

Farm Foundation

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Global Energy *Overview*

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Outline

- **Demand**
- **Supply**
- **Security**

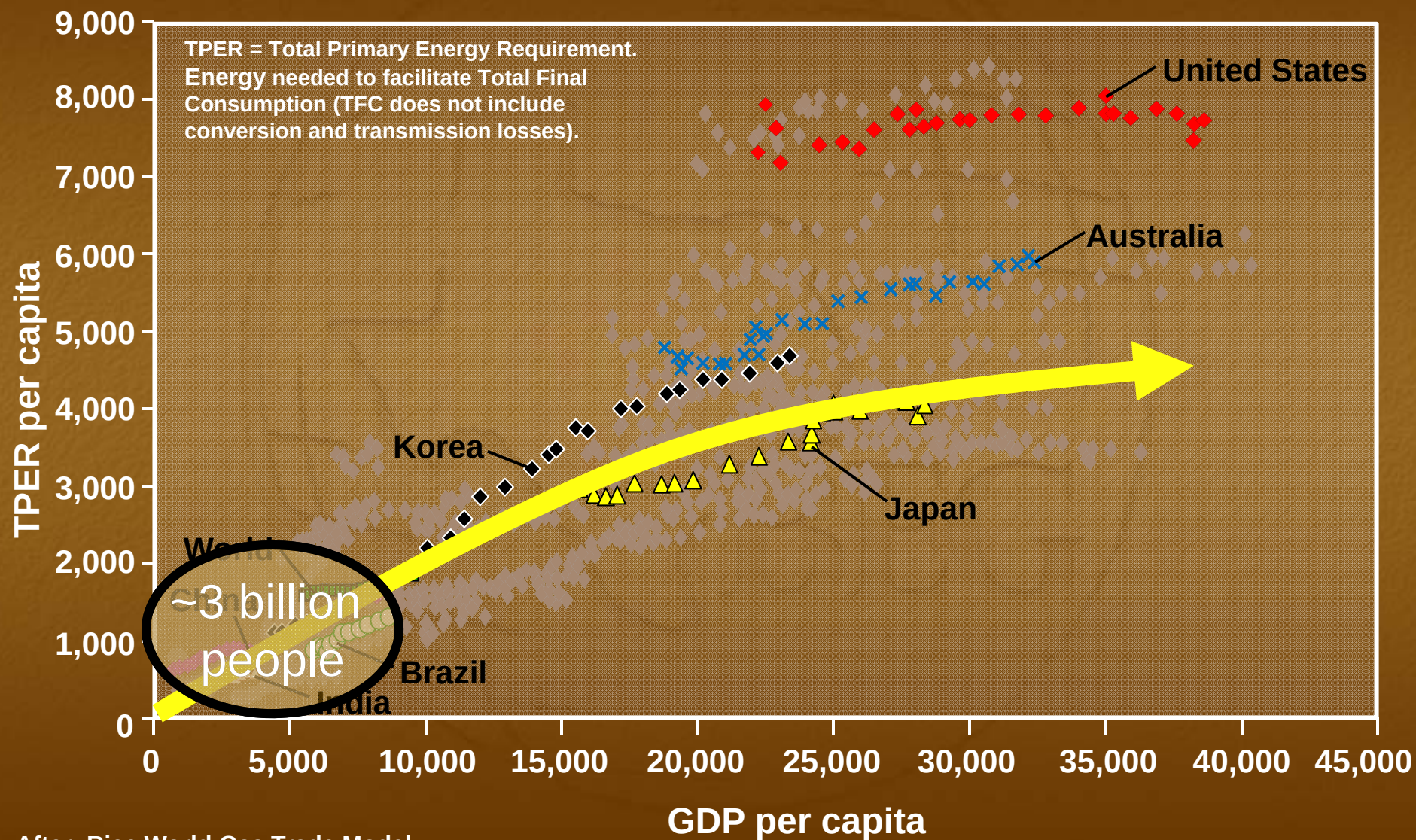
