Ресурсы, технологии, и геополитика: Что мы знаем про сланцы

By

Svetlana Ikonnikova, PhD

University of Texas at Austin

We live on an island surrounded by a sea of ignorance. As our island of knowledge grows, so does the shore of our ignorance.

John Archibald Wheeler, Scientific American (1992), Vol. 267

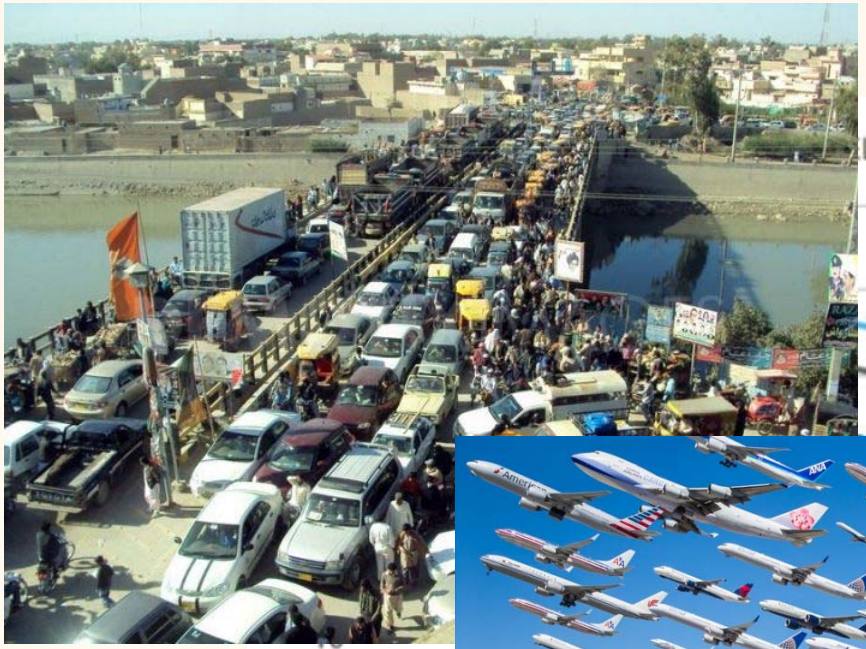
Technology

Modified from http://www.makeuseof.com/tag/replace-devices-with-smartphone/

Efficiency increases but so does our consumption of energy

Samsung Electronics installed Samsung Mobile Charging Stations in airports of main cities in the United States.

Transportation



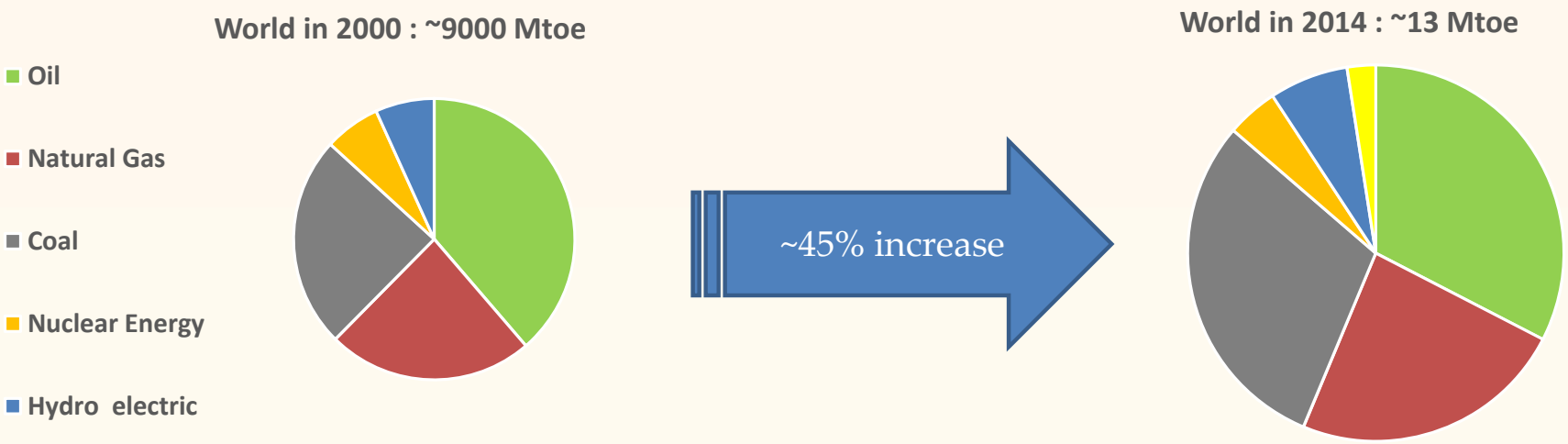
1975

010

SOURCE: EPA.GOV

What changed over the last decade

Where all this energy come from?

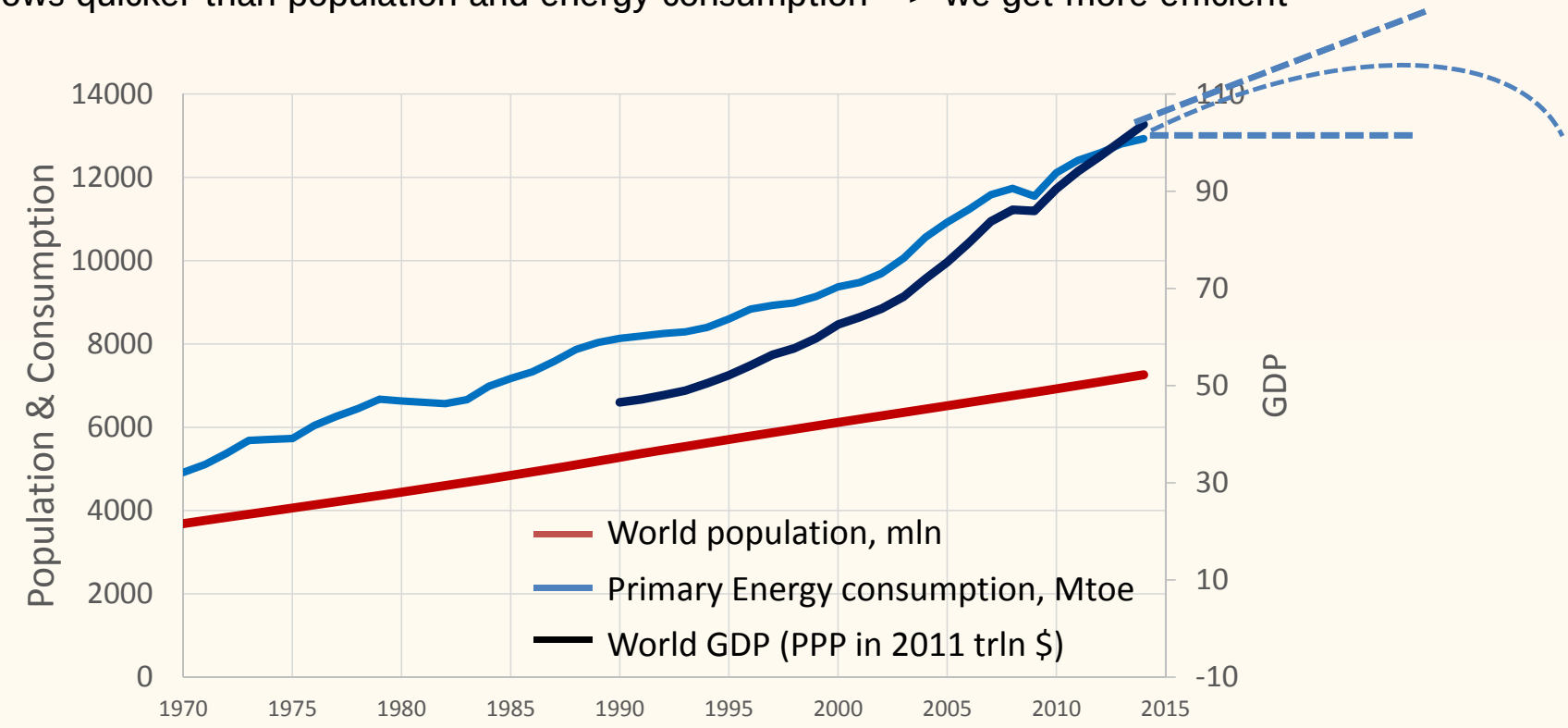


Mtoe – Million tonnes oil equivalent

BP statistical report, 2015

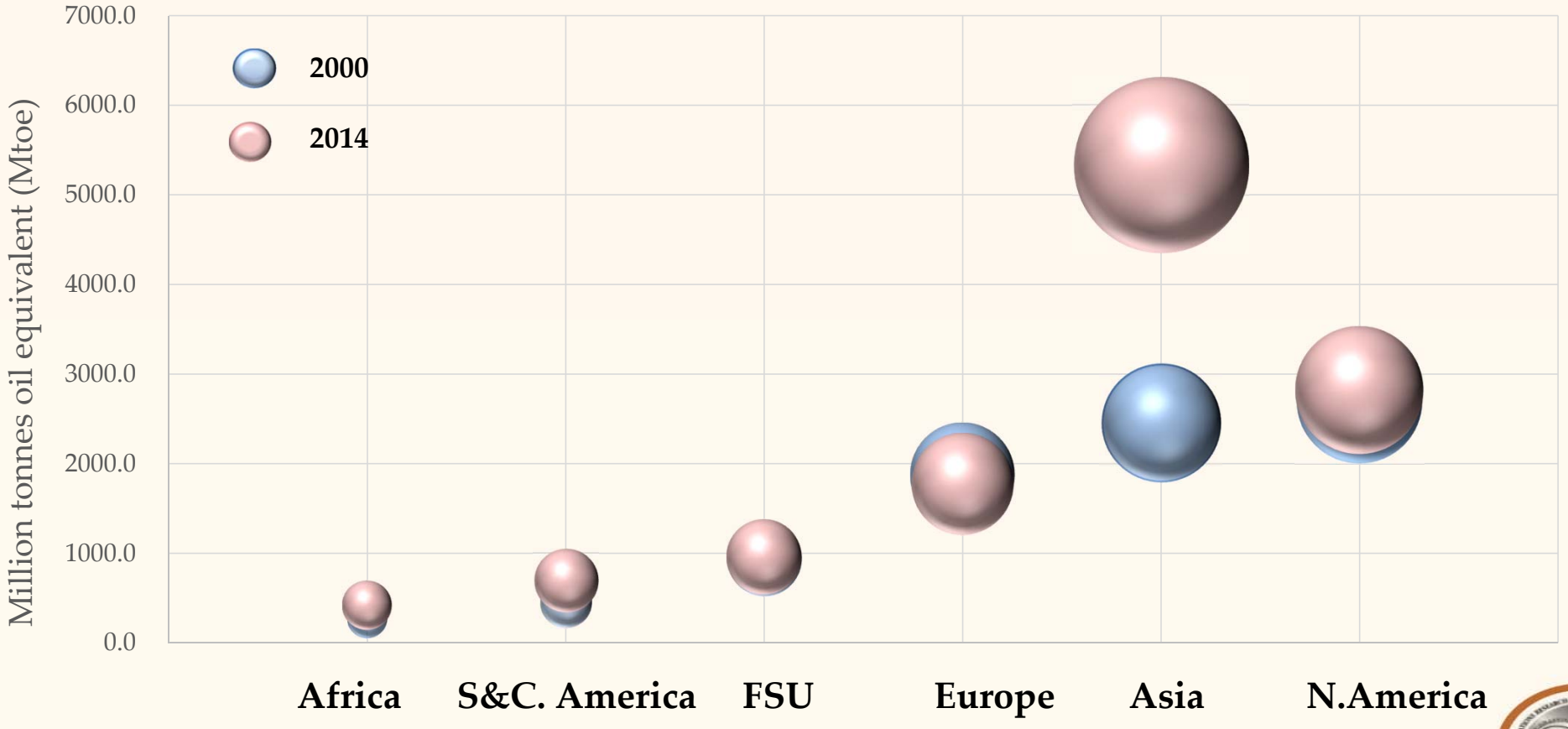
Energy and People

GDP grows quicker than population and energy consumption => we get more efficient

