

Institut "Jožef Stefan"

**The Global Crisis:
An Opportunity for New RTD Strategies
in Environmental and Energy Policies**

Boris Pukl

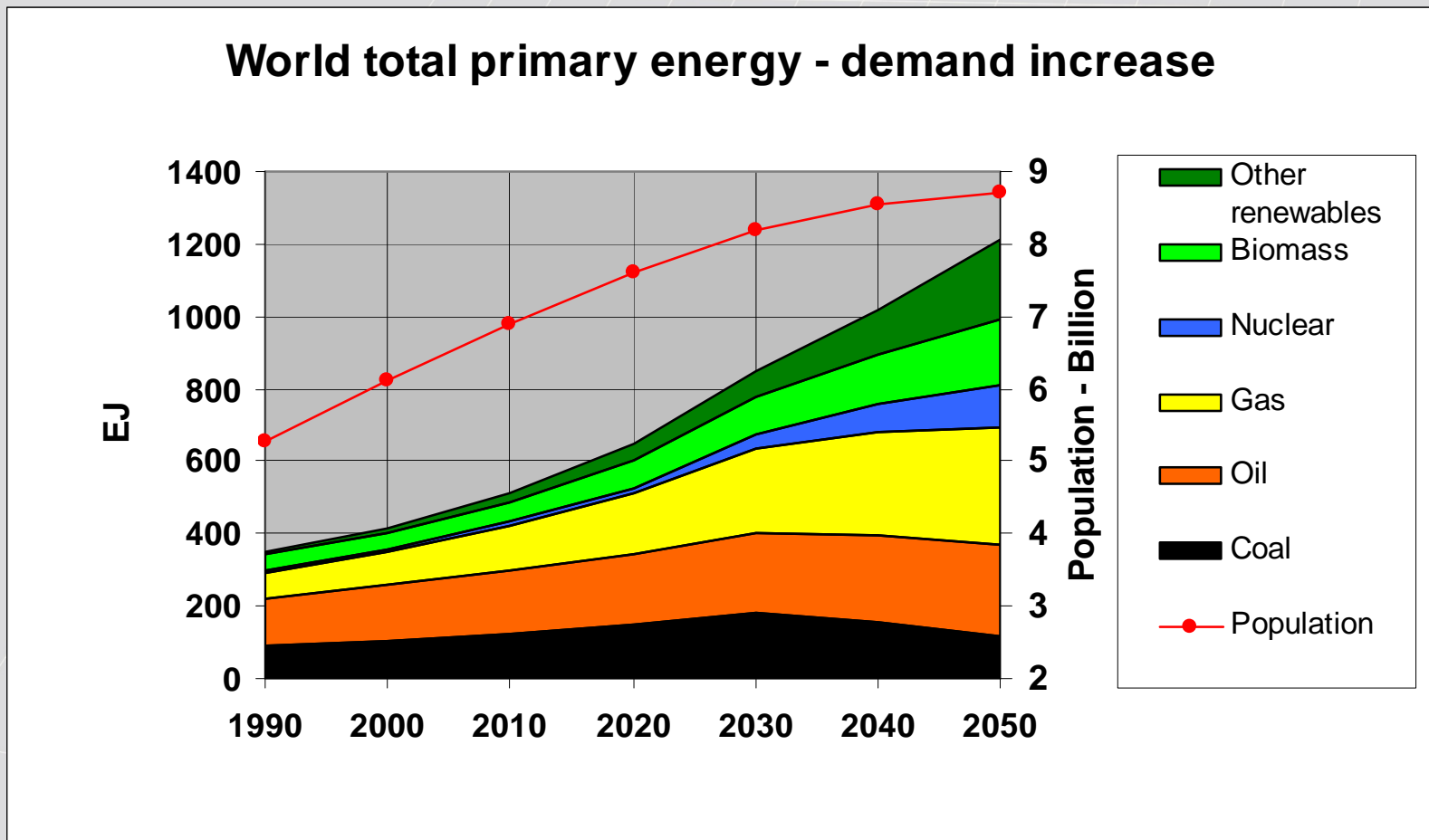
Jožef Stefan Institute, Ljubljana

Institut "Jožef Stefan"

