
Riding the Wave
CAPITALIZING ON THE VELOCITY OF CHANGE
44TH ANNUAL ECC CONFERENCE
engineering and construction contracting association

Clean Energy - It Ain't Easy Being Green

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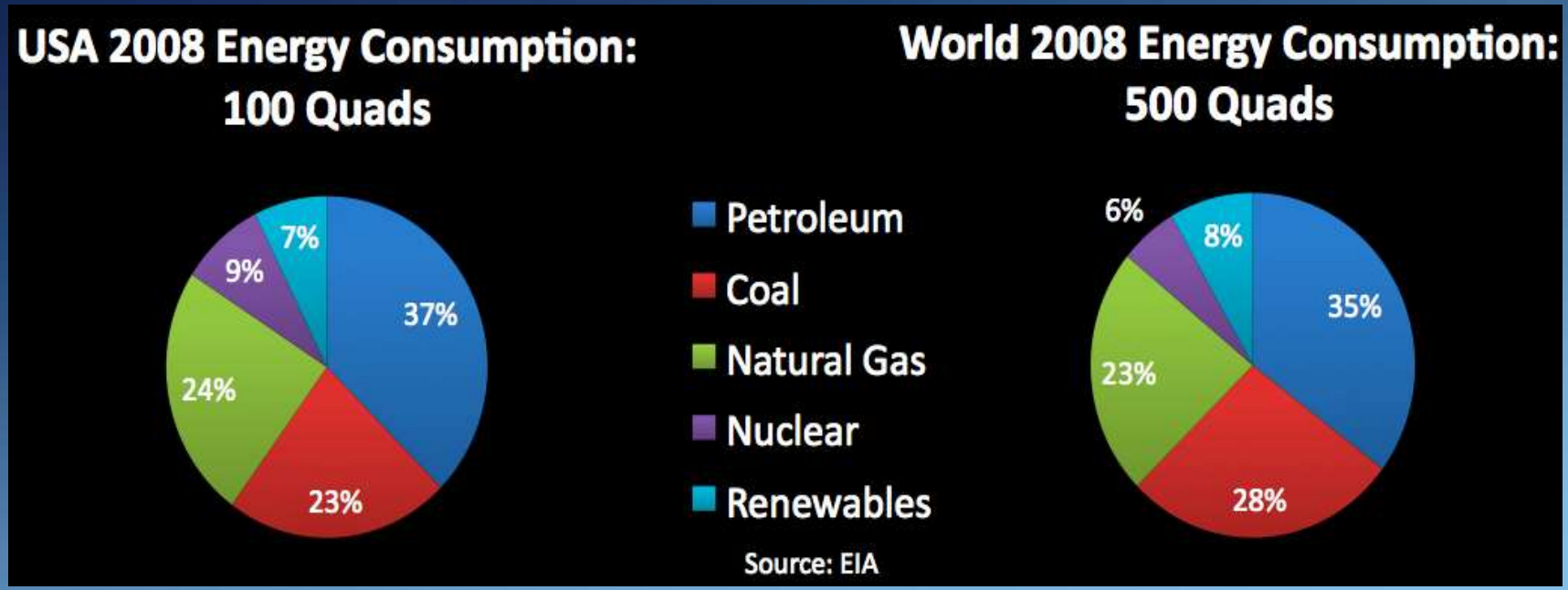
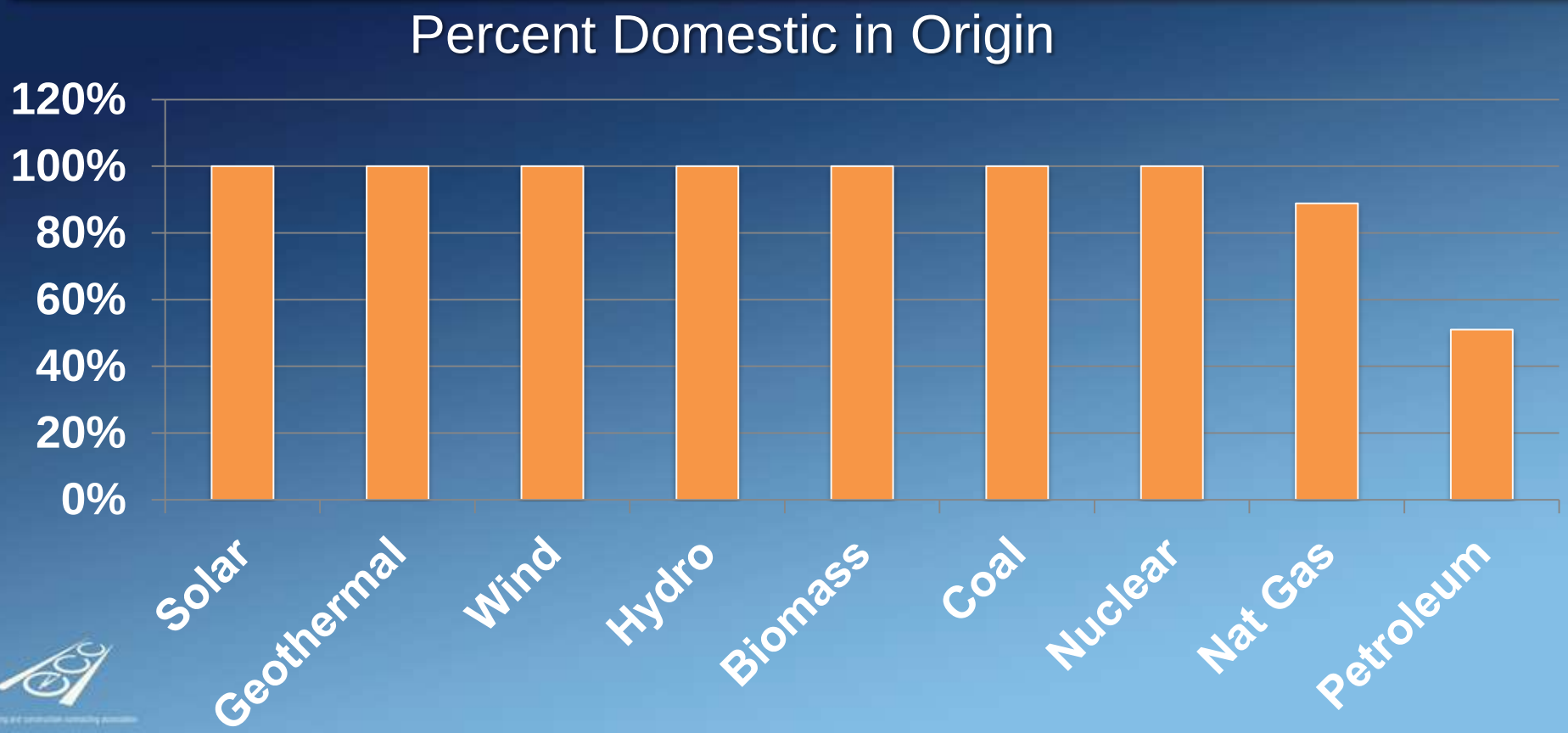
Global Energy

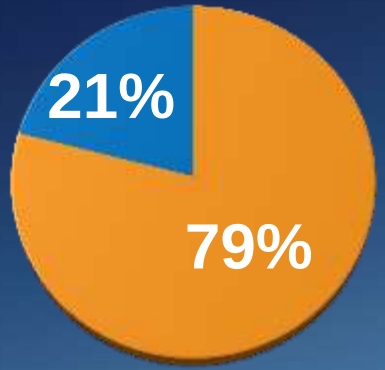
Fossil Fuels Supply ~85% of All Energy Consumption in the U.S. and World

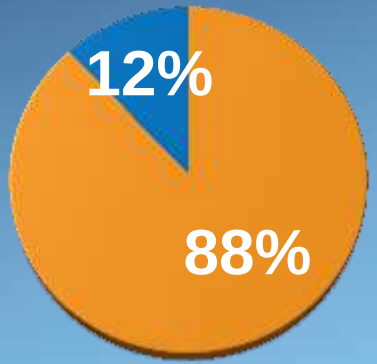


U.S. Energy Dependence?

