

Determinants of Mineral Supply and Depletion Issues- Case of Fossil Fuels

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Outline

- Introduction
- Energy Resources
- Trends
- Scarcity and Depletion
- Implications, and solutions
- Conclusion

Introduction

The background of the slide is a solid dark blue. In the lower right quadrant, there are several overlapping, wavy, light blue lines that create a sense of motion or depth, resembling a stylized wave or a series of curved paths.

Classification

MINERAL RESOURCES

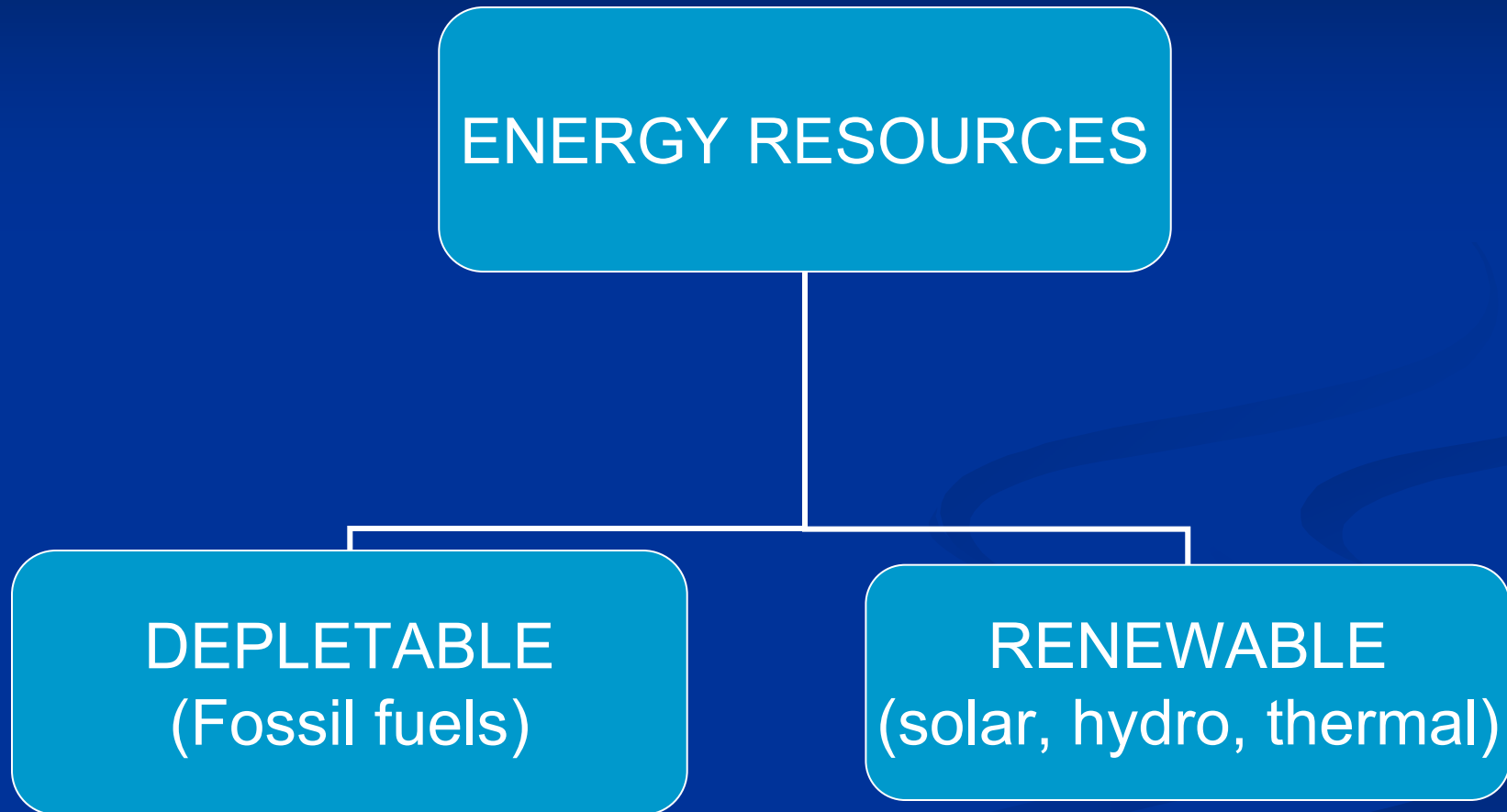
METALLIC

NON-METALLIC


FOSSILFUELS

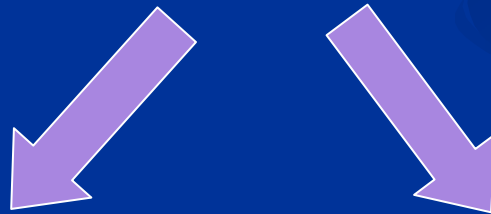


Types of Energy Resources



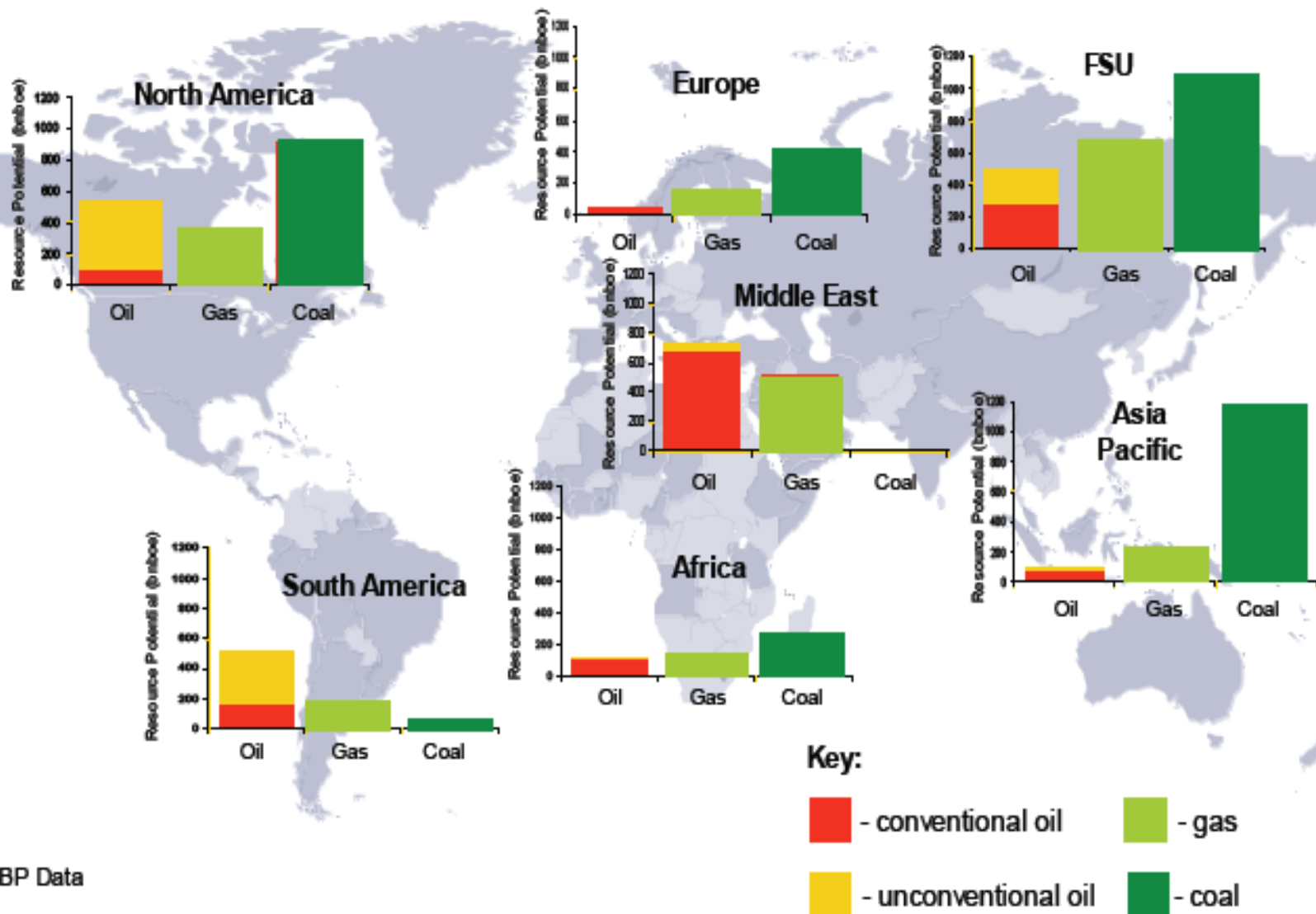
FOSSIL FUELS

- This presentation is about Fossil Fuels
- Depletion = deliberate piecemeal removal of a finite asset  with production, a time frame at which this asset will diminish and ultimately deplete



- Economic depletion Physical depletion

Oil, Gas and Coal Resources by Region (bnboe)



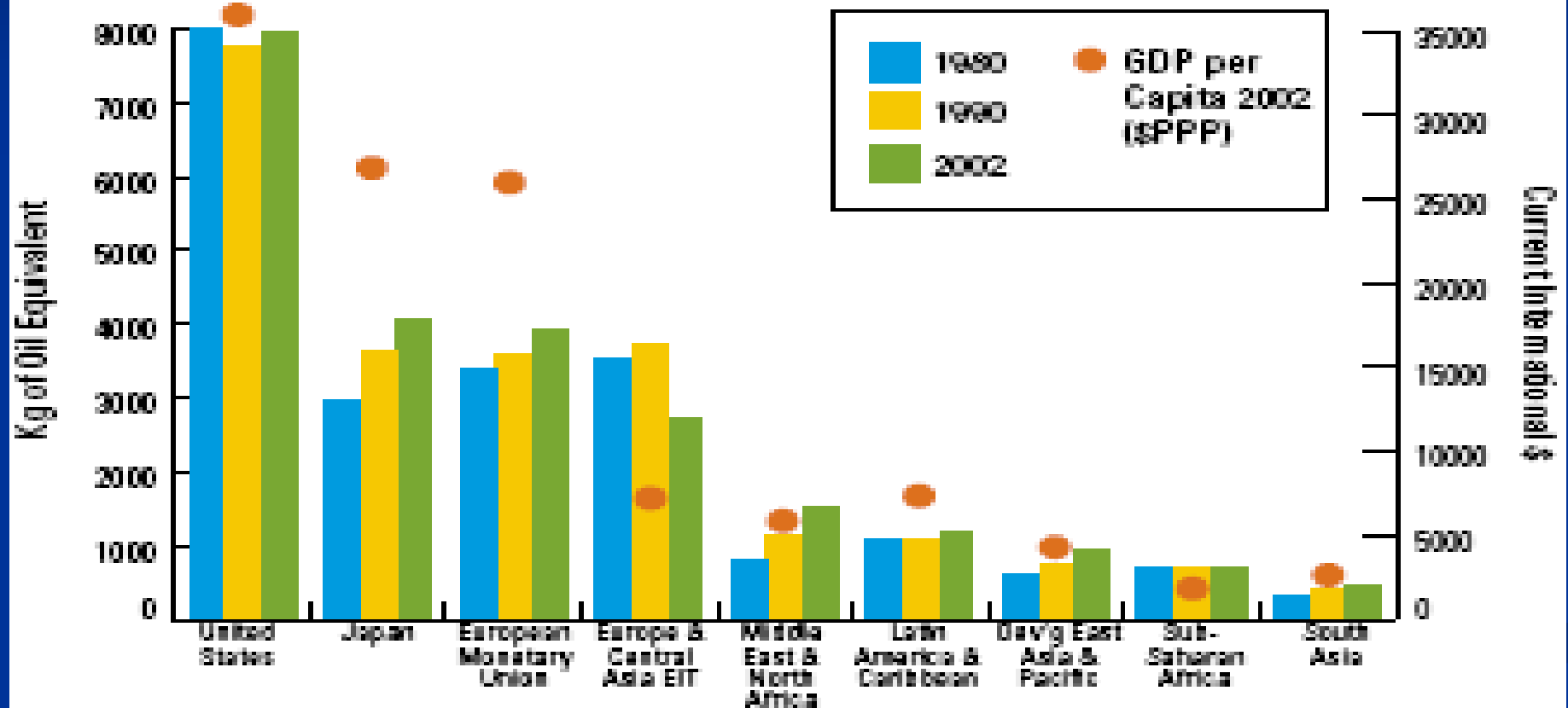
Source: BP Data

Importance of Energy

- Our civilization and prosperity depends on energy input
- Improving standard of living and sustaining them requires energy
- Close relationship between economic development and energy use