CONTENT

- GLOBAL CONTEXT
- ENERGY AND ENVIRONMENT
- SOME POLICY ASPECTS
- SOME TECHNOLOGICAL ASPECTS
- CONCLUSIONS

WORLD TOTAL PRIMARY ENERGY DEMAND

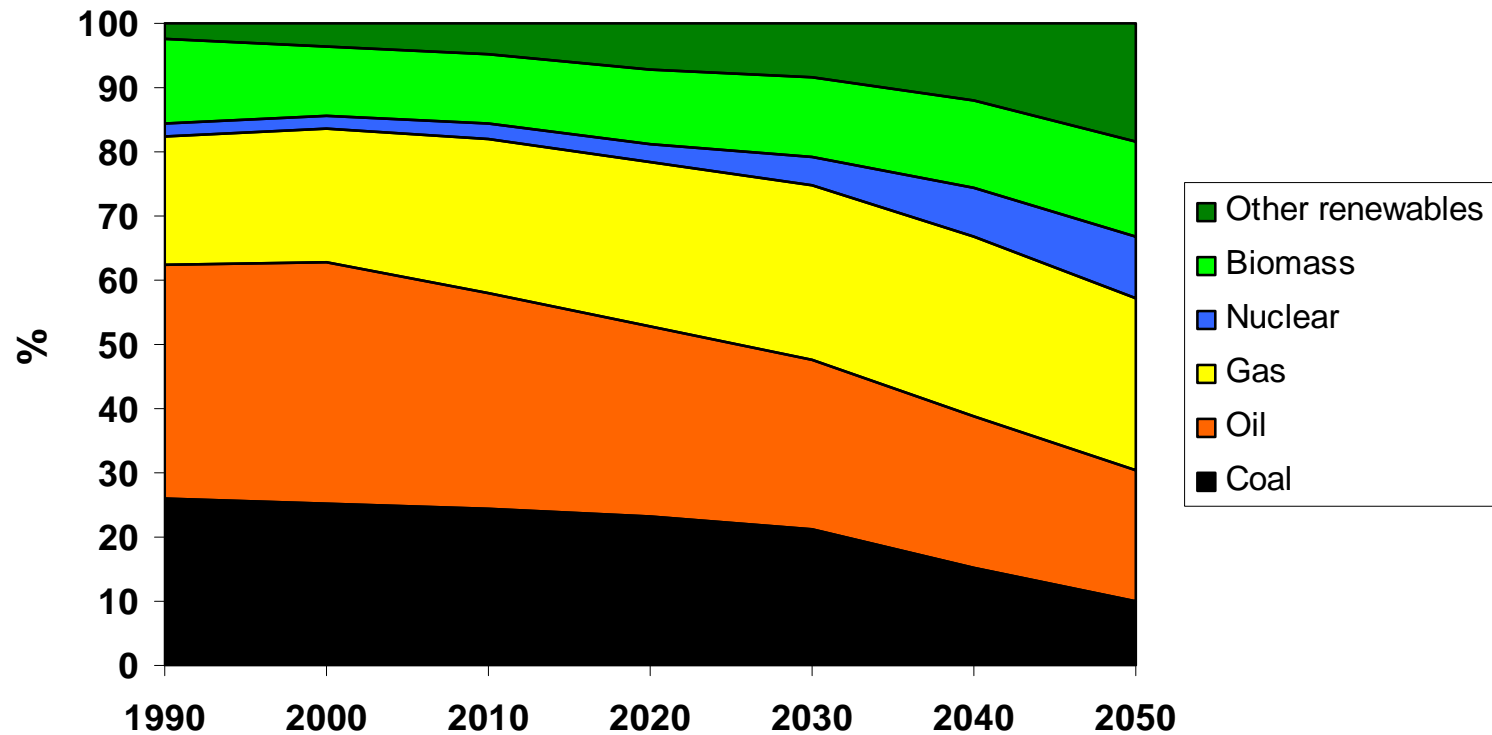