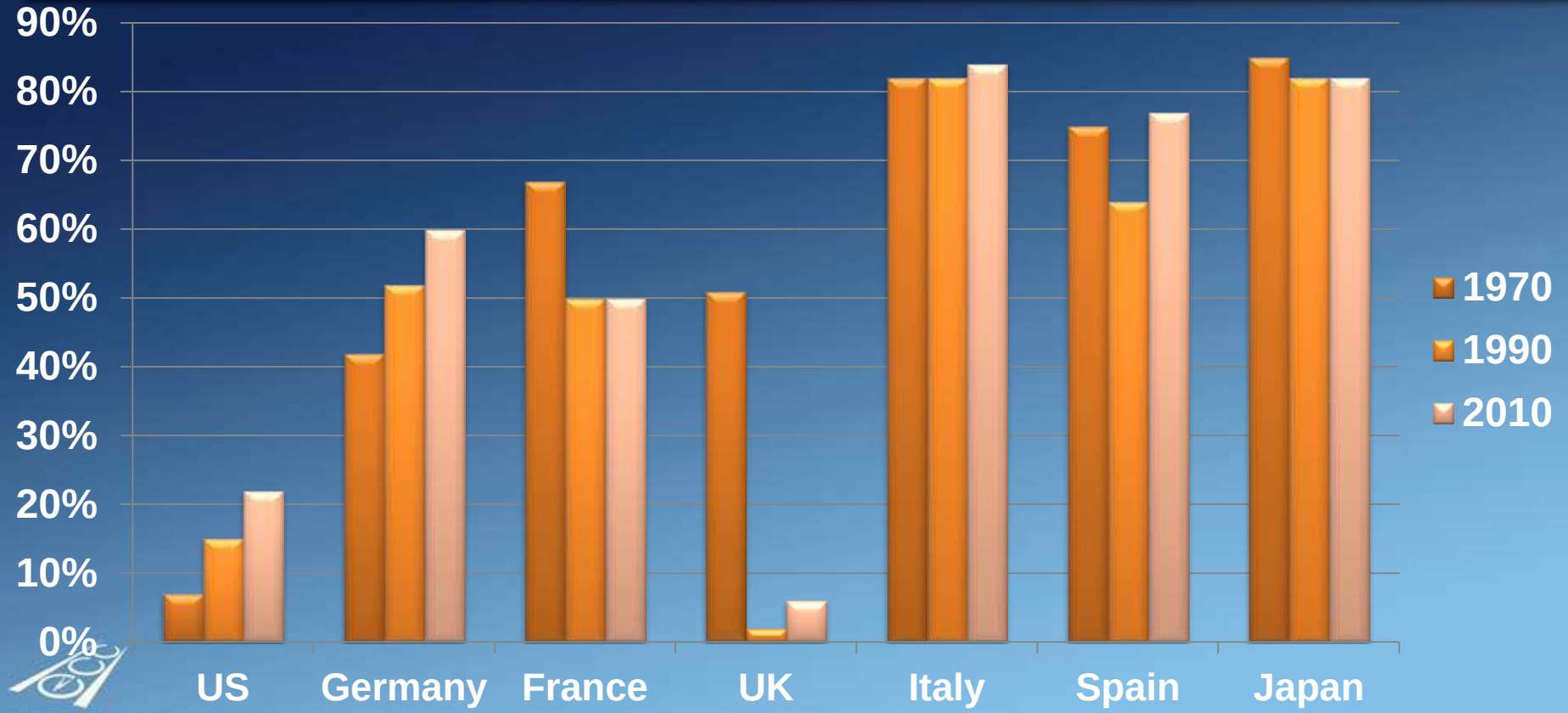


Imported versus Domestic Energy

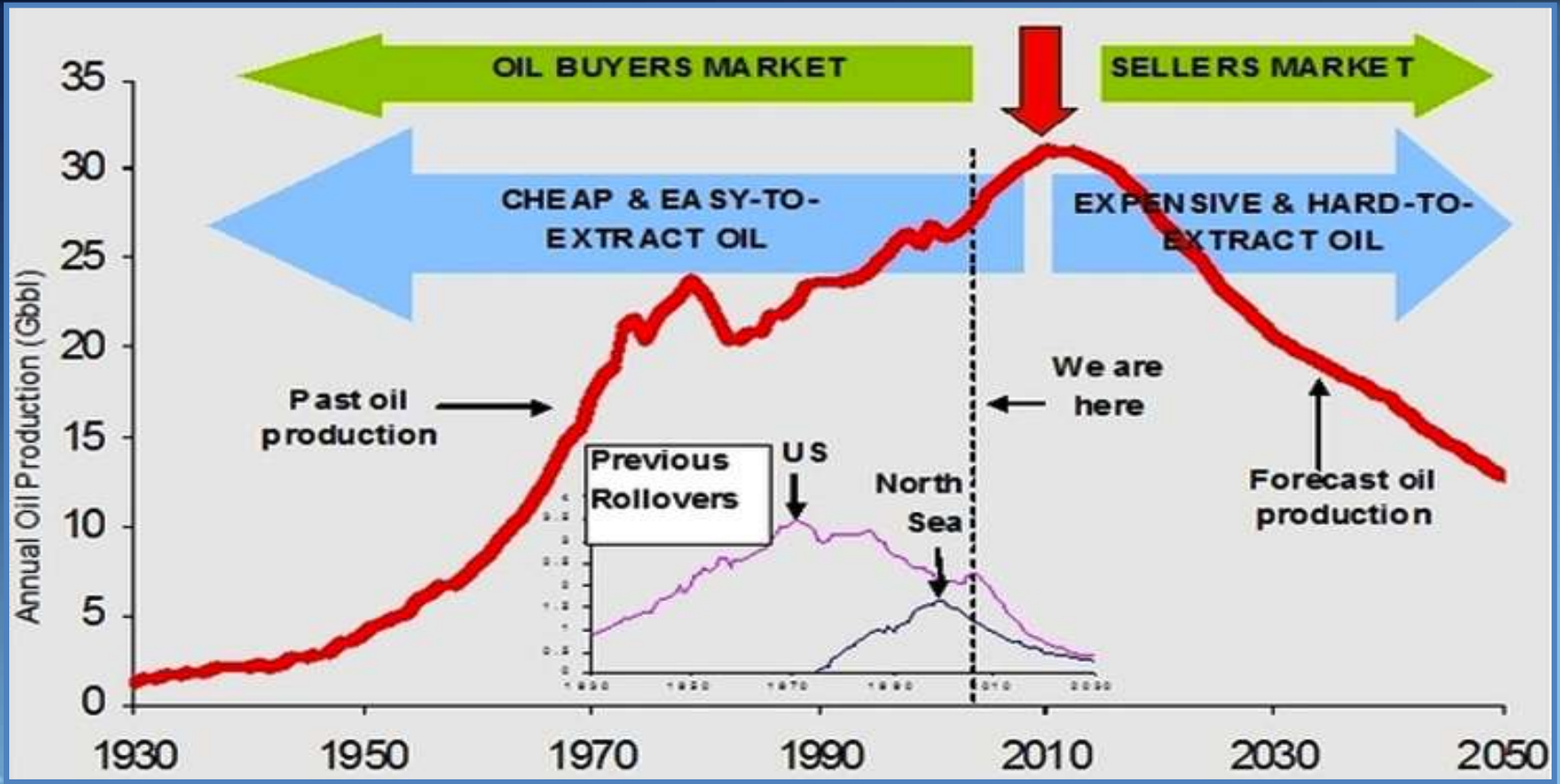




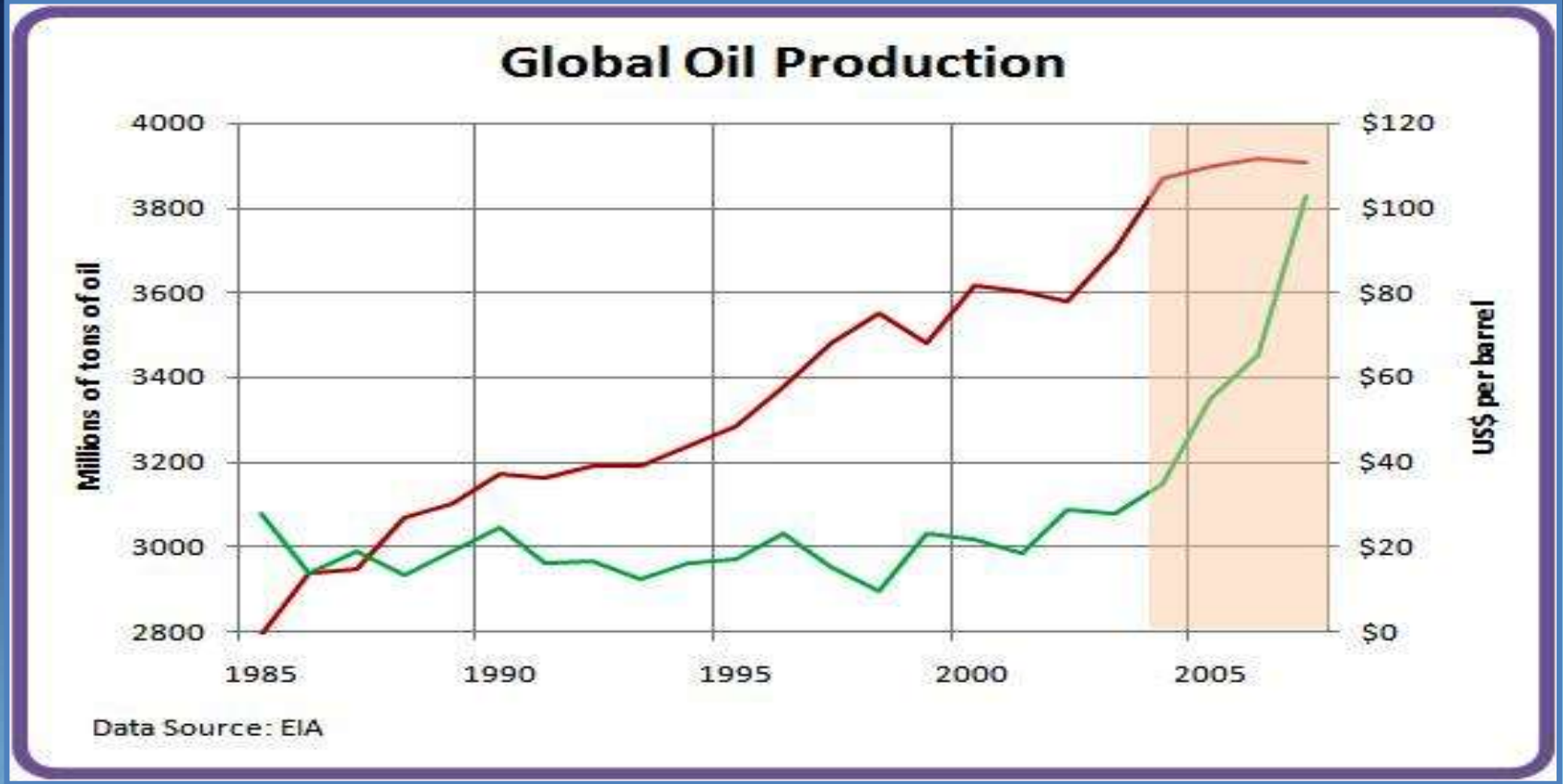
G6 Energy Dependence 1970-2010



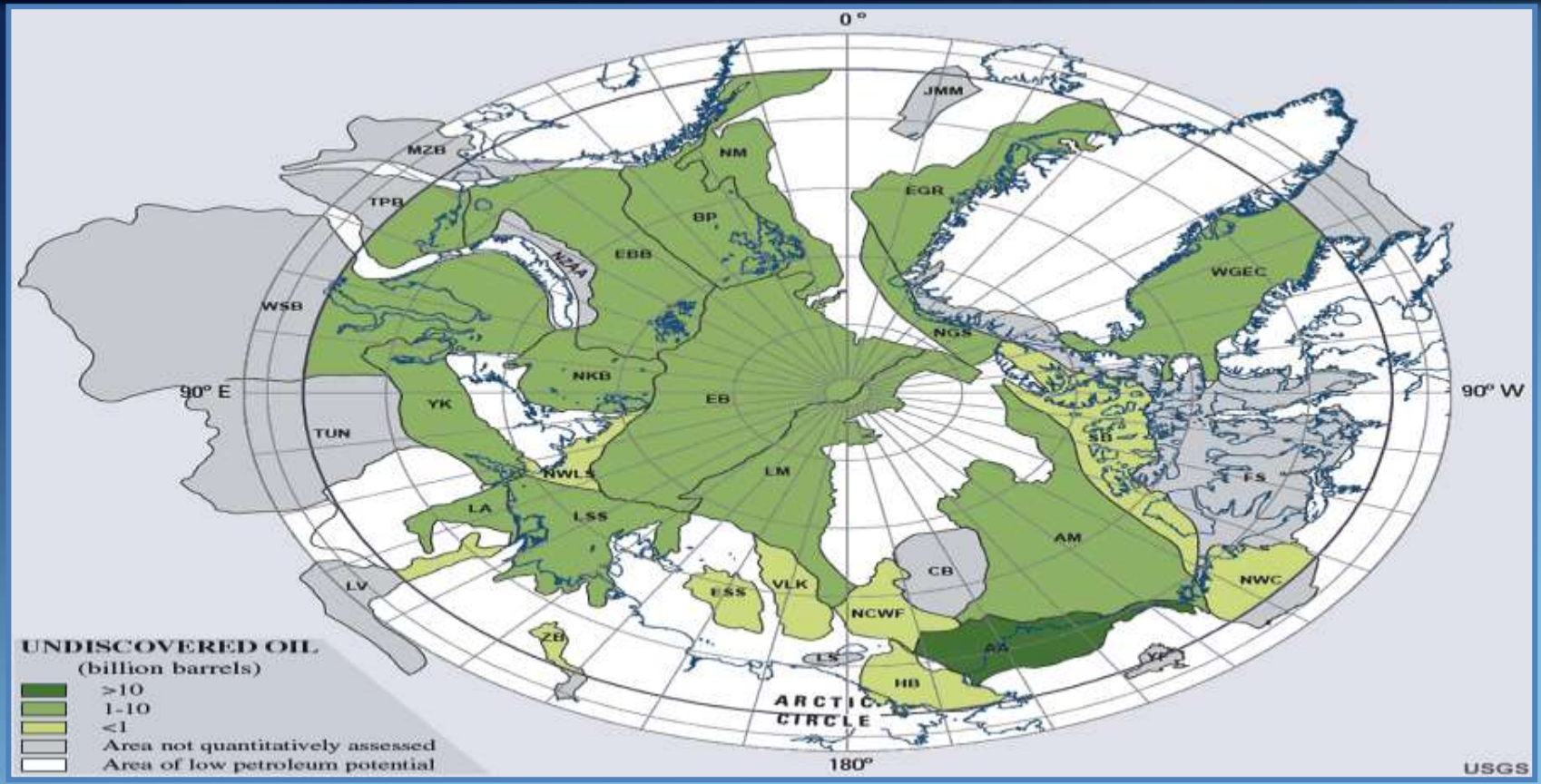
Global Peak Oil? (2006 Prediction)



2009 Production vs. Price



May Be a “Wee Bit O Gas & Oil” up North



At $100/Barrel A Great Deal is Possible

Bambulyak, A. and Frantzen, B. (2011) *Oil transport from the Russian part of the Barents Region. Status per January 2011.* The Norwegian Barents Secretariat and Akvaplan-niva, Norway. – 101 pages.

Figure 4.23 In 2010, the first time in history, a 100 000 tons deadweight tanker passed the Northern Sea Route. *SCF Baltica* carried 70 000 tons of gas condensate from Murmansk to China. Nuclear icebreakers *Rossiya*, *Taymir* and *50 Let Pobedy* piloted the tanker through ice on her way from Novaya Zemlya to Cape Dezhnev.

Russian Icebreakers

- 19 Heavy Icebreakers (2 Meter Ice)
- 9 are Nuclear Powered
- 2 More (Nuclear) in design for 2015 Commissioning