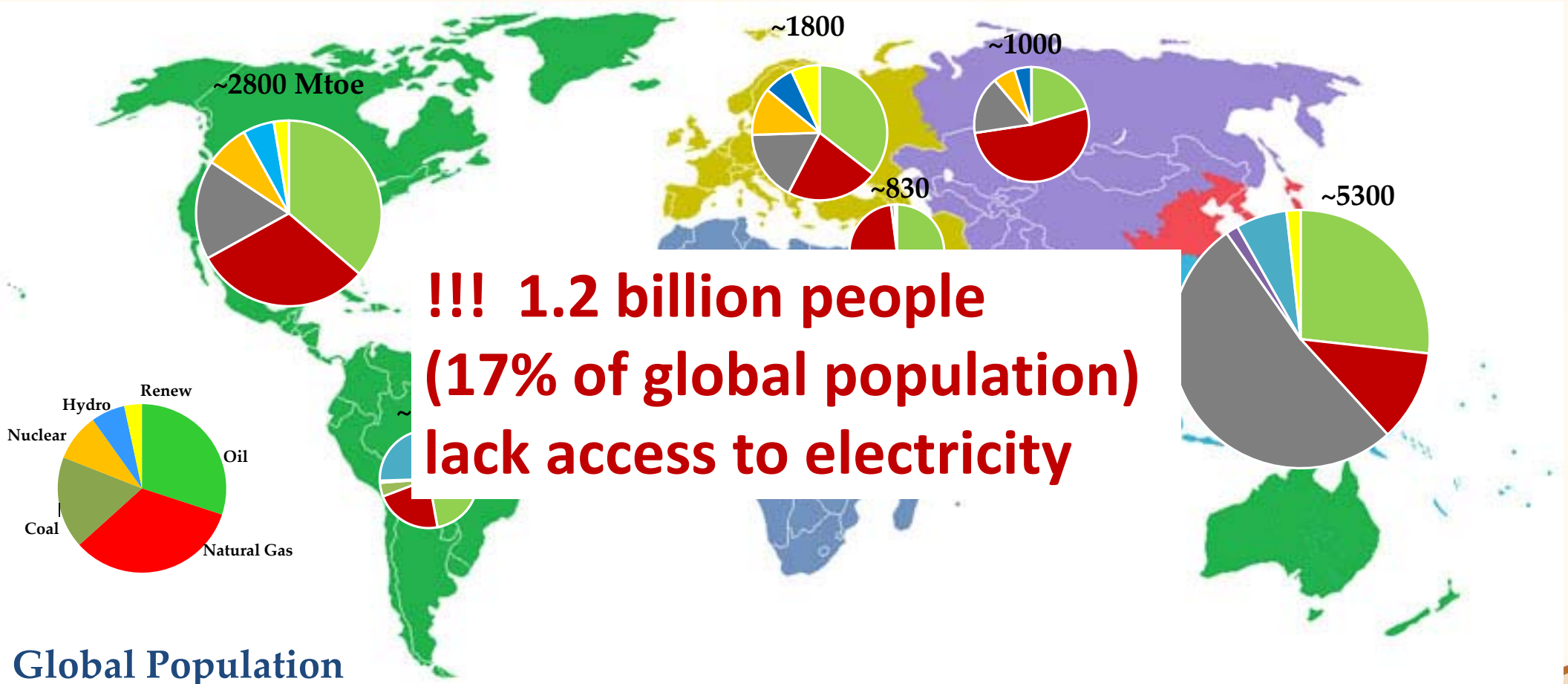


World Bank & BP statistical report, 2015

Change in energy consumption by region



Energy Mix and Demand



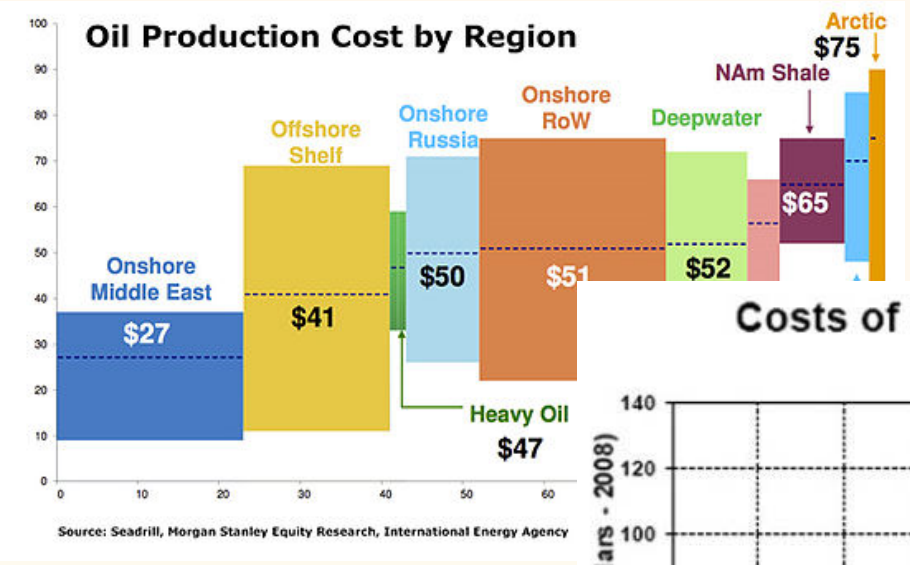
!!! 1.2 billion people (17% of global population) lack access to electricity

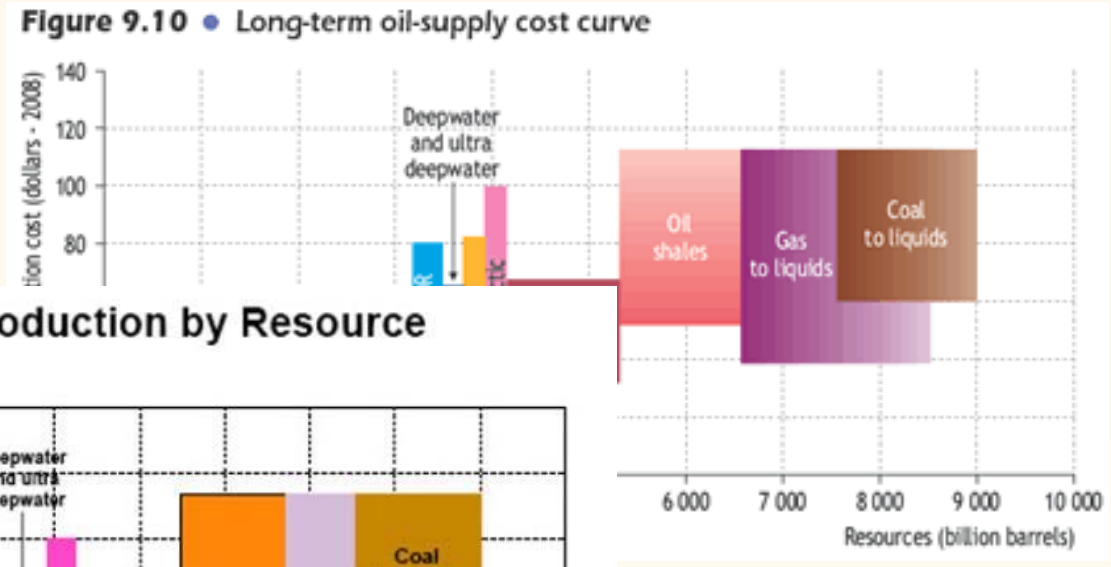
Global Population

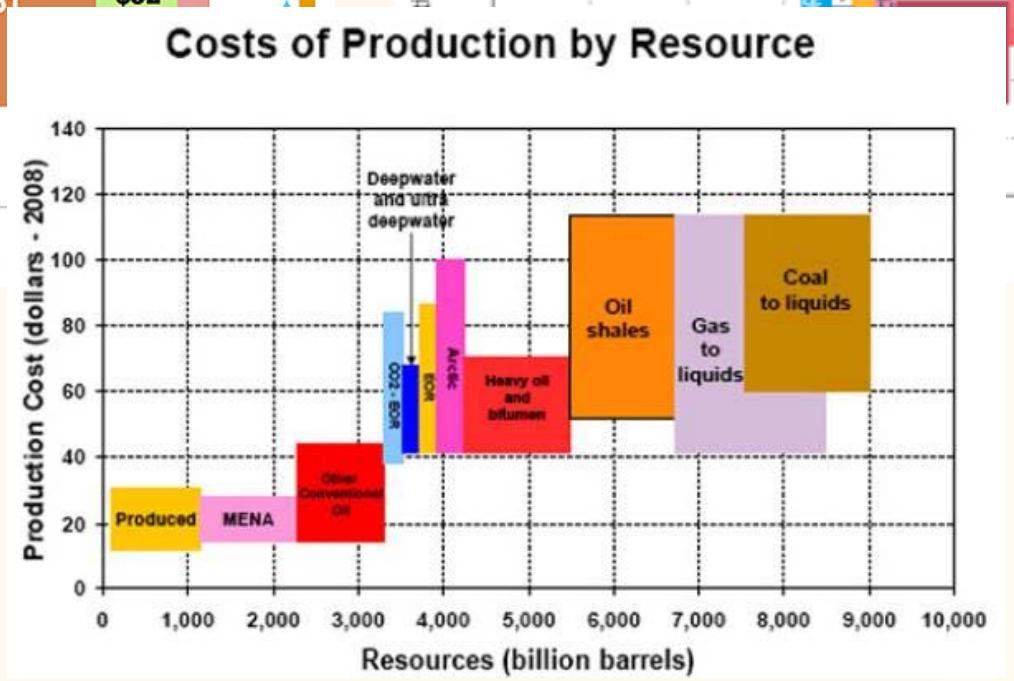
Each color on the map represents ~ 1 billion people