Source: Energy to 2050; IEA 2003

Dubrovnik, 22 - 23 May 2009

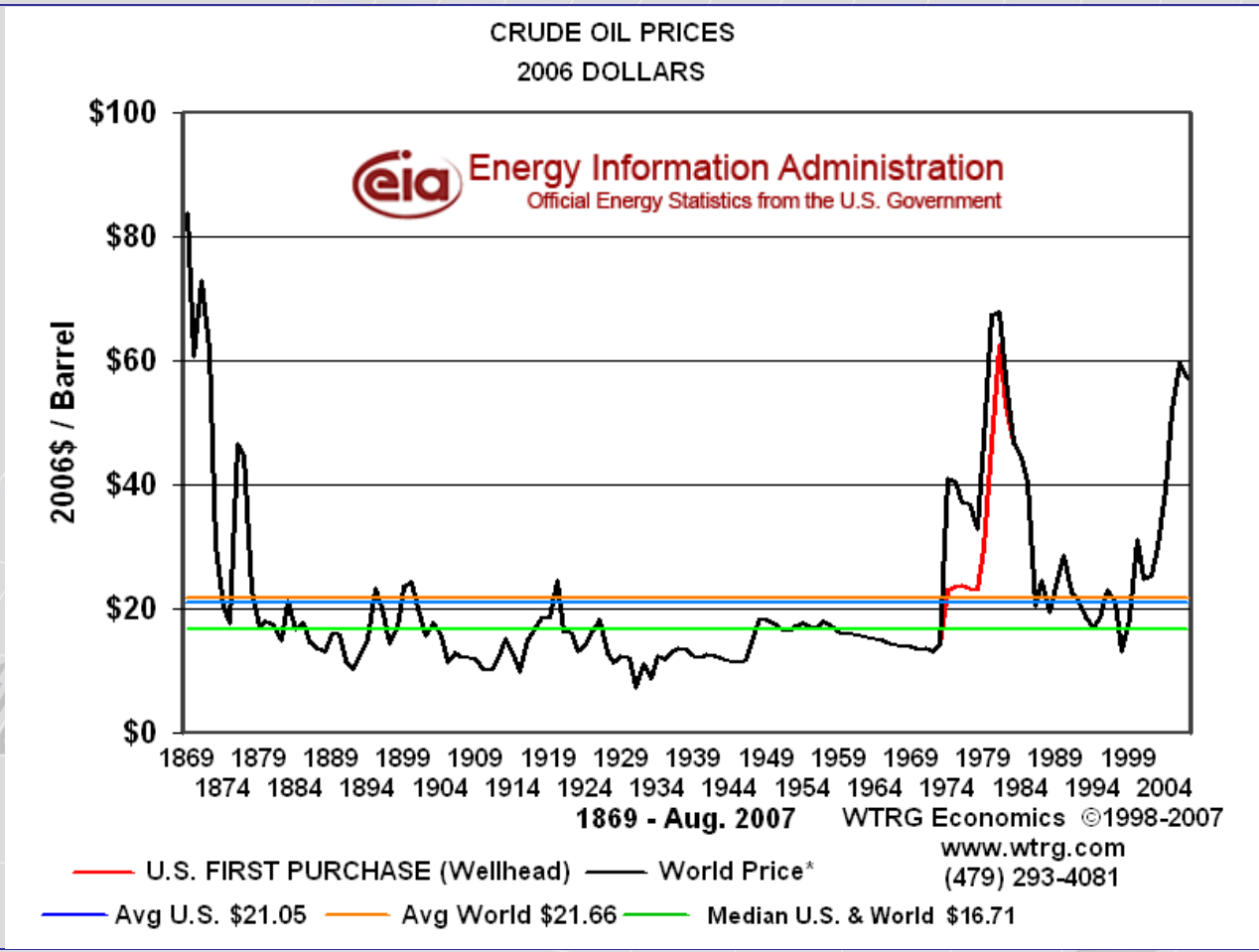
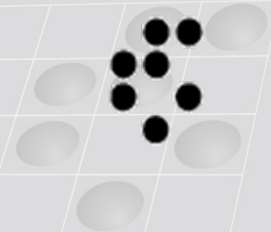
WORLD TOTAL PRIMARY ENERGY DEMAND

