



Energy Challenges: Efficiency & Renewable Energy Responses

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Sustaining Economies and Natural Resources in a Changing World:

Key Role of Land Grant Universities

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Overview

Challenges

- **Economy**—economic development and growth; energy imports
- **Security**—foreign energy dependence, energy availability
- **Environment**—local (particulates, water), regional (acid rain), global (GHGs)

What role can EE & RE serve in meeting these Challenges?

- **Efficiency: Buildings, Industry, Transport**
- **Renewable Fuels**
- **Renewable Electricity**

Speed and Scale

The Oil Problem

Nations that **HAVE** oil
(% of Global Reserves*)

Saudi Arabia	26%
Iraq	11
Kuwait	10
Iran	9
UAE	8
Venezuela	6
Russia	5
Mexico	3
Libya	3
China	3
Nigeria	2
U.S.	2

Nations that **NEED** oil
(% of Global Consumption)

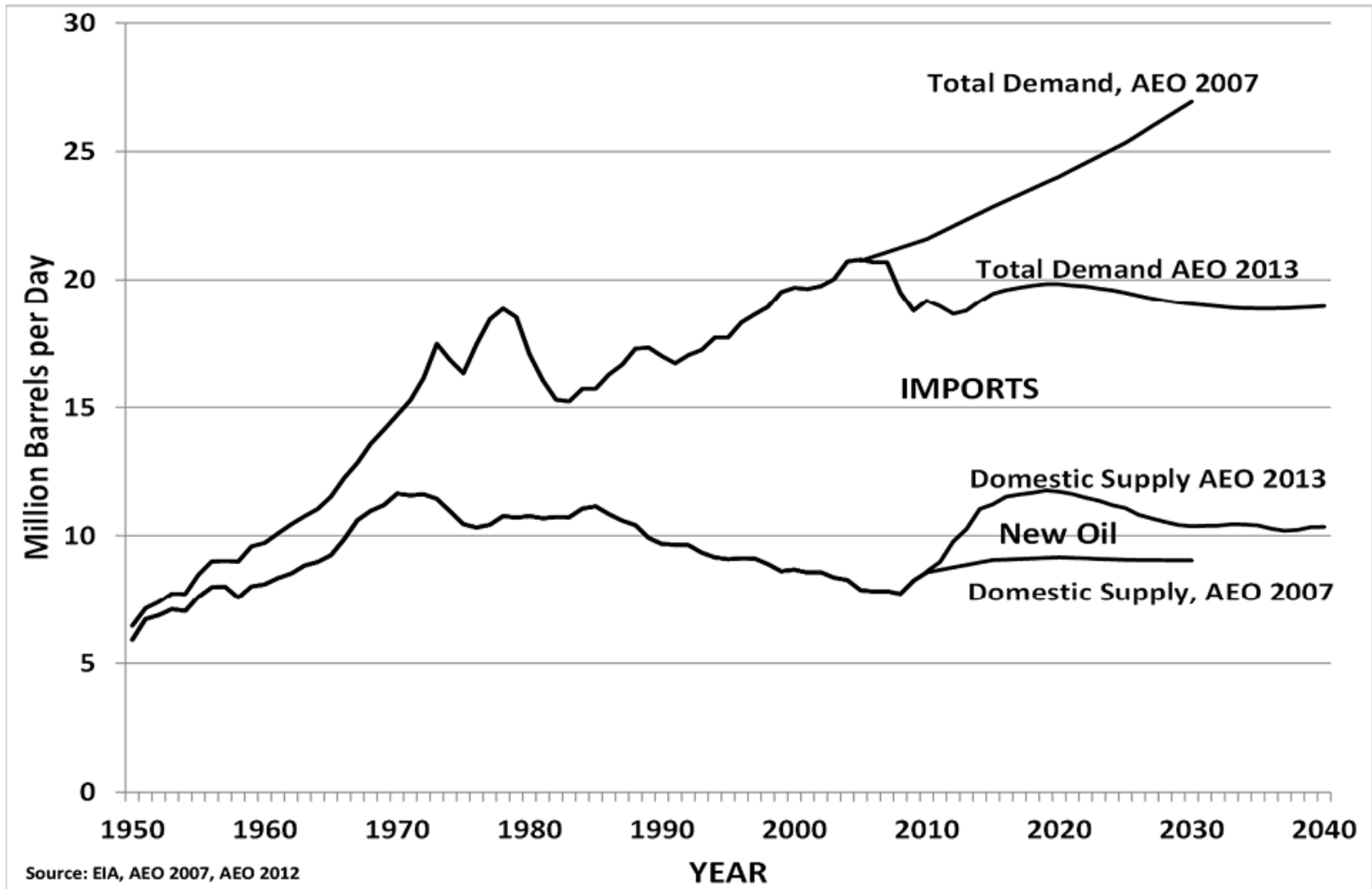
U.S.	24. %
China	8.6
Japan	5.9
Russia	3.4
India	3.1
Germany	2.9
Canada	2.8
Brazil	2.6
S. Korea	2.6
Mexico	2.4
France	2.3
Italy	2.0