Modified from: EIA **Million Tonnes Oil Equivalent (2012)**

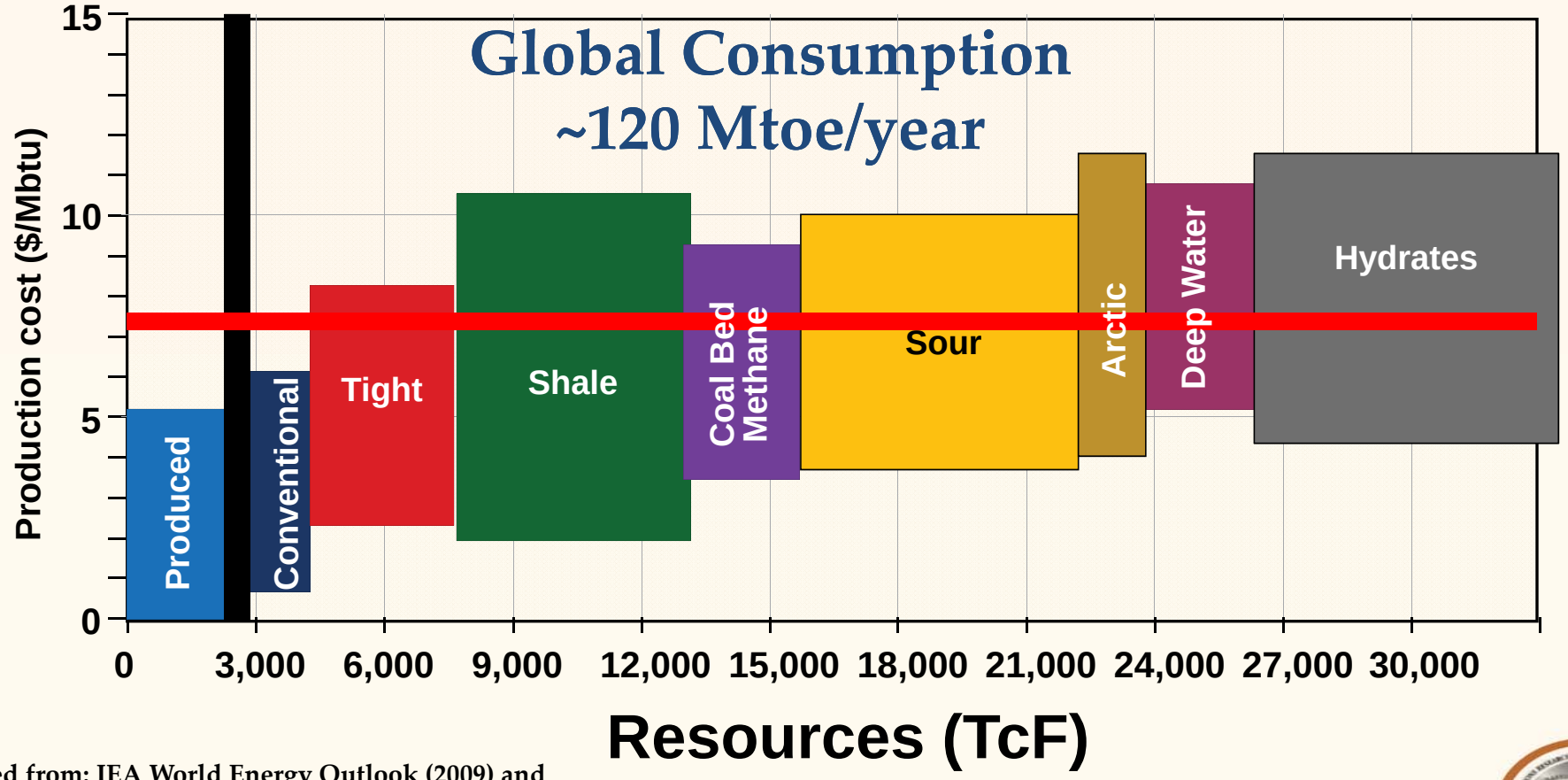
How much energy costs and is available





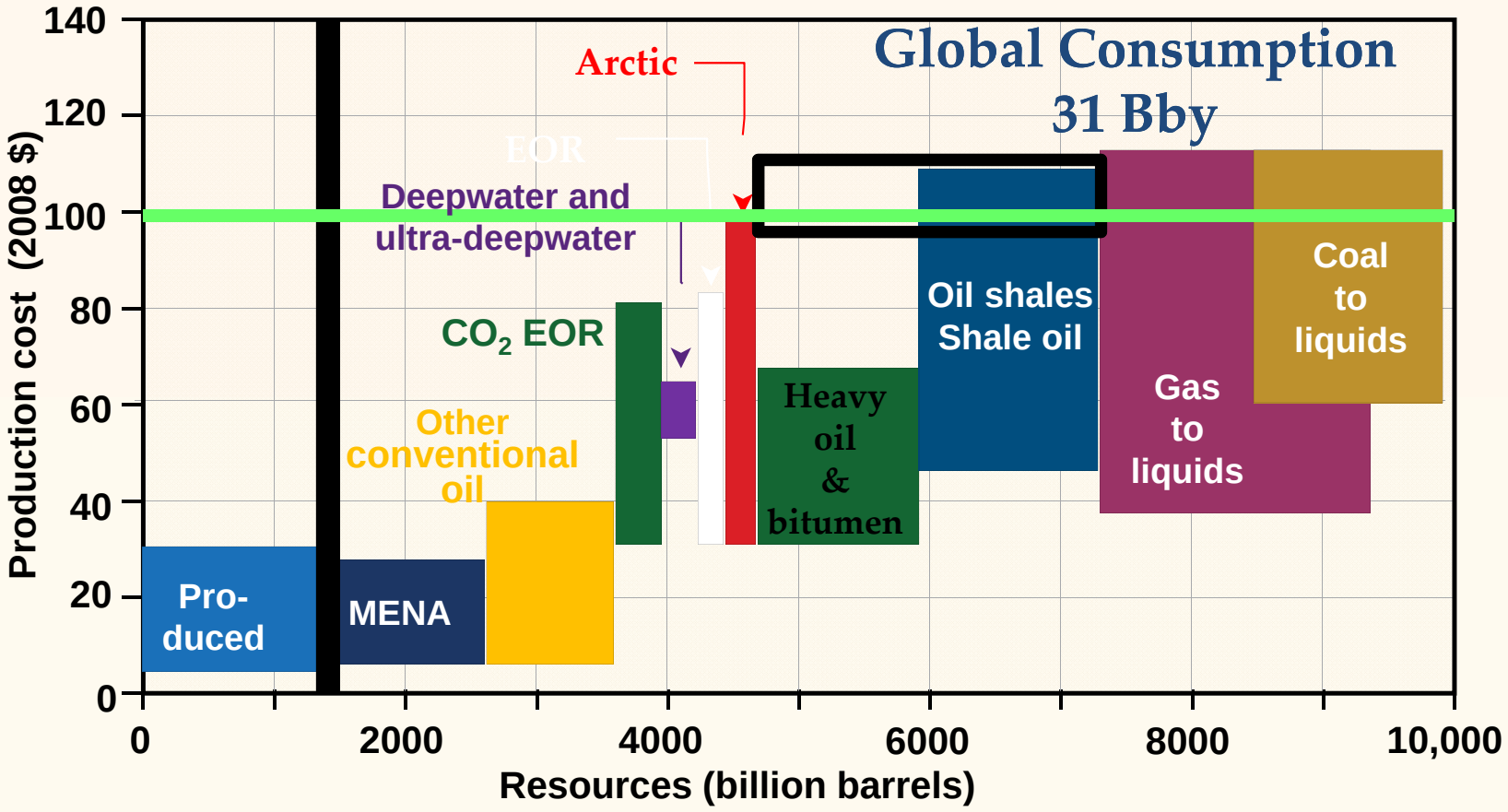


Global Natural Gas



Modified from: IEA World Energy Outlook (2009) and Tinker (2015)

Long-Term Oil Supply

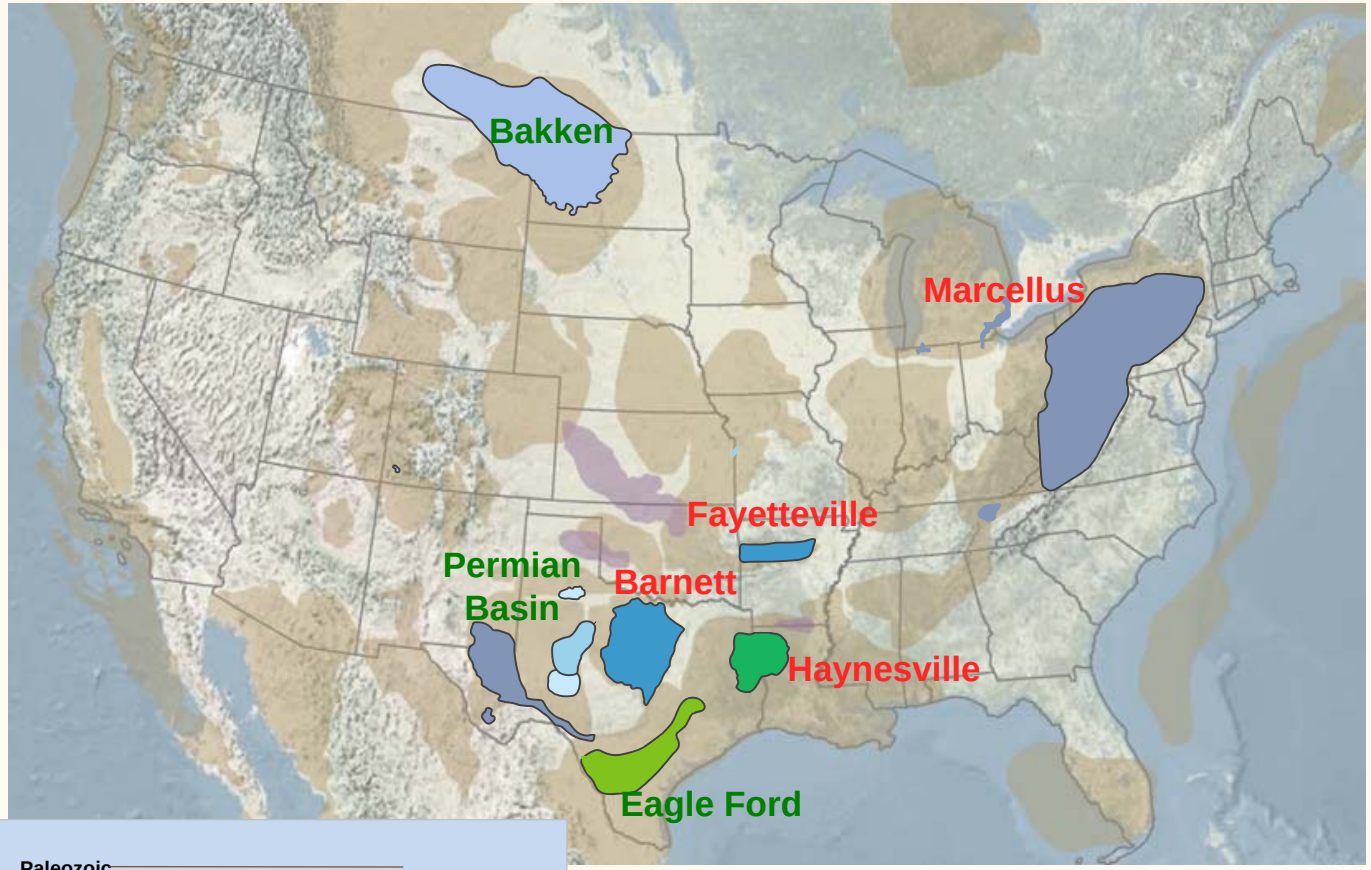


Modified from: IEA World Energy Outlook (2009) and Tinker (2015)