World total primary energy - % shares



CRUDE OIL PRICES

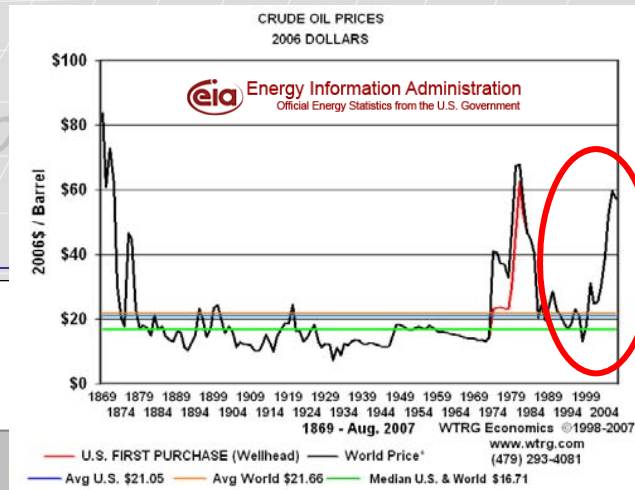
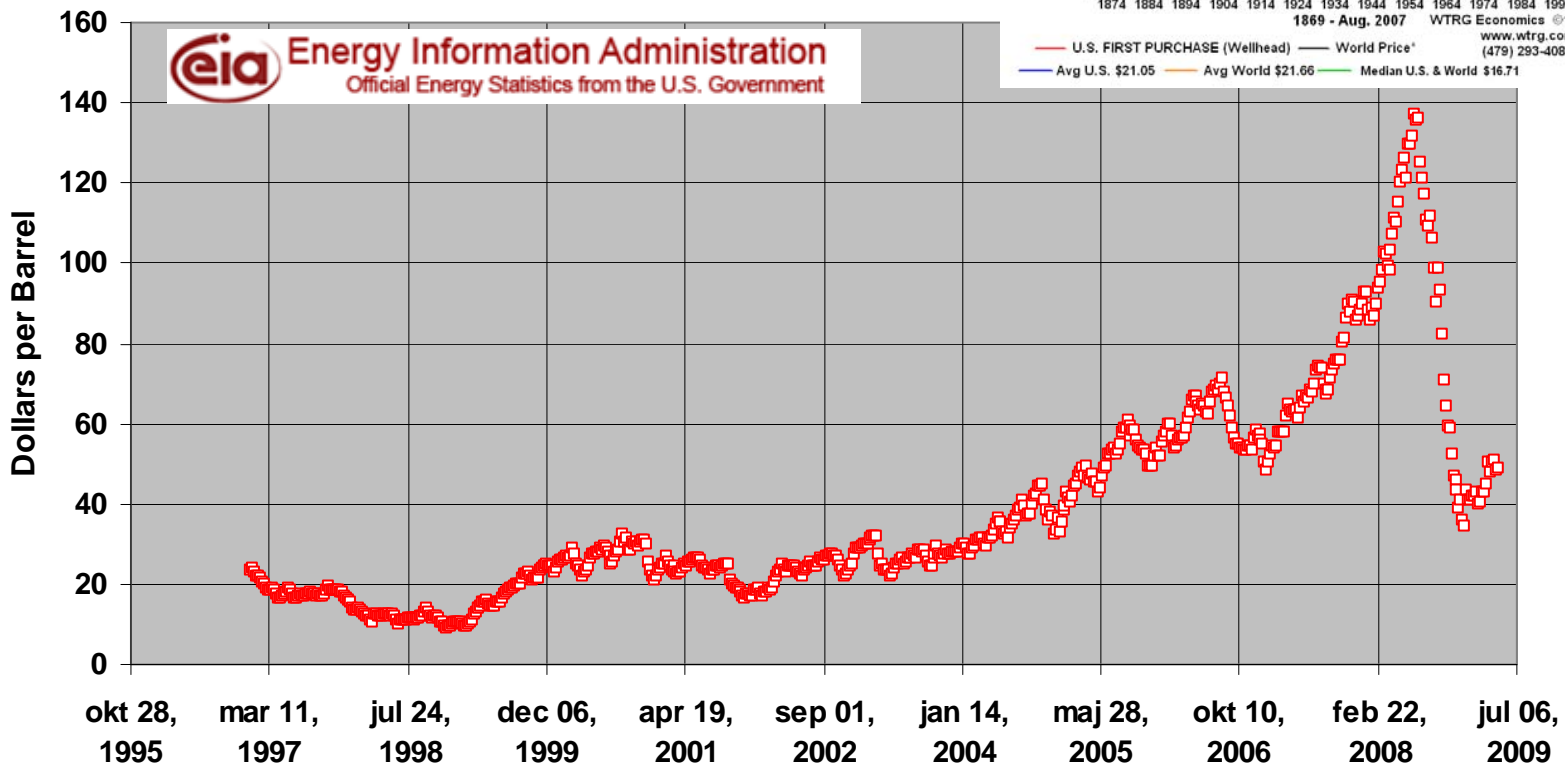
Institut "Jožef Stefan"