Total

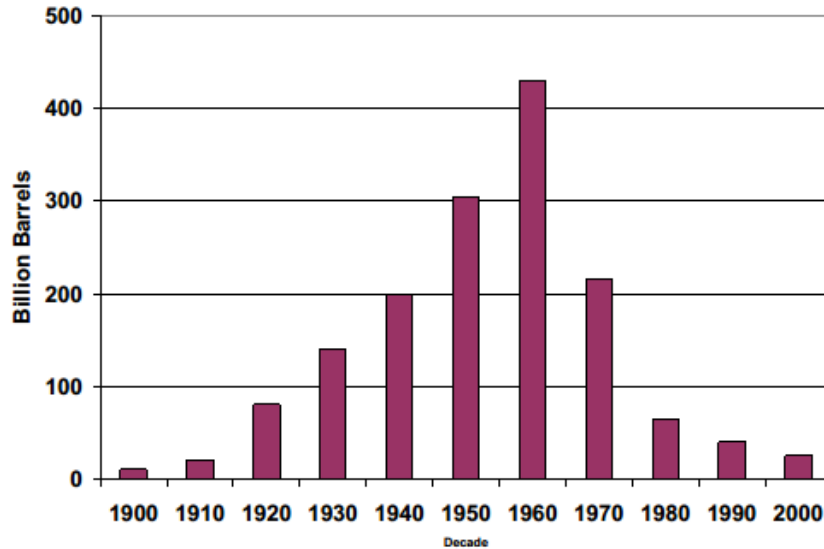
85 MM Bbl/day

Source: EIA International Energy Annual; *Conventional Oil

Oil Supply and Demand?