Prosperity and Energy Use

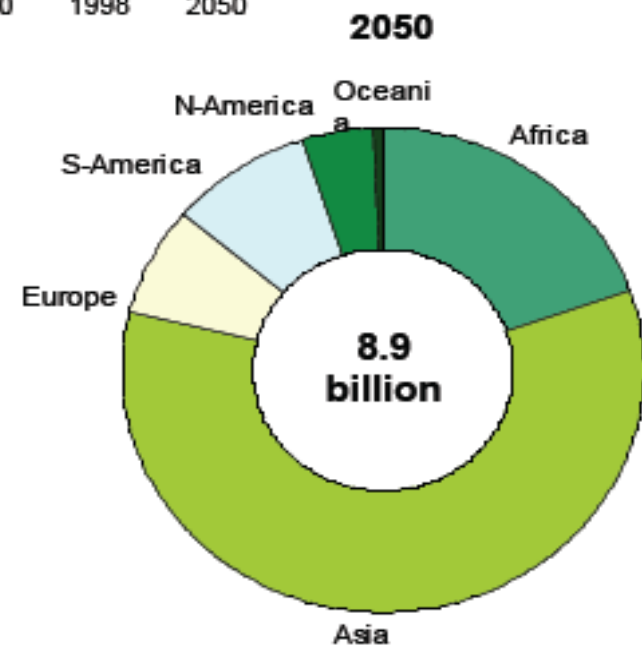
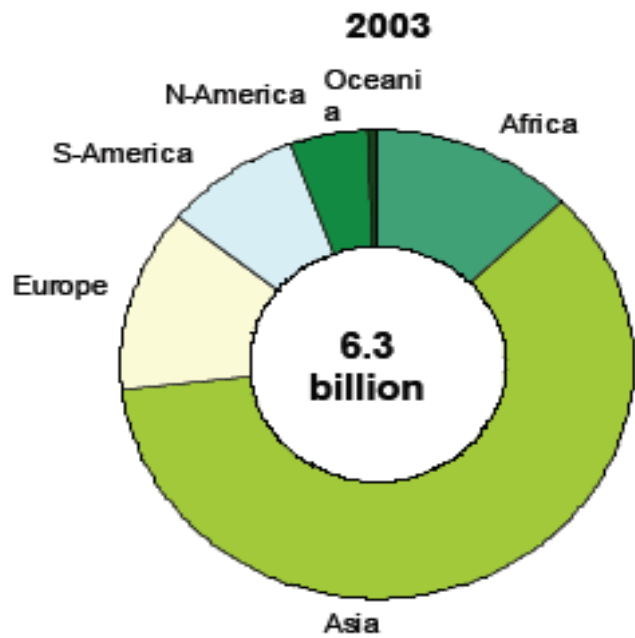
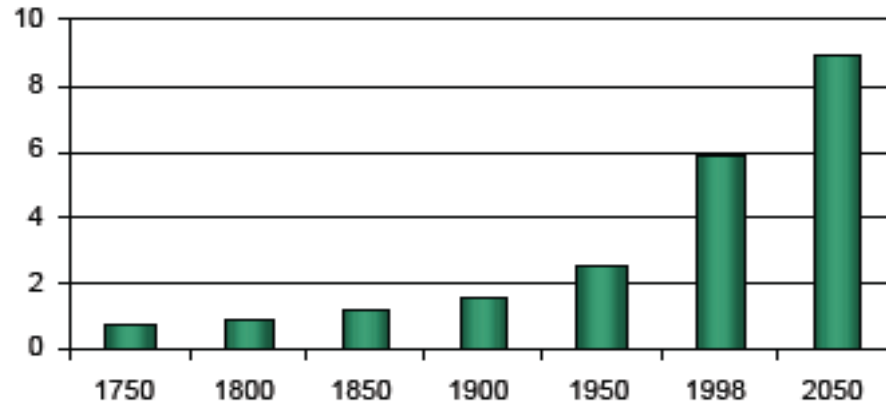
Energy Use per Capita & GDP per Capita



Note: Europe & Central Asia EIT (Economies in Transition) excludes EU accession countries.

Source: World Bank, World Development Indicators 2005.

world population

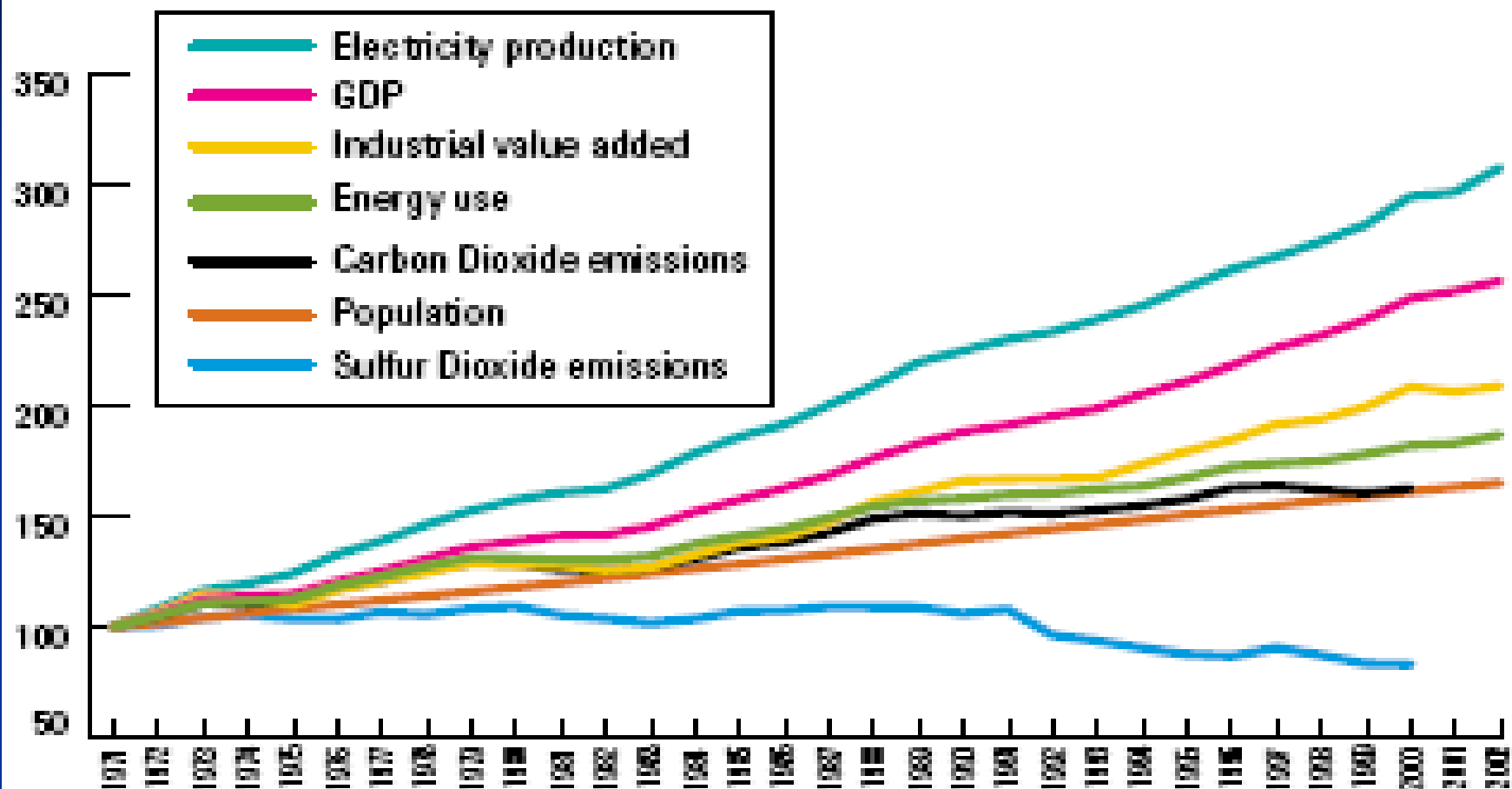


source: United Nations

What are the Challenges?

- Depletable resource....supply challenge
- Increase in population, mineral demand
- Industrialization, economic development
- Environmental Constraints, Climate change
- Anxiety, insecurity of supply
- Sustainability

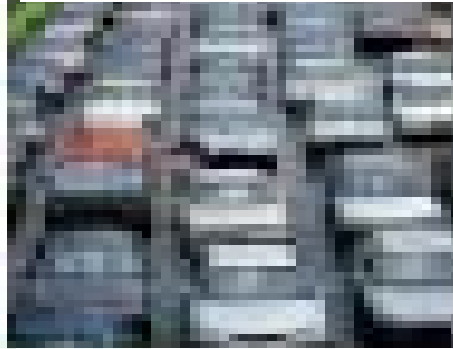
Global Trends: Growth in Economy, Energy & Emissions



Note: Index: 1971=100

Source: UNDESA-DSD, based on data from World Bank, World Development Indicators 2005, and Stern, D., 2005.