CRUDE OIL PRICES

Crude Oil Prices

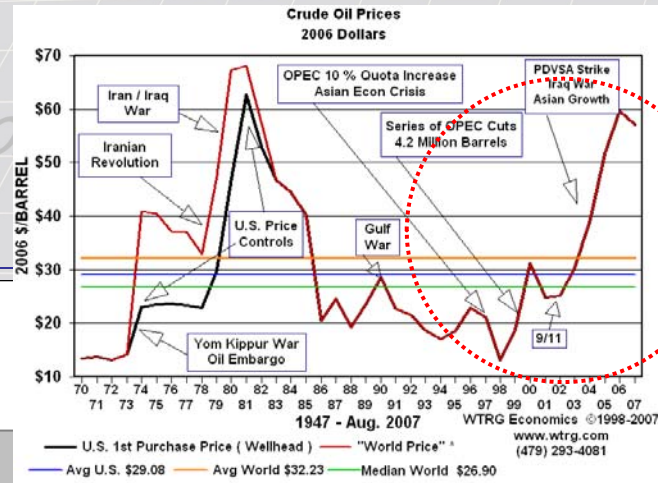
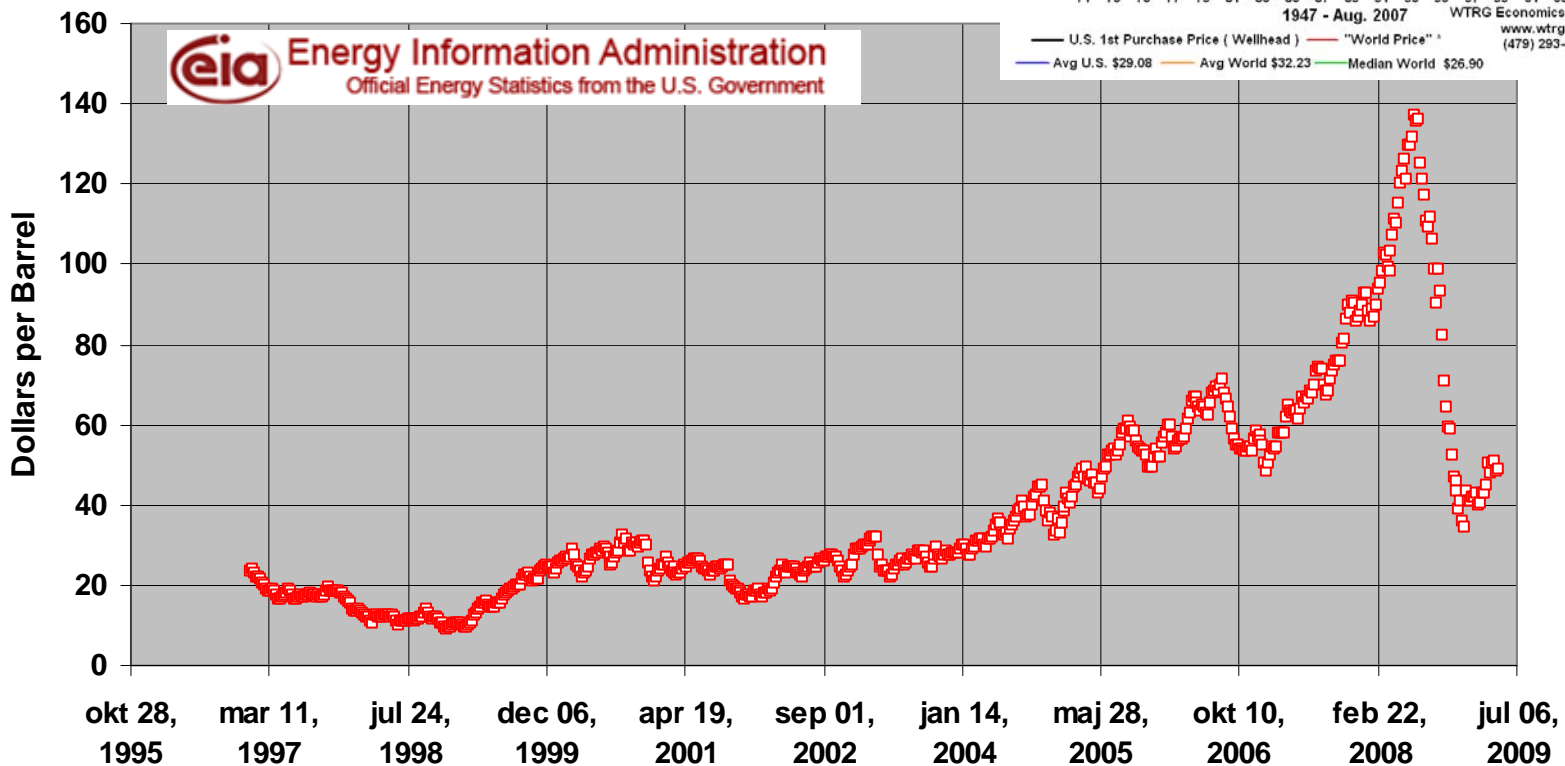
eia Energy Information Administration
Official Energy Statistics from the U.S. Government