Shale Development in the USA

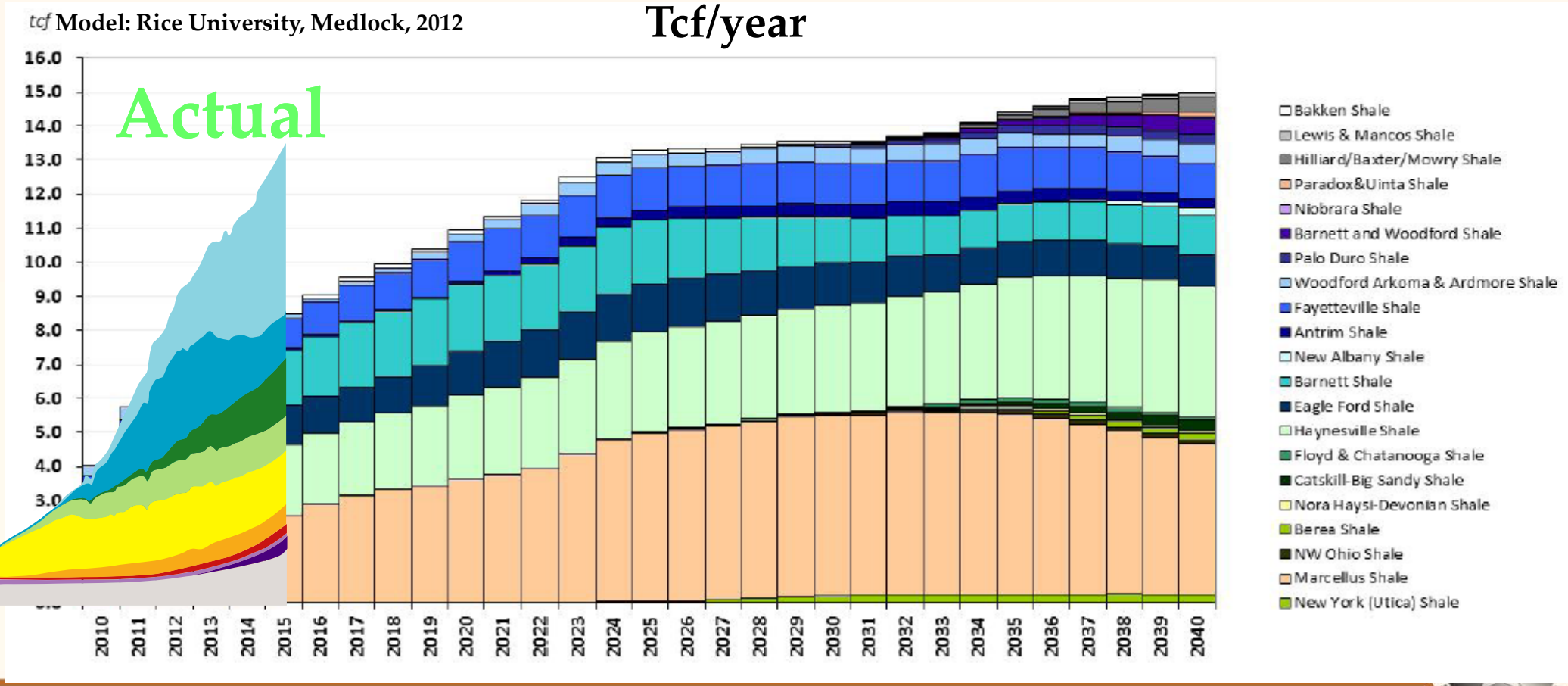
What is shale?

Unconventional Resource Plays



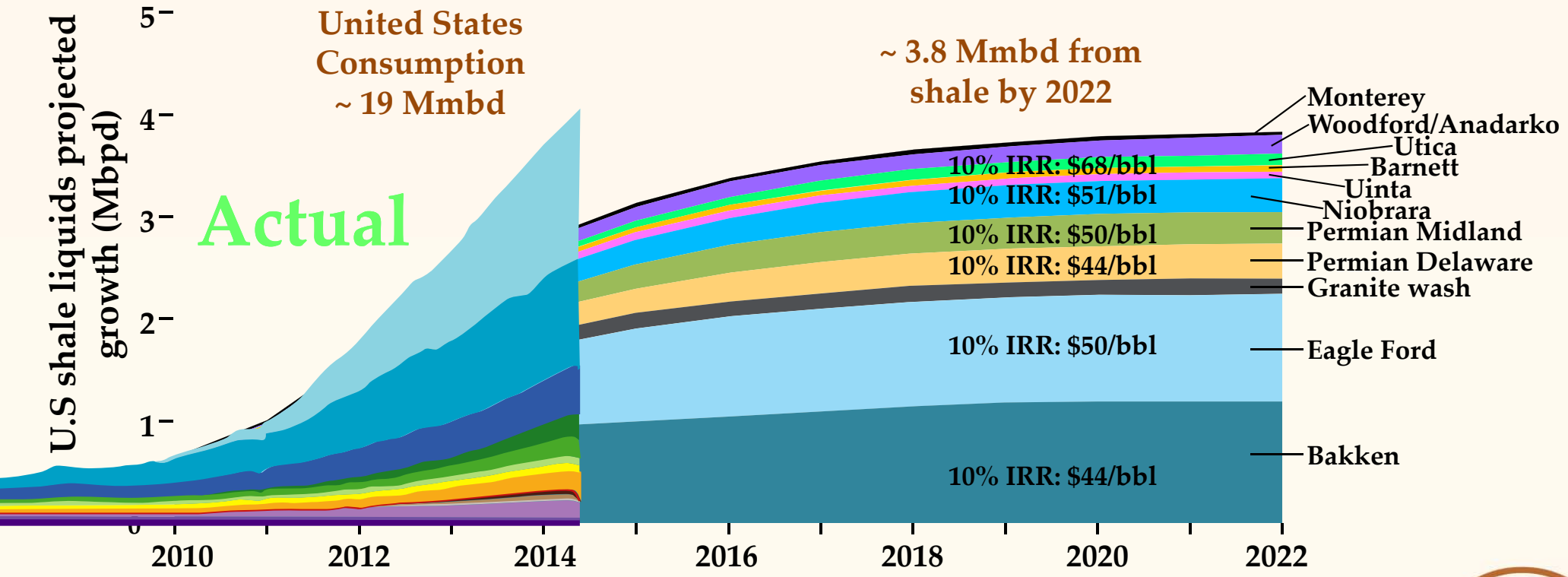
Modified from: EIA and National Geographic

U.S. Natural Gas Forecast vs. Actual



U.S. Shale Liquids

2010 PROJECTION



After Morse et. al., 2012, Energy 2020: North America, the new Middle East: Citi GPS: Global Perspectives & Solutions, figure 14, p. 17.

IRR Source: Rystad Energy

Annual US Oil Production

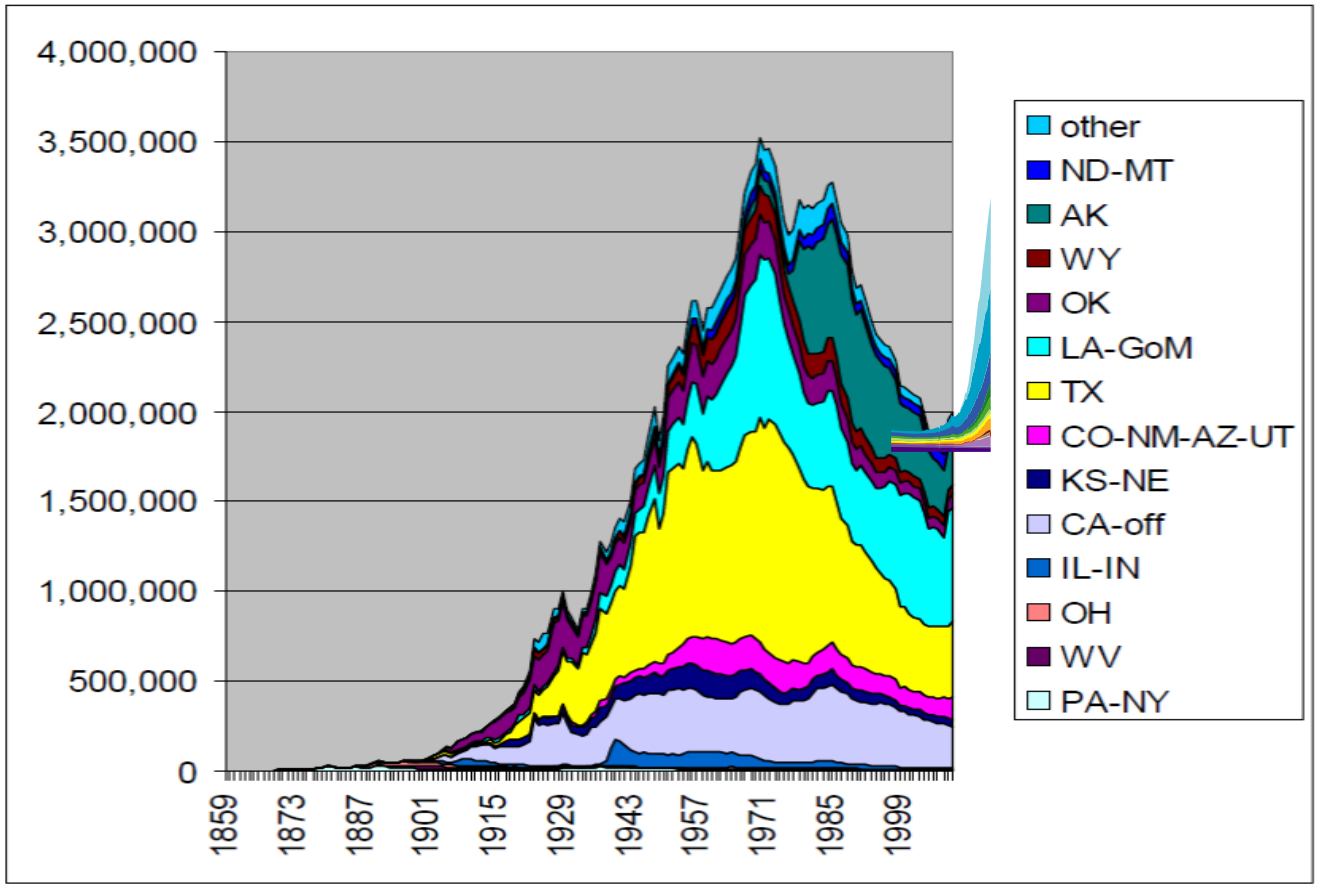
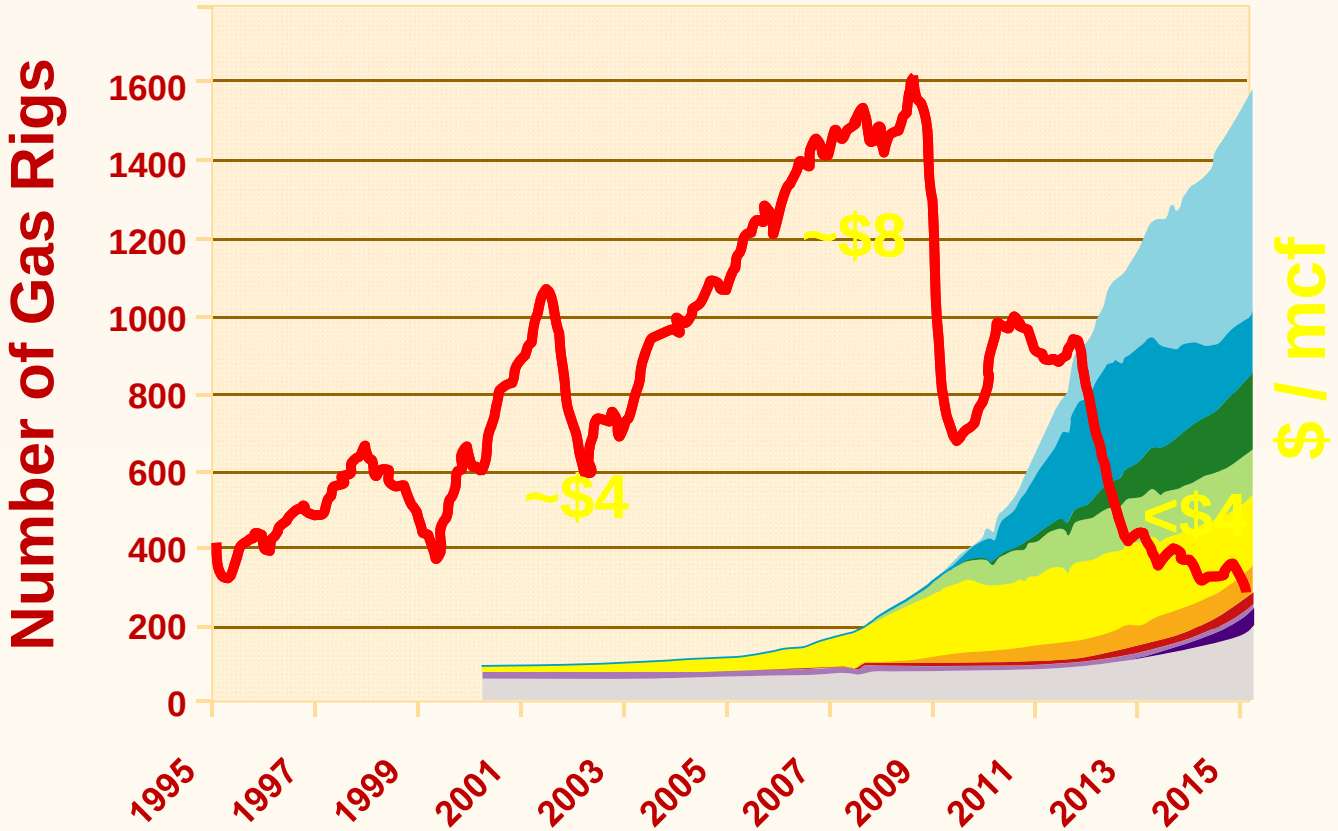