Population

~1 billion people per color

***More people live
inside the circle
than outside...***

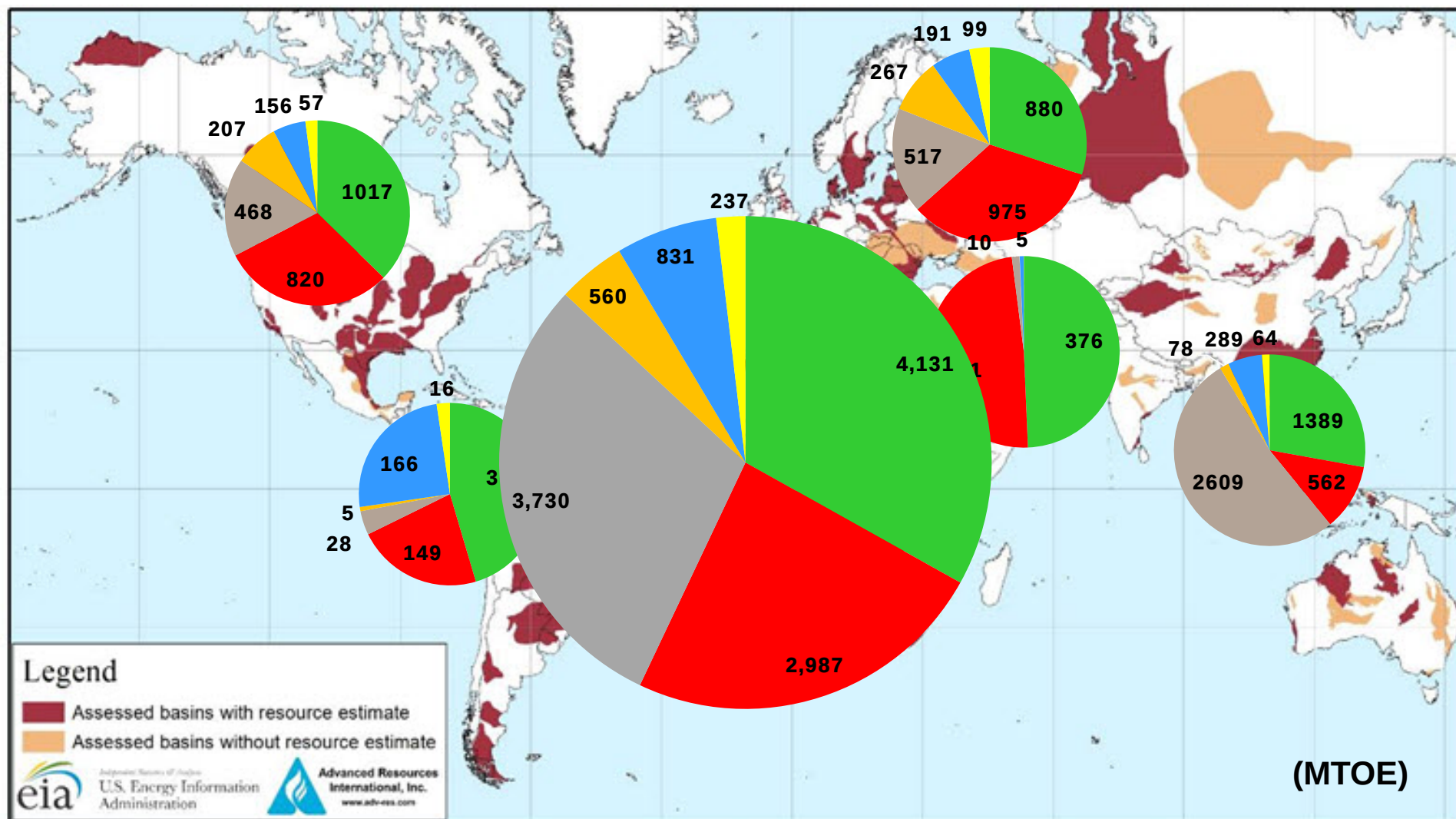


Energy and GDP



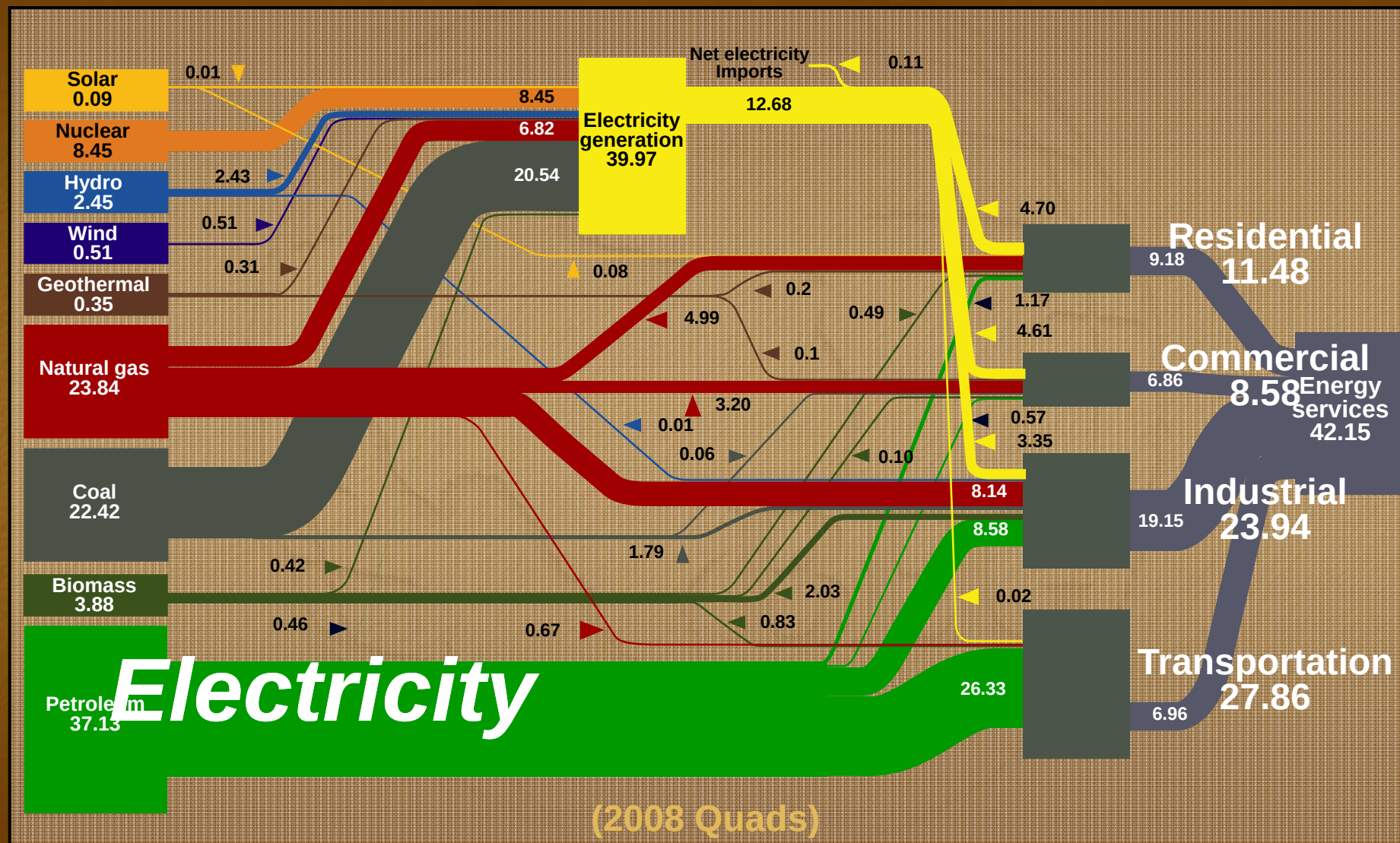
After: Rice World Gas Trade Model
Medlock, 2012

