

Conventional energies/ Development and the environment

International Master in Sustainable Development and
Corporate Responsibility

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PROFESSOR

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Session 1

Natural resources of non-renewable energies

World energy overview



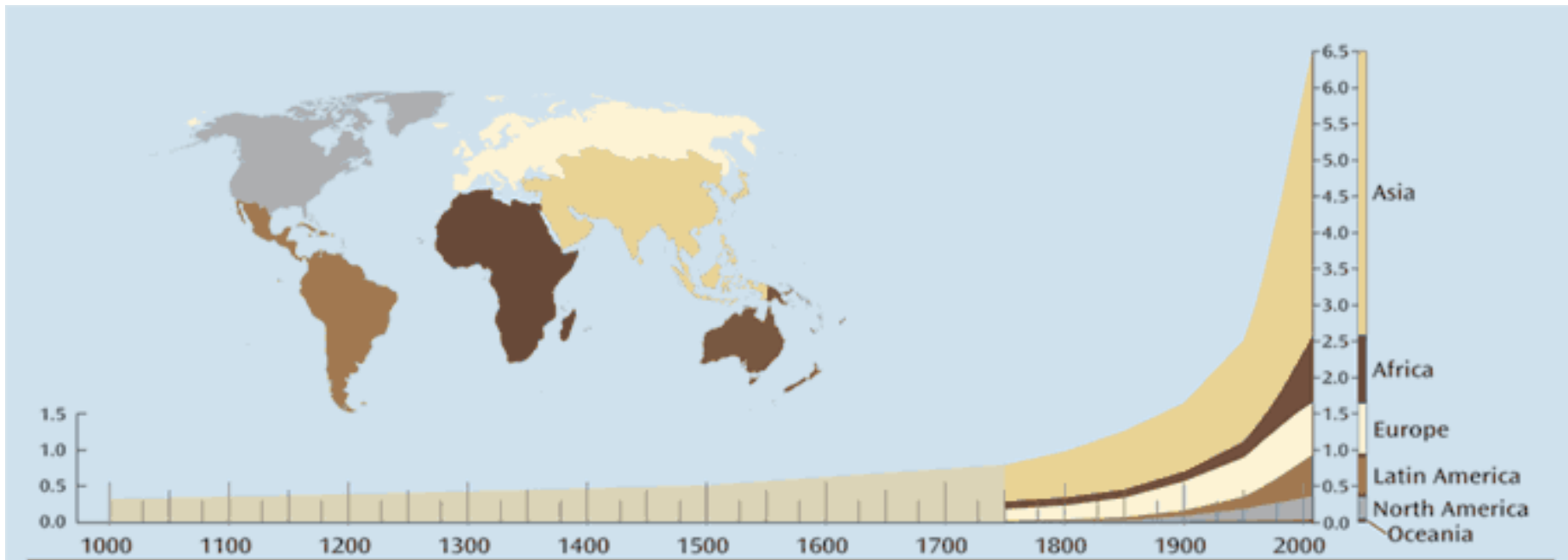
Available energy is a basic necessity of our society.

Without it, virtually all the “routine” commodities would end:

Electricity, transport, heating, potable water, most agriculture, health care, etc.,...

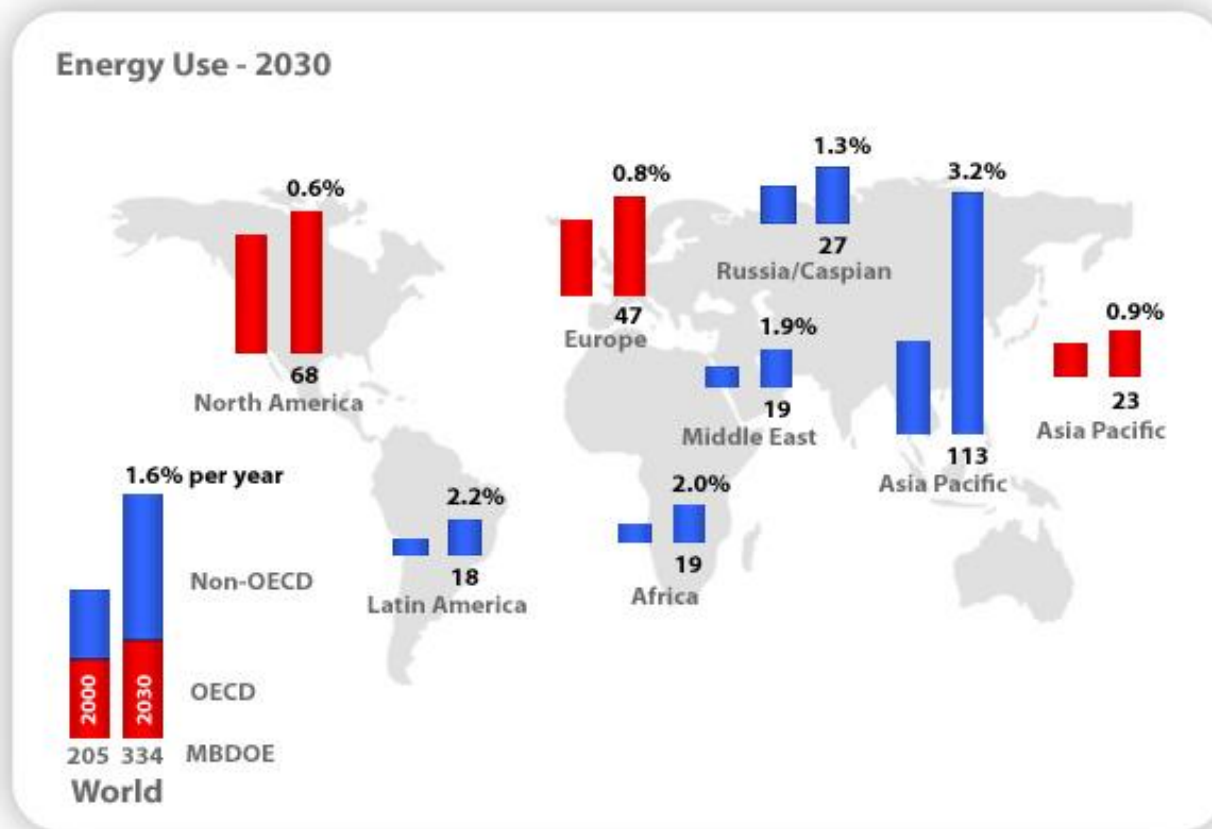
World energy overview

Global Population Growth



World energy overview

Increase of Energy Use



World energy overview



GAS



OIL



COAL

Sources of Conventional Energies



NUCLEAR

World energy overview

Units of Energy

CALORIE: Heat required to raise the temperature of 1 g of water by 1°C

BTU: Heat required to raise the temperature of 1 pound of water by 1°F

JOULE: 0.24 cal = 0.001 BTU (approx.)