Figure 8. Annual crude oil production (in thousands of barrels per year) from entire United States, with contributions from individual regions as indicated.



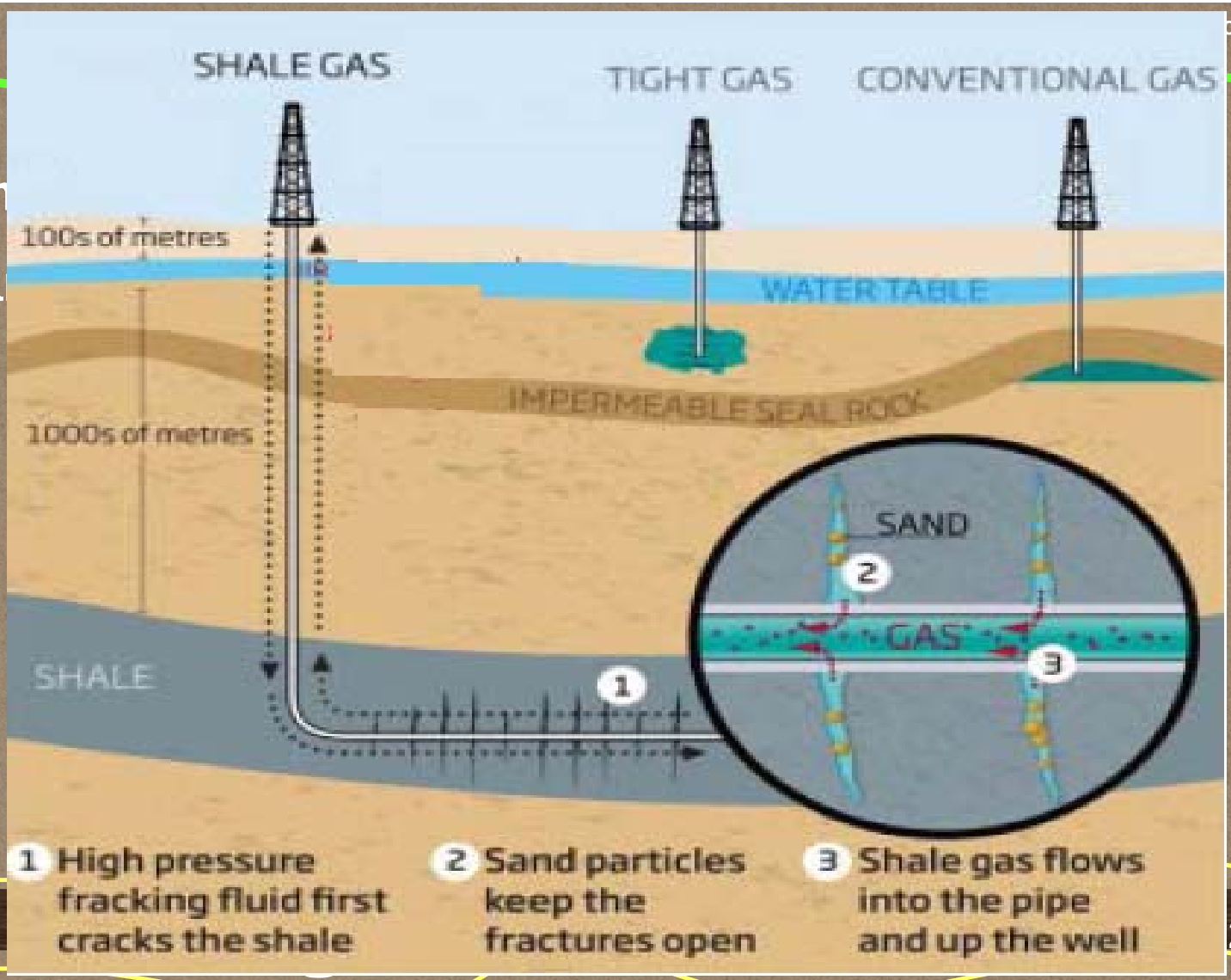
Data: Baker Hughes, 27 Feb 2015


Barnett drilling location
University of Texas at Arlington
From XTO annual report