Global Energy Mix and Demand



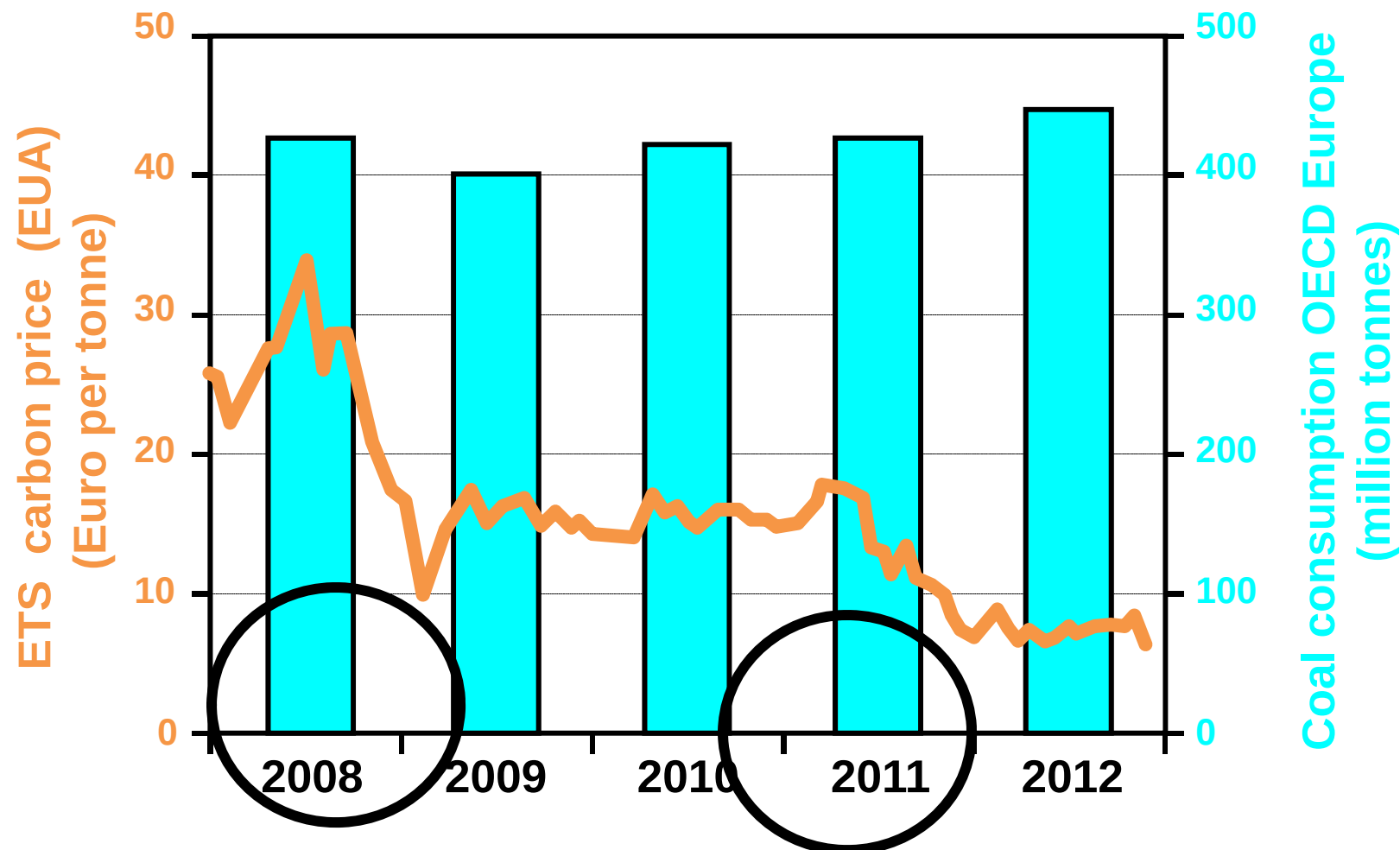
Source: United States basins from U.S. Energy Information Administration and United States Geological Survey; other basins from ARI based on data from various published studies