Incidental Costs

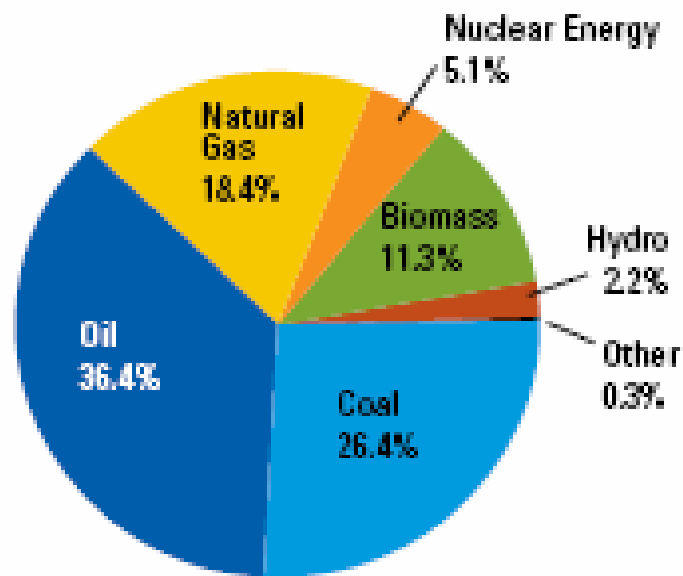


Energy Trends

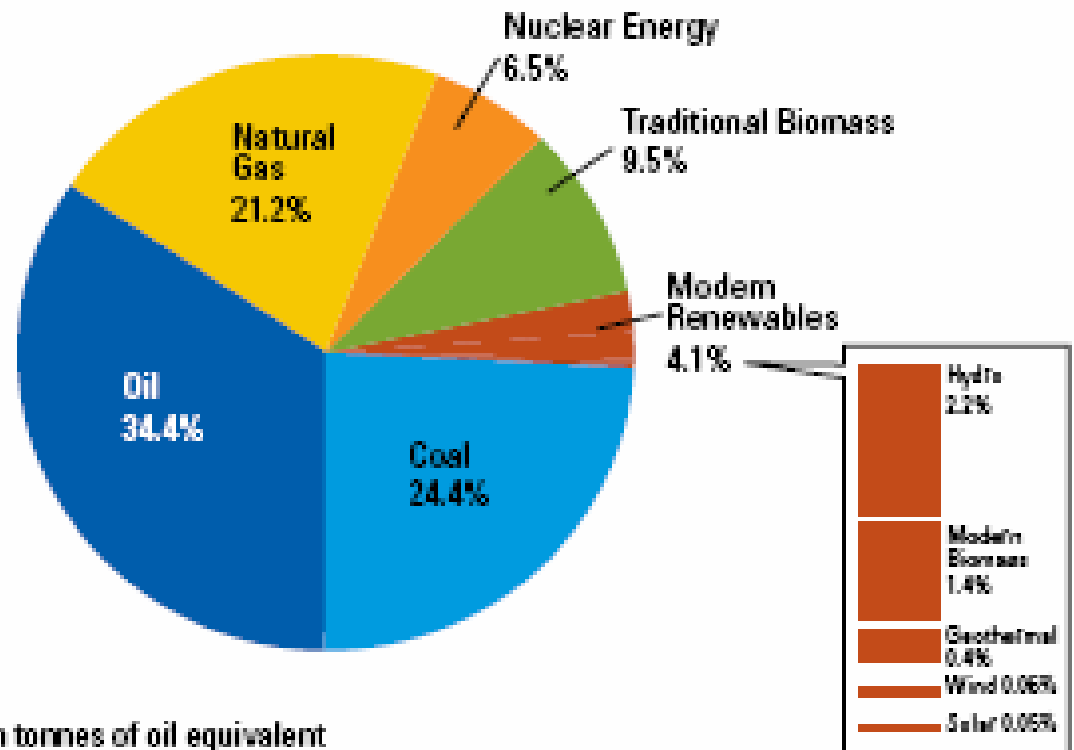
The slide features a dark blue background with a horizontal band of a slightly lighter blue. In the bottom right corner, there are several overlapping, wavy, light blue lines that create a sense of motion or energy.

World Total Primary Energy Supply by Source

1985 (7703 Mtoe*)



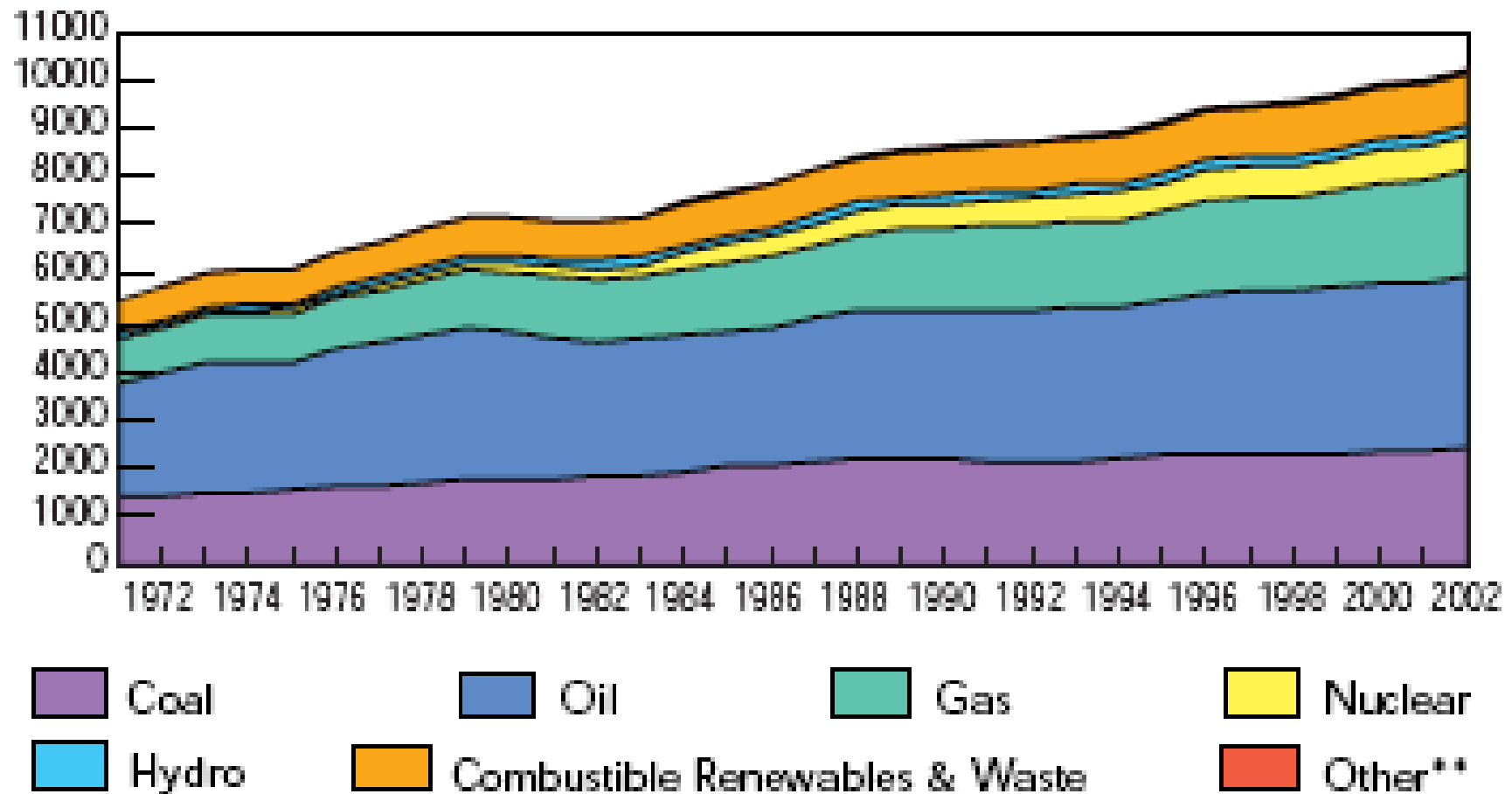
2003 (10723 Mtoe*)



Source: IEA, 2002 & 2005.

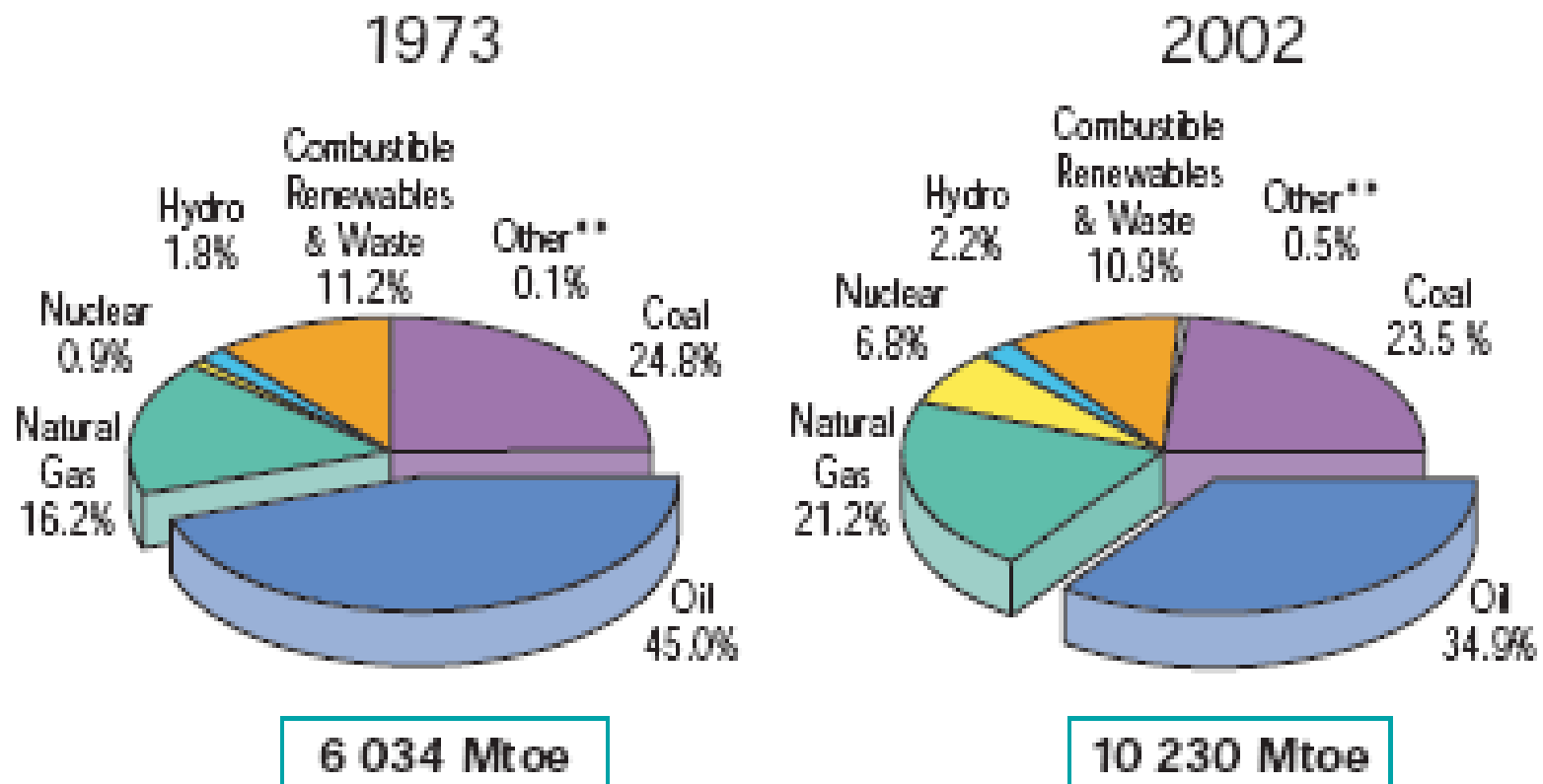
*Mtoe is million tonnes of oil equivalent