Operating and Planned Terminals

Bambulyak, A. and Frantzen, B. (2011) *Oil transport from the Russian part of the Barents Region. Status per January 2011.* The Norwegian Barents Secretariat and Akvaplan-niva, Norway. – 101 pages.

- 9 Terminals Operational in 2009-2010
- 11 More Under Construction

Varandey Offshore Oil Terminal

20 Kilometers offshore in Pechora Sea
Operates year-round at 85 million barrels / year

Canada the New Saudi Arabia?

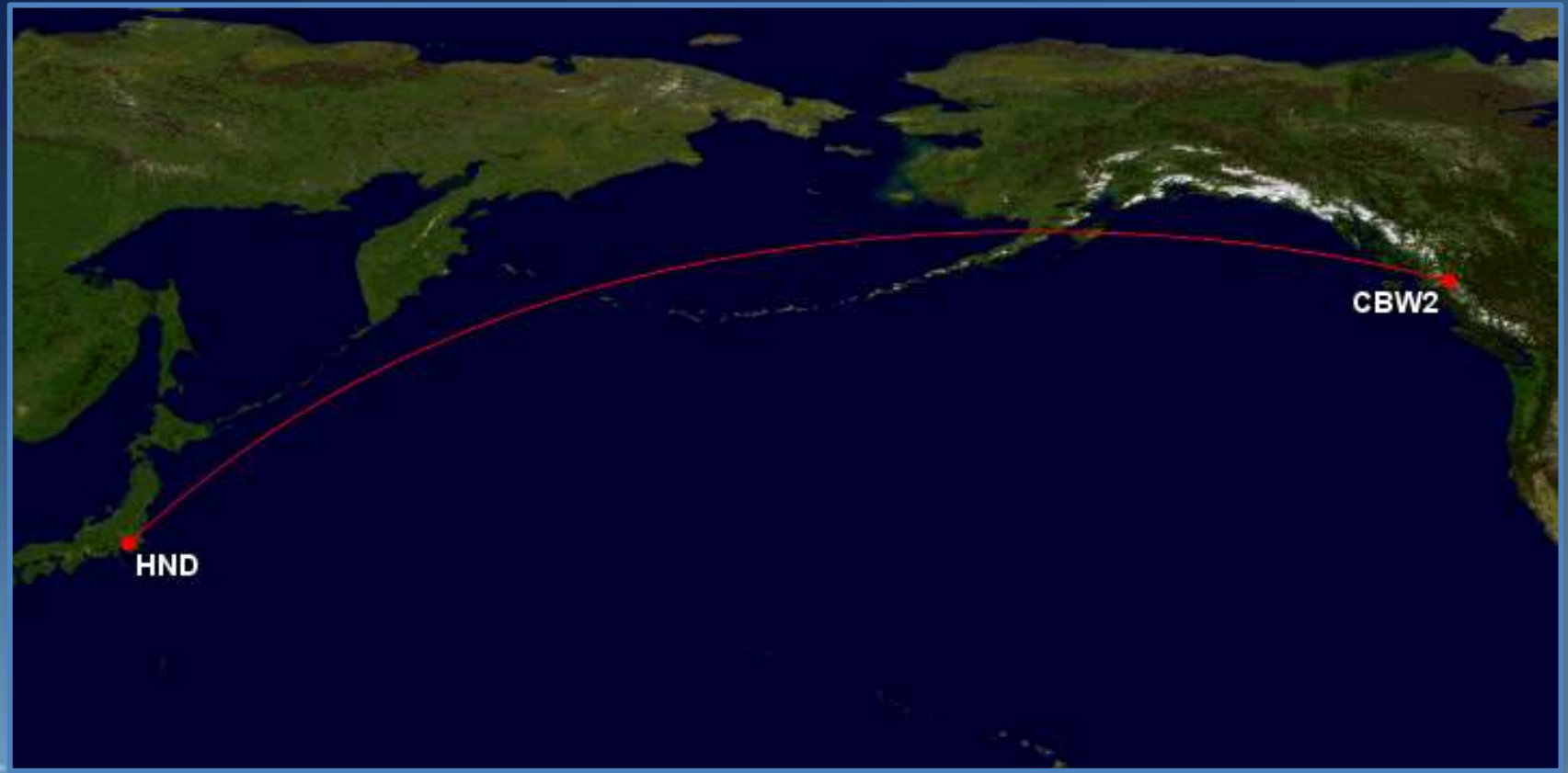
- EIA raised Canada's proven oil reserves to 180 billion bbls from 4.9 billion bbls, thanks to inclusion of the oil sands - also known as tar sands - now considered recoverable with existing technology and market conditions.
- The U.S. agency estimates Saudi Arabia's recoverable oil reserves at 264 billion bbls. The EIA projects Canadian oil sands could produce 2.2 million barrels a day by 2025 compared with the current level of about 700,000 b/d, which already represents more than a fourth of total Canadian output of 3.1 million b/d.

