Nuclear Energy: Time to revisit the option?

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Roxas Boulevard
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Philippine Situation

- At the cross roads
- Needs sufficient supply of cheap, safe and reliable source of energy
- Several choices: hydro, biomass, oil, coal, natural gas, nuclear, geothermal, solar, wind, etc.
- Each has its advantages/disadvantages
- All need a lot of money
- Must study thoroughly options

Quo Vadis?

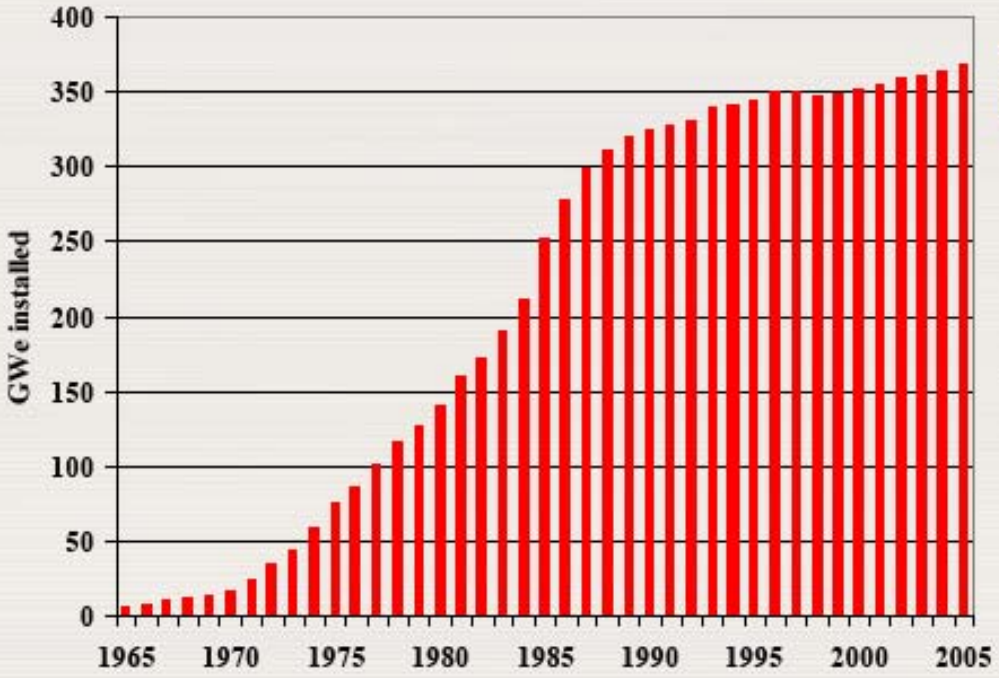
- We depend heavily on imported oil (gasoline/diesel), coal, natural gas, LPG, geothermal, etc.
- Started using solar and wind sources
- Implemented alcohol and cocomethyl ester blends for the automobile industry
- We need a new source of power to produce our electricity with oil hitting US$100/barrel and maybe US$200/barrel in the future
- We must plan AHEAD

Nuclear Power

- One of the choices for us is NUCLEAR POWER
- This has been with us since 1945 when Japan was bomb by the Allies
- It was born as a destructive power and some people can not accept it as a useful, cheap, reliable, safe and beneficial source of energy

Nuclear power today:

By 1 January 2007, 435 nuclear power plants (NPPs) operated in 30 countries worldwide, with a total installed capacity of 367 500 MWe.



"Rising Expectations ??"

