan
  - Turkey
  - Egypt



Source: Noble Energy presentation, July 23, 2013

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Benefits to State of Israel

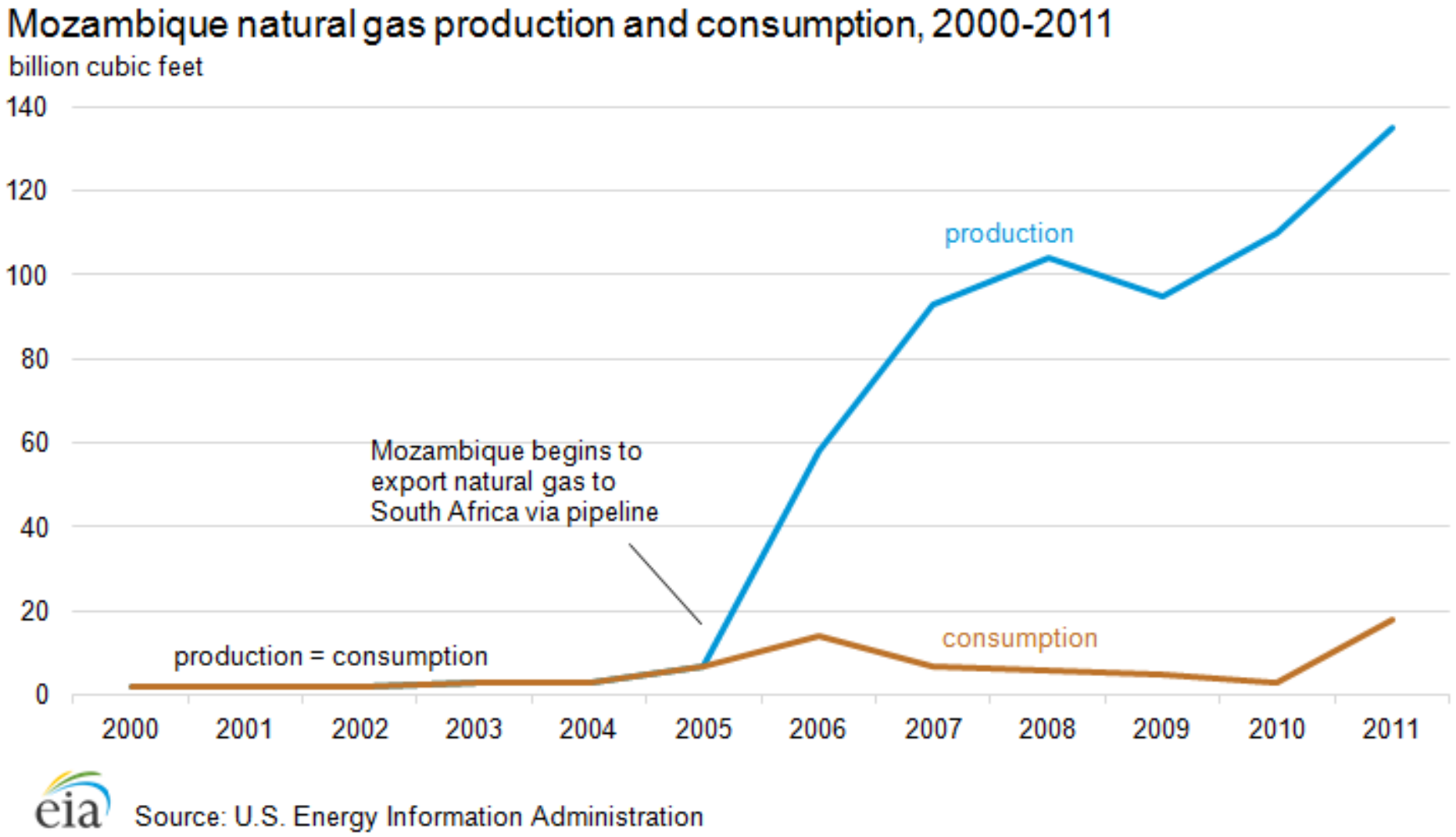
- Over the next 30 years government revenues from Tamar and Leviathan exceed $100 billion
- Price of domestically produced natural gas is 1/3 that of alternative fuels (HFO and Diesel, and imported LNG)
- One-year delay of Tamar cost IEC approximately 12 billion NIS
- Economic analysis indicates that adoption of the Zemach recommendations on Leviathan increases the net present value (NPV) of the government's interest ~$10 billion
- Government can realize benefit ahead of actual gas sales based on project capital and timeline commitments