WATT: 1 J/s (1 kWh = 1 kW × 1 hour = 1000 × 3600 J = 3.6 × 10⁶ J)

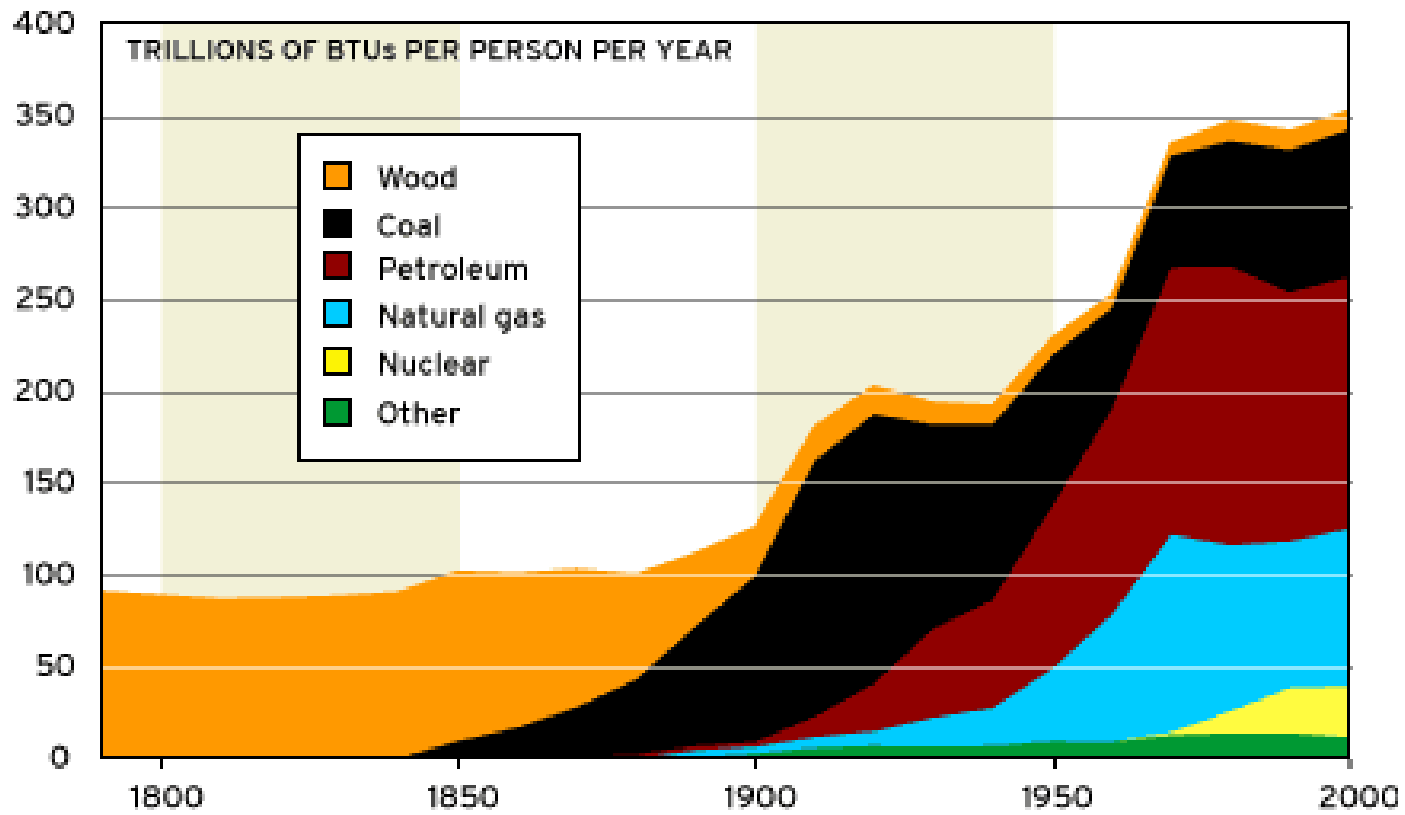
TCE (Tonne of Coal Equivalent): Heat released by burning 1 ton of a typical coal (29 GJ)

TOE (Tonne of Oil Equivalent): Heat released by burning 1 ton of a typical crude oil (42 GJ)

BOE (Barrel of Oil Equivalent): Heat released by burning 1 barrel (159 liters = 42 US Gallons) of a typical crude oil (6 GJ)