CRUDE OIL PRICES

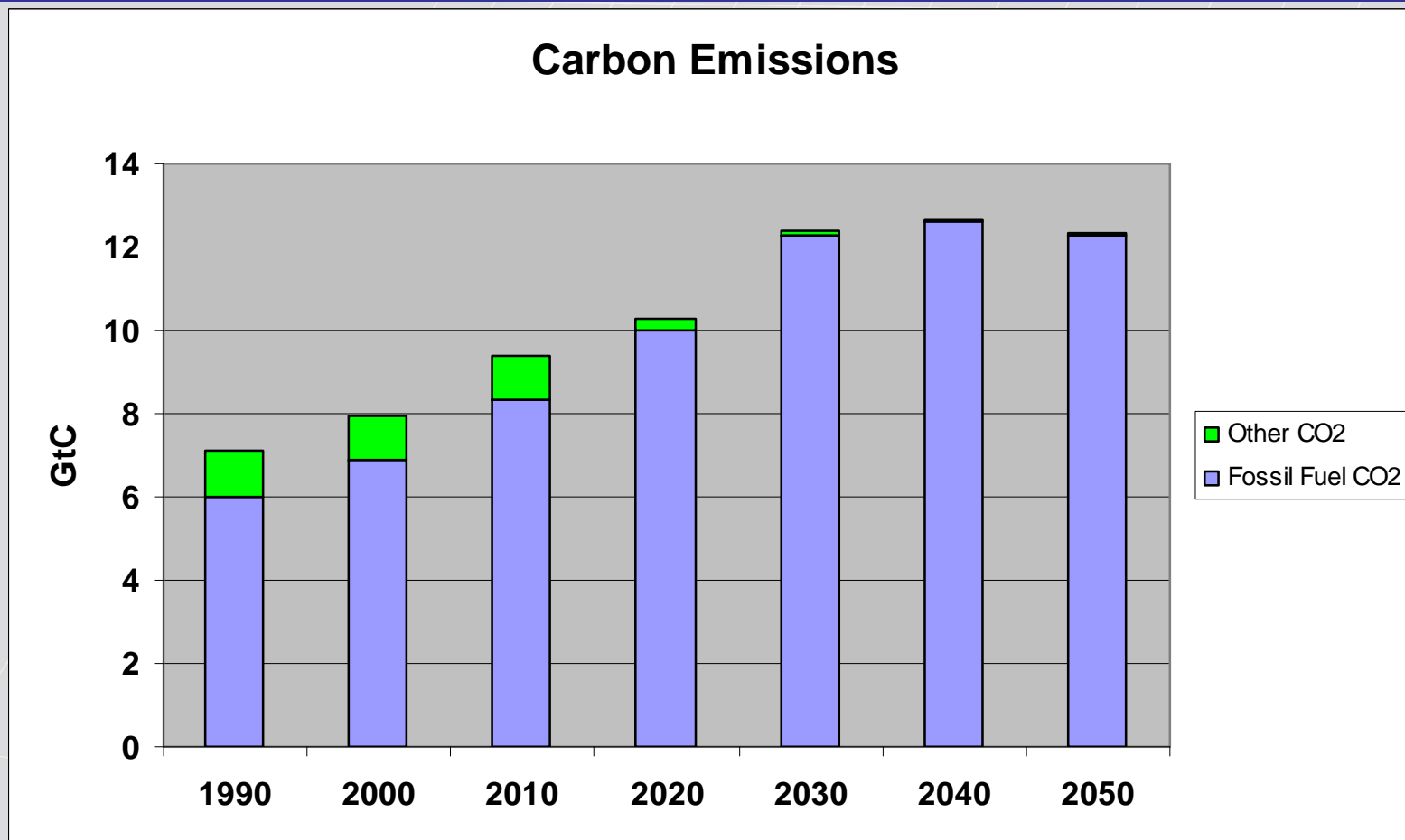
Crude Oil Prices

eia Energy Information Administration
Official Energy Statistics from the U.S. Government



CARBON EMISSIONS

Institut "Jožef Stefan"



Source: Energy to 2050; IEA 2003

Dubrovnik, 22 - 23 May 2009

- Do we have any alternative to the fossil fuels?
- Can our economies run without carbon-based energy sources?
- Have we yet developed strategies and technologies for fuelling the transport sector in the future?