We are not Canada's Only Customer

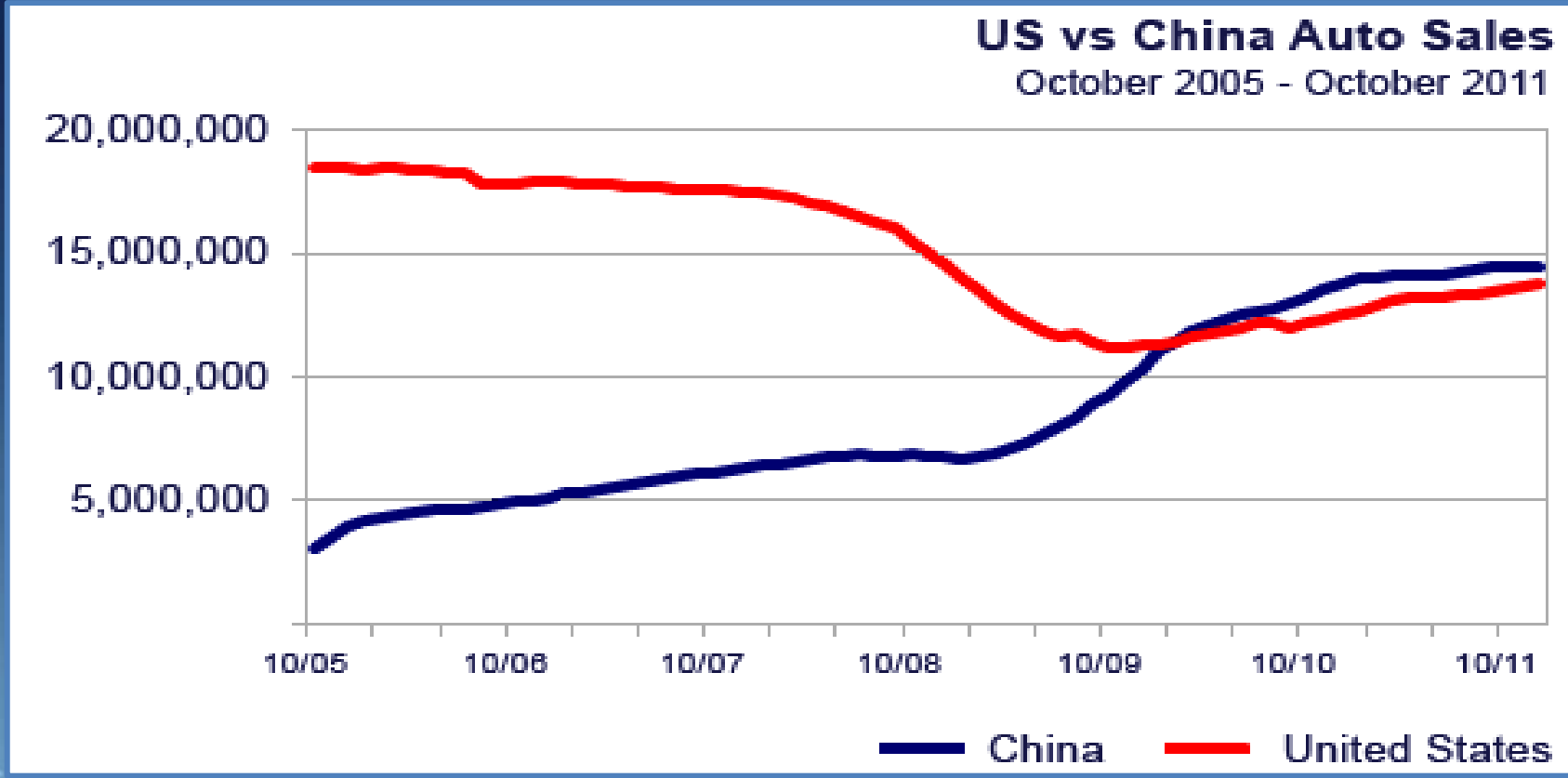
"Canada LNG & Oil terminal to change Asian energy landscape"