Evolution from 1971 to 2002 of World Total Primary Energy Supply* by Fuel (Mtoe)



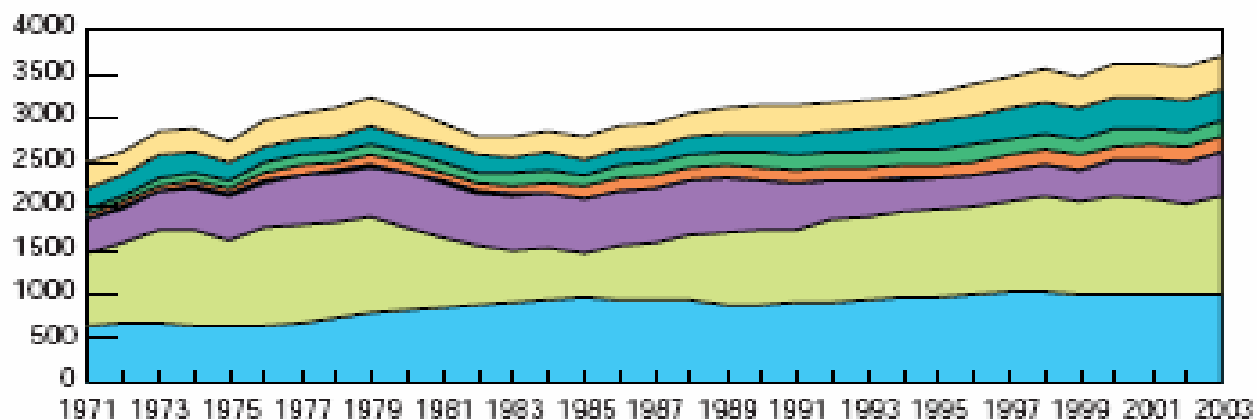
Source: IEA Key World Energy Statistics, 2005

1973 and 2002 Fuel Shares of TPES*



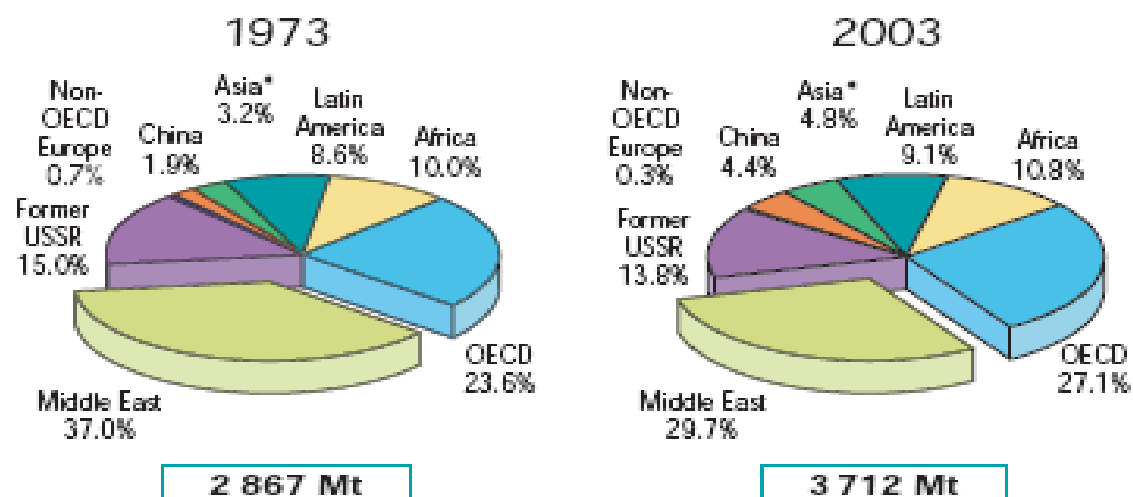
Source: IEA Key World Energy Statistics, 2005

Evolution from 1971 to 2003 of Crude Oil Production by Region (Mt)

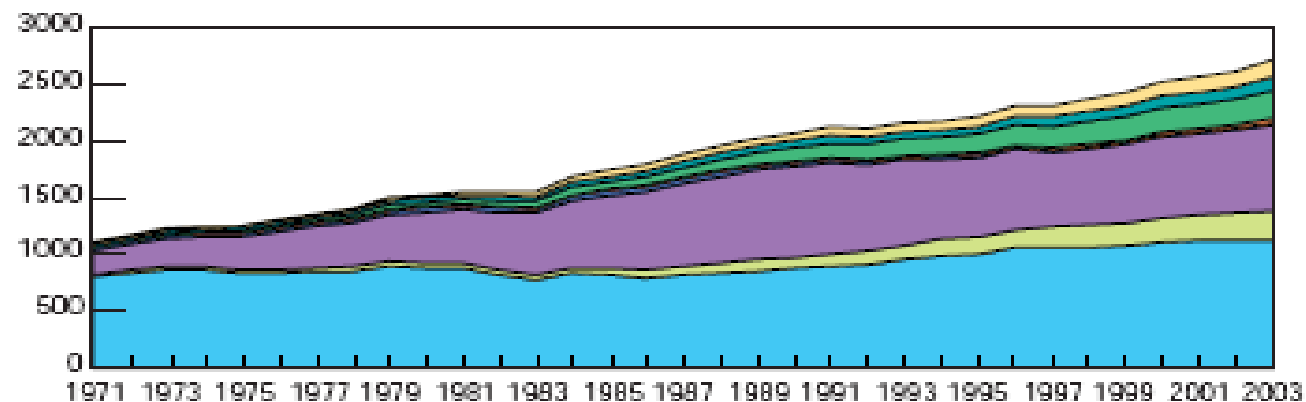


1973 and 2003 Regional Shares of Crude Oil Production

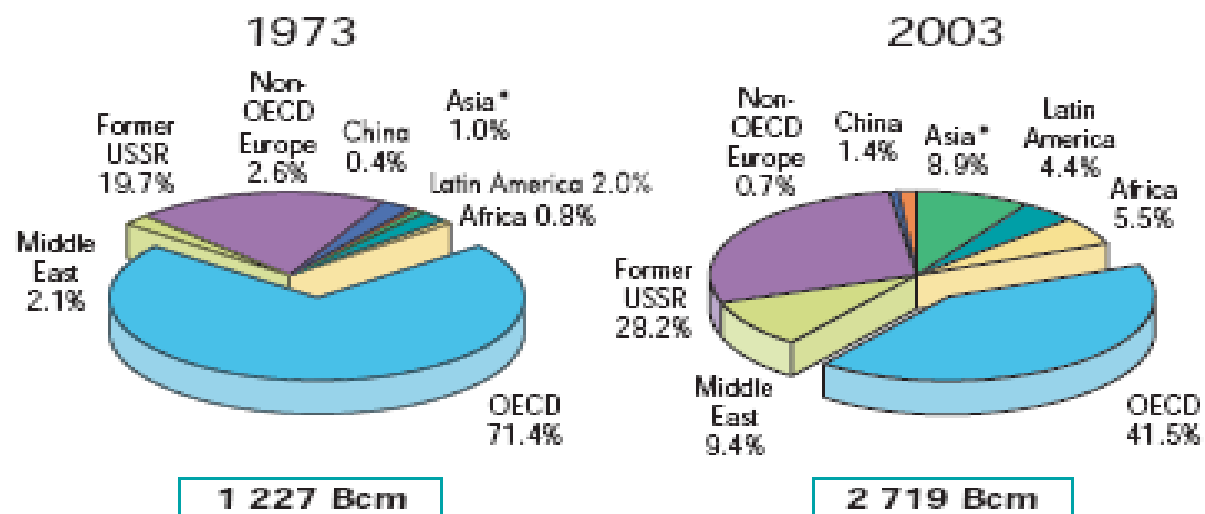
Source: IEA Key World Energy Statistics, 2005



Evolution from 1971 to 2003 of Natural Gas Production by Region
(Billion Cubic Metres)

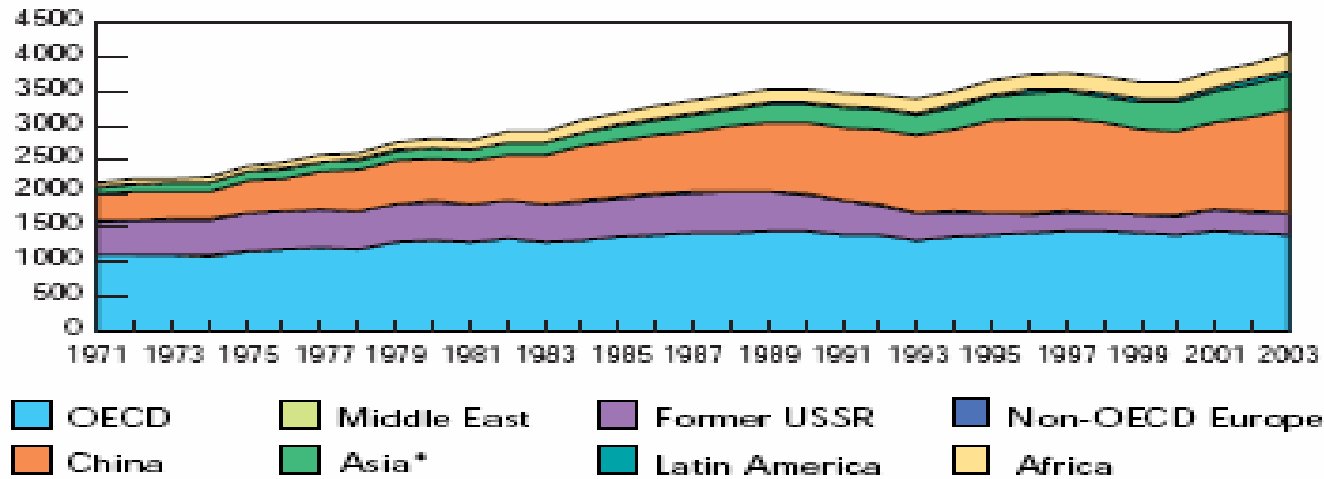


1973 and 2003 Regional Shares of Natural Gas Production

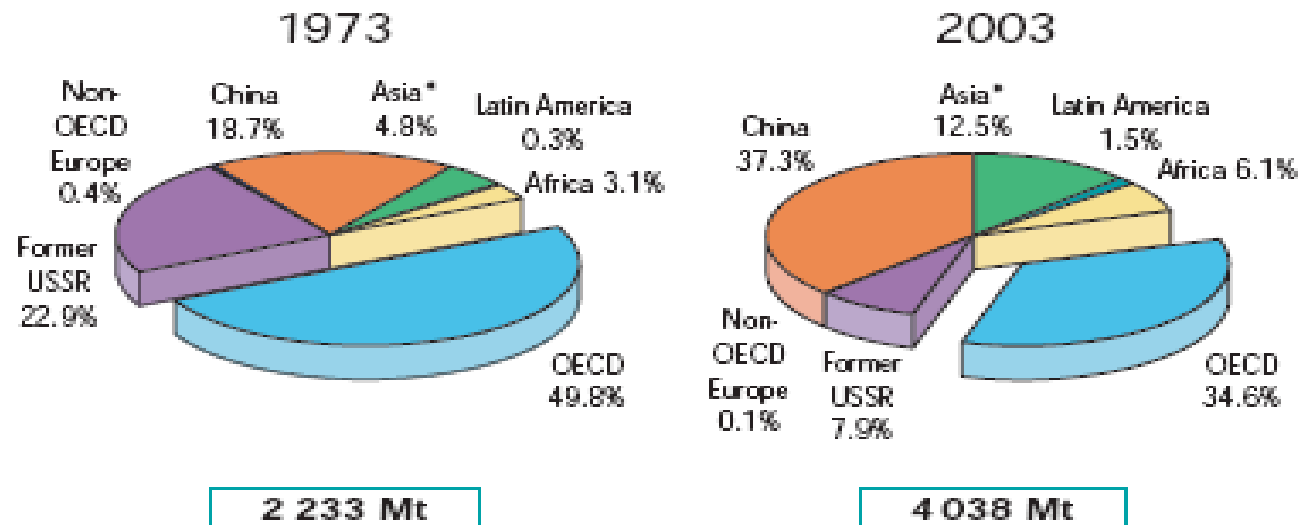


Source: IEA Key World Energy Statistics, 2005

Evolution from 1971 to 2003 of Hard Coal Production by Region (Mt)