U. S. Energy Flows

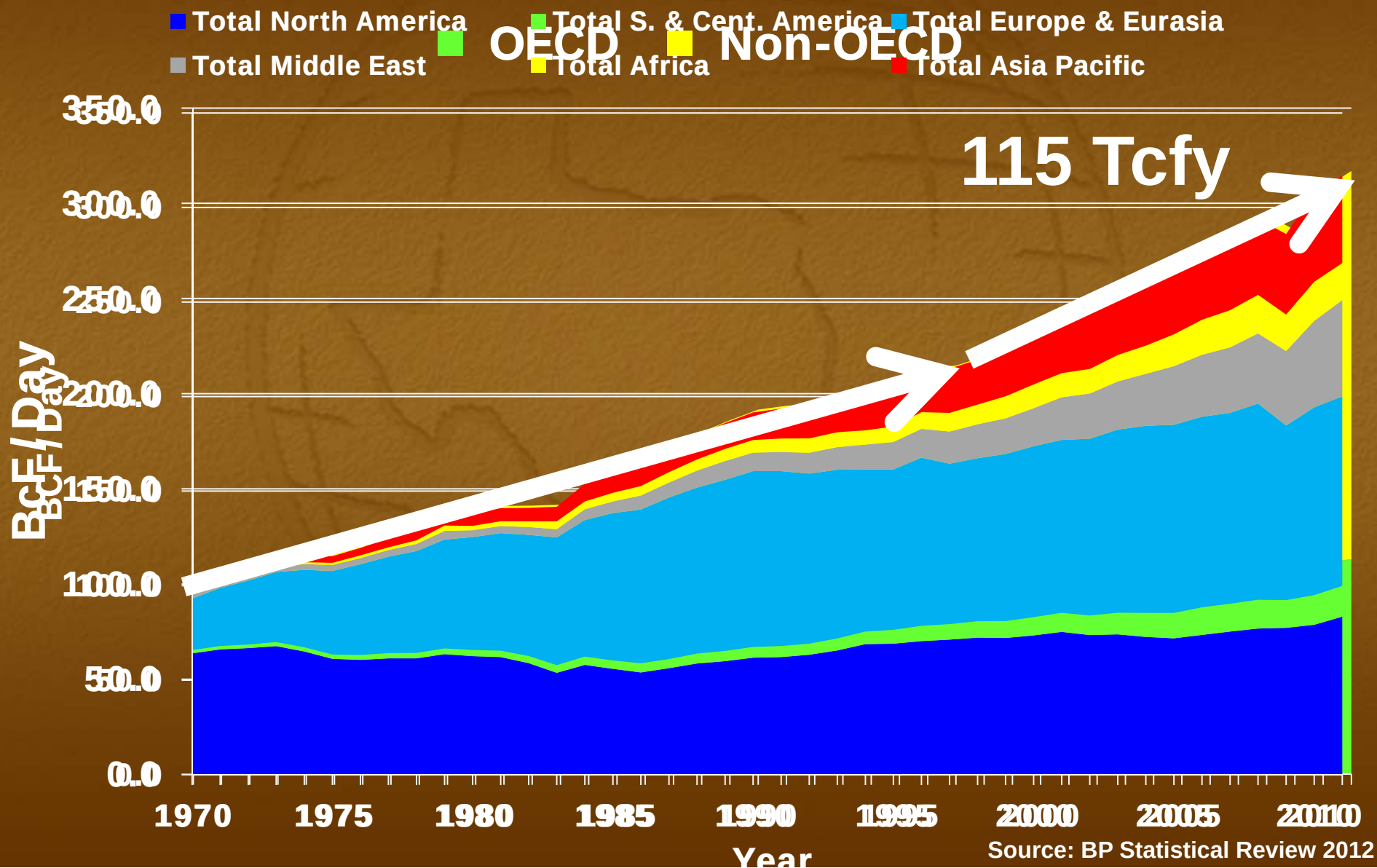


Source: Lawrence Livermore National Laboratory and U.S. DOE based on Annual Energy Review, 2008 (EIA, 2009)
 From National Academies Press, *America's Energy Future*, 2009