31 Dec 2010
Commodity Online

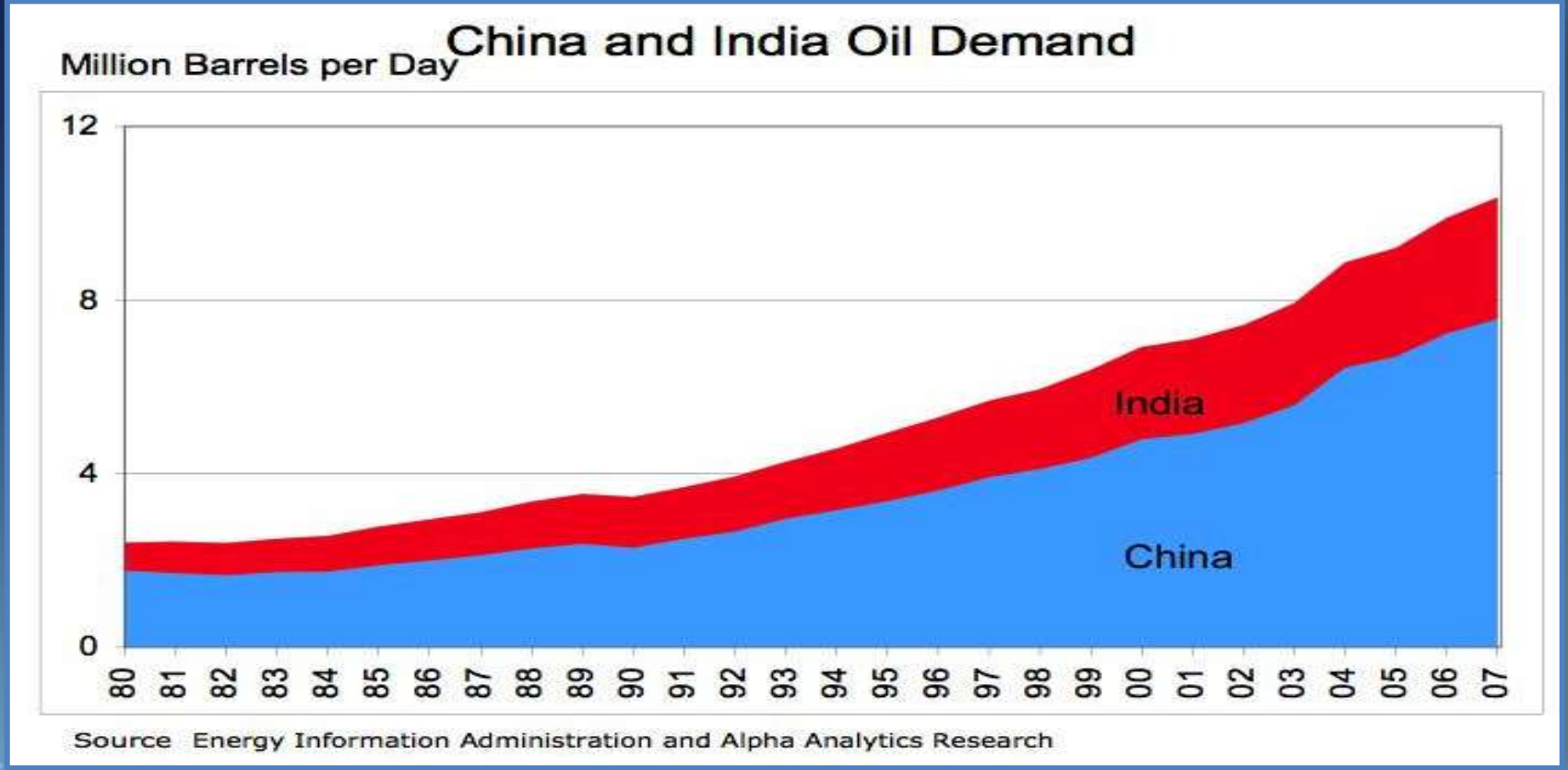
Kitimat to Tokyo 4346 nm



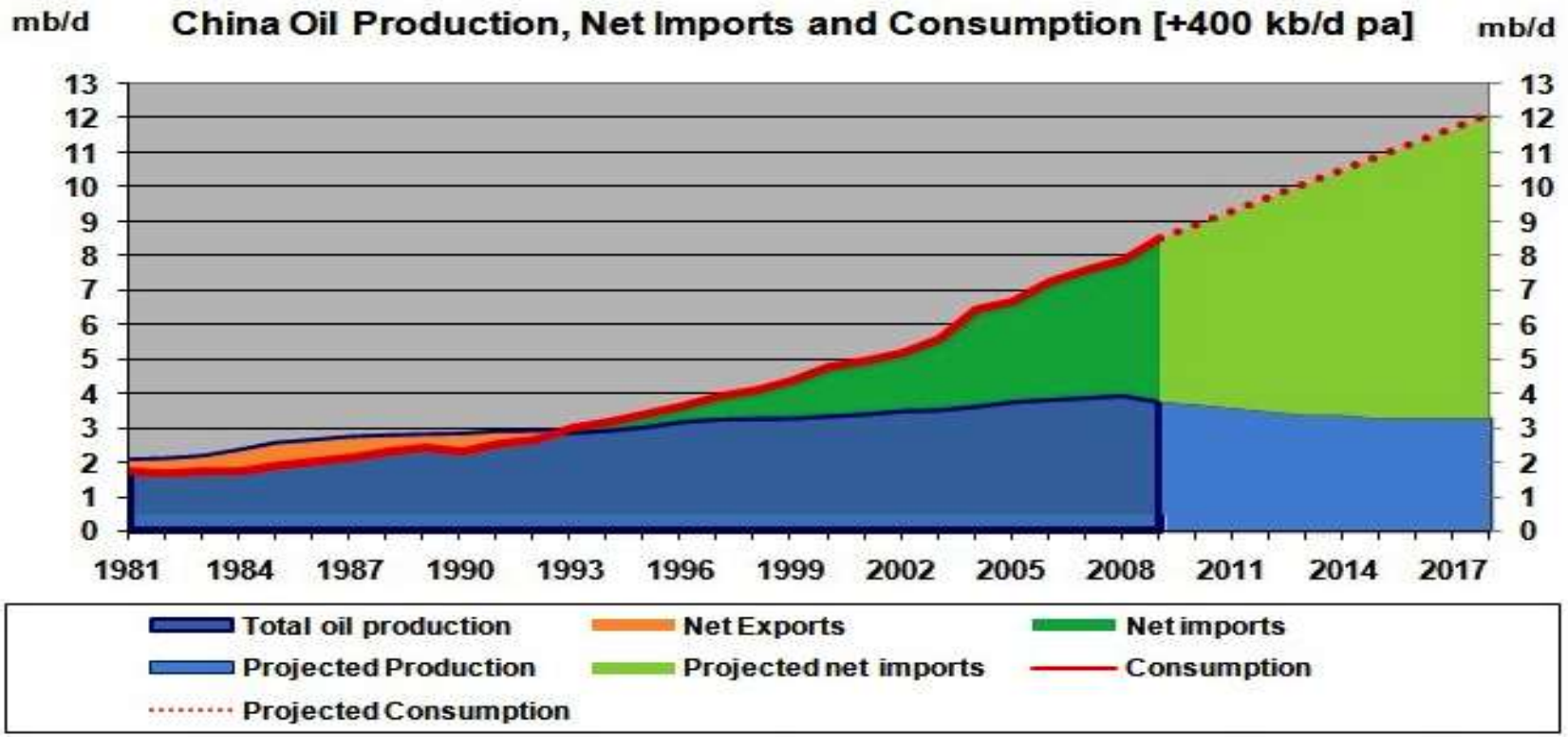
China Surpasses U.S. in Auto Sales



Industrialization Requires Energy



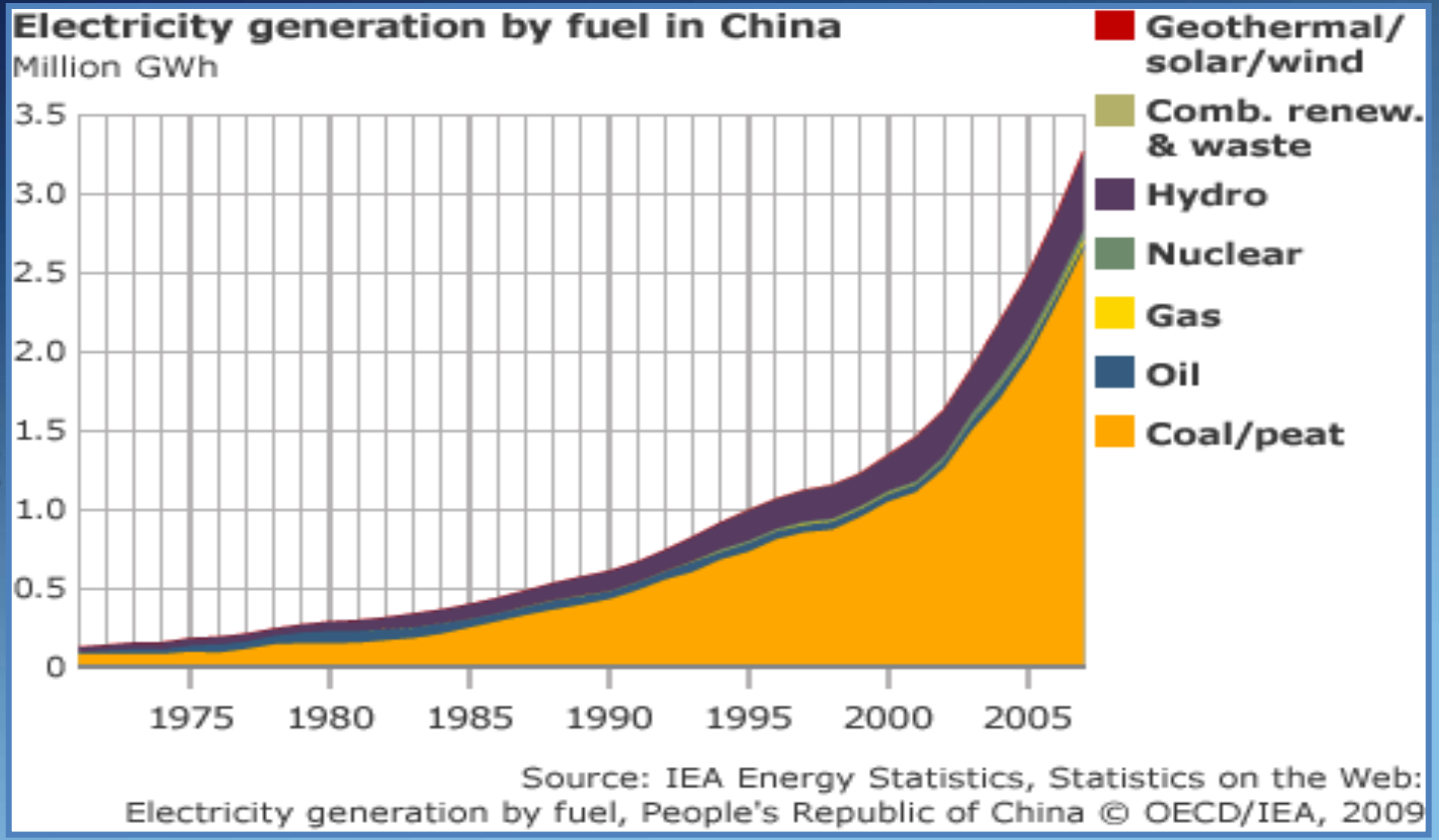
China Oil Production vs Consumption



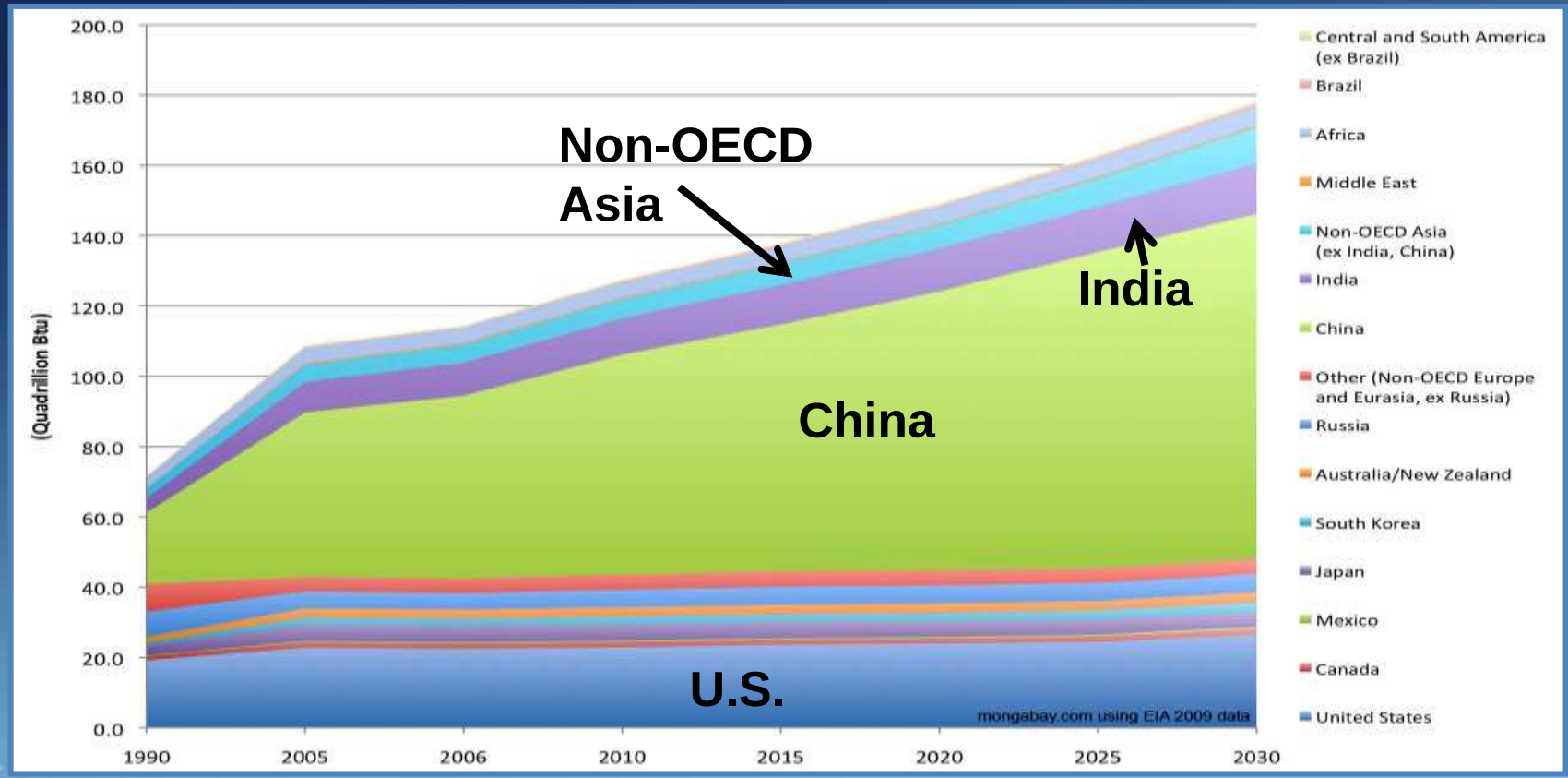
China's Territorial Claims

China Electricity Production

In 2010 & 2011 China Commissioned New Coal Power Plants at the rate of 1/wk



World Coal Consumption



But It's Not Just Australia

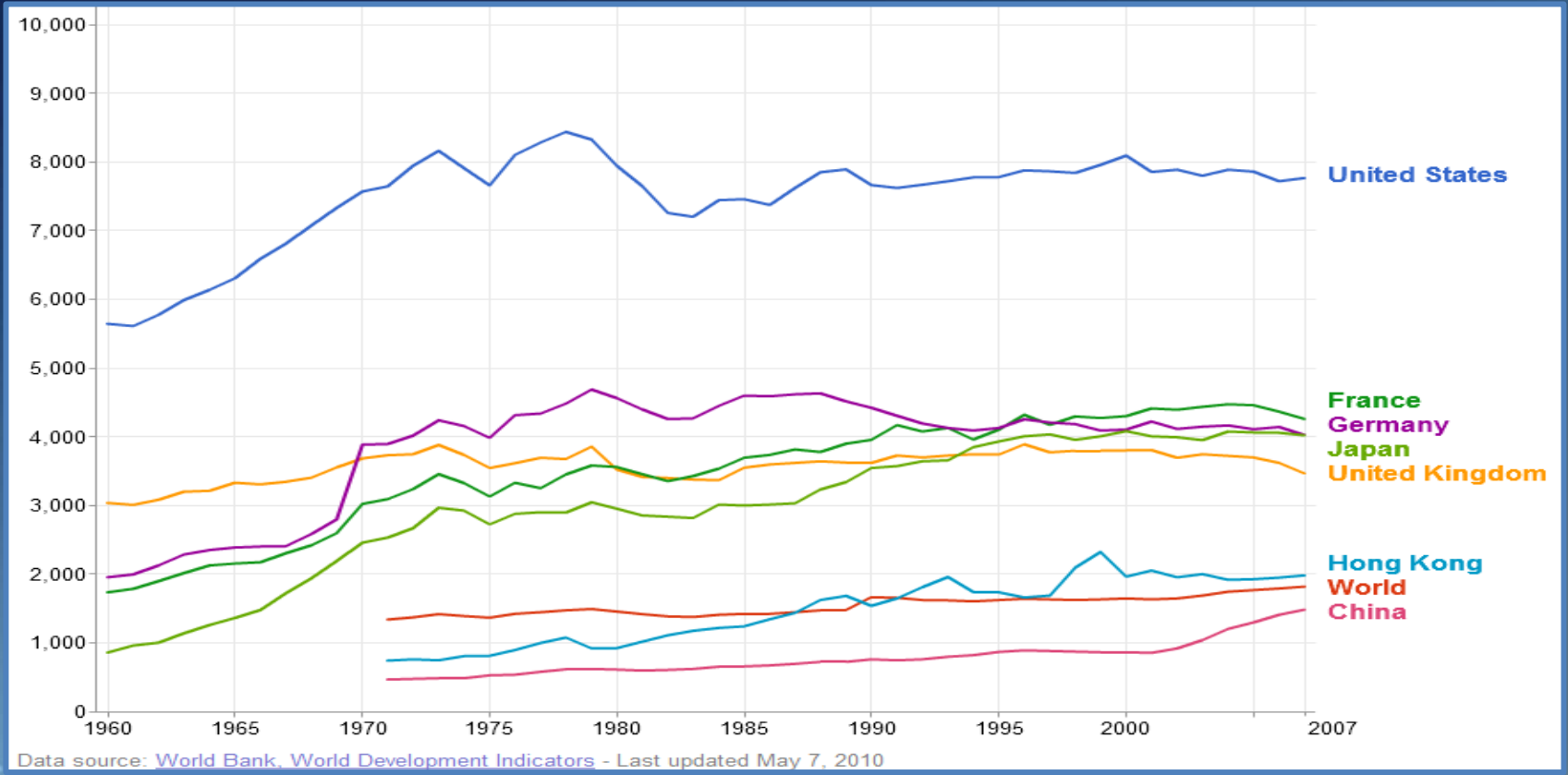
Is Sending Wyoming Coal to China Smart Economics?