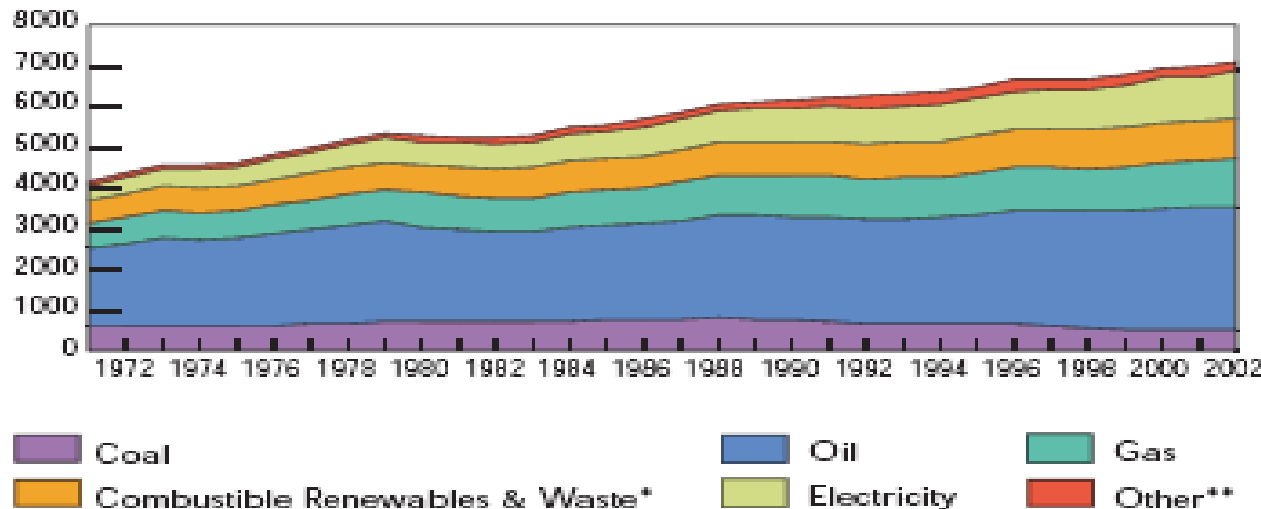


1973 and 2003 Regional Shares of Hard Coal Production

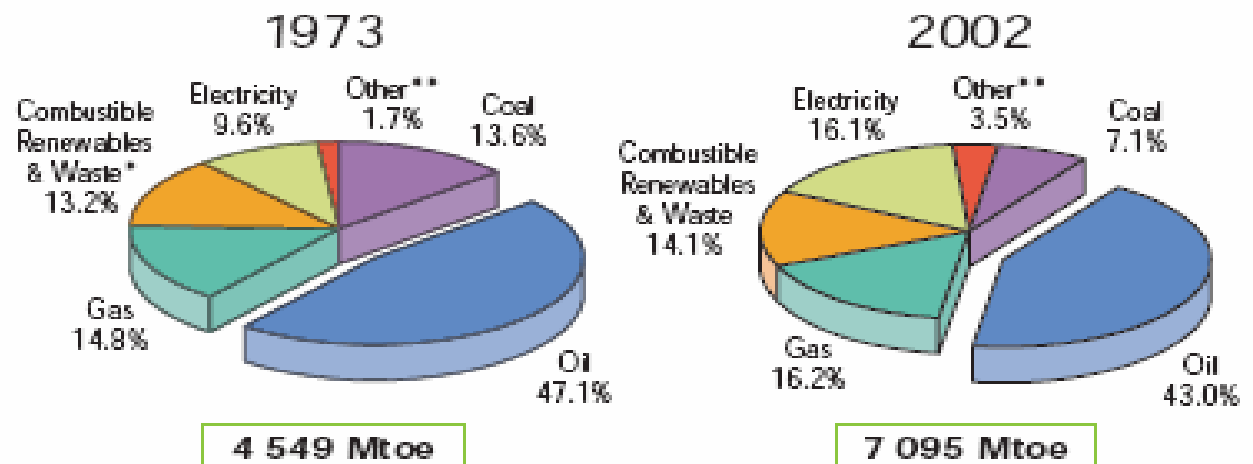


Source: IEA Key World Energy Statistics, 2005

Evolution from 1971 to 2002 of World Total Final Consumption by Fuel (Mtoe)

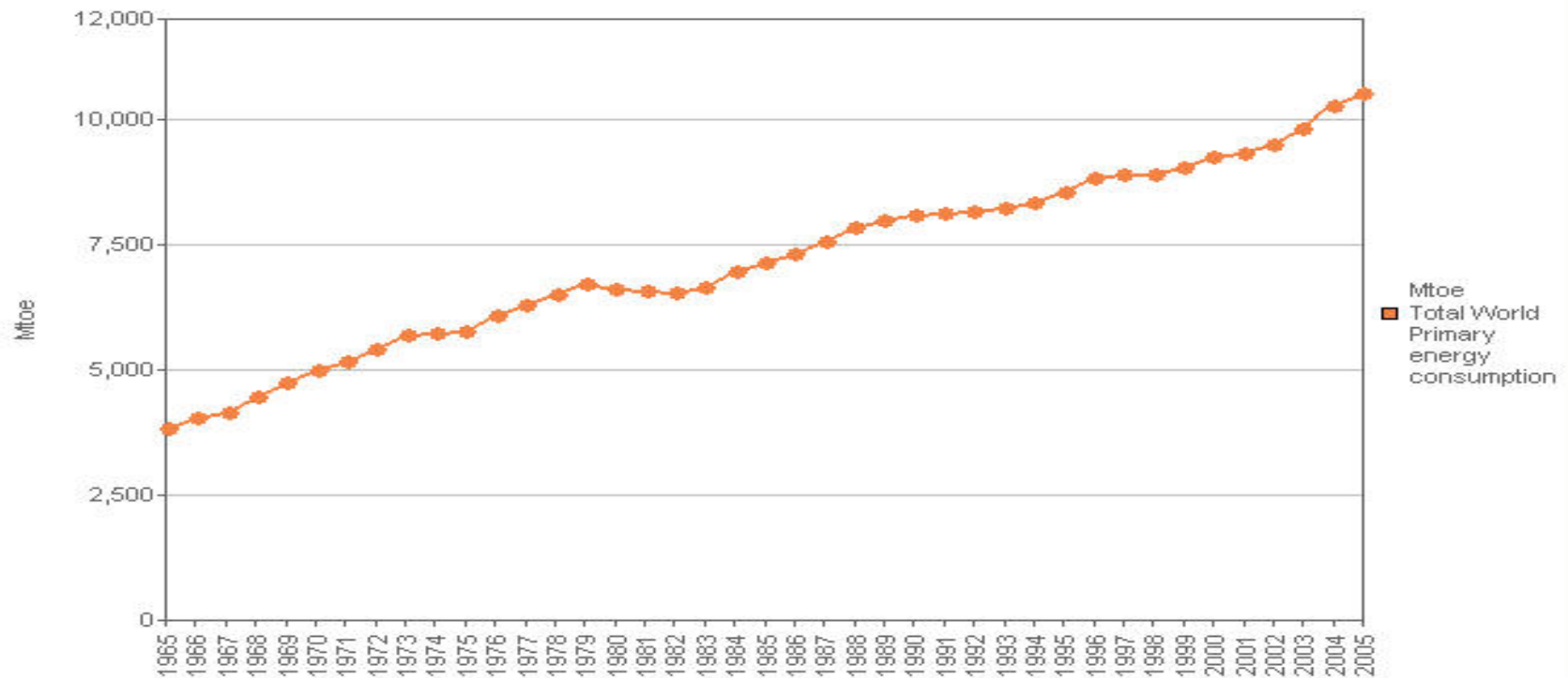


1973 and 2002 Fuel Shares of Total Final Consumption



Source: IEA Key World Energy Statistics, 2005

World Primary Energy Consumption



Source: BP Statistical Review of World Energy 2006

Depletion and Scarcity



Are Minerals Getting Scarce?

SCARCITY INDICATORS

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graph TD; A[SCARCITY INDICATORS] --> B[ECONOMIC (PRICE, COST, RENT)]; A --> C[PHYSICAL (RESERVES, R/P)];
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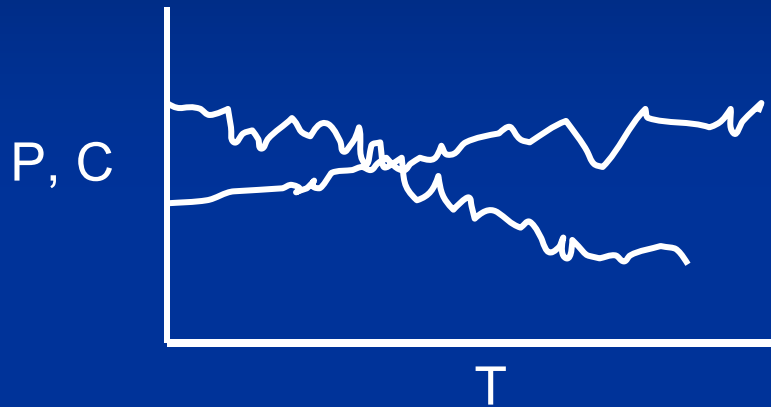
ECONOMIC
(PRICE, COST, RENT)

PHYSICAL
(RESERVES, R/P)