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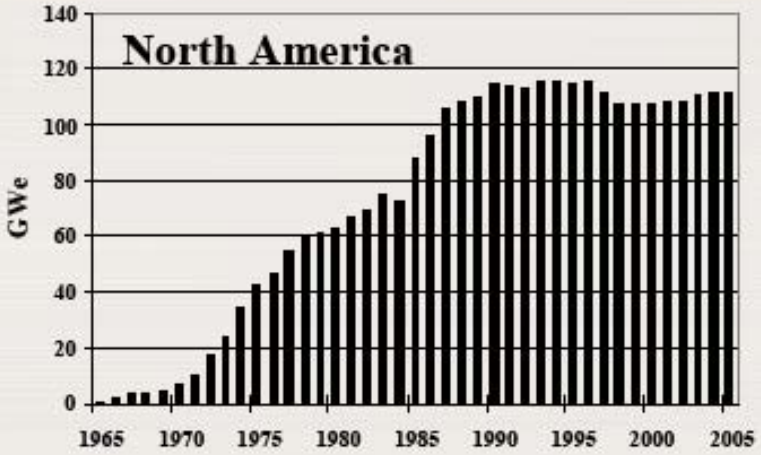
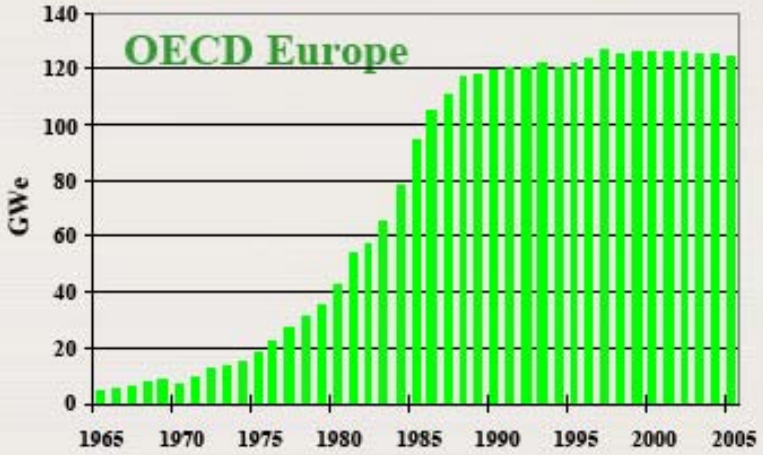
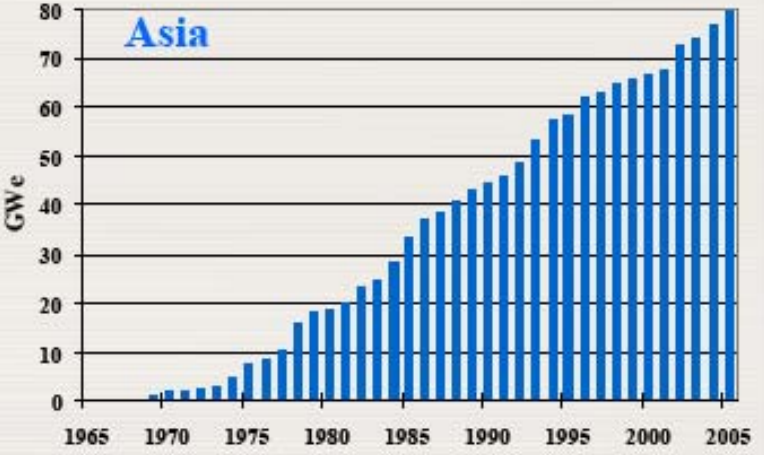
Development of regional nuclear generating capacities







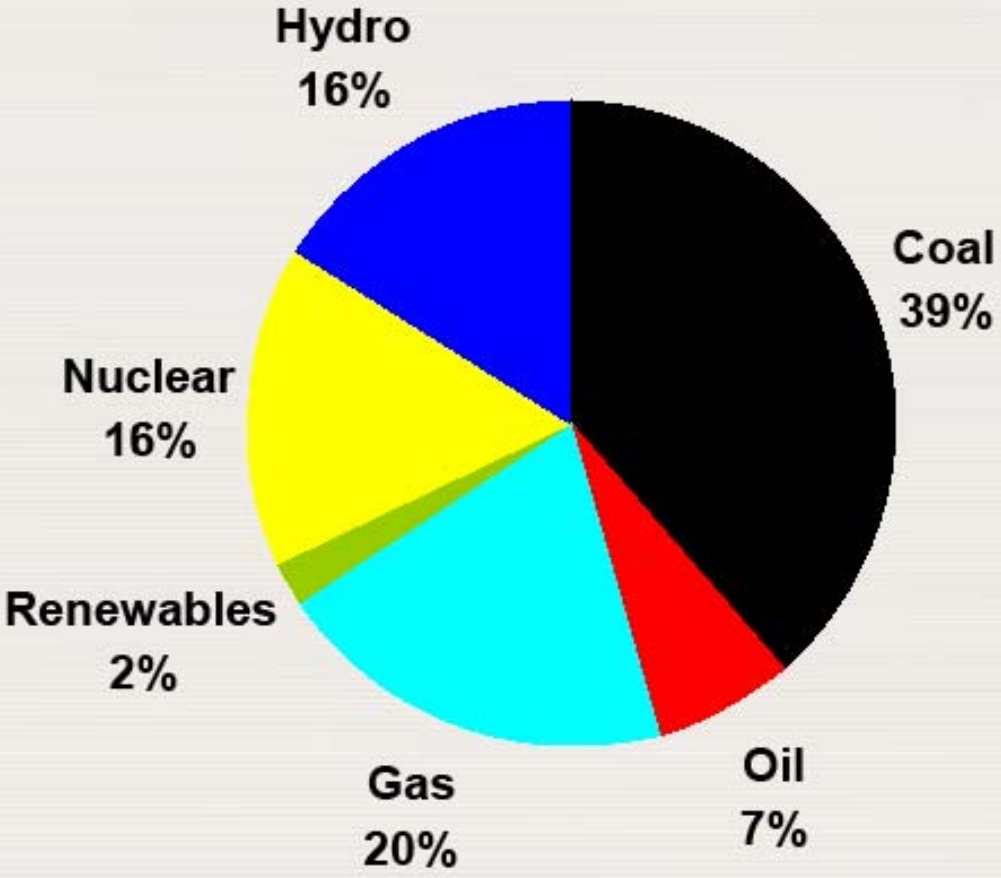
Reasons for the mid 1980s Stagnation:

- Energy efficiency improvements
- Economic restructuring
- Significant drop in electricity demand
- Excess generating capacity
- Oil (traded fossil energy) price collapse
- Advent of the high-efficient cheap gas turbine technology (GTCC)
- Electricity market liberalization & privatization

Reasons for the mid 1980s Stagnation:

- Little regard for supply security
- Regulatory interventions after Three Mile Island
- High interest rates
- Chernobyl
- Break up of the Soviet Union
- Reasons for the mid 1980s stagnation :
- All the above together: Nuclear power out of favor (poor economics and lack of demand)

Global electricity generation in 2004: 17,400 TWh or 16% of global supply



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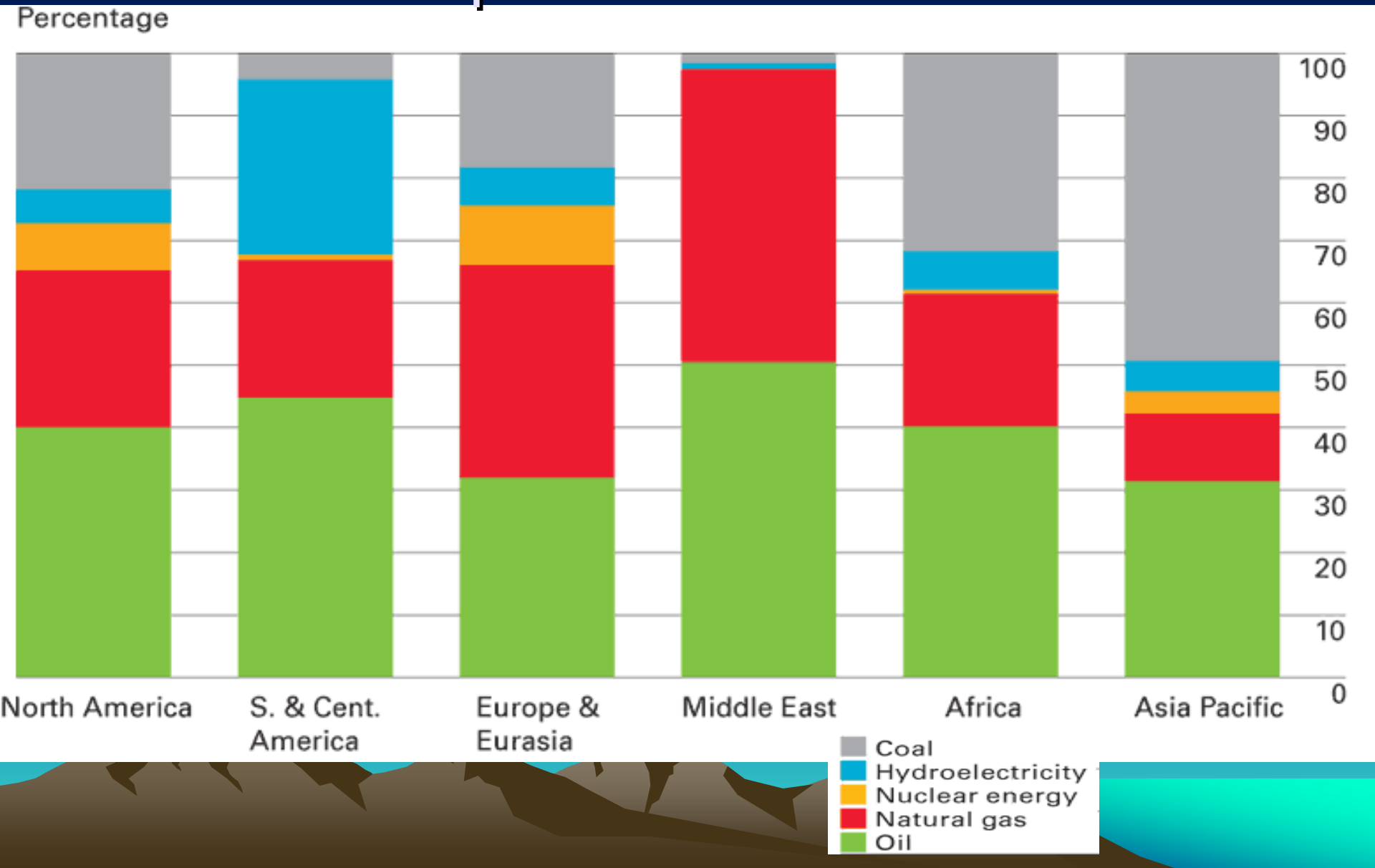
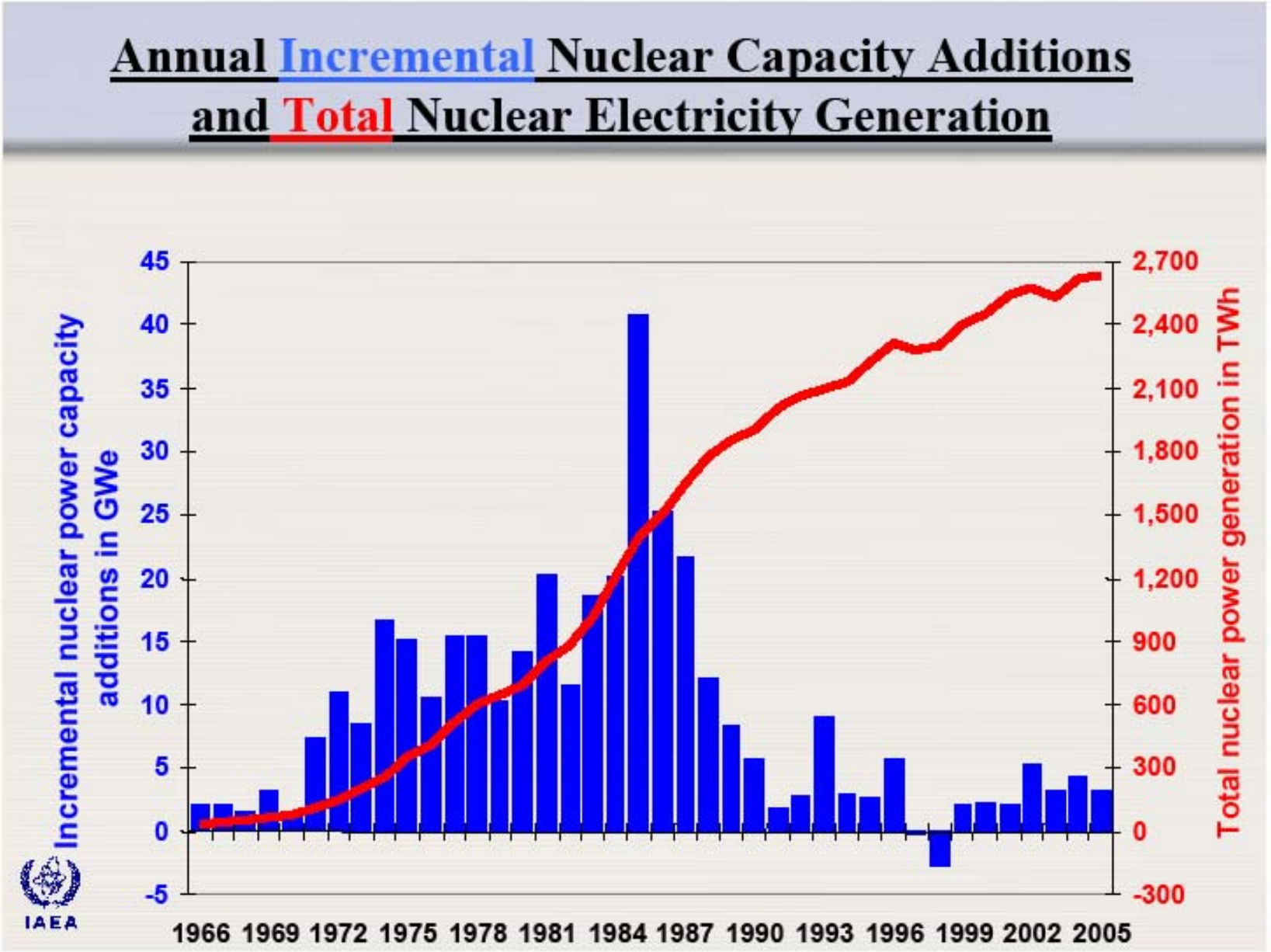
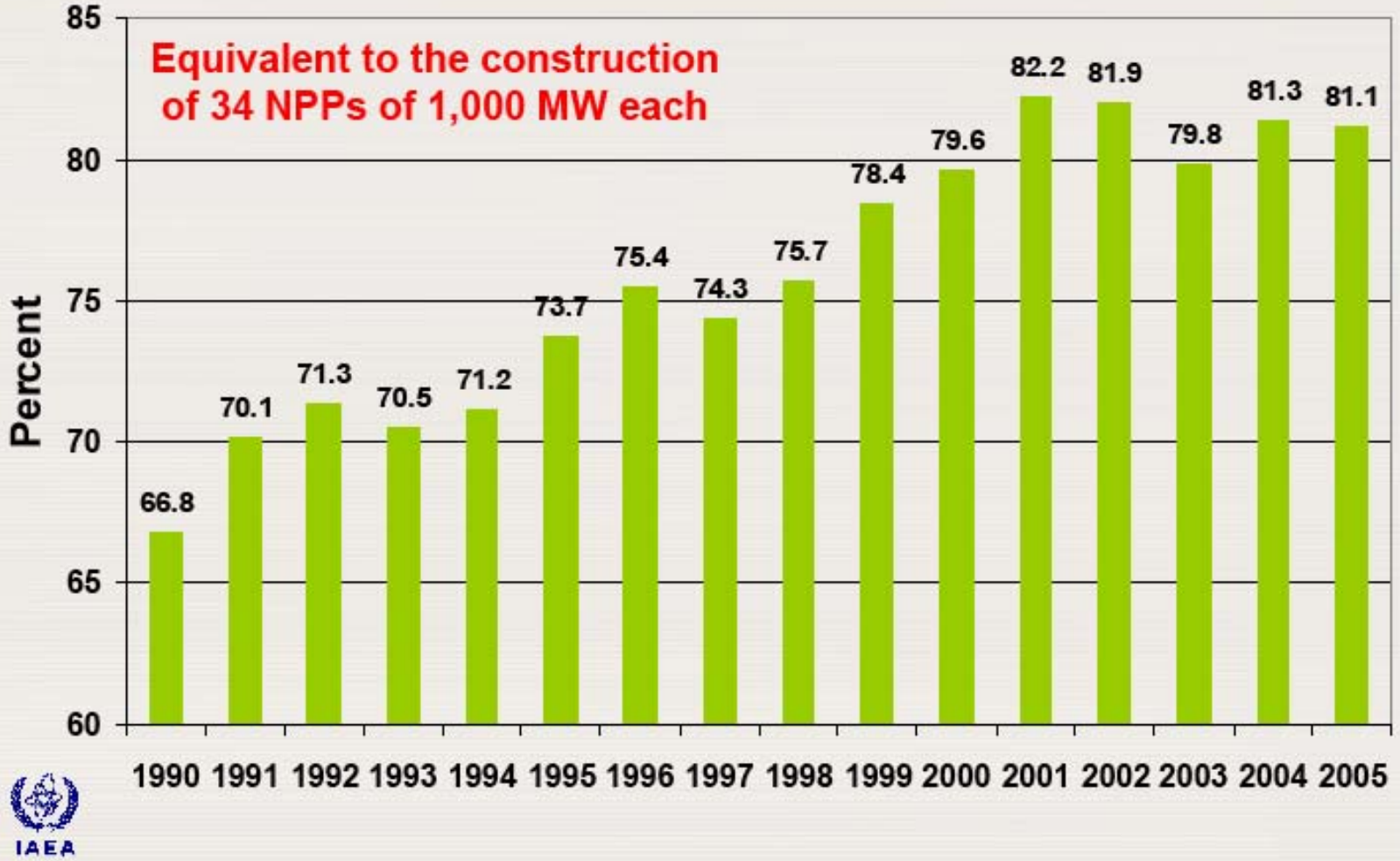
Regional primary energy consumption pattern 2006