onnikova, NES, 2016

Water + Chem

Proppant (sa

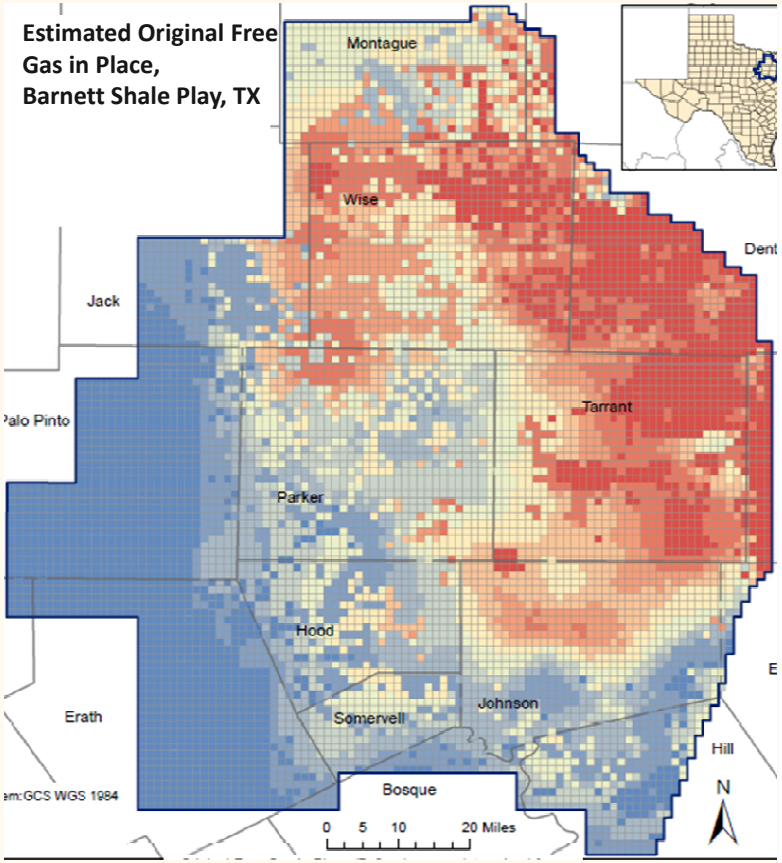


1,000 to 4,000+ m

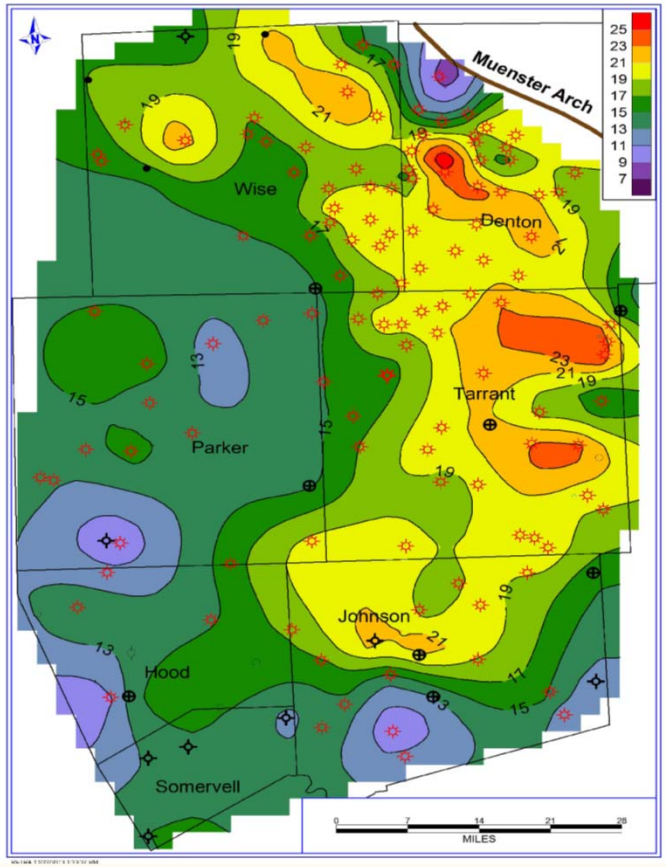
Shale

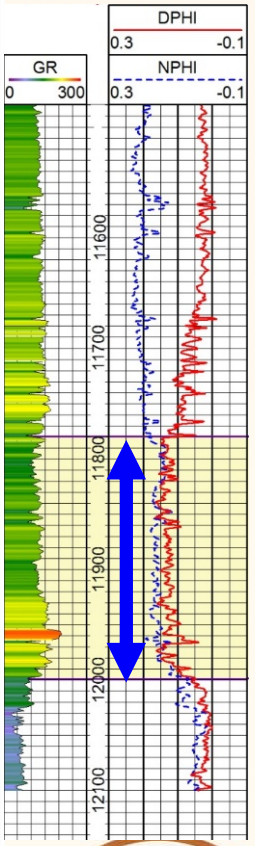
200 m

Barnett
Original Gas In Place

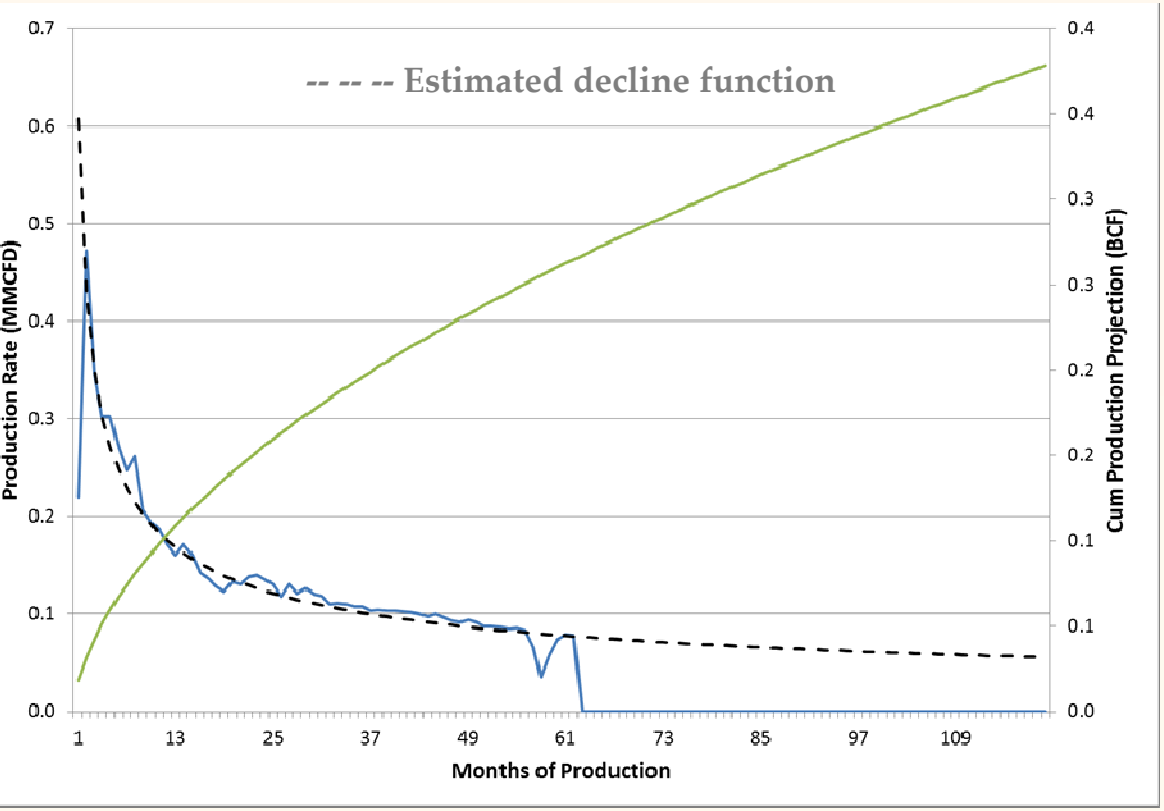


Barnett
Porosity * Thickness



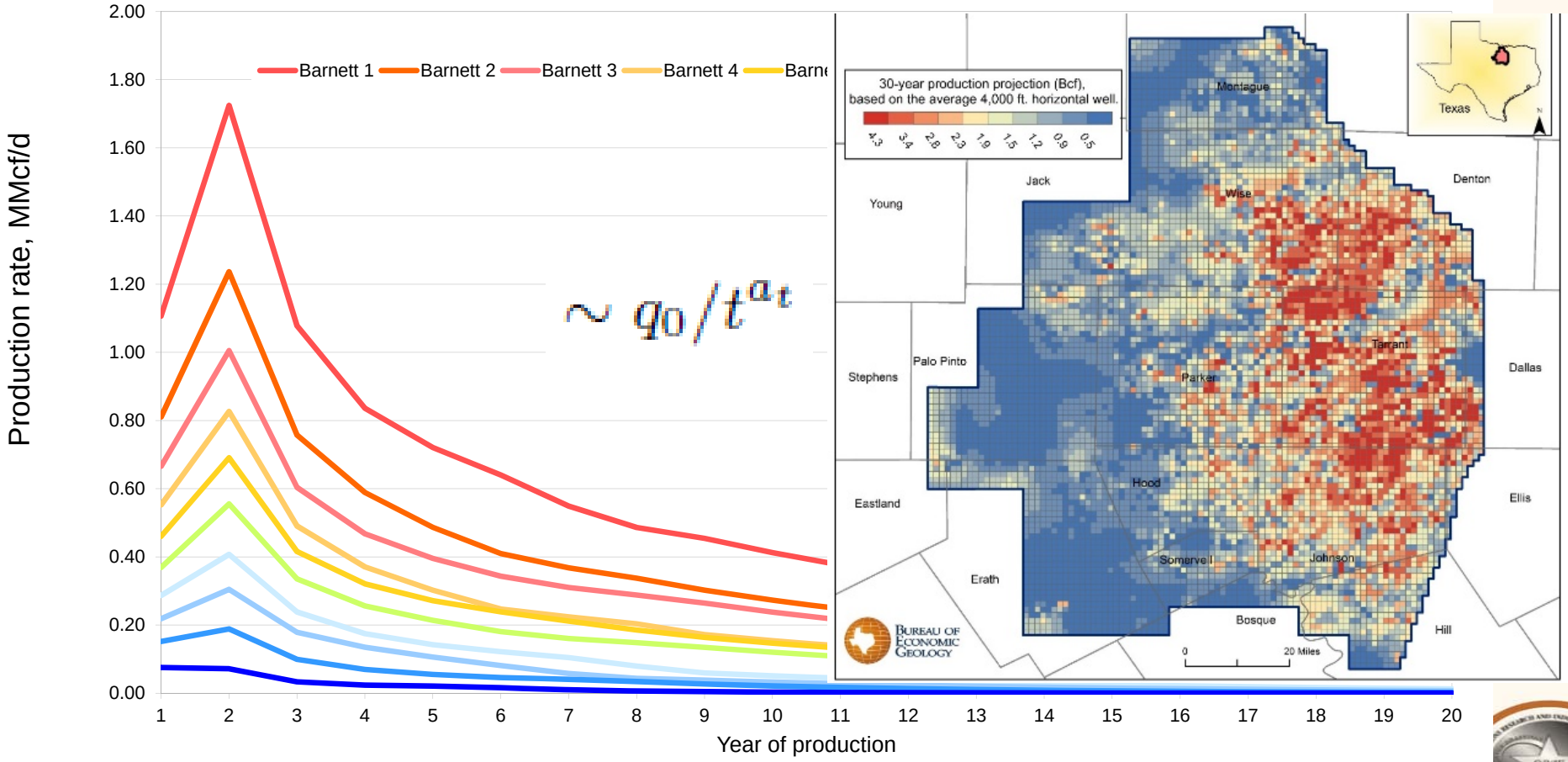


Estimating Decline

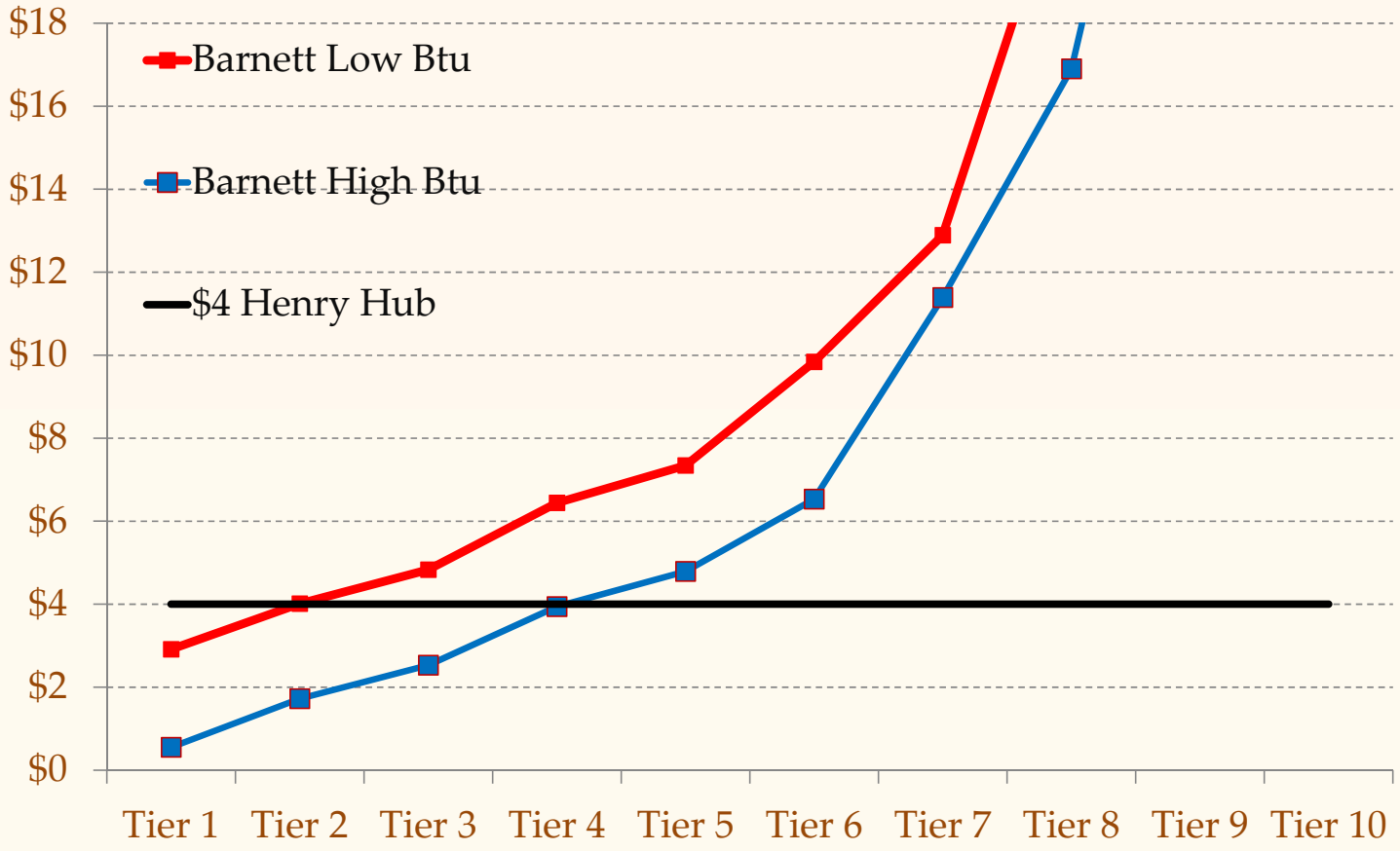


- **Production decline is a function of physical and geological rock properties based on the *physical flow model***