Indicators and Scarcity

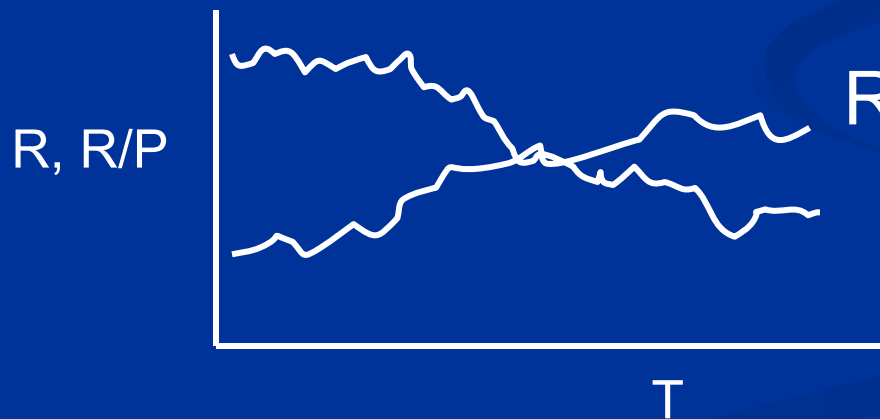
- Scarcity of a resource may be implied when there is a:
 - Price increase
 - Cost increase
 - Rent increase
 - Psychological hype
 - Collusion among producers
 - Speculation regarding availability

Possible Trends



$$P(C) = \alpha_0 + \alpha_1 t + \varepsilon_t$$

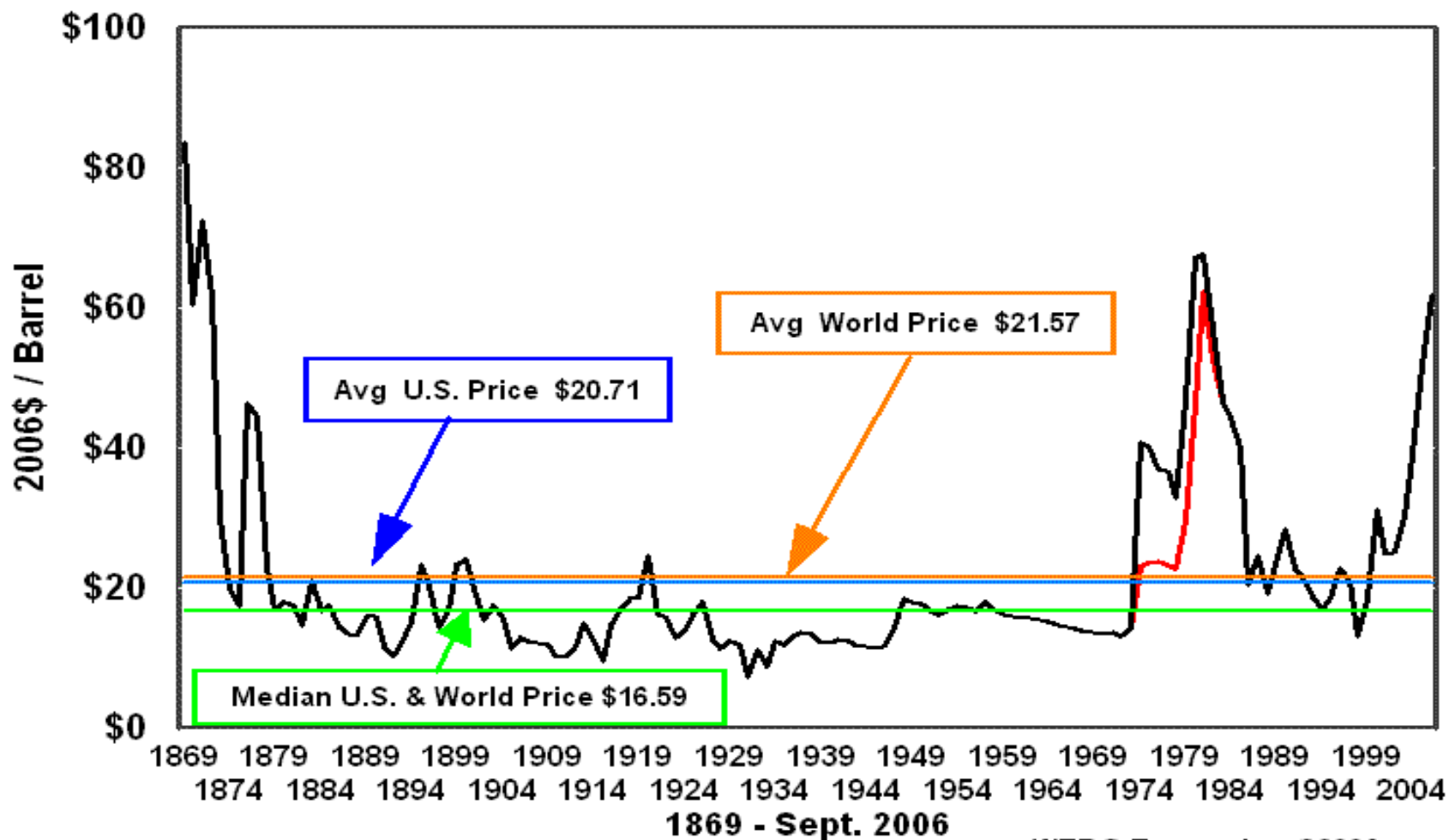
$$P(C) = \alpha_0 - \alpha_1 t + \varepsilon_t$$



$$R = \beta_0 + \beta_1 t + \varepsilon t$$

$$R = \beta_0 - \beta_1 t + \varepsilon t$$

CRUDE OIL PRICES 2006 DOLLARS

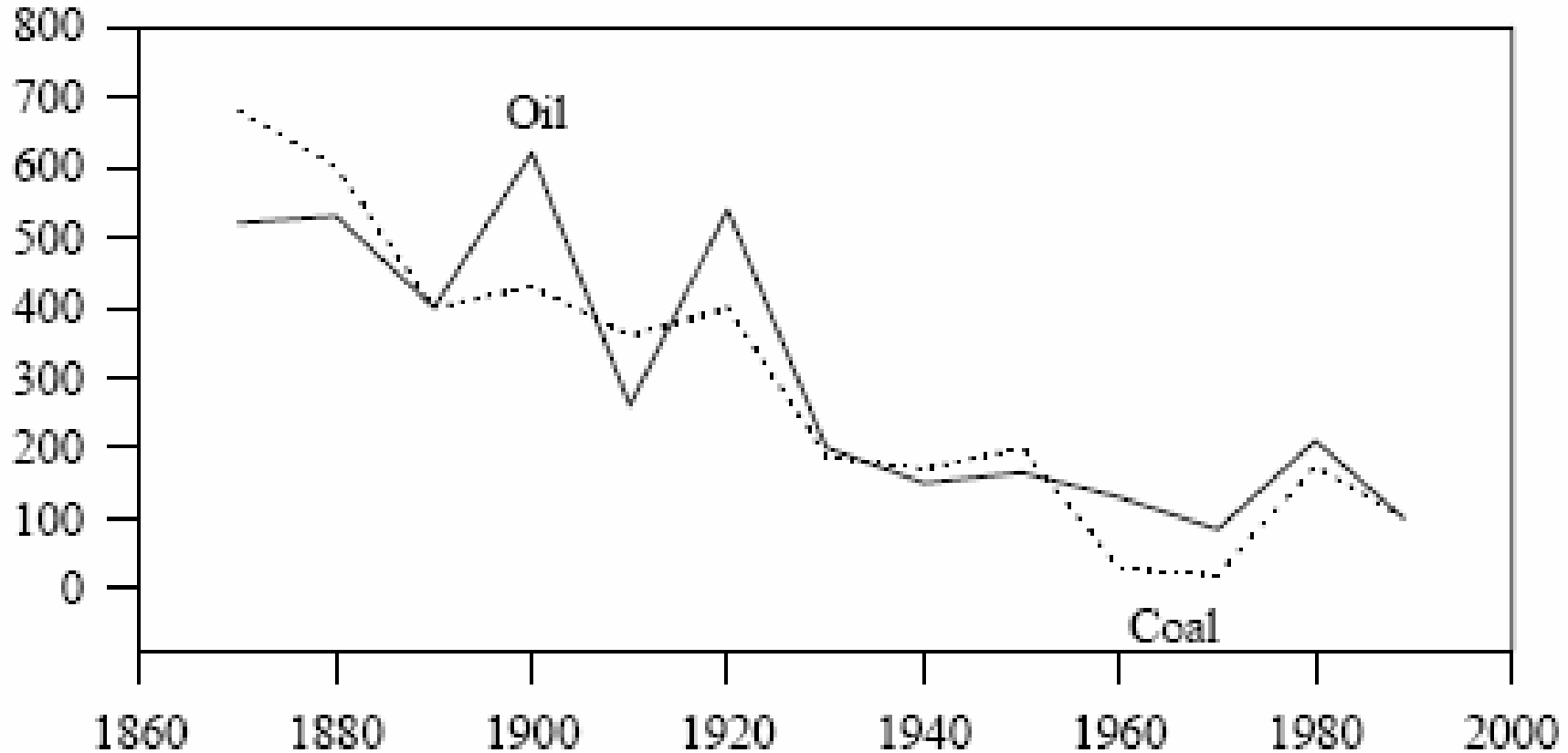


— U.S. FIRST PURCHASE (Wellhead) — World Price*

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Fossil Fuels, Relative indices Price Trends

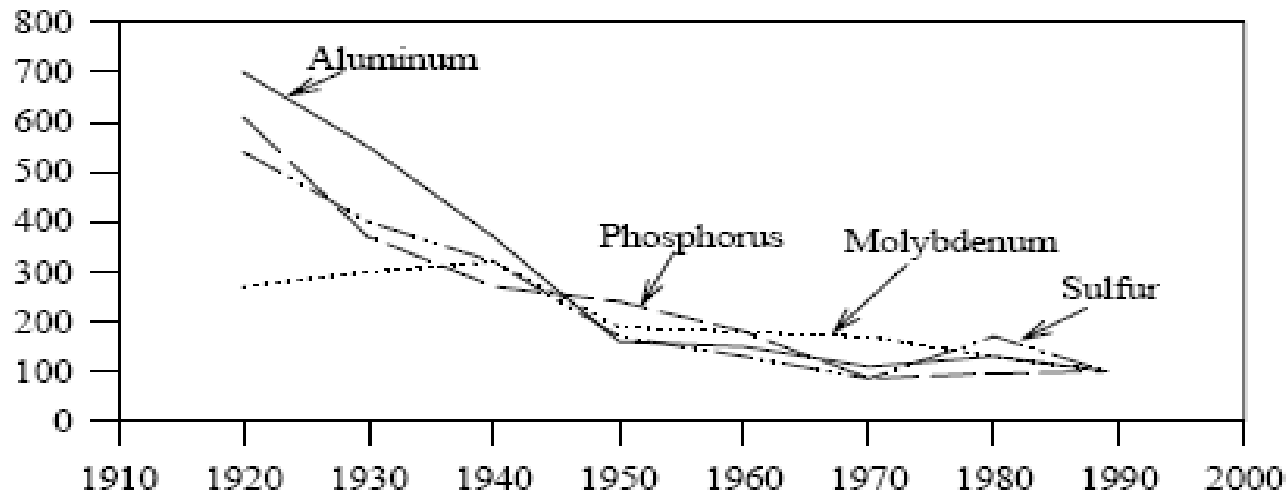
Real price index, 1989 = 100



Source: Norrdau (1992)