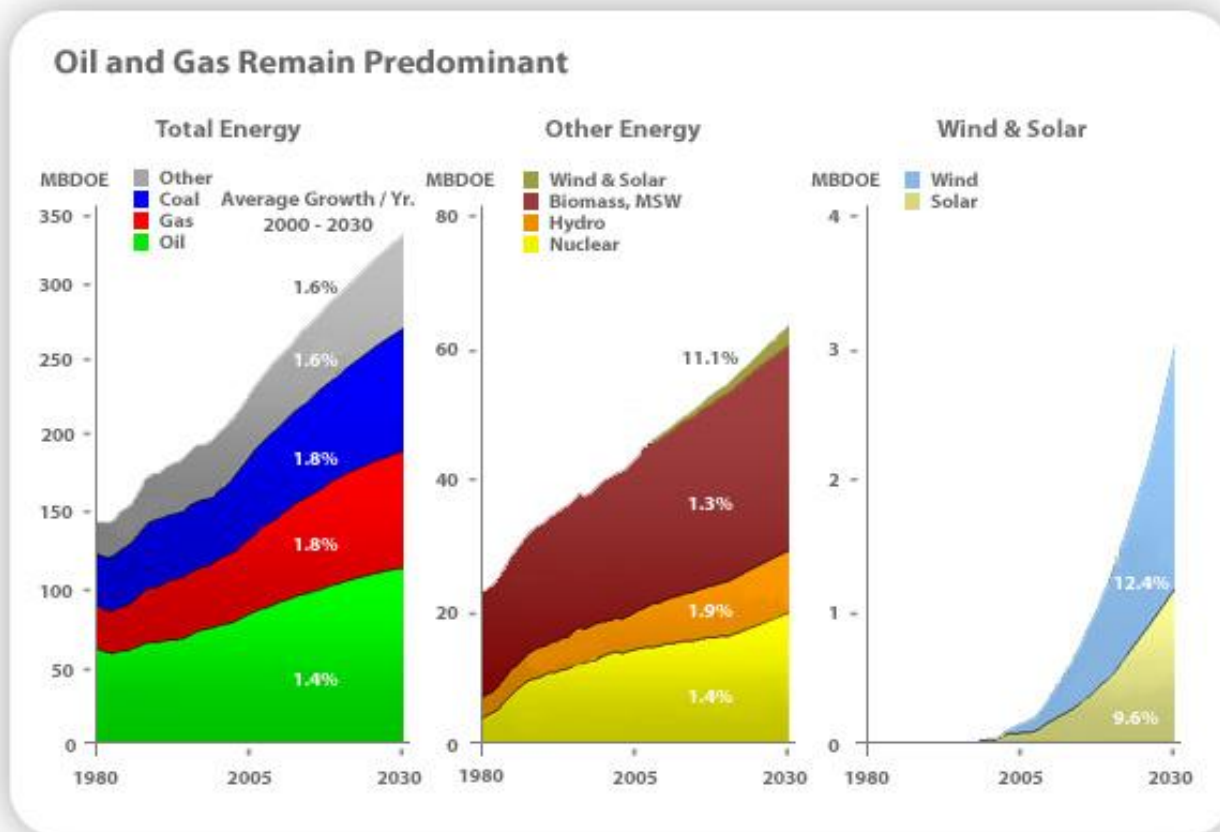
World energy overview

Energy Mix (USA)



World energy overview

World Energy Consumption (daily) per Source



World energy overview

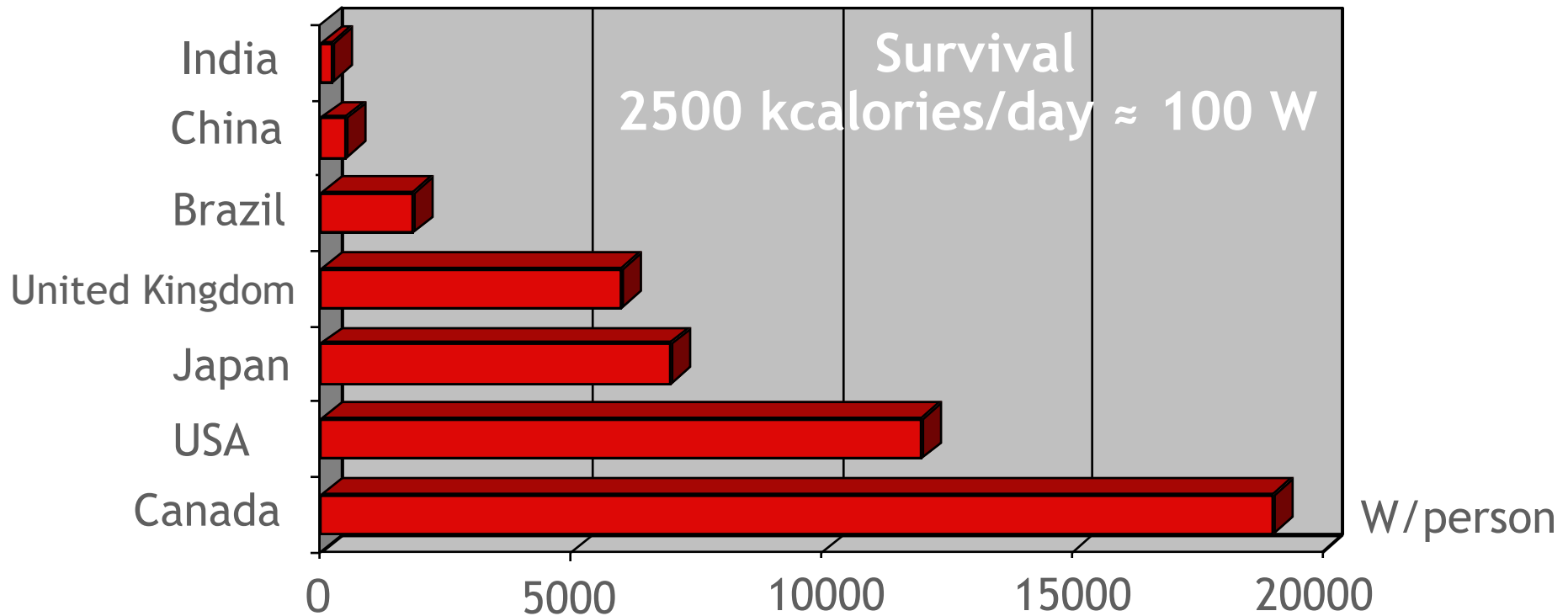
Final Use of Energy (OECD)

ELECTRICITY	20%
TRANSPORT	30%
HEATING & COOLING	50%

The world currently requires over **200 million barrels** of oil equivalent per day to support economic growth. That requirement will only increase as time goes on due to population growth and the industrialization of nations such as China and India.

World energy overview

Energy requirements per person



World energy overview

World Energy Consumption Increase

Assumption: Population doubles and less than 1/3 of American consumption allows a reasonable quality of life

World average: 2,000 W/person
Total Consumption:
6,500 millions x 2,000 x 1 year = **13 TWy**