Resources and Supply Projections

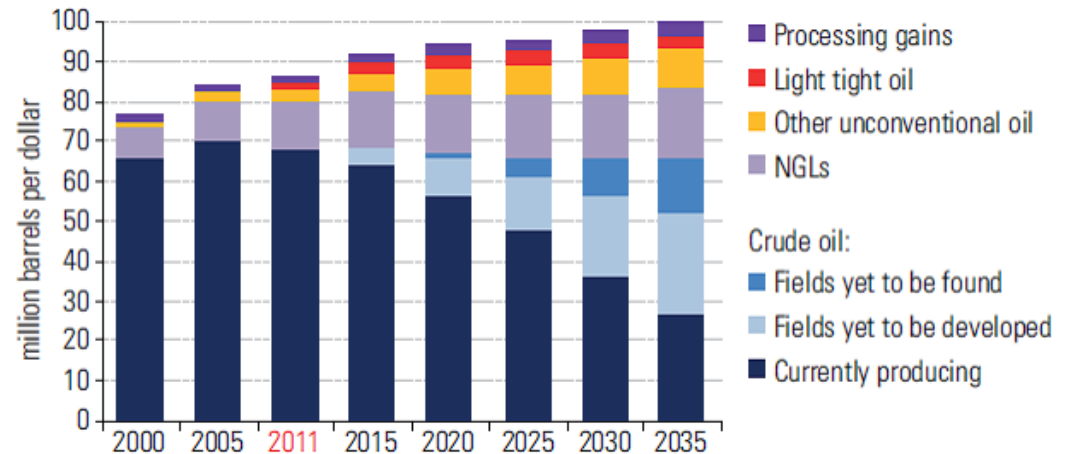


Discovery of Giant Oil Fields by Decade

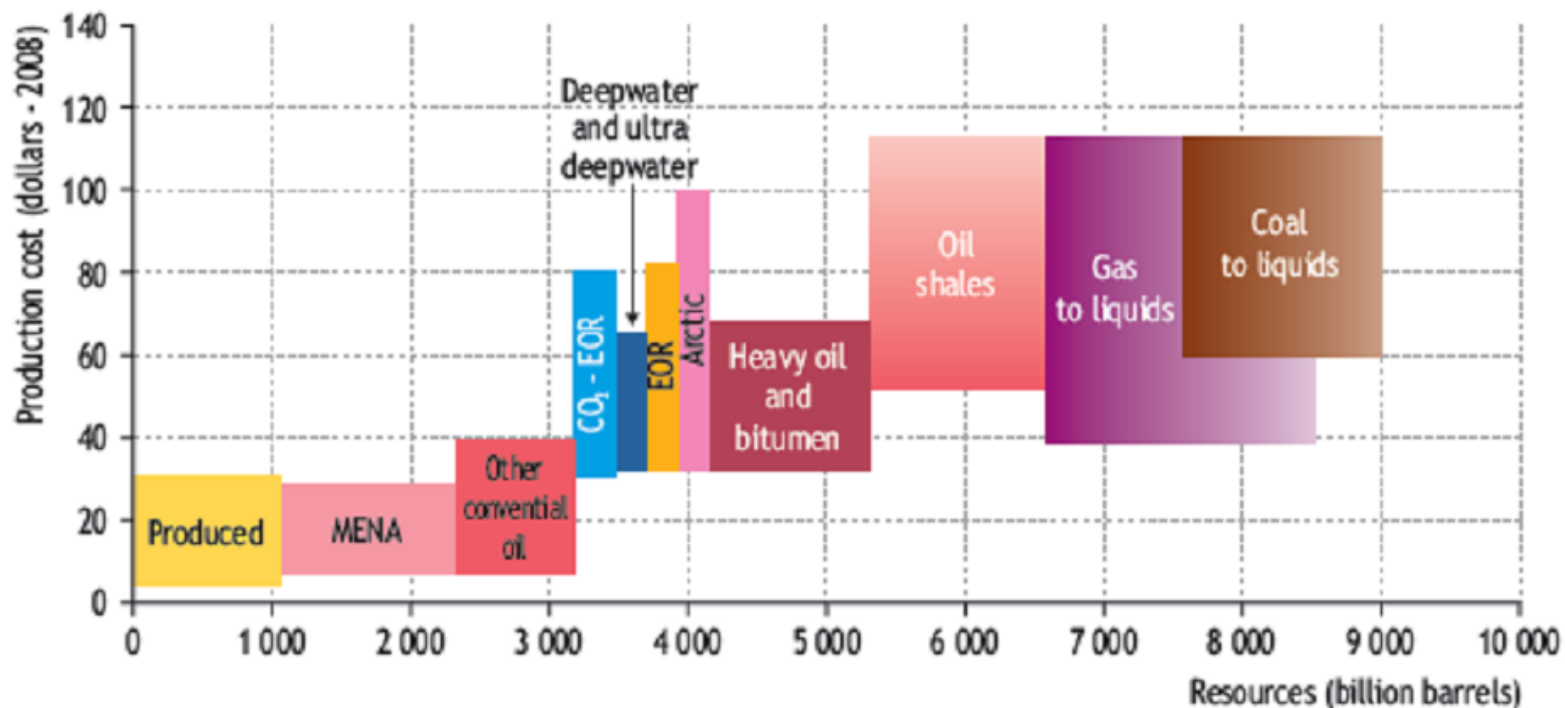
Fredrik Robelius, Uppsala Universitet

New oil supply by type in the new policies scenario

IEA World Energy Outlook 2012, Fig. 3.15



Unconventional Resources

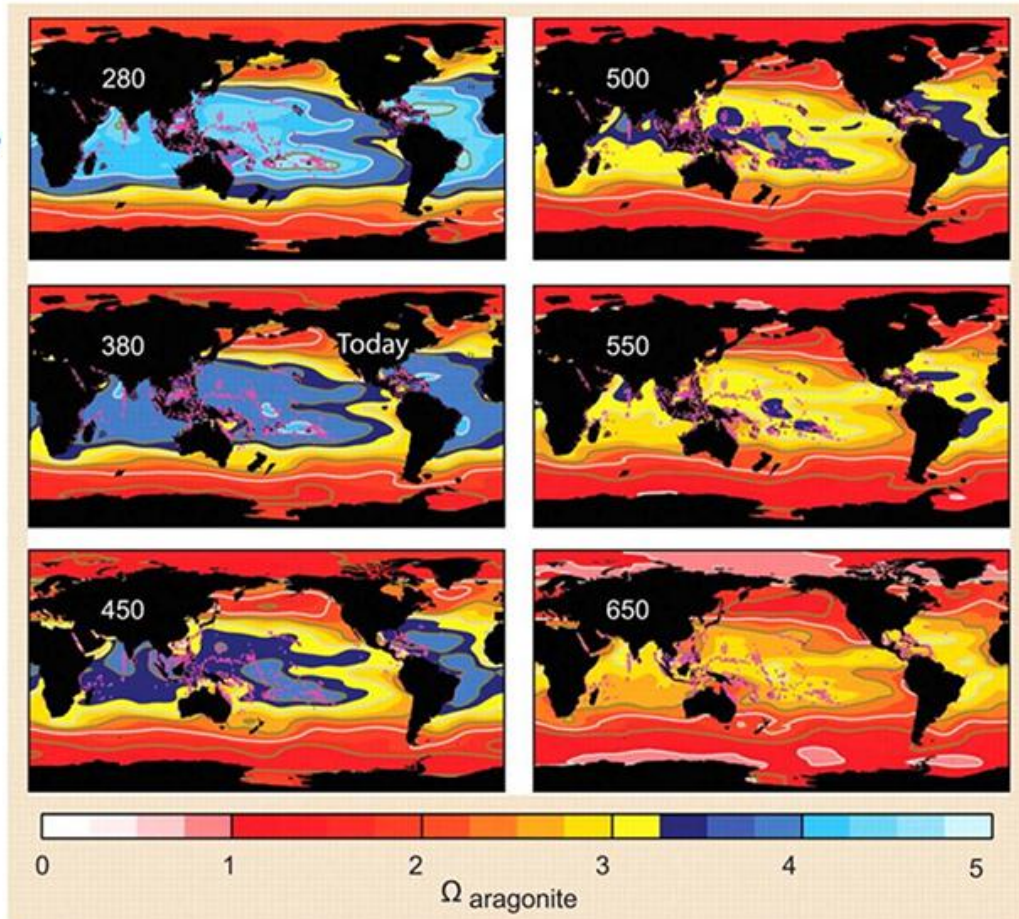


- **Constraints: Cost; Energy; Water; Atmosphere**

Source: IEA, World Energy Outlook 2008, part B, Figure 9.10

Potential Impacts of GHG Emissions

- **Temperature Increases**
 - Ice Loss from Glaciers, Ocean Thermal Expansion, and Sea Level Rise
 - Ecological Zone Shifts ... and Extinctions
 - Agricultural Zone Shifts ... and Productivity
- **Ocean Acidification**
- **Precipitation Changes and Water Availability**
 - Agricultural Productivity
 - Wildfire Increases



Source: Hoegh-Guldberg, et al, Science, V.318, pp.1737, 14 Dec. 2007