The Electricity Mix

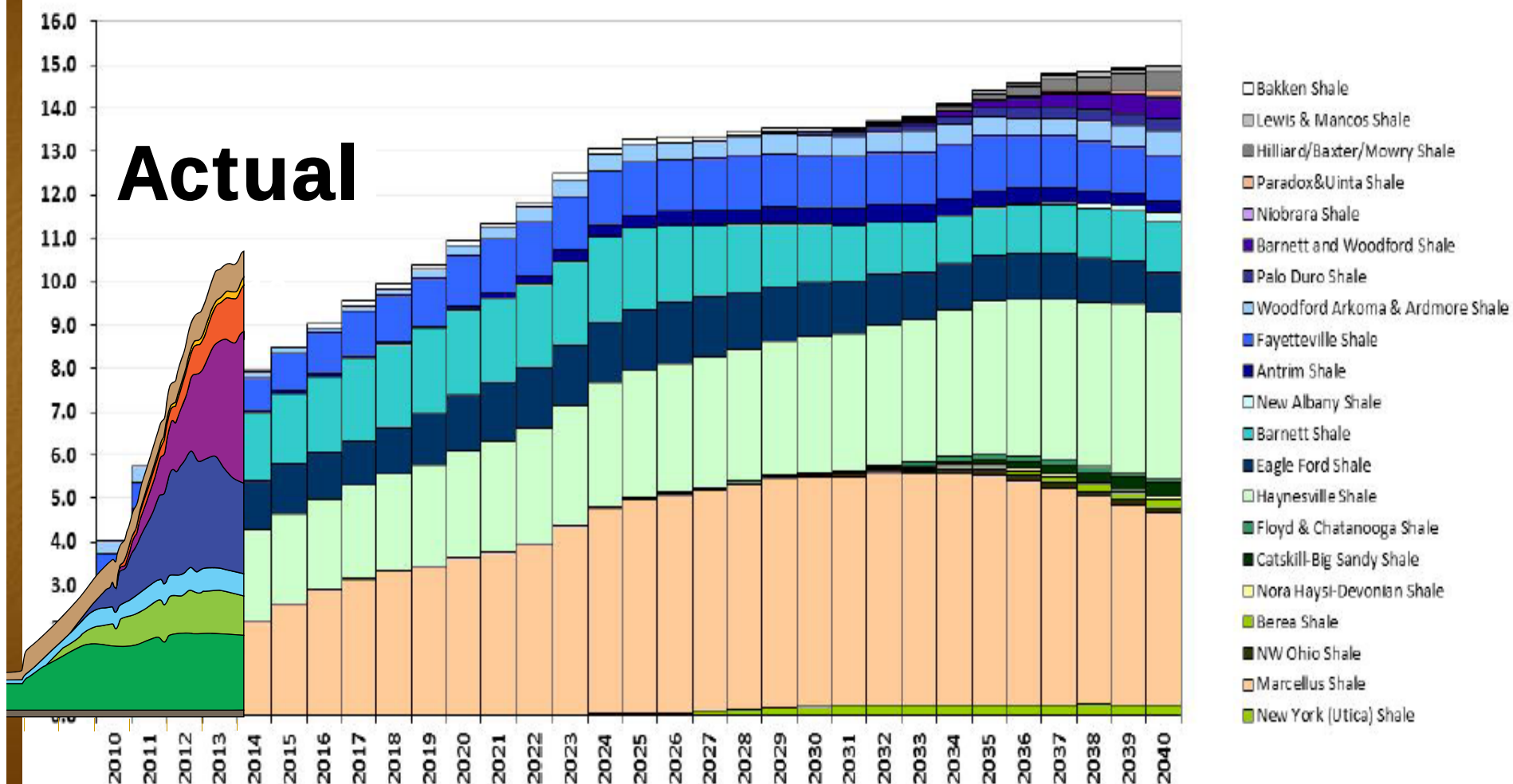


Global Natural Gas Production



2013 Dry Shale Gas Production

Model: Rice University, Medlock, 2012





Options to Natural Gas for Power

I. Coal

- o Available, affordable to generate, reliable
- o **Dirty, expensive to build**



II. Nuclear

- o Efficient, no emissions, affordable generation
- o **Expensive to build, waste, safety**