World
Consumption
of Energy

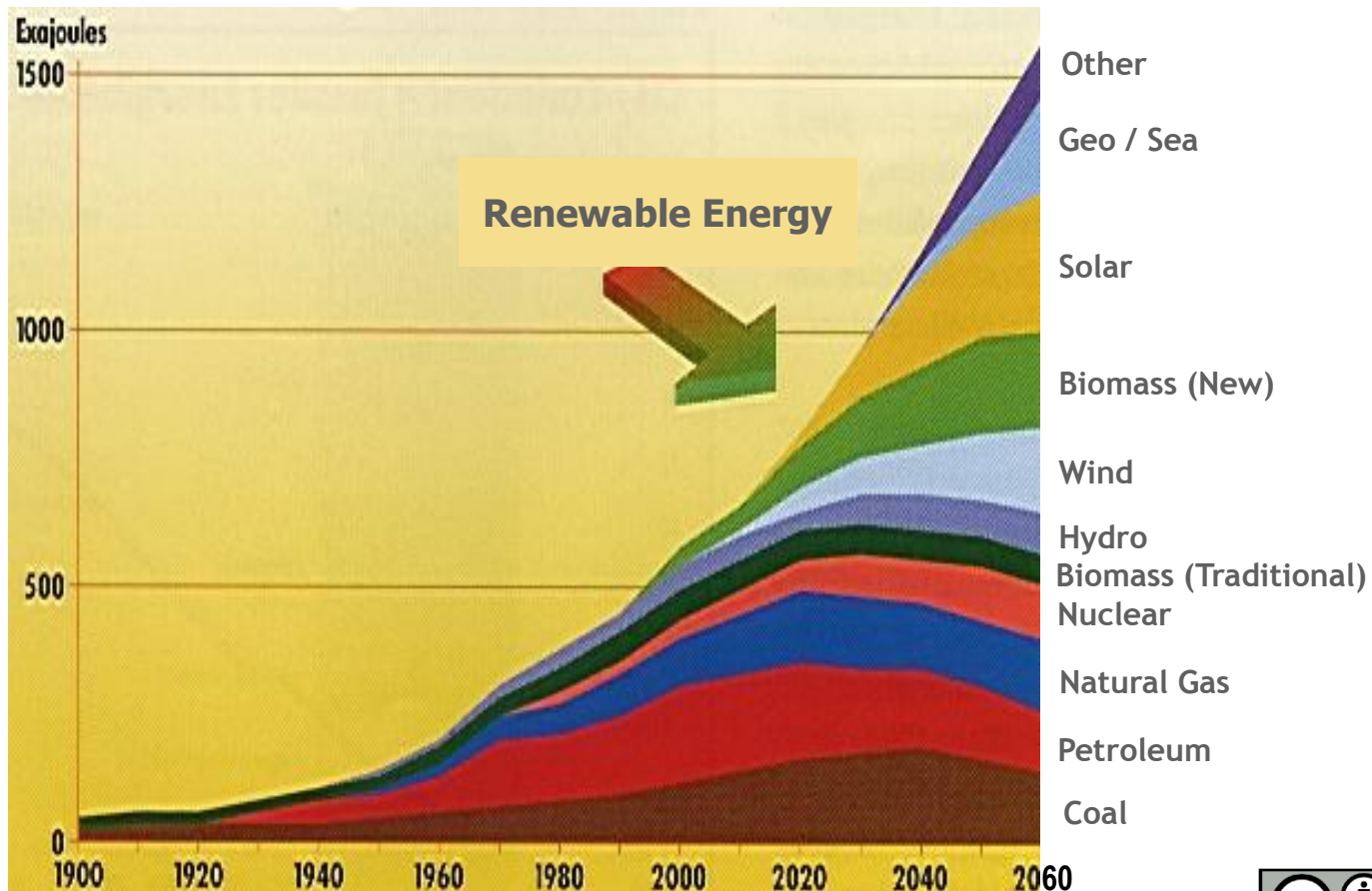
x 3? =

World
Consumption
of Energy
XXIst Century

Total Consumption (XXI):
13,000 millions x 3,000 x 1 year = **39 TWy**

World energy overview