Coal originating from the Powder River Basin in Wyoming and Montana would travel to Washington via rail to a former aluminum plant site in Longview. From there, Millennium Bulk Logistics, a subsidiary of Ambre Energy, proposes to ship it to clients in Asia, chiefly China.

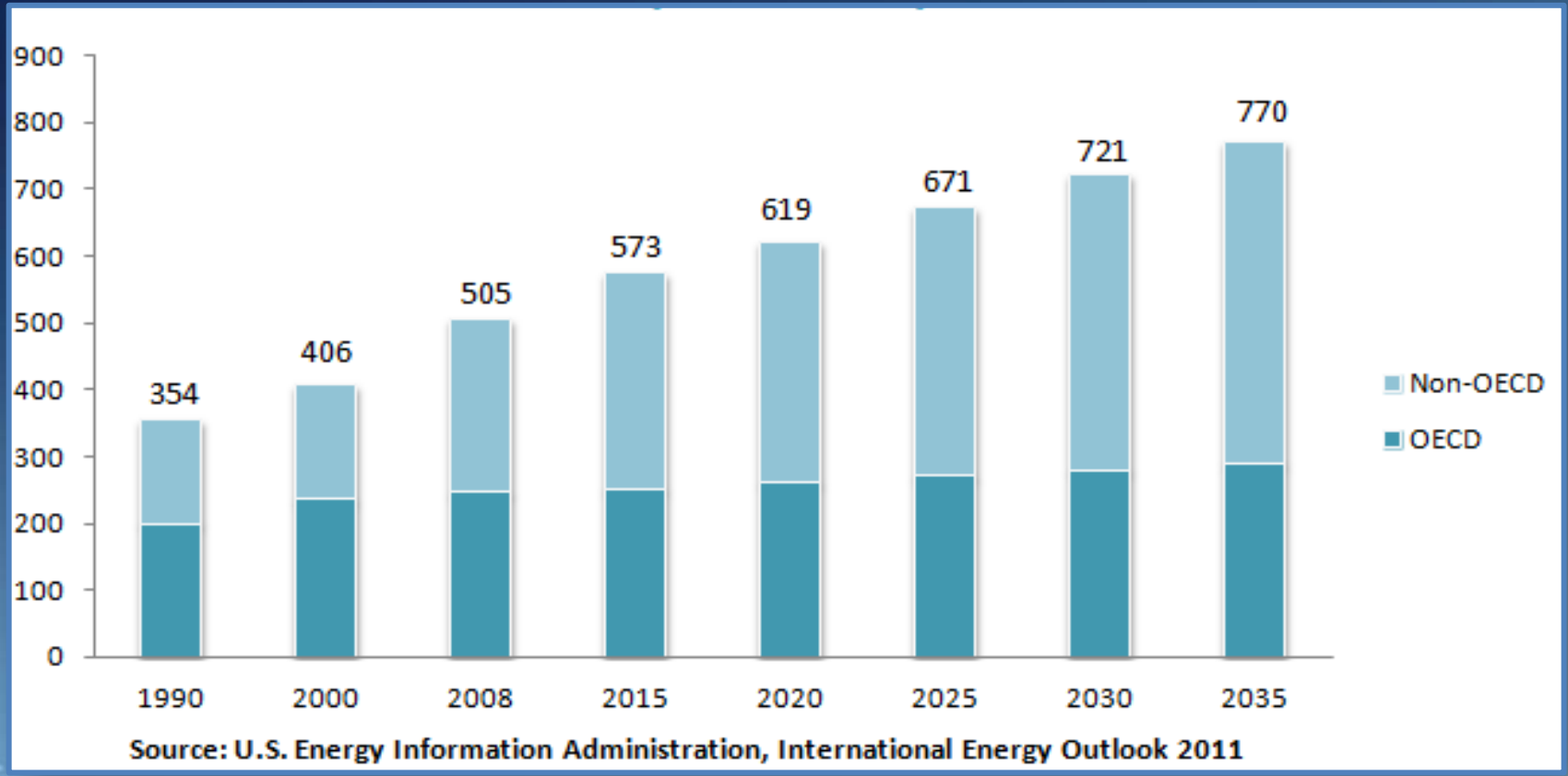
China Coal Reserves	35 Years*
US Coal Reserves	240 years*