III. Wind



No energy source is perfect

IV. Solar

- o Simple, no emissions, local
- o **Expensive, intermittent, land**



V. Hydro

- o Efficient, affordable to generate, no emissions
- o **Water, land, drought**

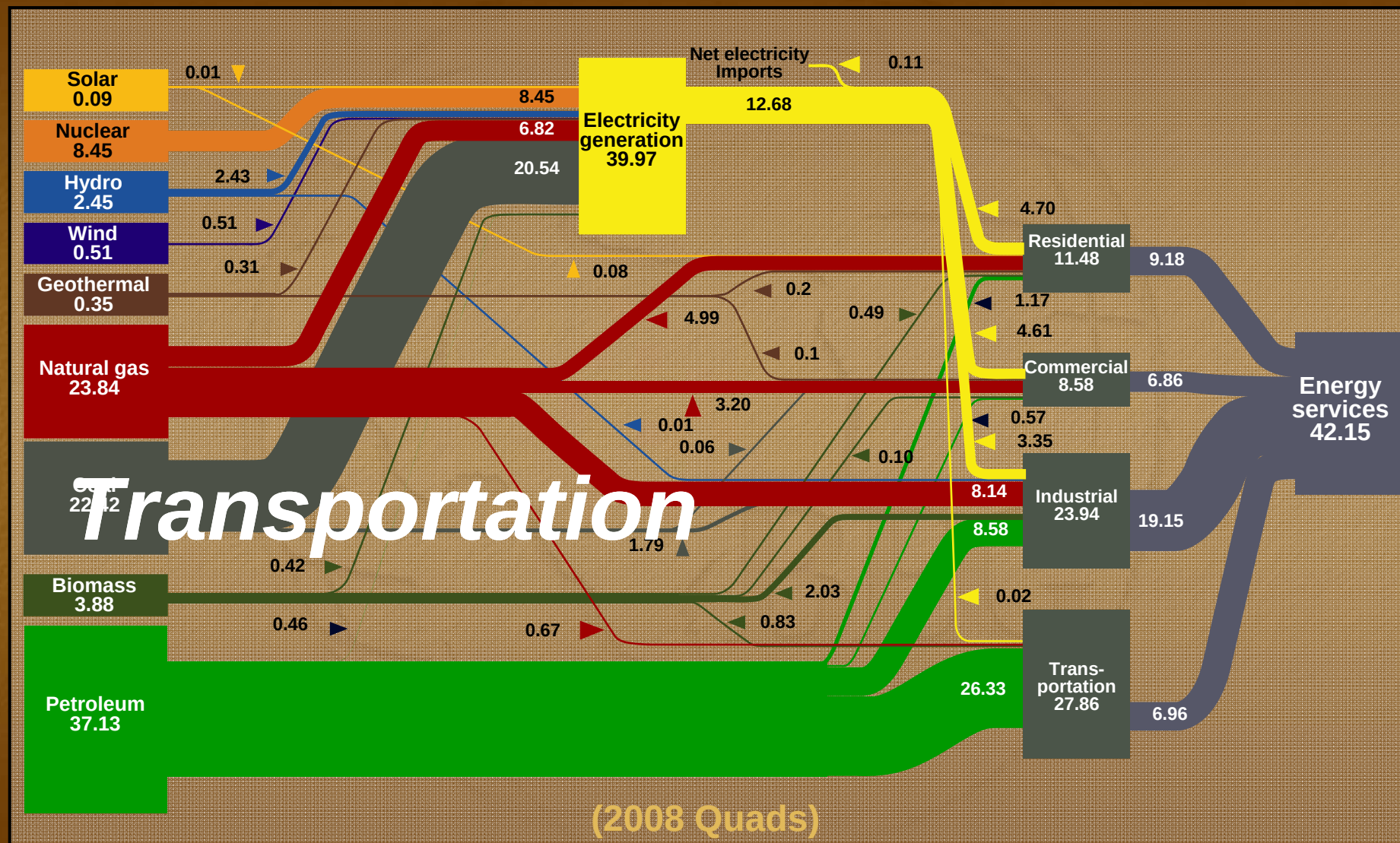


VI. Geothermal

- o Affordable where concentrated, no emissions
- o **Geology**



U. S. Energy Flows

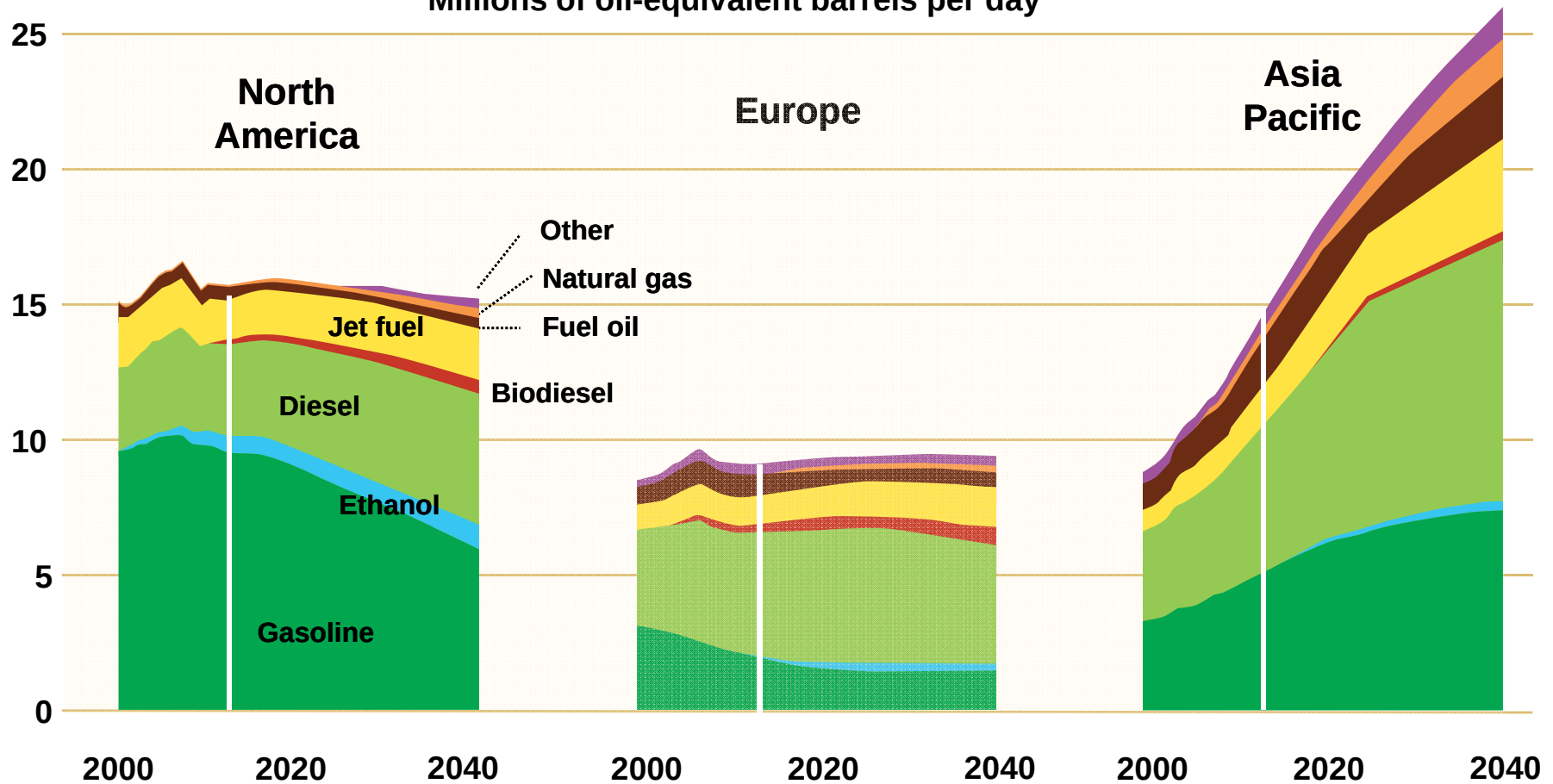


Source: Lawrence Livermore National Laboratory and U.S. DOE based on Annual Energy Review, 2008 (EIA, 2009)
 From National Academies Press, *America's Energy Future*, 2009