Renewable Scenario



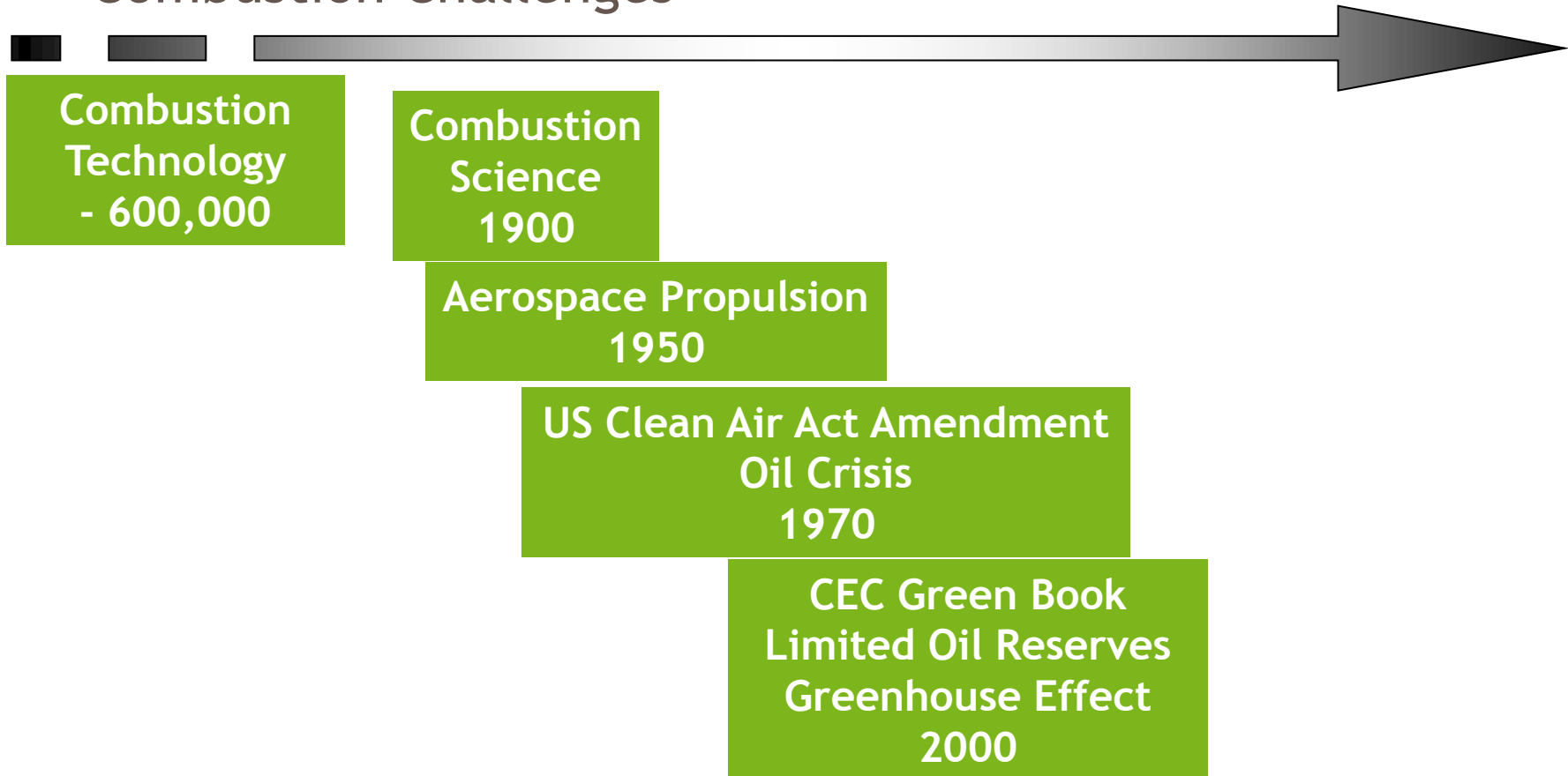
World energy overview



Punishment of Prometheus for giving
fire to mankind

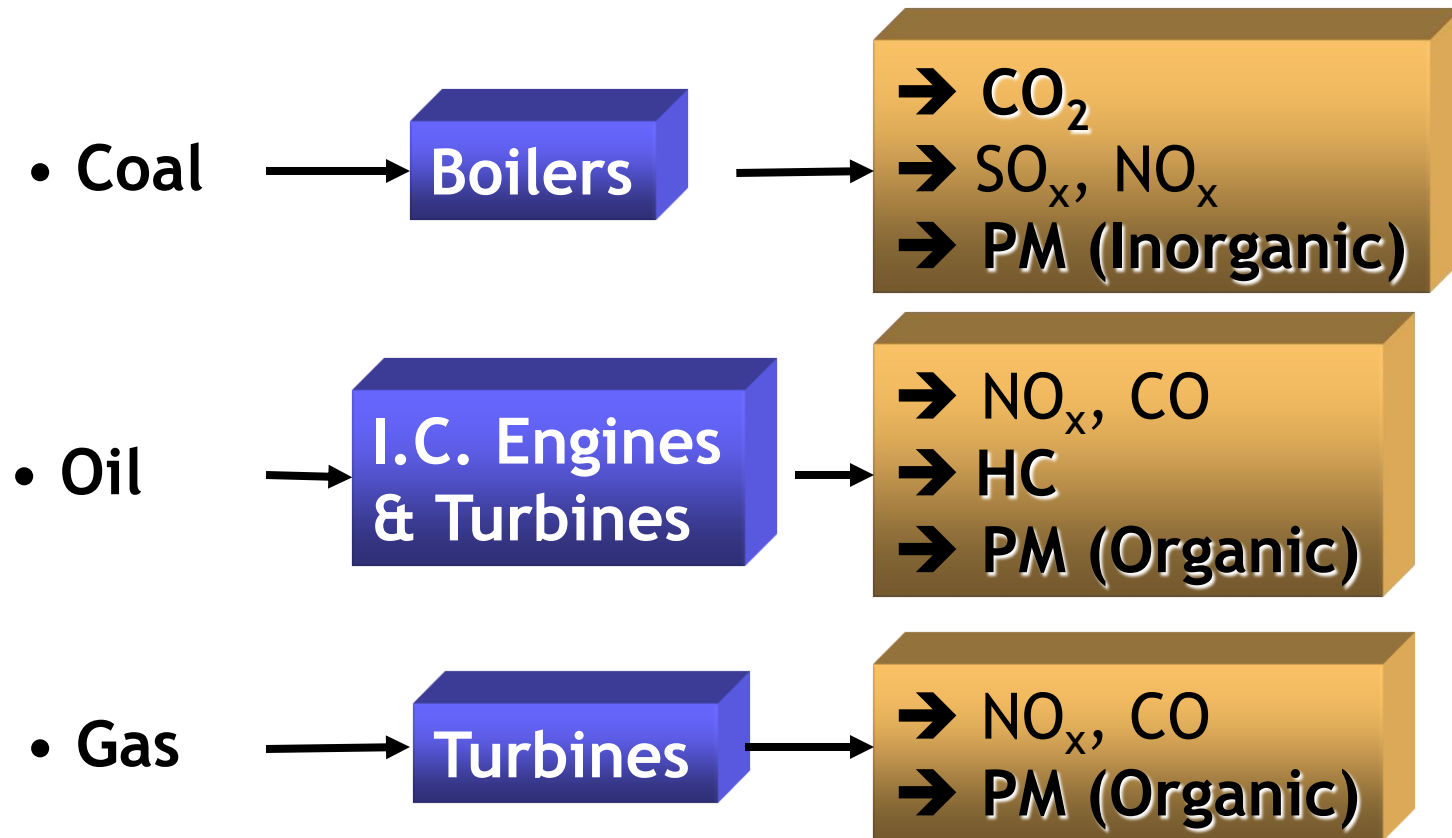
World energy overview

Combustion Challenges