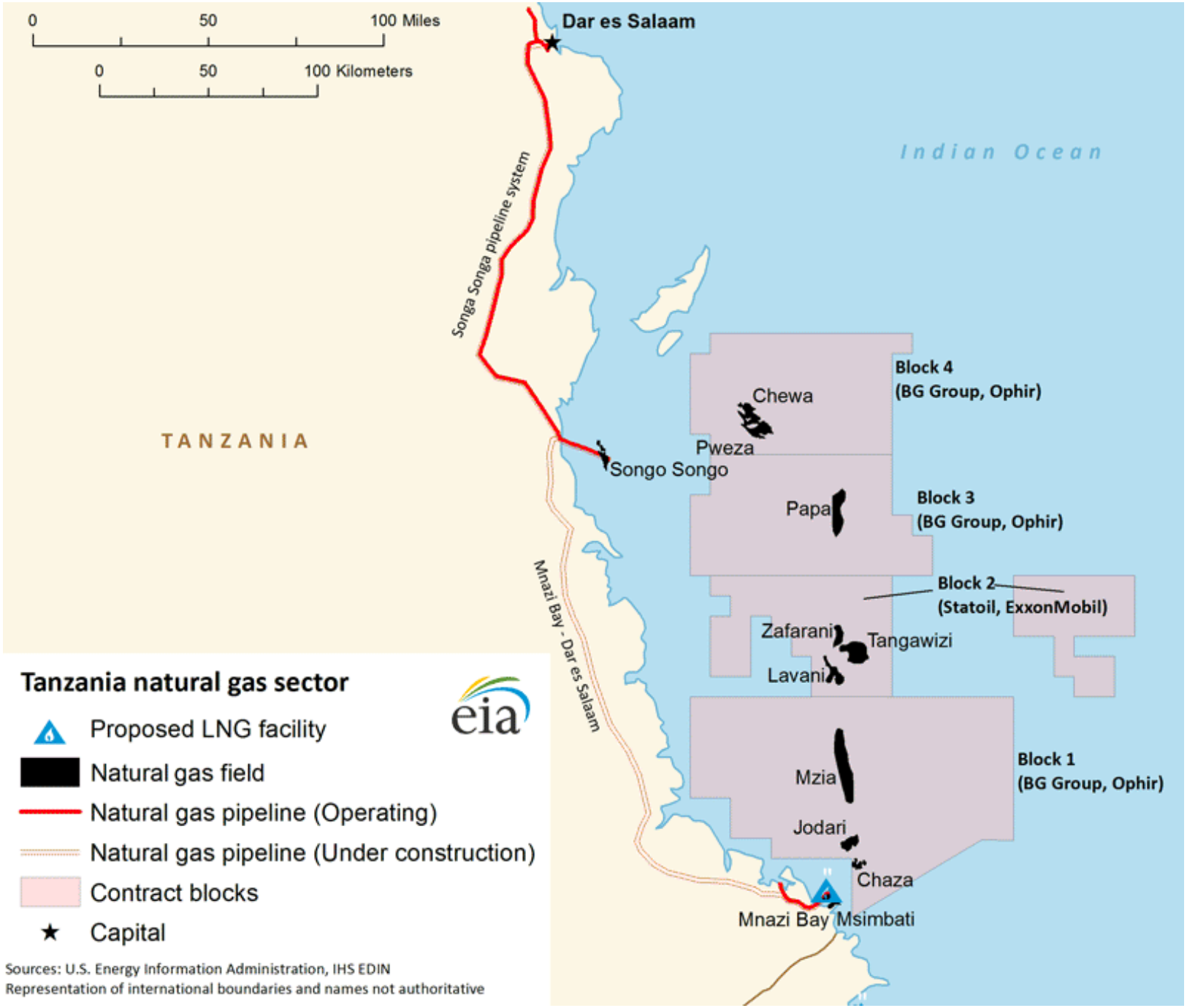
Source: Noble Energy presentation, July 23, 2013