* At Current Consumption

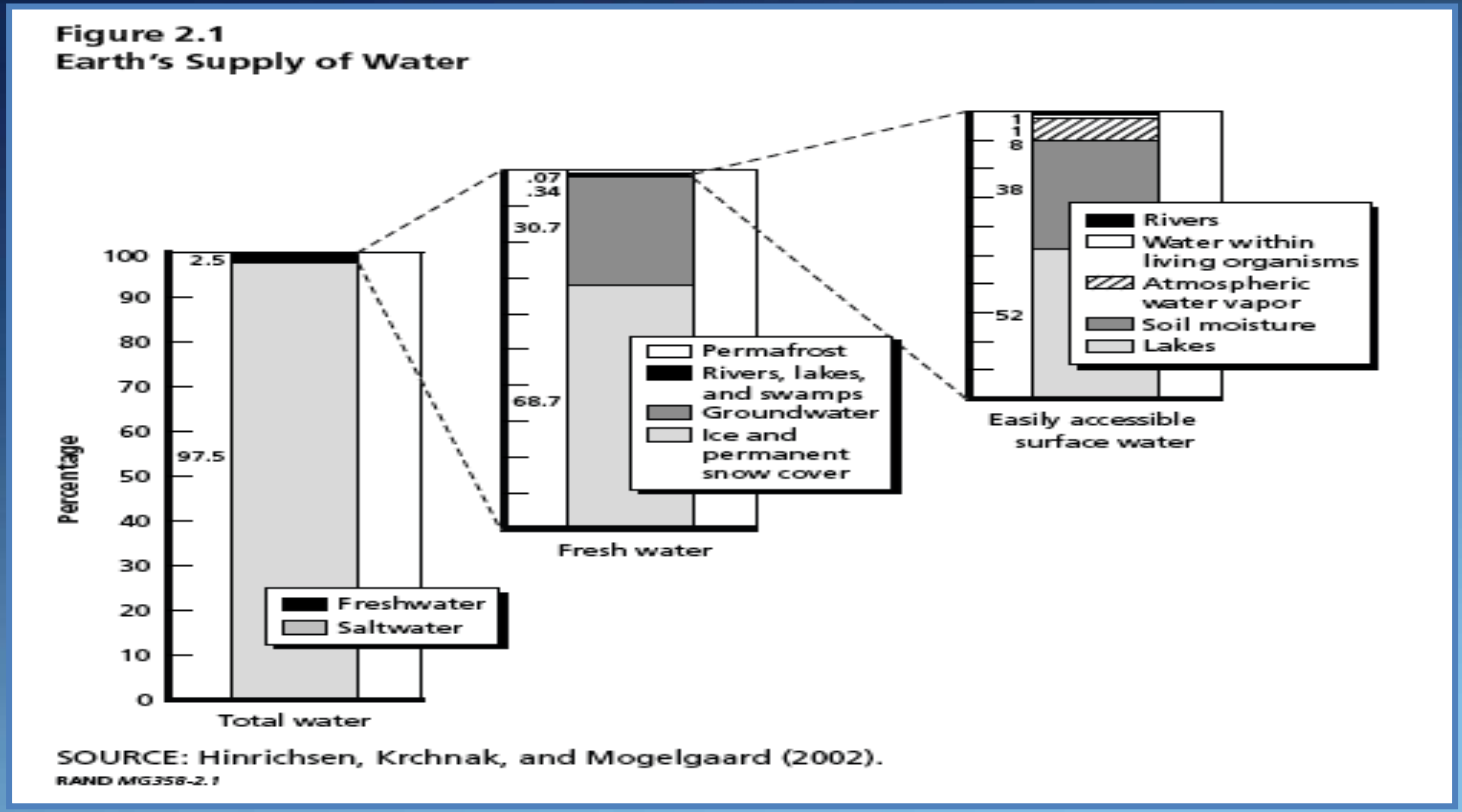
Per Capita Energy Use



Global Energy Consumption 1990-2035



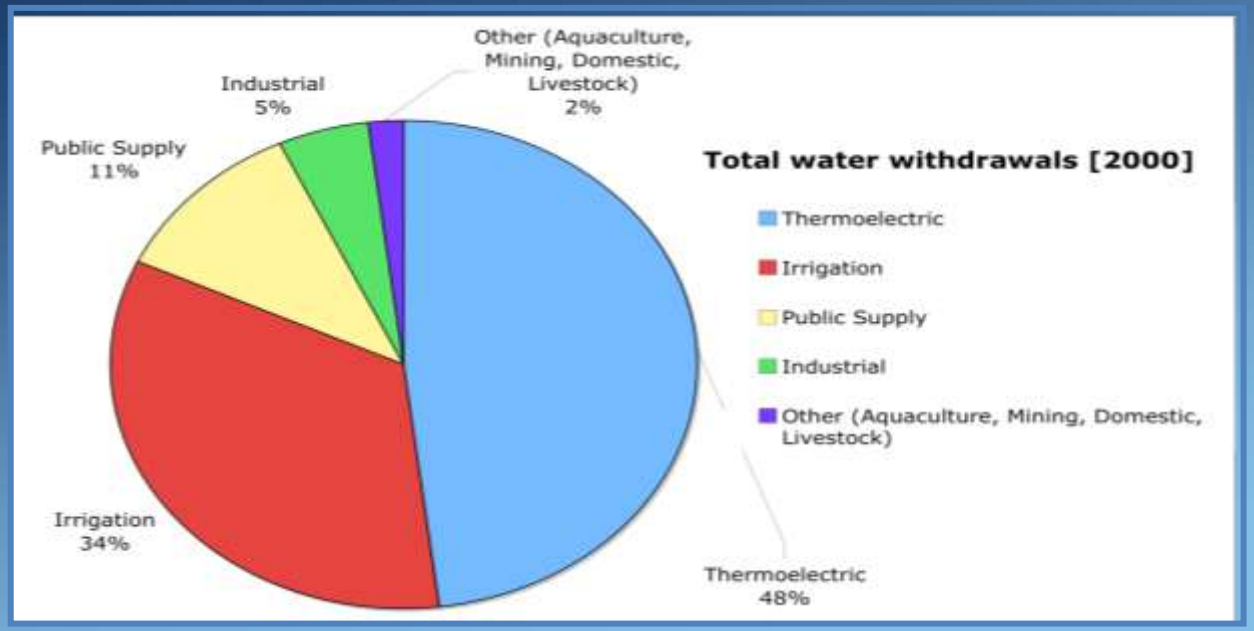
Freshwater Is A Small Part of the Total Supply



"Liquid Assets," Jill Boberg, RAND

The Thermoelectric Power Sector is the Largest User of Water in the US

- 48% of total water withdrawals (39% of freshwater w/drawal)
- *Withdrawal*: 0.2-42.5 gal/kWh *Consumption*: 0.1-0.8 gal/kWh



The Water Sector Uses a Lot of Energy

- Energy is used to produce, move, heat and treat water
  - ~ 3% of U.S. electricity for water/wastewater plants
  - ~10%+ including end-use (heating, etc.)
- Largest energy user in most municipalities (~50%)
  - most WWTPs are municipally-owned
- California is an extreme example
  - CA spends ~19% of its electricity on water
  - Similar story wherever water is scarce

Water Production, Treatment and Distribution Requires Energy

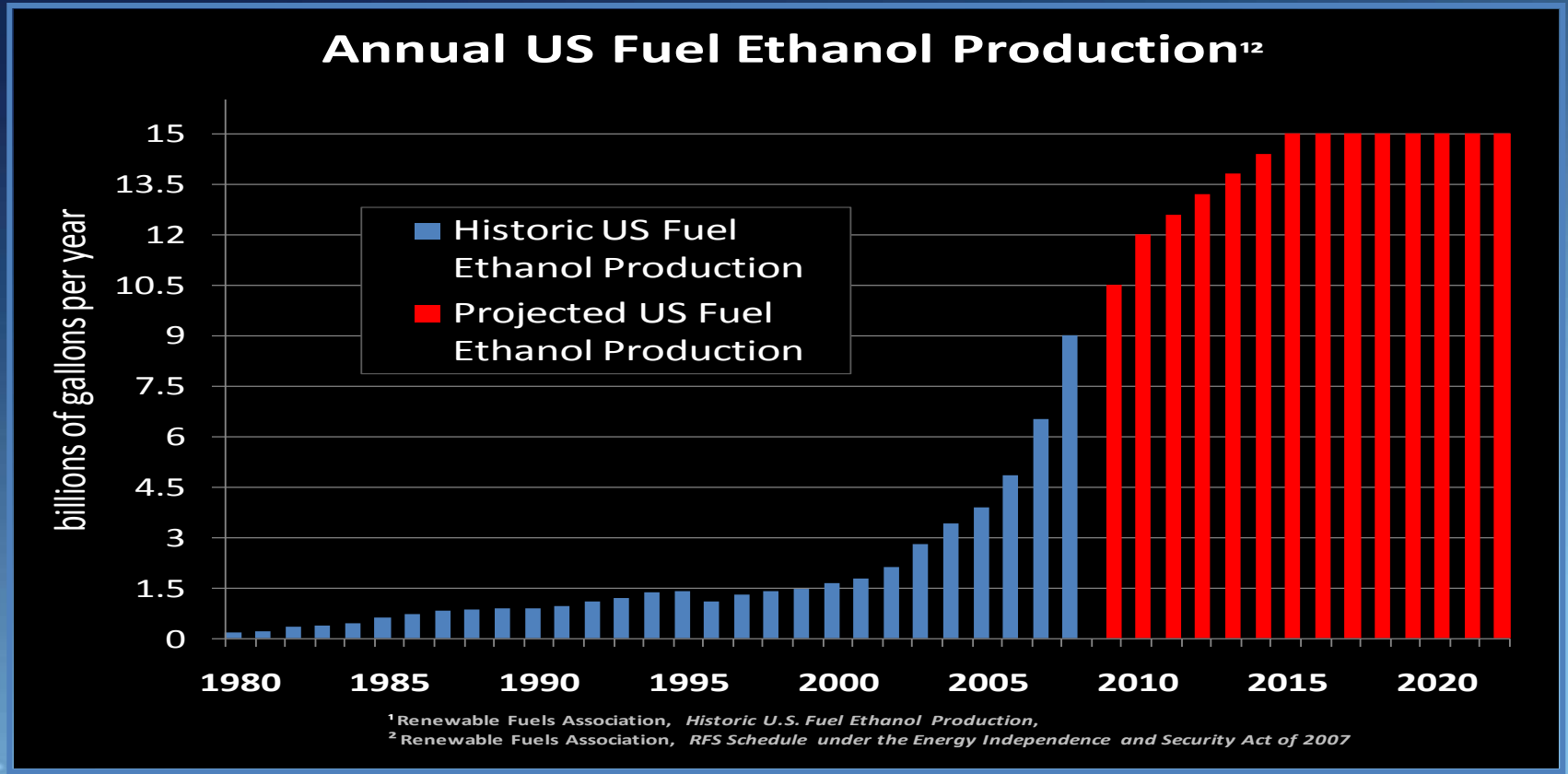
Source/Treatment Type	Energy Use [kWh/Mgal]
Surface Water	1,400
Groundwater	1,800
Brackish Groundwater	3,900-9,750
Seawater	9,780-16,500

Biofuels Are Very Water-Intensive

- Growth/Production
  - ~780 LH2O/ Lfuel for irrigated corn in the US
  - 15 to 260 LH2O/ km for corn ethanol (withdrawals)
  - 3 to 146 LH2O/ km for corn ethanol (consumption)
  - ~510 LH2O/ Lfuel for irrigated soy in the US
  - ~35 LH2O/ km for soy biodiesel (withdrawals)
  - ~28 LH2O/ km for soy biodiesel (consumption)
- Processing/Refining
  - 1-3 LH2O/ Lfuel for petroleum fuels
  - 3-6 LH2O/ Lfuel for biofuels

[Source: King & Webber, 2009]

EISA 2007 will significantly increase the production of biofuels in the future



We Are Moving Towards More Water-Intensive Energy

- Nuclear power, Solar CSP
  - Note: also choosing water-lean energy forms

    i.e. Solar PV, wind, natural gas

- Future transportation fuels are especially thirsty
  - Unconventional fossil fuels (2-4x worse)
  - Natural Gas (better to 1-2x worse)
  - Electricity (2-3x worse)

    Good with wind/solar PV, worse with nuclear
  - Hydrogen (1-500x worse)