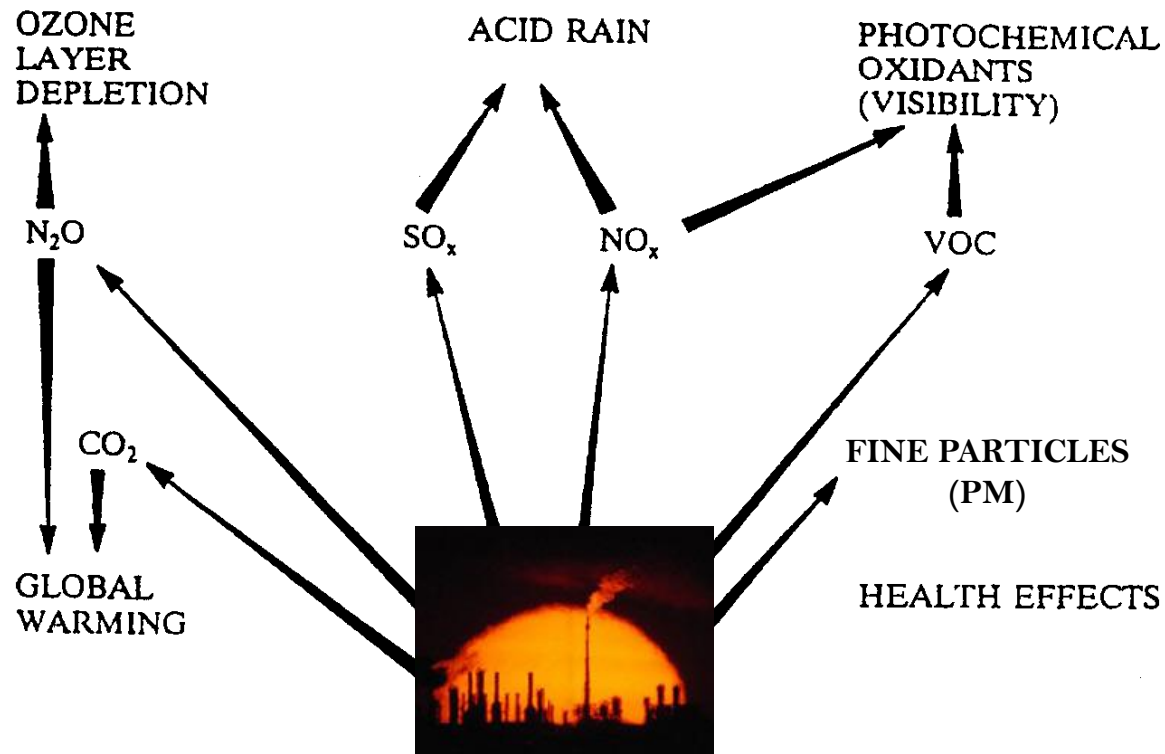
World energy overview

Fossil Fuels and Combustion Technologies



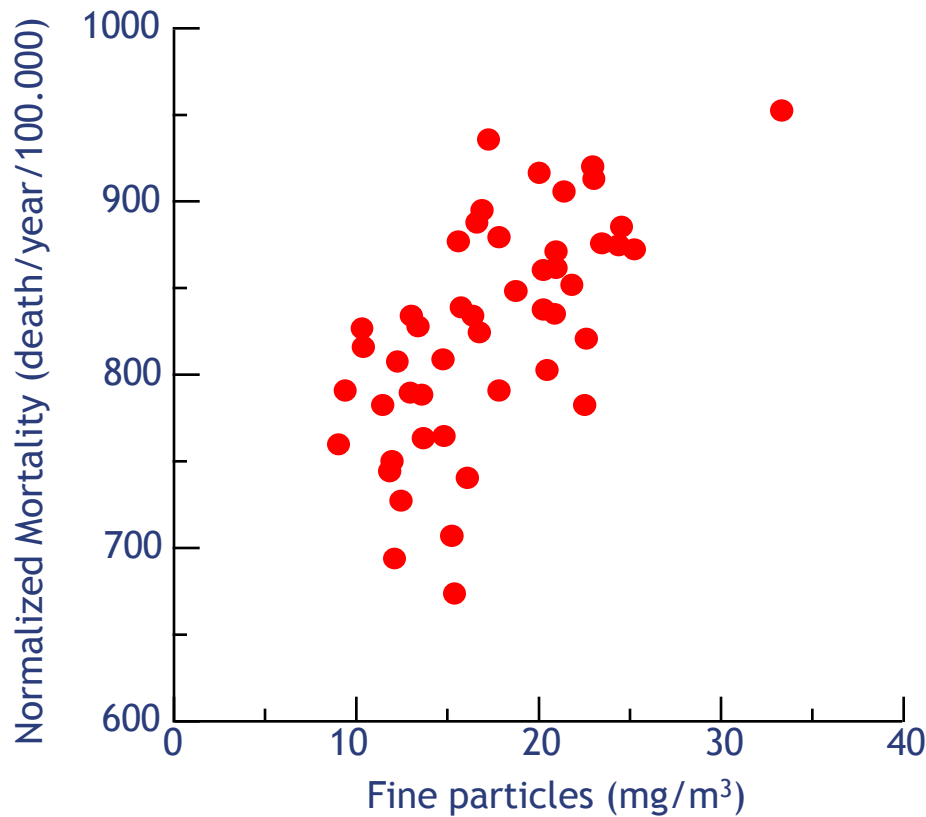
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Combustion Emissions