The Future Transportation Mix

U.S. and China Vehicle Sales

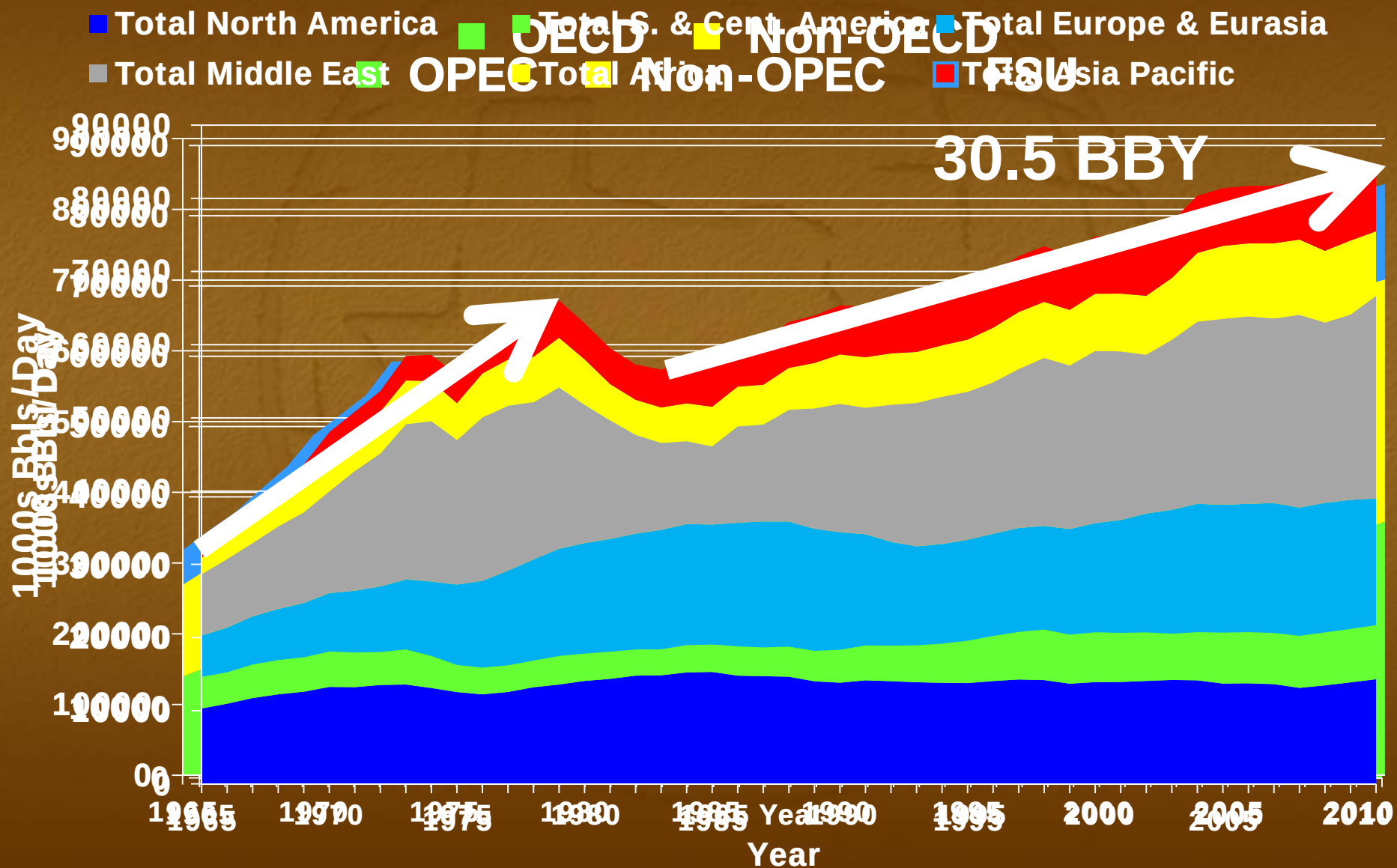
Millions of oil-equivalent barrels per day



ExxonMobil Corporation, 2013 The Outlook for Energy: A View to 2040, page 20.

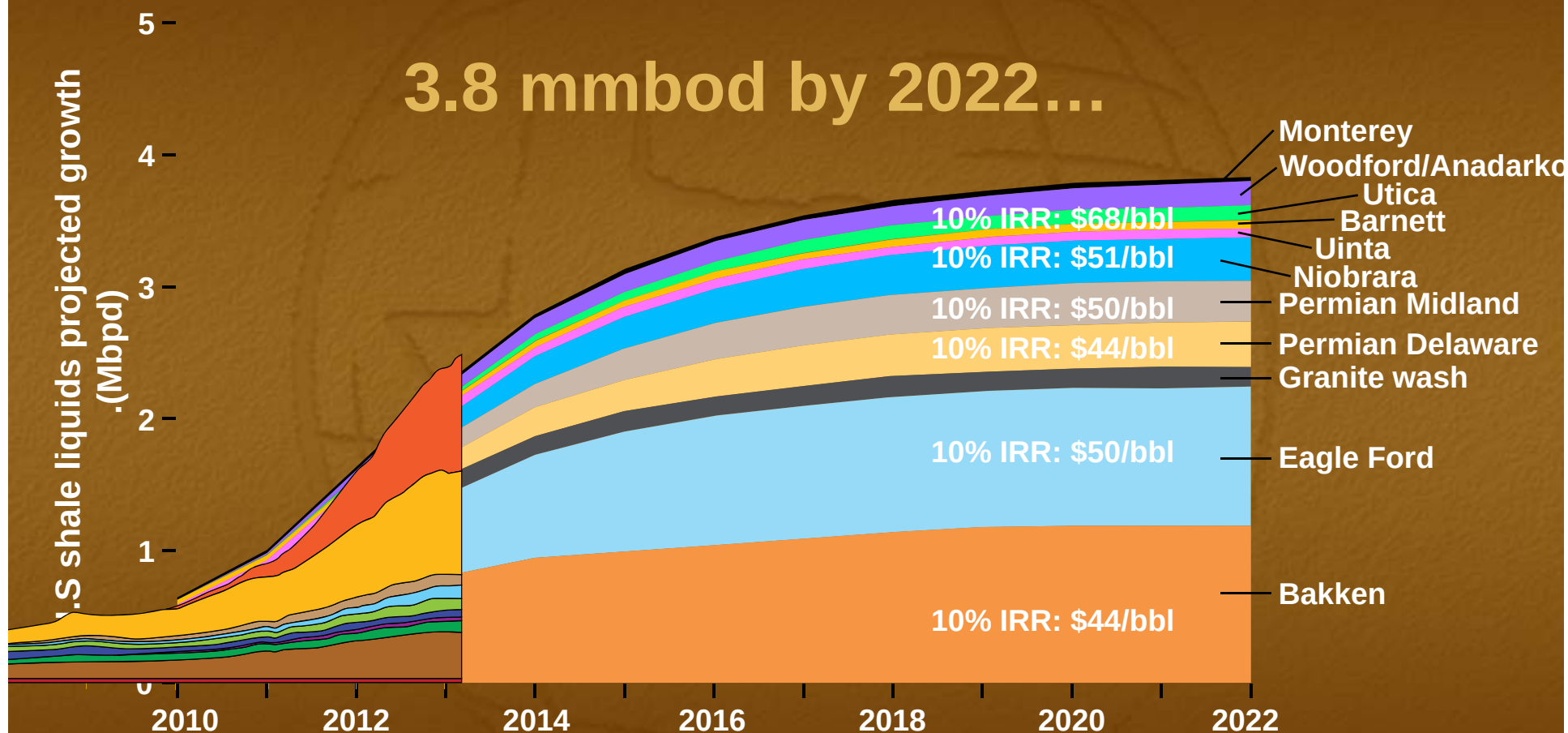
U.S. Bureau of Transportation Statistics, RJ Estimates, China Association of Automobile Manufacturers
From Raymond James and Associates, Inc., August 2, 2010