**In the long run the only alternative is the efficient use of energy
and renewable energy sources!**

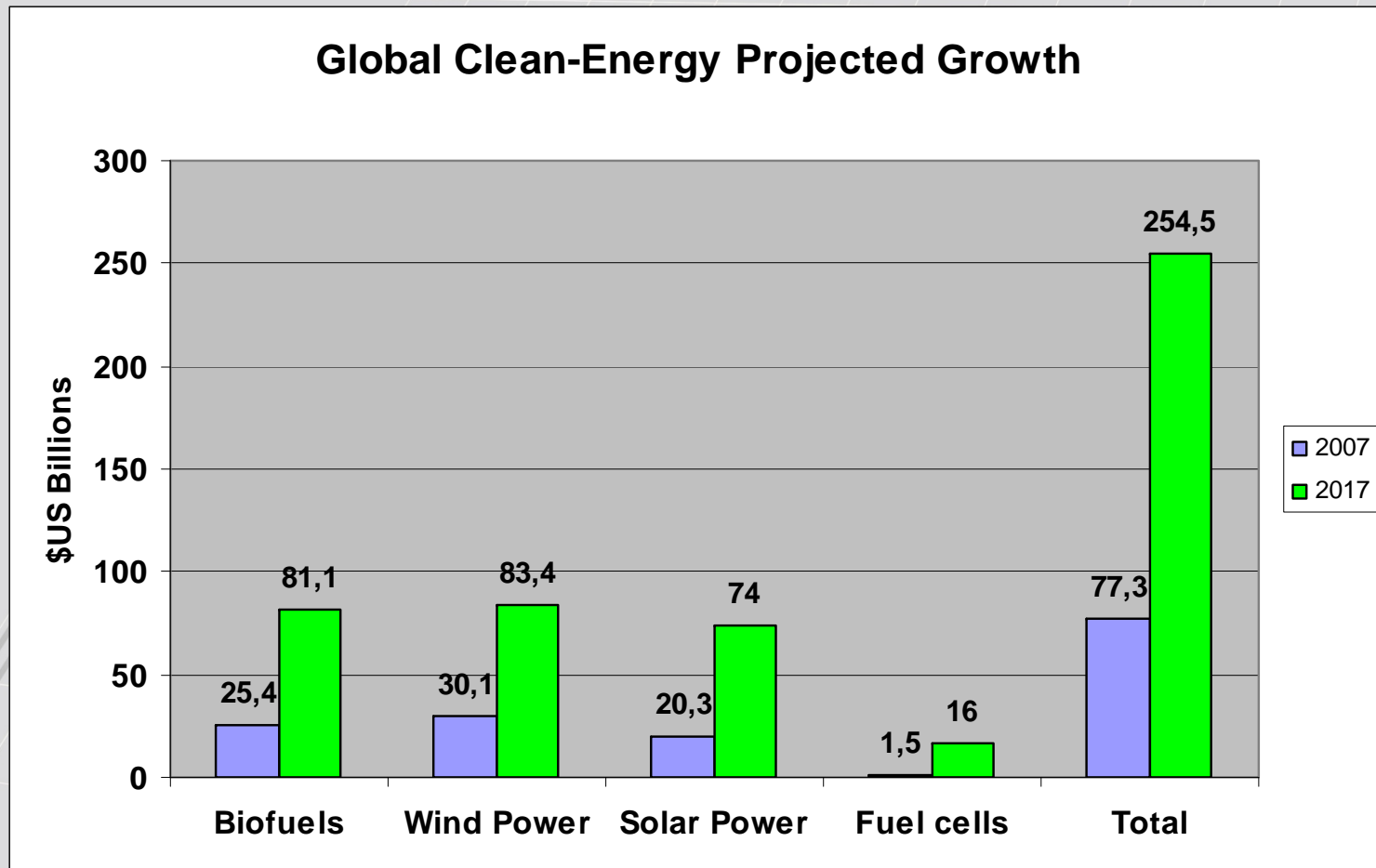
RENEWABLE ENERGY SOURCES (1)

- 13.5% of the total primary energy supply worldwide(2001);
- 80% biomass and waste, 20% hydro-power and other sources;
- 18% of the global electricity production;
- OECD countries 5.7% of the primary energy (mostly for power generation);
- Less-developed regions much higher: 50% in Africa, 33% in Asia and 28% in Latin America (mostly in the building, commercial and services sectors).
- Renewable energy sources other than biomass: major growth is expected in the coming decades;
- The share in the total energy output is likely to increase from 3.6% in 2000 to 18.9% in 2050;