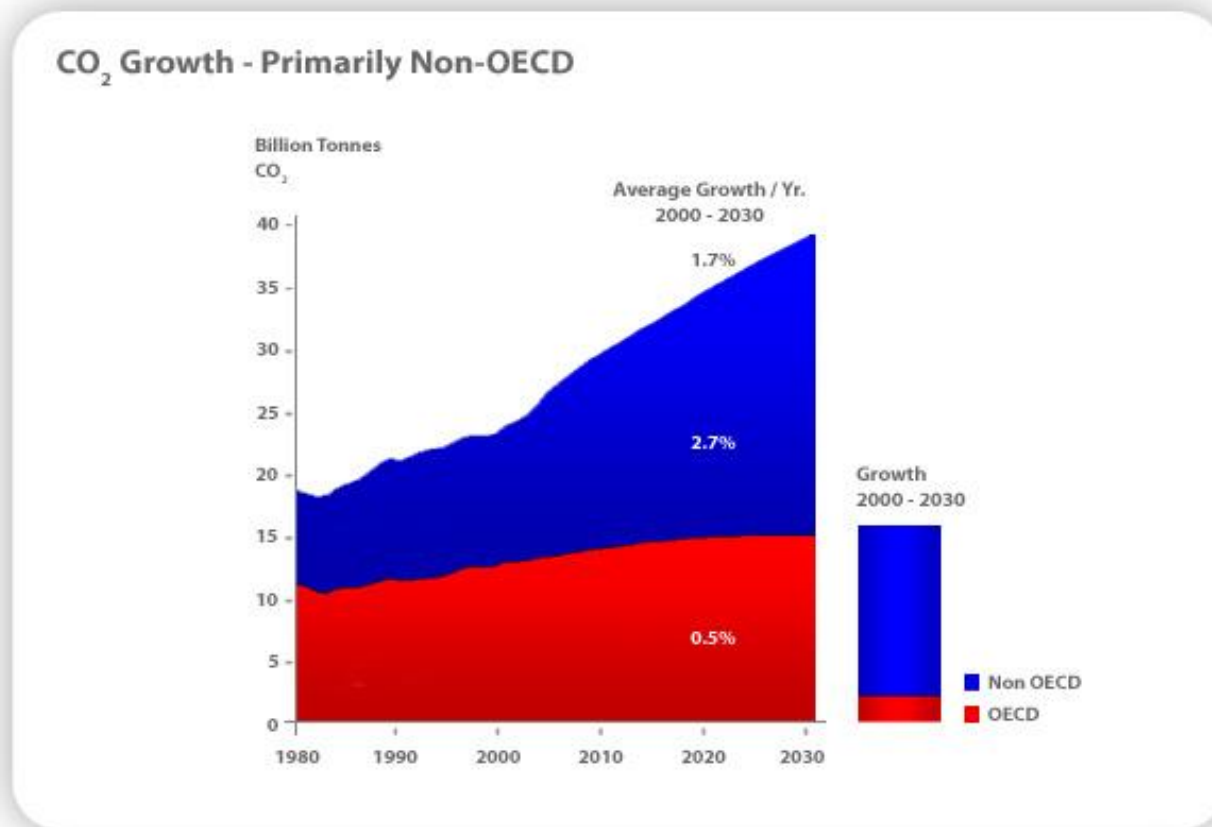
World energy overview

Health Effects of Urban PM



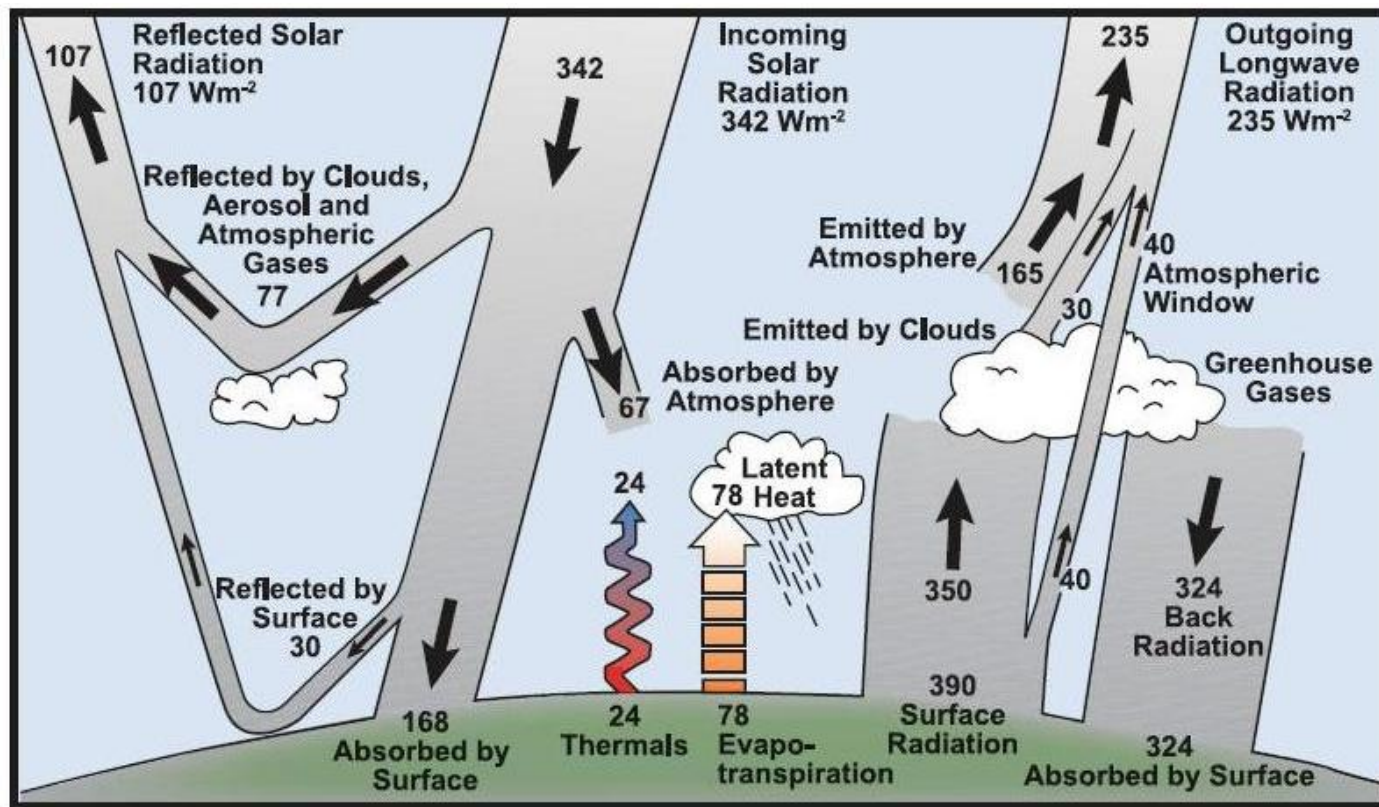
World energy overview

World CO₂ Emissions Scenario



World energy overview

Solar Radiation and Greenhouse Effect



World energy overview

Energy Generation in XXIst Century: Challenges

- Population Growth



Intensive

- Limited Resources



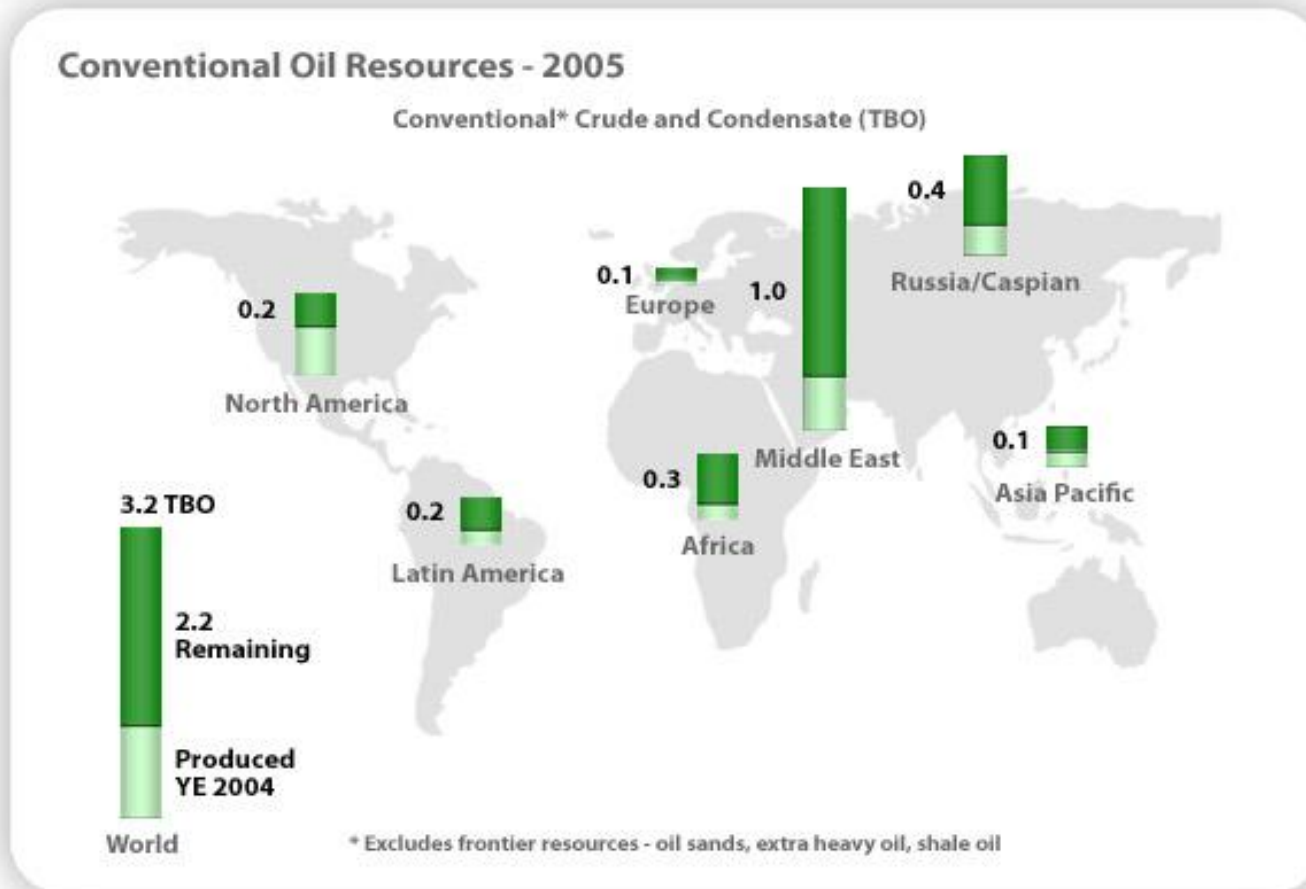
More Efficient

- Environmental Impact



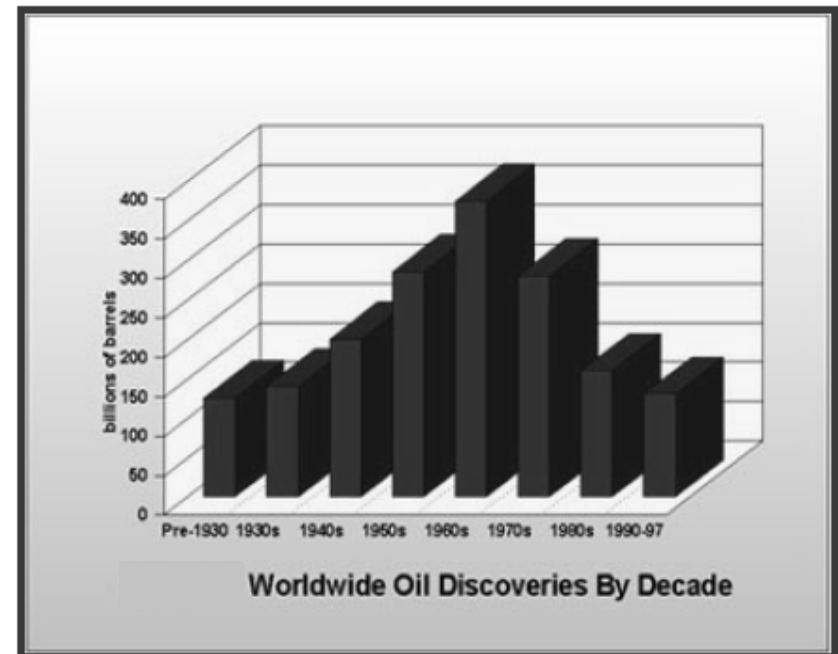
Less Pollutant

Fossil Fuels



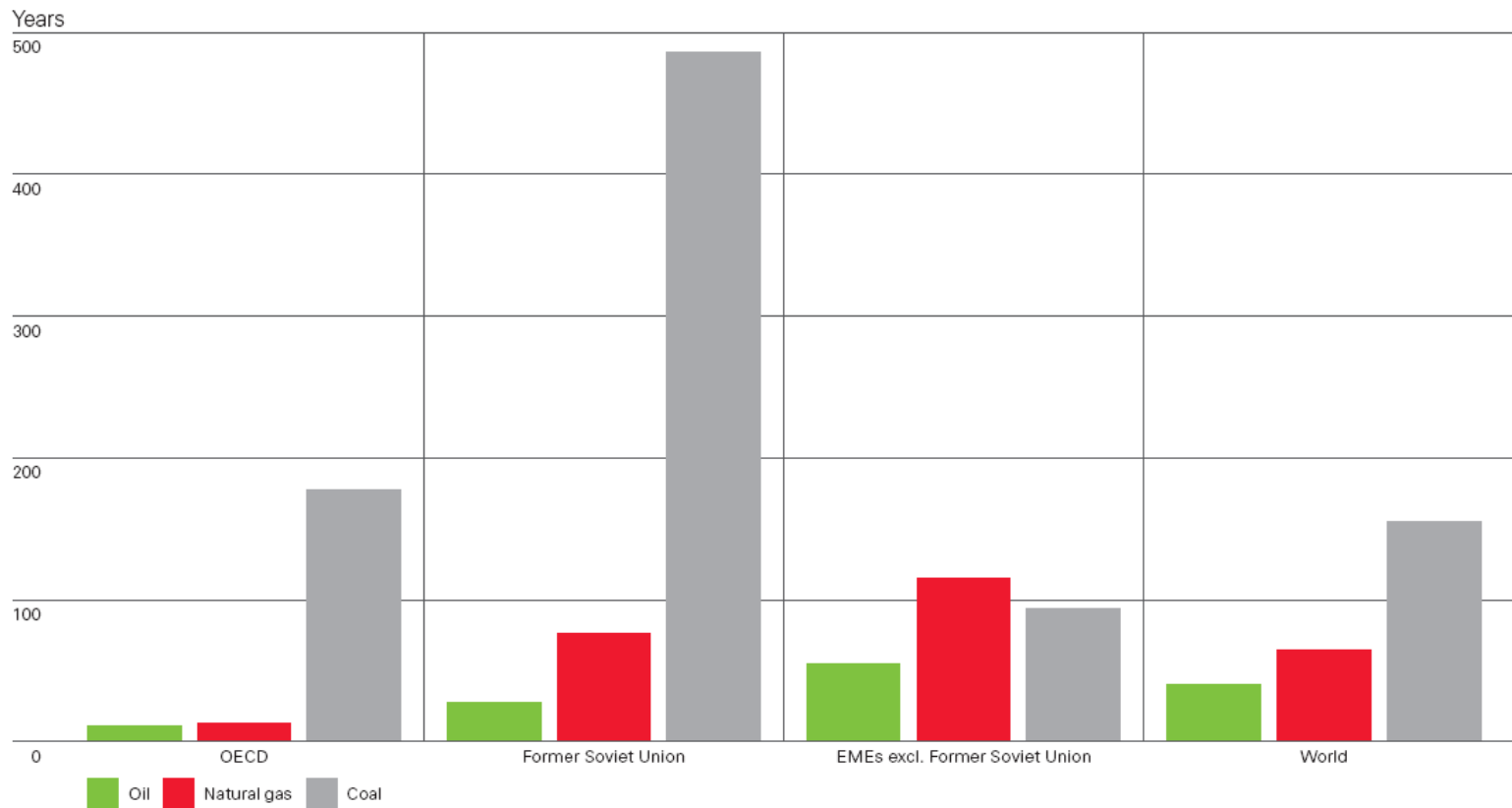
Fossil Fuels

- Large percent of current supply comes from old oilfields:
 - 20% from 14 super giant fields (average age is > 50 years).
 - 70% of oil production comes from fields found > 30 years ago.
- Last new frontier was found decades ago:
 - Arctic oil (North Slope and Western Siberia) = 1960s
 - North Sea = 1970s
- Deepwater oil in mature basins was final frontier = 1990s
 - Gulf of Mexico - Peaking (?)
 - Brazil - Peaking (?)
 - West Africa



Fossil Fuels

World Reserves / Consumption per year



Uranium Minerals

World Reserves of Uranium (Total: 3.3 M tonnes)