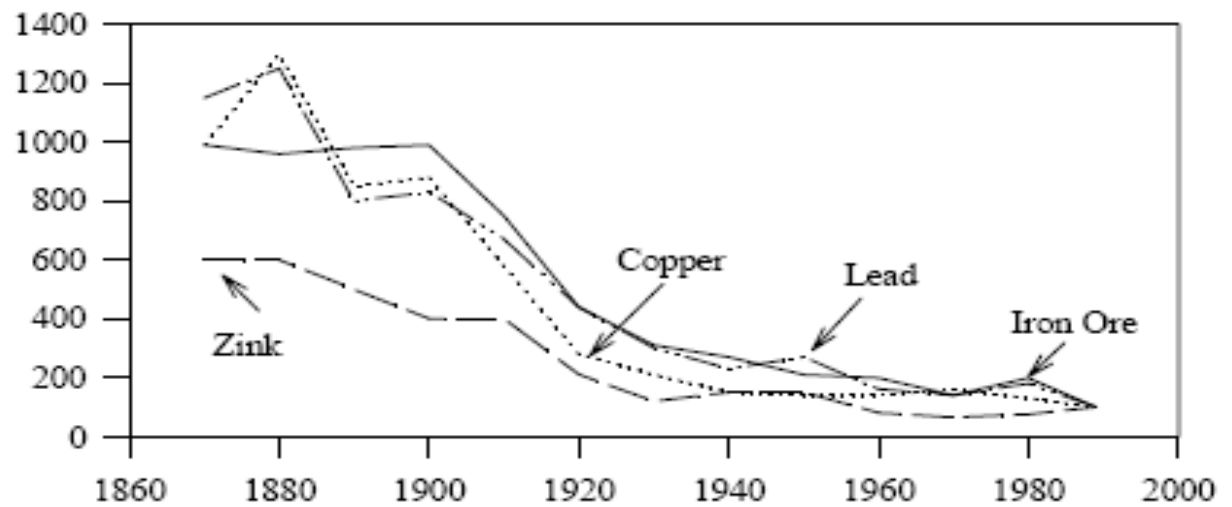
Mineral Price Trend

Real price index, 1989 = 100

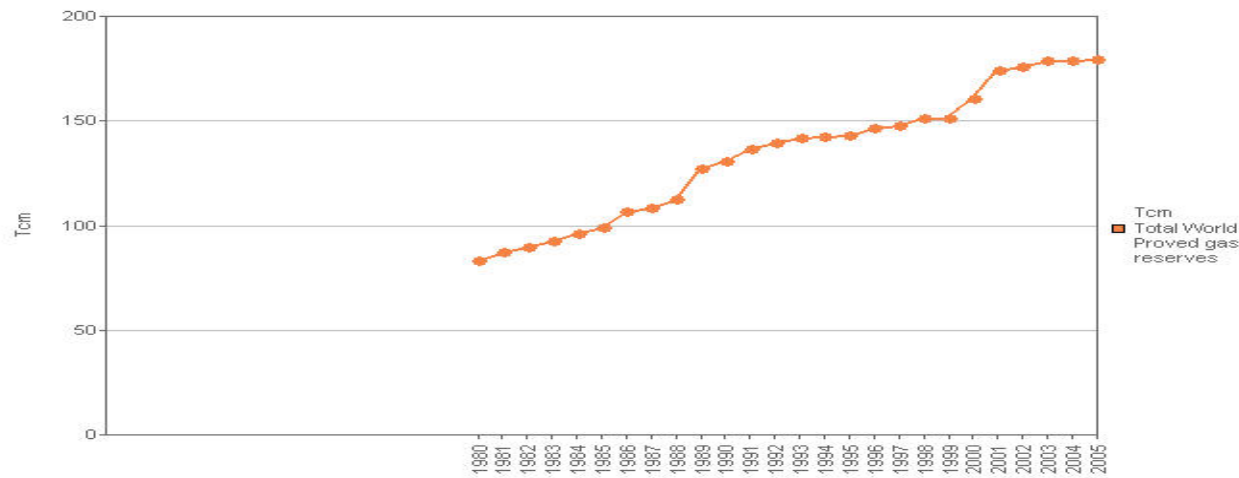


Source: Nordhaus (1992)

Real price index, 1989 = 100

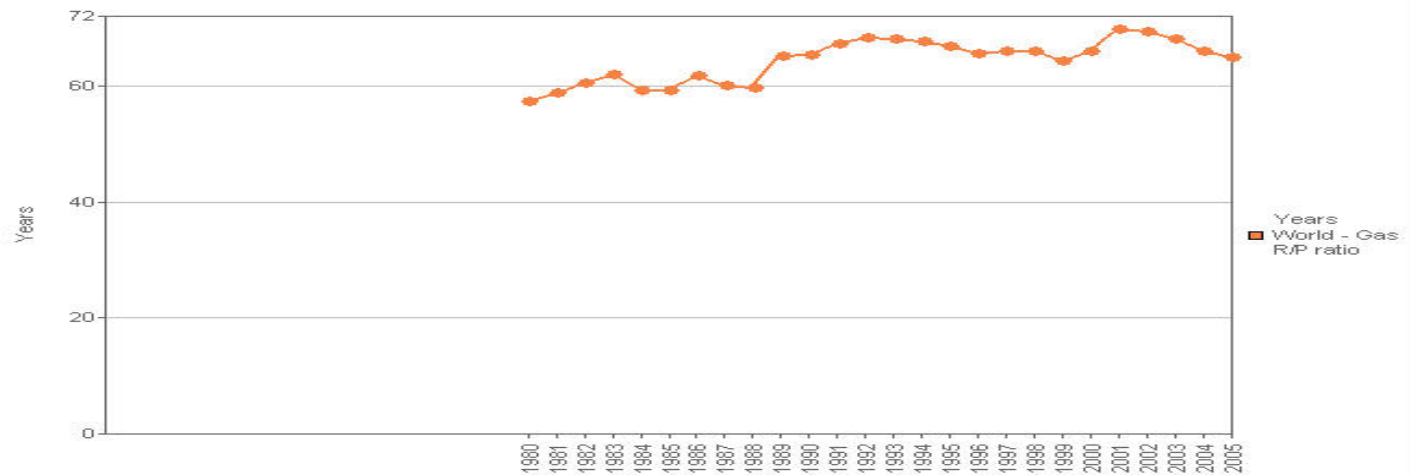


World Gas Reserves



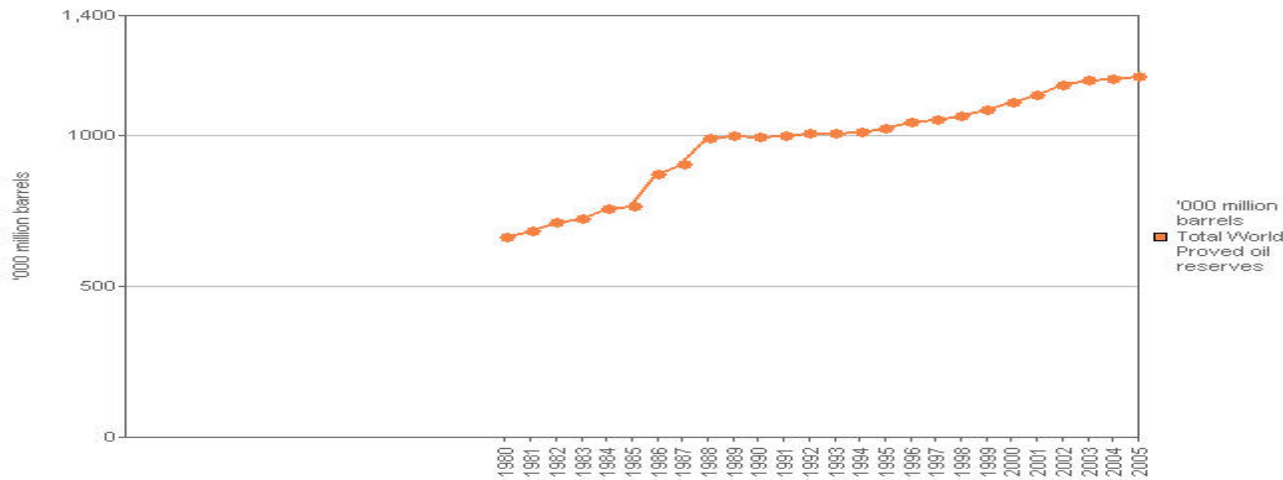
Source: BP Statistical Review of World Energy 2006

World Gas R/P



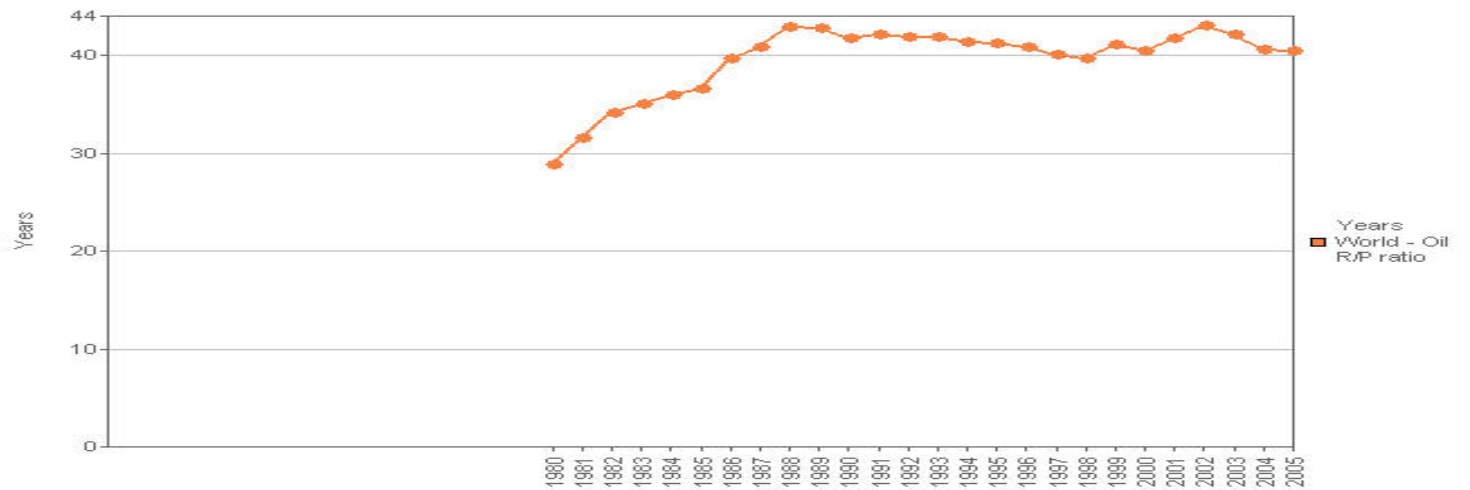
Source: BP Statistical Review of World Energy 2006