Game Changer for Israel and the Middle East Region

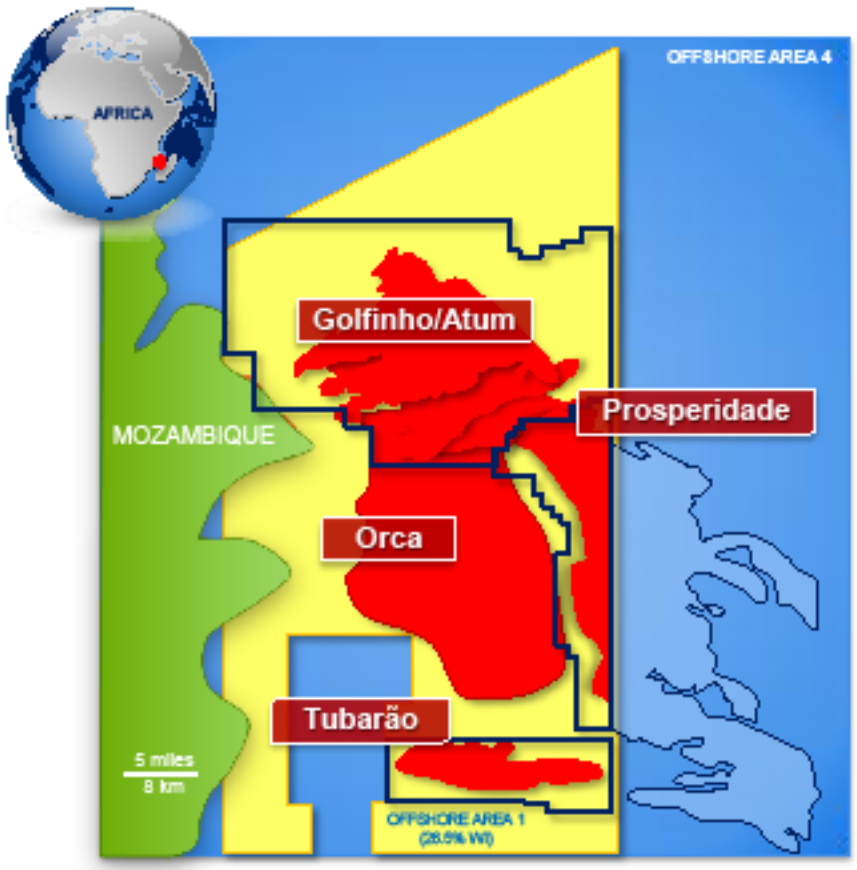
- Noble supplies 100% of Israel's gas requirements
- Noble has entered into gas sales agreements with the Palestinian Authority and a company in Jordan.
- Noble is looking at further exports to Egypt and Turkey and additional volumes to Jordan

Africa – The Dark Continent

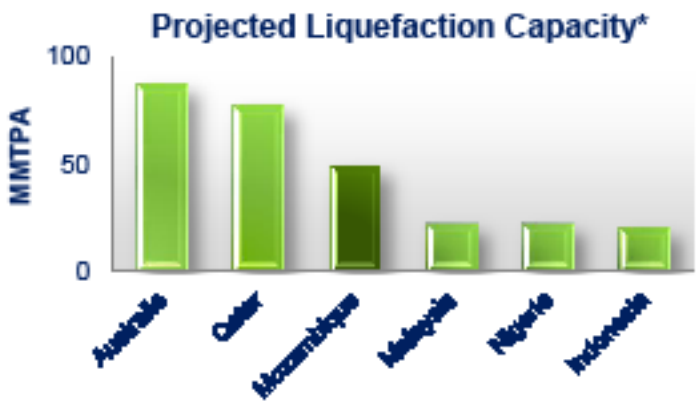

Mozambique natural gas production and consumption, 2000-2011
billion cubic feet
140
120
100
80
60
40
20
0
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
production
consumption
Mozambique begins to export natural gas to South Africa via pipeline
production = consumption
eia
Source: U.S. Energy Information Administration