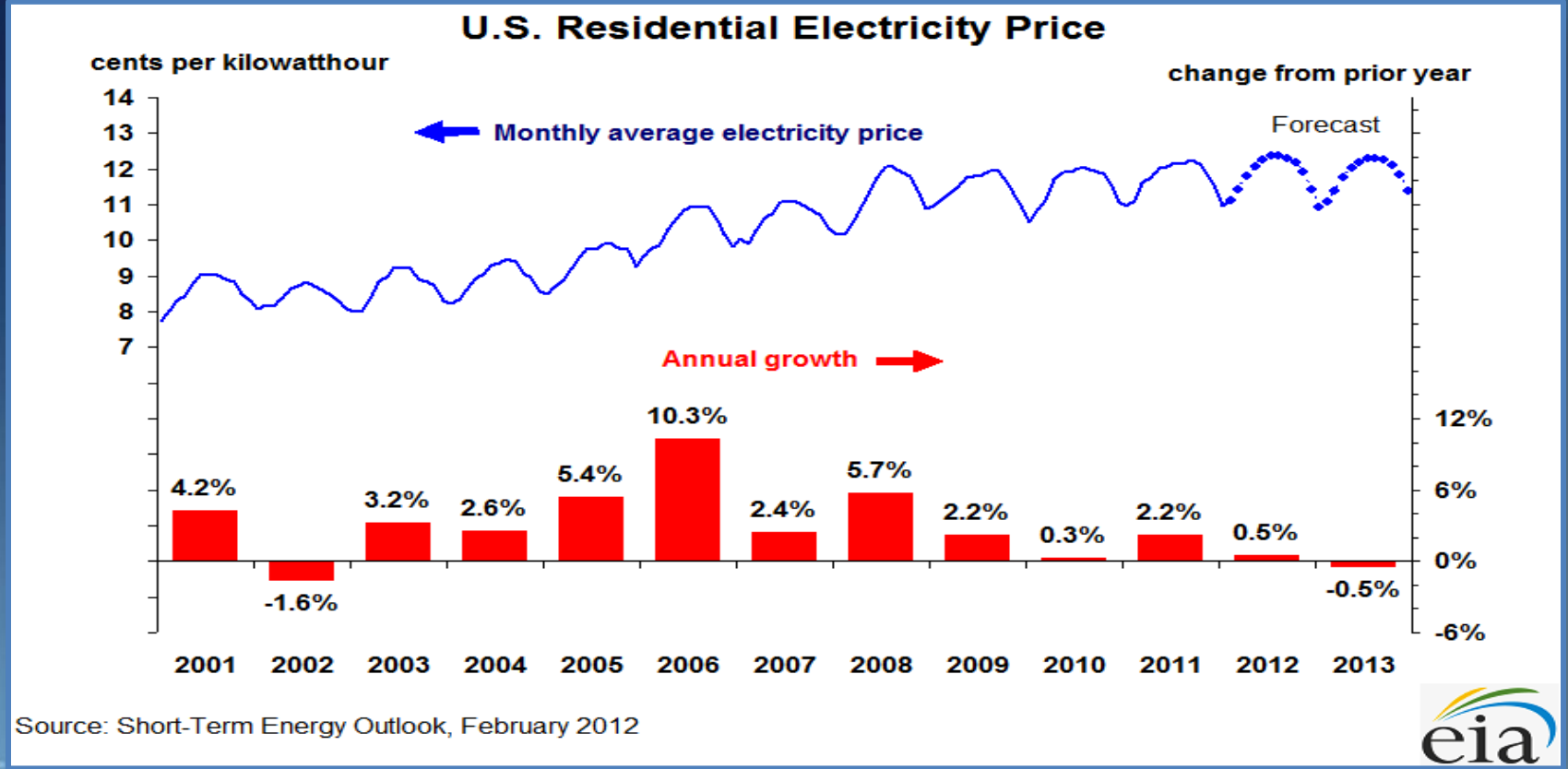
    Good with wind/solar PV, worse with nuclear
  - Biofuels (1-1000x worse)

[Source: King & Webber, 2009]

New Power Generation Trends & Risk

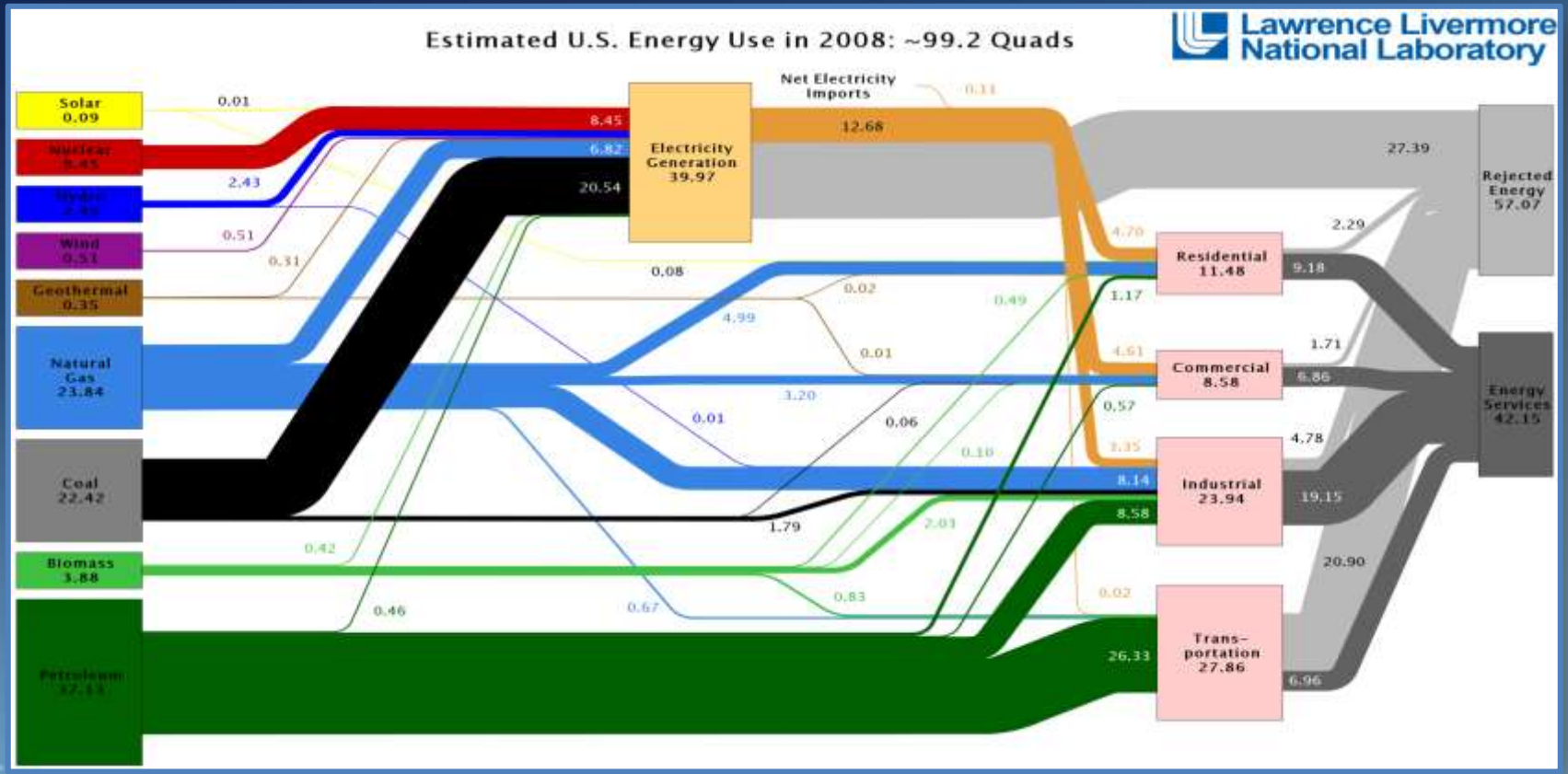
	Build $/MW	O&M $/MW	Fuel $/MW	External $	Total $
Coal	↗	→	↗	↑	↑
Nat Gas	↗	→	↗	↗	↗
Nuclear	↗	→	→	↗	↗
Hydro	↑	→	↗	↑	↑
Wind	↘	↘		→	↘
Solar	↘	↘		→	↘

U.S. Electricity Price Trend



Source: Short-Term Energy Outlook, February 2012

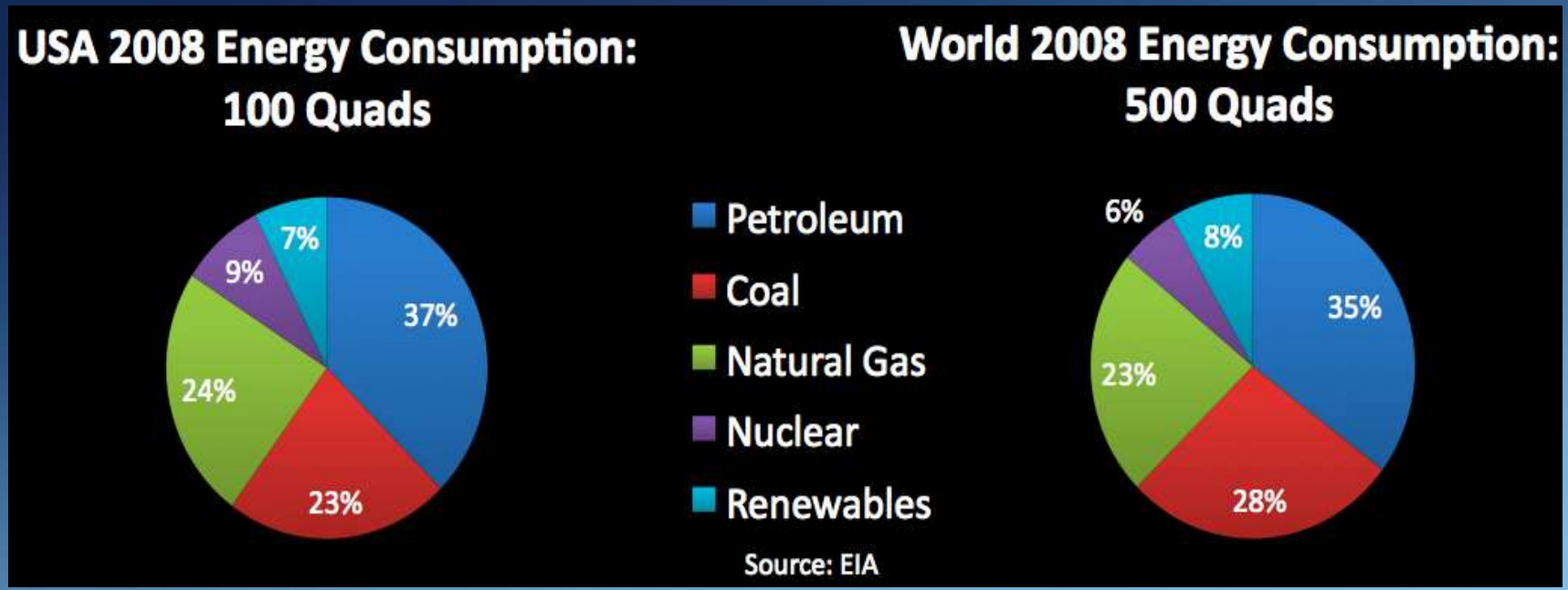
US Energy Consumption 2008



So What Does It All Mean

- Fossil Fuel Supply is Finite and Demand is Growing
- Global Oil Production Has Probably Peaked, Demand Has Not
- Global Coal Use is Increasing Rapidly (China & India)
- Shale Gas Offers Hope But May be Outstripped by Demand
- The “Rest of the World” is Building Power Plants & Buying Cars
- The “Rest of the World” is Industrializing & Building Infrastructure
- The Cost of Fossil Fuel Derived Energy is Increasing
- The Cost Of Most Everything is Tied to the Cost of Energy

U.S. Energy Consumption



5% of the World's Population (U.S.) Responsible for 20% of World's Energy Use

Global Demographics

And they will all want to live like us…

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