World Proven Oil Reserves



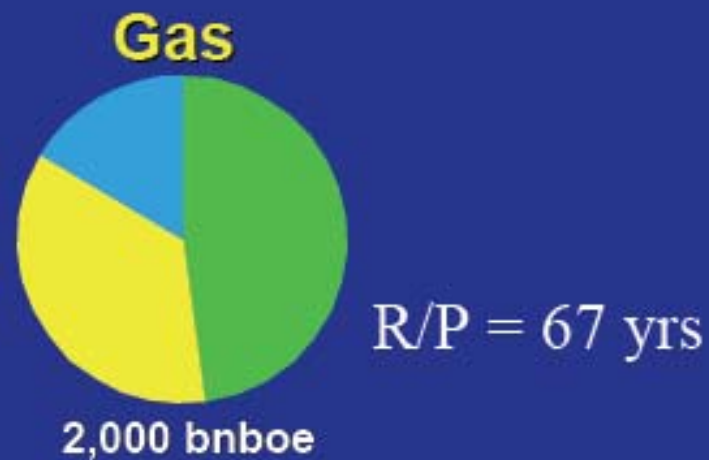
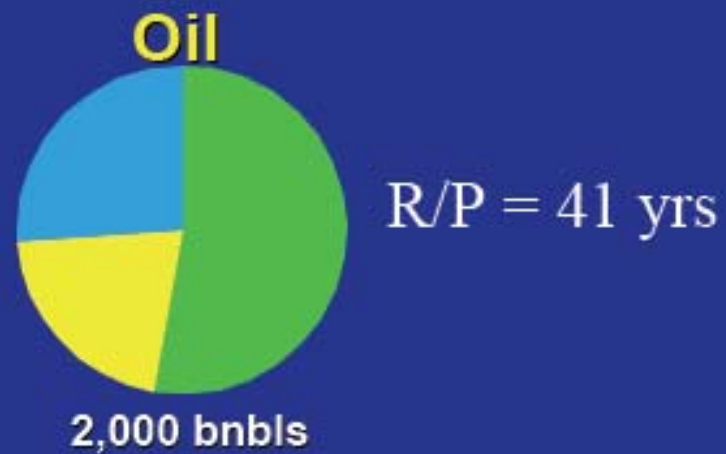
Source: BP Statistical Review of World Energy 2006

World Oil R/P ratio



Source: BP Statistical Review of World Energy 2006

Fossil Fuel R/Ps



Based on the numbers...

- Economic, and physical indicators do not conclusively imply that fossil fuels are getting scarce
- Previous (historical) increases in price of crude have been initiated by speculation and man-made crises.
- Recent (last 5 years or so) increase in real price of crude possibly indicate a tightening of crude supply.

Analysis and Implications

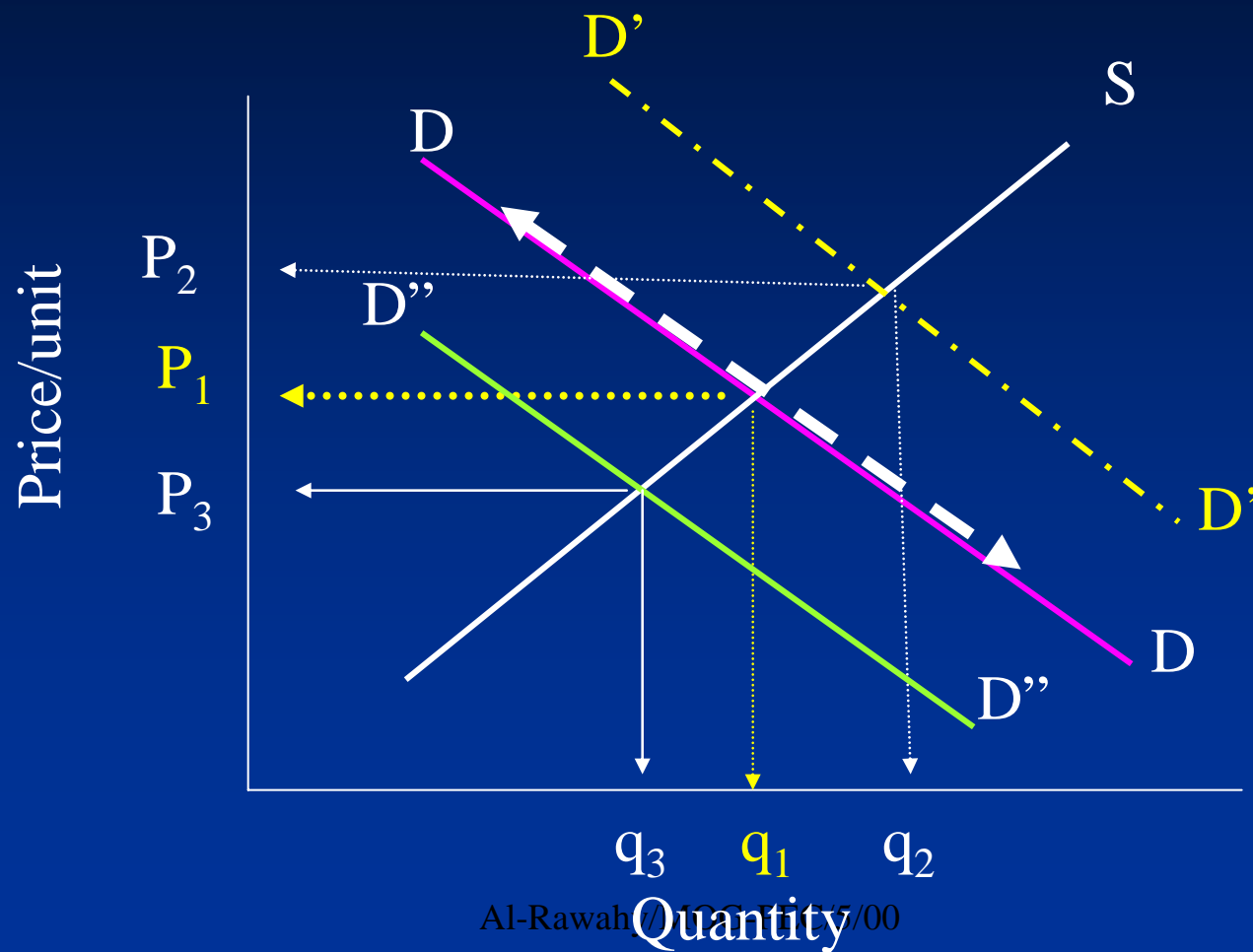
The slide features a dark blue background with a lighter blue horizontal band across the middle. The title 'Analysis and Implications' is centered in the lighter band in a bold, italicized yellow font. In the bottom right corner, there are several overlapping, wavy, light blue lines that create a sense of motion or depth.

Determinants of Demand

- Income
- Price
 - own, substitute
- Population
- Consumer preference

*Movement along
Demand Curve, or
Shift of Demand
Curve*

Demand-Supply Analysis



Supply Extension

Higher Energy Prices

Create new reserves

Capacity addition

Technological Development

Create new reserves

Novel E&P methods

Engineering models

End-use and Demand side options

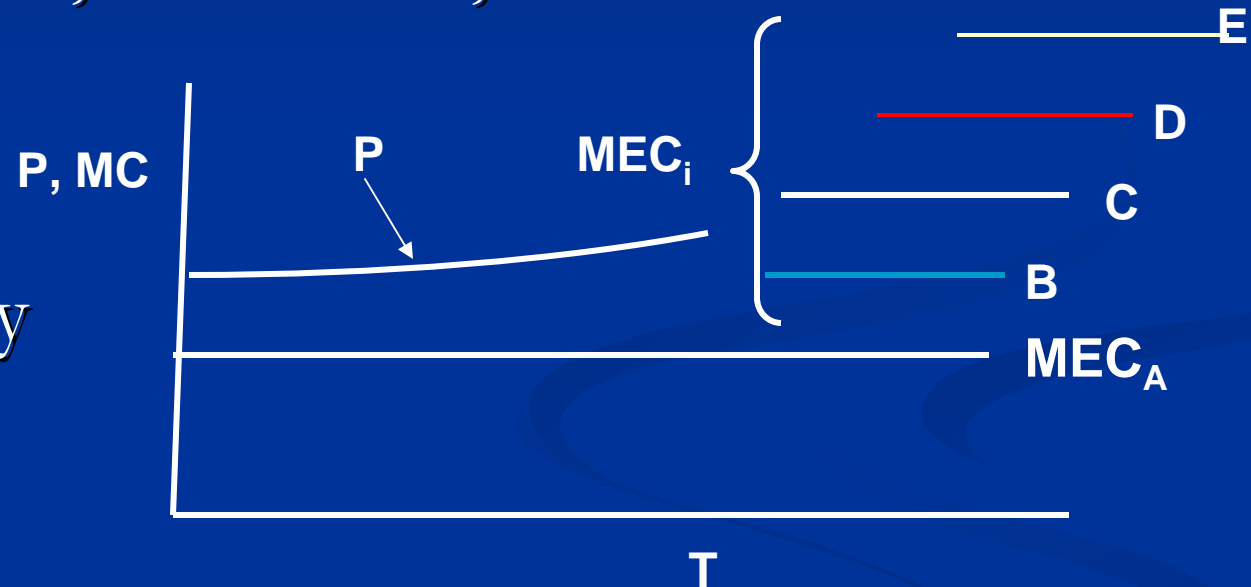
- Efficiency in end-use sectors
 - Appliances, transportation, engine technology, urban planning, reduction in congestion
 - Power plants: increase in efficiency, electricity storage option, hybrid option
 - Industry: smart(er) manufacturing centers
 - Others

Supply Mechanics

- Significant Energy supply sources:
 - Conventional and unconventional oil, gas, coal
 - Nuclear and renewables.
- Economics:
 - As $D > S$, increase in price \longrightarrow encourages exploration \longrightarrow discovery \longrightarrow more reserves; also, encourages conservation, substitution \longrightarrow extends depletion time

Concept of Shelf Technologies

- Availability of substitutes
- Varying MEC, ease of use, environmental impact
- Lag time
- Switchability



If price is prohibitive or comparable to the next option, substitution occurs.

Essential Questions

- Are reserves sufficient?
- What are the approximate production costs?
- What is the lead time and what are the initial difficulties for significant production and use globally?
- What are the approximate prices for end-users?
- What are the environmental impacts from using the resource?
- Sustainability

Do we have an Energy Crises?

- Absolutely NO, Plenty of other energy sources are available.
- Crude oil is least in reserves among the fossil fuels, but is the most used as a source of energy...convenient, availability, oil-based equipments.
- Environmental concerns will be important in shaping up the fate of the other competing/complementary energy sources

The List

- Conventional, Unconventional
- Primary, secondary, tertiary
- GTL, CTL
- Biofuels
-and the Renewables:
Solar, Wind, hydro, geo
- Nuclear

Conclusions

- FF provides more than 80% of global primary energy needs.
- Depletion base of FF can be effectively lengthened through a variety of implementable options:
 1. Engineering, science, technology, and continued R&D. Recovery improvement; engineering technologies in developing, and conversion of reserves, better understanding of the biology, chemistry and physics of reservoirs and fluids, extend base assets, prioritize end-use sectors, innovative and effective approach in supply and curtailing demand

Conclusions

2. Diversification of energy sources
3. International trust, respect, cooperation, and dialogue between nations.