Production Profiles by Tier

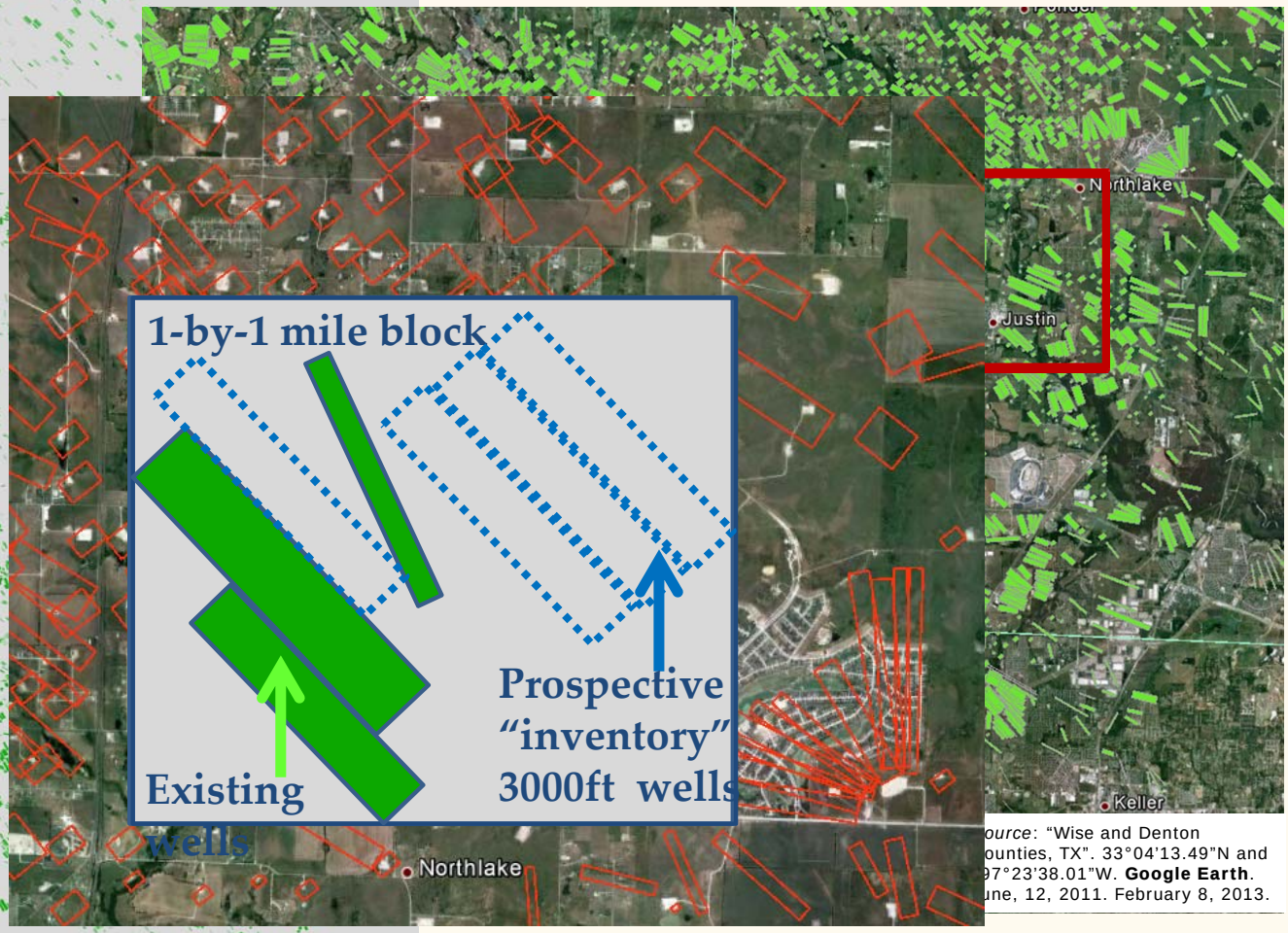


Breakeven Well Economics



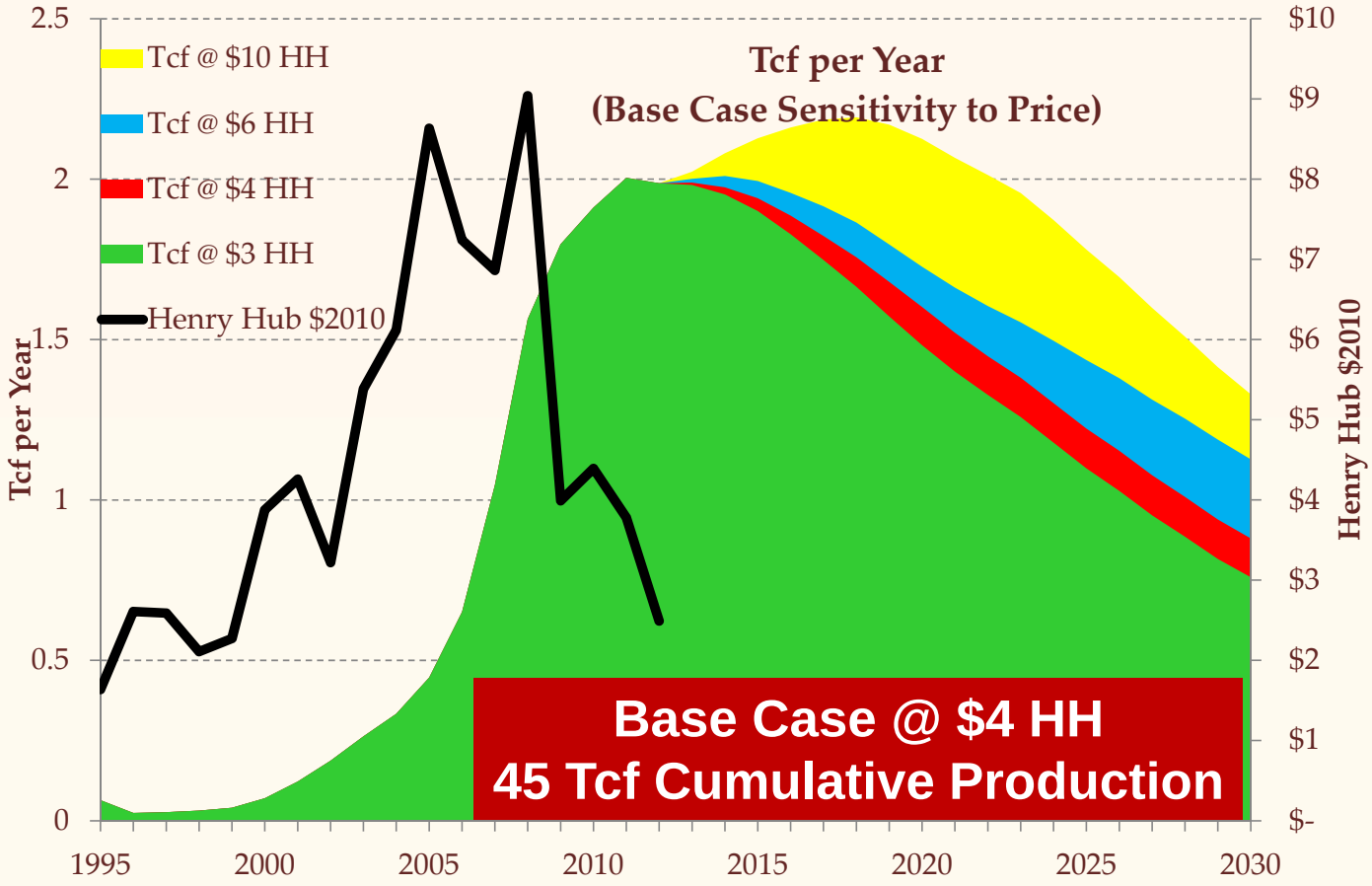
Gulen et al., 2013

Drainage areas of the existing wells

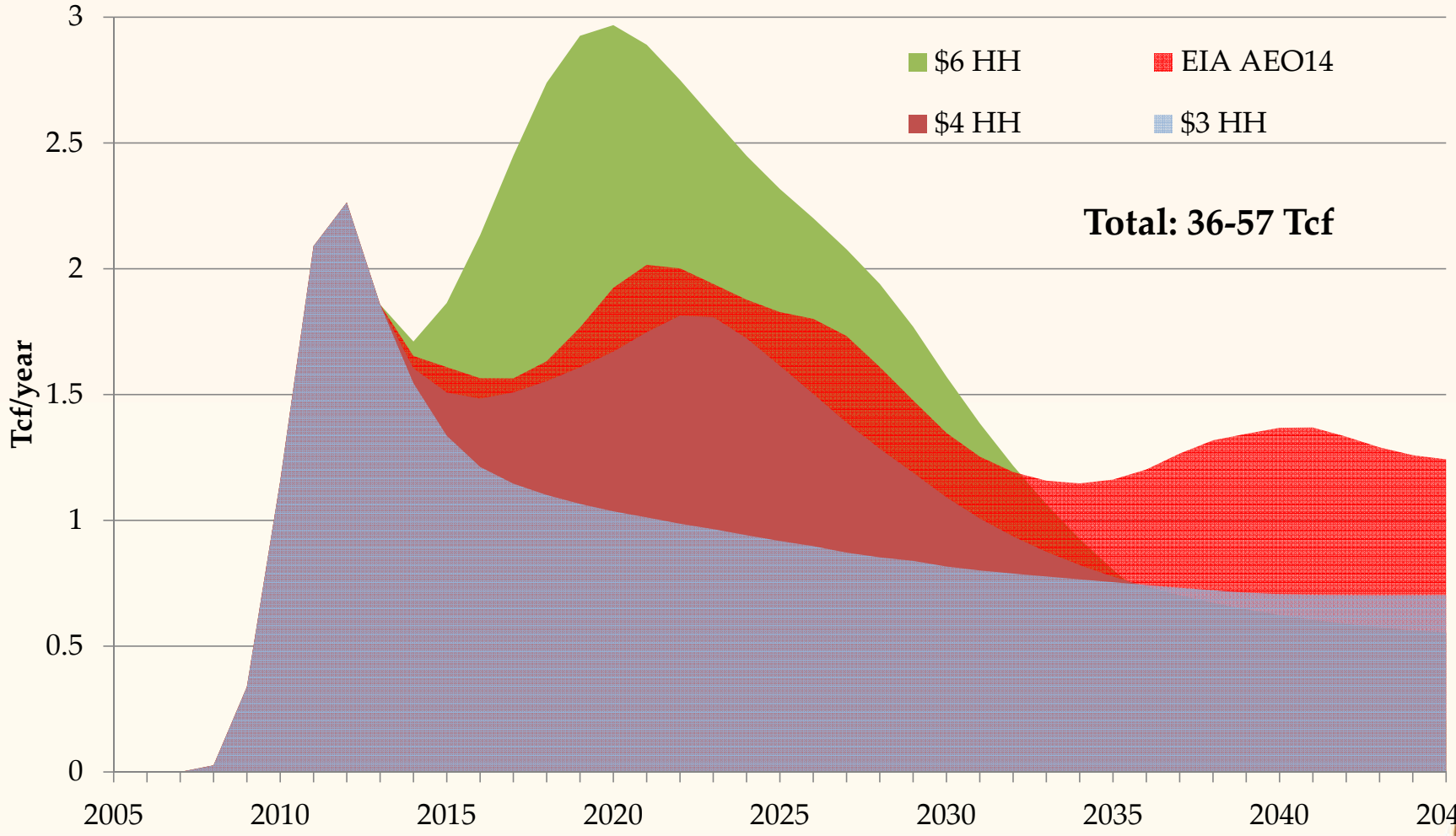


ource: "Wise and Denton ounties, TX". 33°04'13.49"N and 97°23'38.01"W. **Google Earth**. une, 12, 2011. February 8, 2013.