Global Oil Production

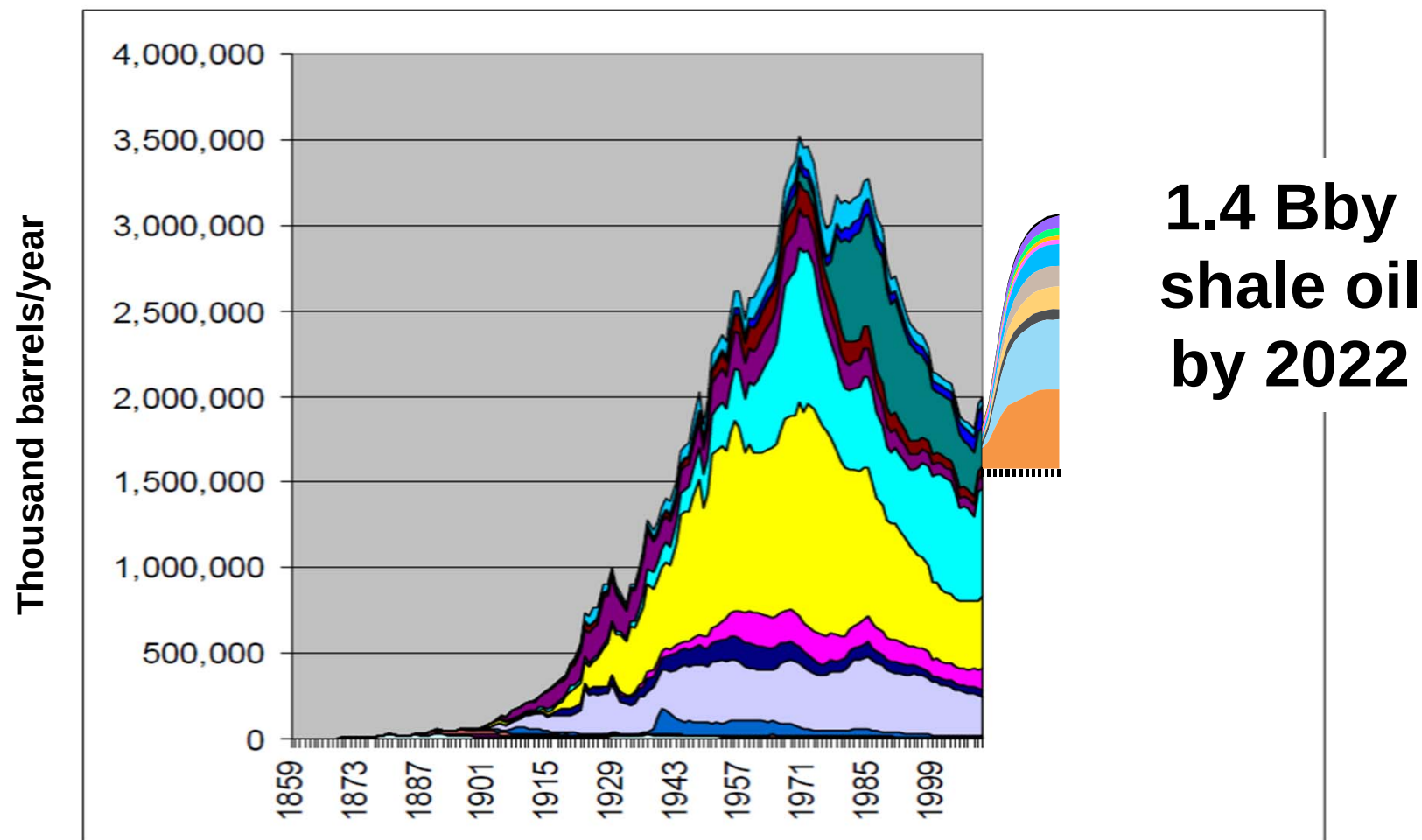


2010 U.S. SHALE LIQUIDS PROJECTION

3.8 mmbod by 2022...



Annual US Oil Production



From: James D. Hamilton, Working Paper 17759, NATIONAL BUREAU OF ECONOMIC RESEARCH, 2012

Options to Oil for Transport

I. Biofuels

- o Valuable supplement, lower carbon
- o **Scale, land use, cost**

II. CNG, LPG, LNG, GTL

No energy source is perfect

- o Clean depending on source, efficient engine
- o **Expensive, chemicals, range**

IV. Hydrogen

- o Ten years away



Energy Security

Affordable

Cost

Price Volatility: stable or fluctuating

Infrastructure: Cost to build the plant

Available

Reliable

variable

*Security drives the
pace of change*

Sustainable

Clean: air and atmospheric emissions

Dense: land footprint

Dry: fresh water use/risk



Thanks!