RENEWABLE ENERGY SOURCES (2)

- In Europe, the remaining potential for **hydropower** is very limited but large in North America and in many developing countries;
- The rest would have to come from **wind**, from the various **solar options** and from **geothermal** sources.
- The intermittence of the power supply from wind and solar sources remains a problem;
- Low efficiency of the transformation of solar radiation into power (solar-based power technologies); the transformation into heat to produce either hot water or electricity is much better;
- A **geothermal energy** is fairly well-established technology (significant resources in practically all world regions);
- The economic potentials of the renewable energy sources are very high.

GLOBAL CLEAN ENERGY PROJECTED GROWTH



Source: R. Pernick, C. Wilder: The Clean Tech Revolution, 2008

Dubrovnik, 22 - 23 May 2009

NUCLEAR POWER

- Nuclear power is an important source of the non-carbon emitting energy supply;
- Significant growths are expected in the future (new plants and the share of nuclear power in global electric power supply);
- General acceptance of nuclear power in society is sometimes not favourable;
- Concerns: the safety of nuclear power plants and the problem of the long-term disposal of radioactive material;
- Higher safety and significantly lower levels of radioactive waste production will be required in the future;
- New concepts and new reactor designs will have to be introduced in the future.

FOSSIL-FUEL-BASED TECHNOLOGIES

- Reductio in the share of fossil-fuel sources in the energy supply is required;
- Significant improvement in energy transformation efficiency in fossil-fuel-based technologies for power generation is required;
- The average efficiency level for conventional plants (fossil-fuel power generation technologies) is below 40%;
- Technologies already exist that substantially improve these efficiencies;
- New gas turbines already have better performances; cogeneration has very high overall efficiency.

HYDROGEN / CARBON CAPTURE

- Introduction and commercialisation of **hydrogen**;
- Hydrogen production, transport, storage and the application of hydrogen technologies.
- Hydrogen technologies have big potentials;
- Hydrogen technologies are not mature enough for commercial use;
- In the short to medium term, **carbon capture and storage** would contribute significantly towards a non-carbon-based energy system.

ENERGY END-USE

- Improvement of fossil-fuel-based technologies in all energy end-use sectors: industry, building, commercial and transport.
- The potential for energy-efficiency improvements is significant;
- **Industrial sector:** the promotion of energy efficiency, the reduction of polluting emissions and the reduced use of carbon-based fuels;
- Various trade schemes, taxes and other economic incentives;
- **Building and commercial sector:** a significant scope for energy-efficiency improvement;
- Efficient building design and the integration of solar heating and PV in buildings;
- **Transport sector:** enormous efficiency improvements and the reduction of energy consumption;
- Improvement of internal combustion engines, diesel engines, different engine concepts and different fuels, hybrid vehicles (electrical storage and conventional engines), fuel-cell vehicles (hydrogen, bio fuels or fossil fuels);
- New energy taxes in combination with efficiency standards and possible health impacts of polluting emissions.

TECHNOLOGICAL ASPECTS

Energy supply:

- Improvement of energy efficiency in supply technologies;
- Advanced gas technologies in power generation will be required (combined cycle gas turbines, gas transport, storage and liquefaction/re-gasification);
- Cleaner coal technologies will be required;
- Improvement of combined heat and power production;
- Improvement of nuclear technologies (life extension and safety; new reactor concepts);
- Power generation technologies from renewable sources (solar PV, high temperature solar thermal, wind, biomass, and hydro);
- Technologies for hydrogen production (from coal, gas, nuclear or biological agents), transport and long-term storage;
- Power-storage technologies;
- Carbon capture and storage for large-scale use;
- Further development of fusion technologies.

TECHNOLOGICAL ASPECTS

Energy demand:

- Energy efficiency improvements and conservation in all sectors; more efficient appliances along with optimised performance;
- Low energy- and material-intensive manufacturing processes and services;
- passive heating and cooling technologies & architectures in buildings along with efficient systems for building management;
- Fuel-efficiency improvement in conventional vehicles together with the employment of alternative fuels (bio fuels);
- Development of hybrid and electric vehicles;
- Fuel-cell (gas or hydrogen fuelled) cars;
- Hydrogen-storage technologies;
- Mass transport systems and advanced public transport systems;
- Fuel cells for direct use of power.