Barnett Shale: Base Case



Haynesville Shale: Expensive and young

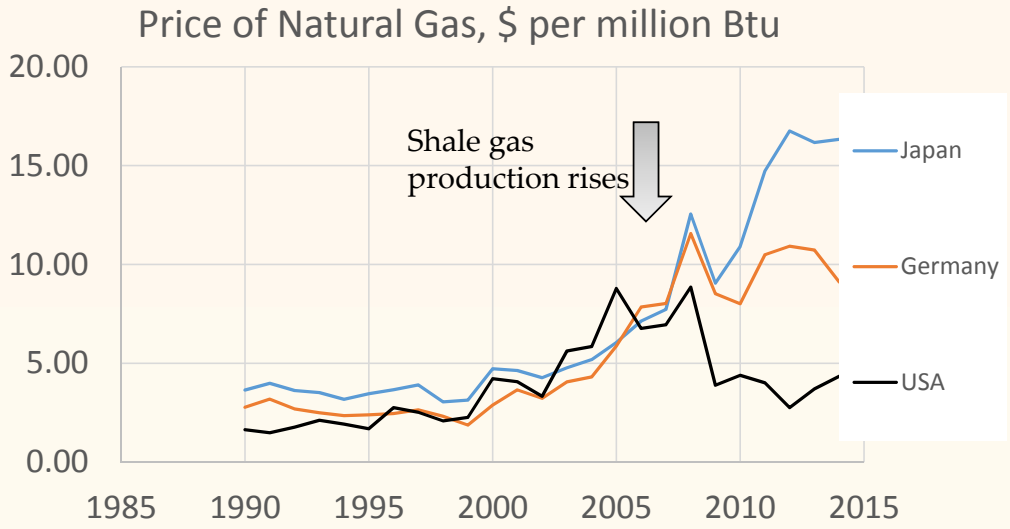


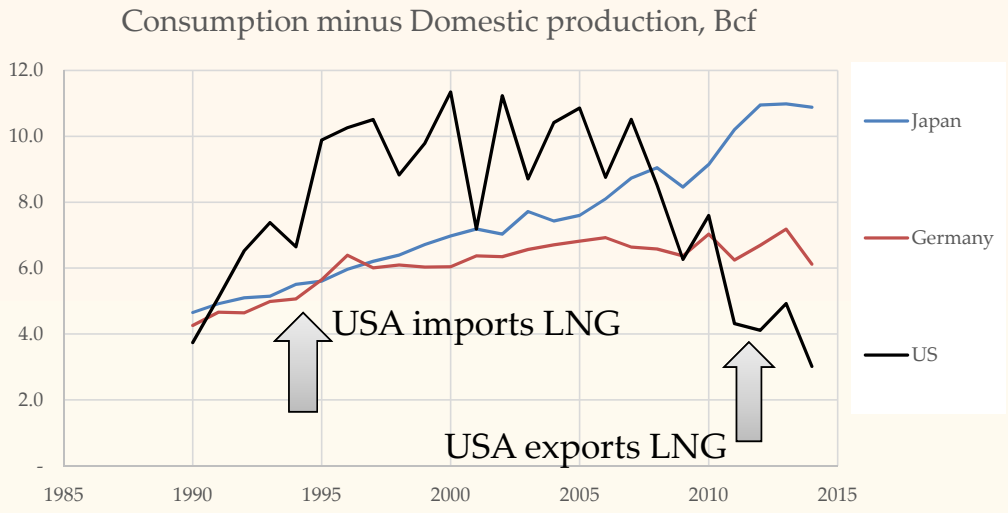
Conclusions

- Currently, shale gas production is almost 30% of the total US natural gas production.
- Operators get smarter in drilling wells and continue to reduce costs, using e.g. cluster and infill drilling.
- Even if the price continues to stay low, the share of shale gas will increase.
- The resource is enough to last for the decades, the rates will, though, depend on price.
- Shale development and the ability to address environmental issues is increasing important

Why it all matters

How much it costs

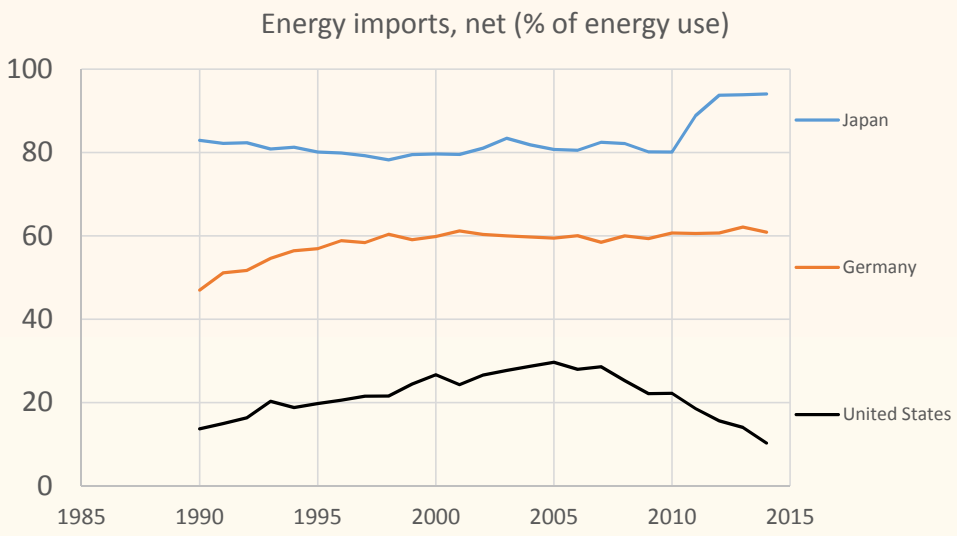


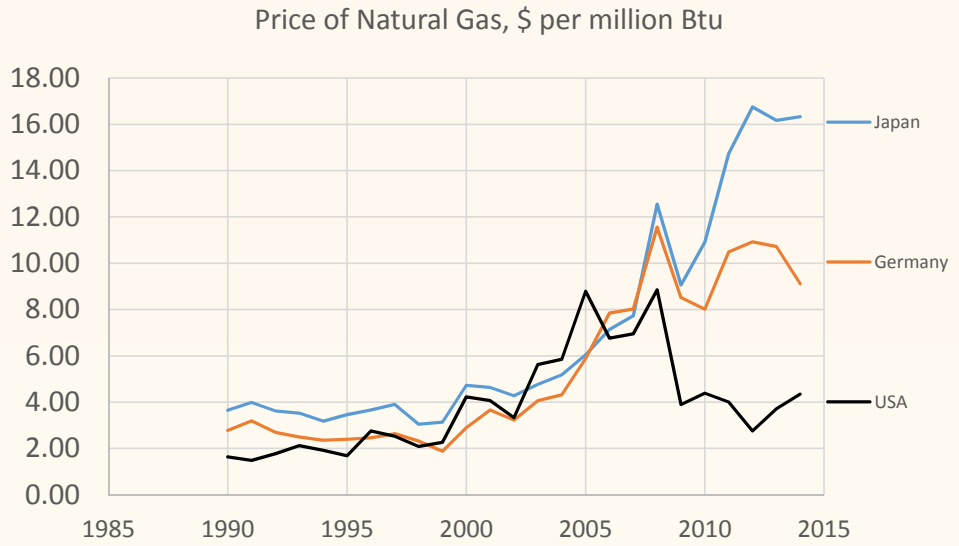


What changed?

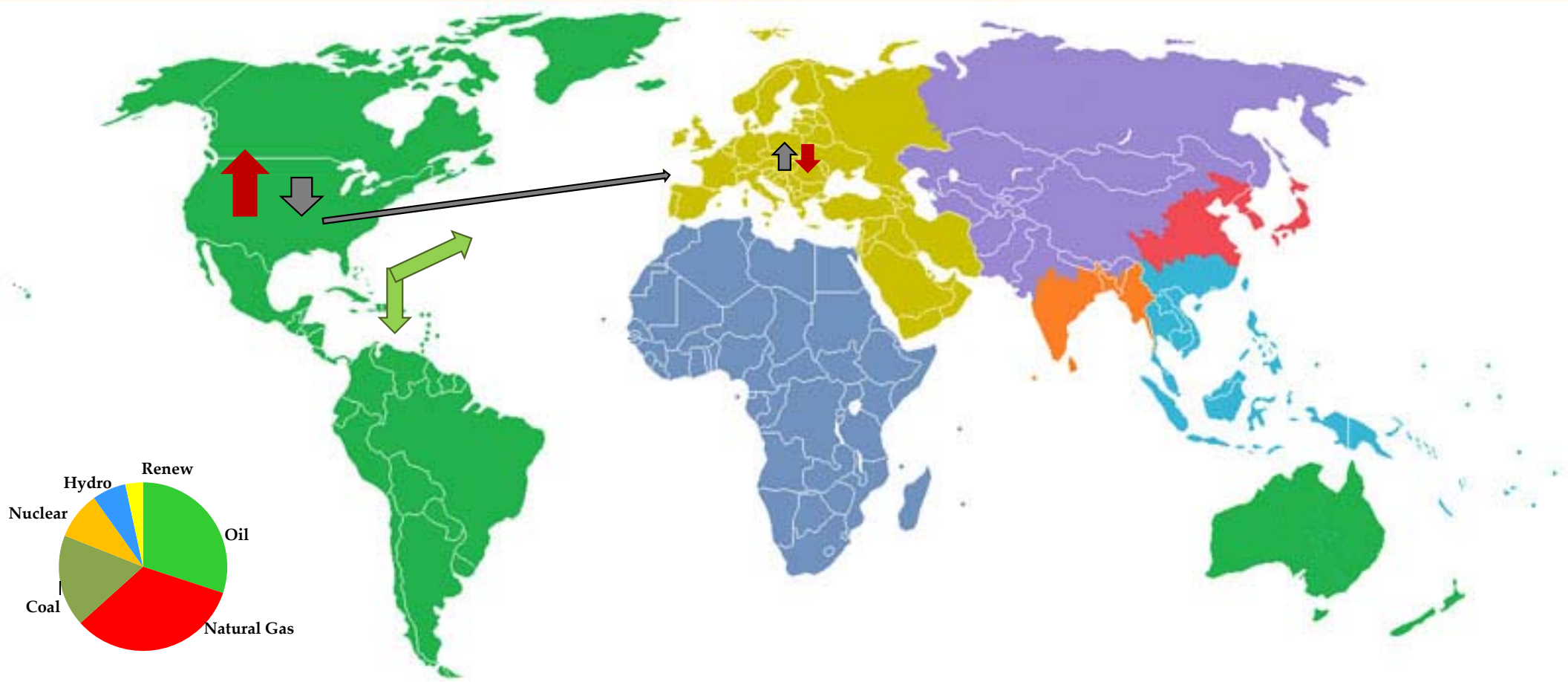
based on BP statistical Survey, 2015

Trade power


Energy imports, net (% of energy use)
100
80
60
40
20
0
1985
1990
1995
2000
2005
2010
2015
Japan
Germany
United States


Price of Natural Gas, $ per million Btu
18.00
16.00
14.00
12.00
10.00
8.00
6.00
4.00
2.00
0.00
1985
1990
1995
2000
2005
2010
2015
Japan
Germany
USA

Redistribution of export/import



Modified from: EIA **Million Tonnes Oil Equivalent (2012)**

Conclusion

- Technology allows to produce available resource and make it more affordable
- Production technology affects the distribution of geopolitically meaningful resources and export/import flows
- Change in production may shape environmental discussions
- With the increasing globalization of markets, a technology breakthrough in any sector would ultimately affect decision making throughout the world