0
50
100 Miles
0
50
100 Kilometers
Dar es Salaam
Indian Ocean
Songa Songa pipeline system
TANZANIA
Block 4
(BG Group, Ophir)
Chewa
Pweza
Songo Songo
Block 3
(BG Group, Ophir)
Papa
Block 2
(Statoil, ExxonMobil)
Zafarani
Tangawizi
Lavani
Mnazi Bay - Dar es Salaam
Block 1
(BG Group, Ophir)
Mzia
Jodari
Chaza
Mnazi Bay
Msimbati
Tanzania natural gas sector
eia
Proposed LNG facility
Natural gas field
Natural gas pipeline (Operating)
Natural gas pipeline (Under construction)
Contract blocks
Capital
Sources: U.S. Energy Information Administration, IHS EDIN
Representation of international boundaries and names not authoritative

Mozambique: Premier Global LNG Supply



- **Massive Resource**
  - 45 - 70+ Tcf Recoverable Natural Gas in Area 1
  - Resource Size Supports 50 MMTPA
- **Extensive Appraisal Drilling**
- **Obtained Reserves Certification**
- **Global Endorsement**
  - $9.6 Billion Pre-Transaction Market Valuation
  - 3.3 MMTPA Non-Binding HOAs with Multiple Asian Customers



* Wood Mackenzie

Location & Cost Advantages Enhance Value

- **High-Quality Reservoirs**
  - High Deliverability
  - Established Reservoir Continuity
- **Proximity to Shore 5 - 25 Miles**
  - Initial Subsea-to-Shore Development
- **Natural Harbor**
- **Scalable Onshore Development**
  - 17,000+ Acre Site
  - Future Expansion Capability to 50 MMTPA
- **Proximity to Asian Markets**

Proponents of Fracking

"We produce more natural gas than ever before…and nearly everyone's energy bill is lower because of it…[T]he natural gas boom has led to cleaner power and greater energy independence."

- President Barack Obama

"We should strengthen our position as the top natural gas producer...[I]t not only can provide safe, cheap power, but it can also help reduce our carbon emissions."

- President Barack Obama

"There's nothing inherently dangerous in fracking that sound engineering practices can't accomplish."

- Gina McCarthy, Current EPA Administrator

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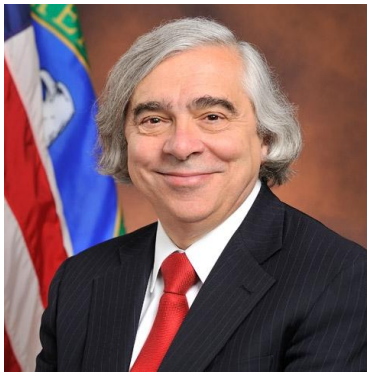
“I’m not aware of any proven case where the fracking process itself has affected water.”

- Lisa Jackson, Former EPA Administrator

“I still have not seen any evidence of fracking per se contaminating groundwater.”

- Ernest Moniz, Secretary of Energy



“This [hydraulic fracturing] is something you can do in a safe way.”

- Steven Chu, Former Secretary of Energy

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“Fracking has been done safely for decades.”

- Sally Jewell, Secretary of Interior

“I would say to everybody that hydraulic fracturing is safe…[it] is creating an energy revolution in the United States.”

- Ken Salazar, Former Secretary of Interior

“I know and you know that fracking is not a threat to our communities when it is done safely and responsibly.”

- Mark Udall, Senator of Colorado

“We believe oil and gas development can thrive while also meeting our high standards for protection of health, water and the environment.”

- John Hickenlooper, Governor of Colorado

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