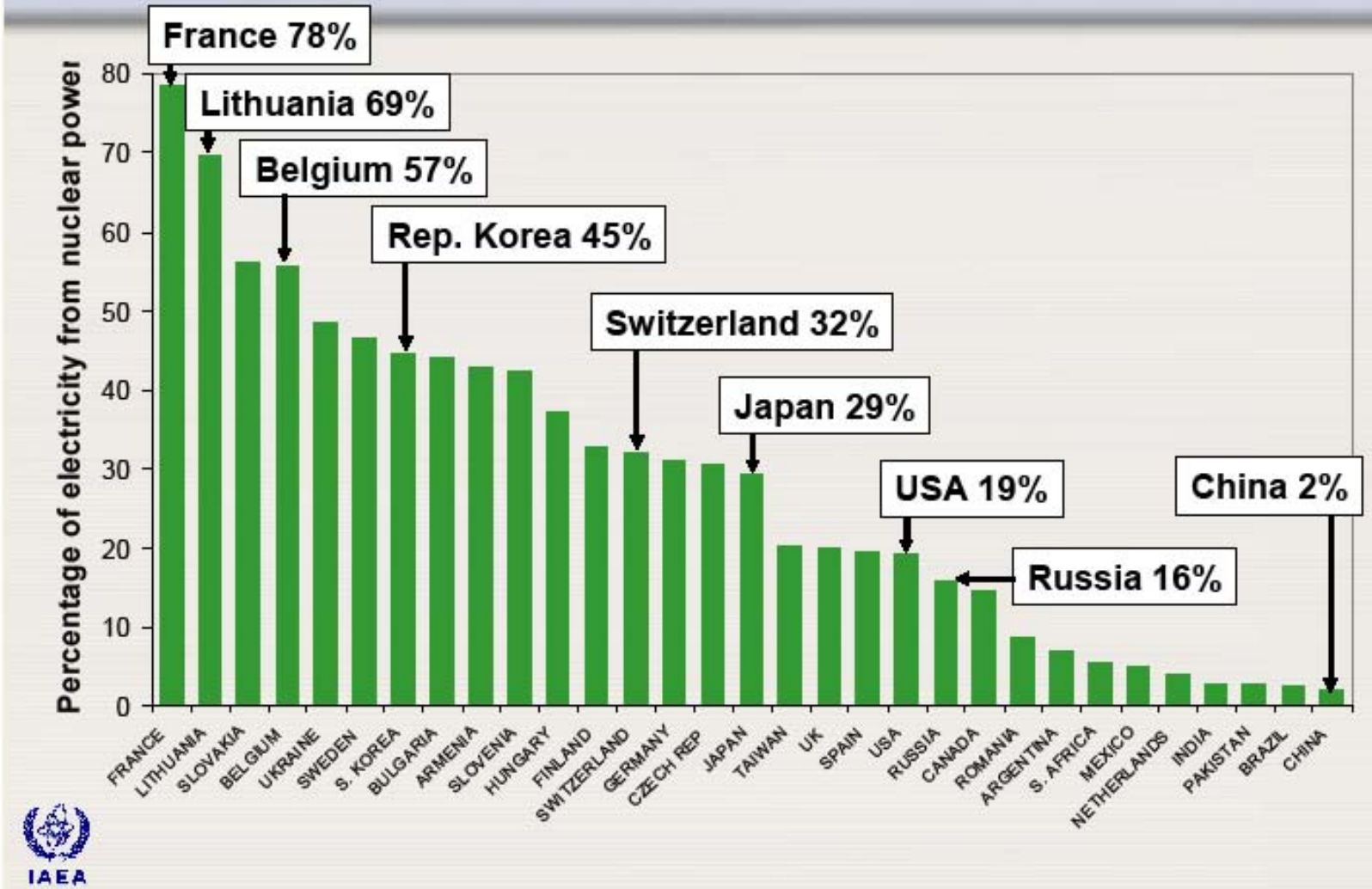
Annual Incremental Nuclear Capacity Additions and Total Nuclear Electricity Generation



Global energy availability factor of nuclear power plants



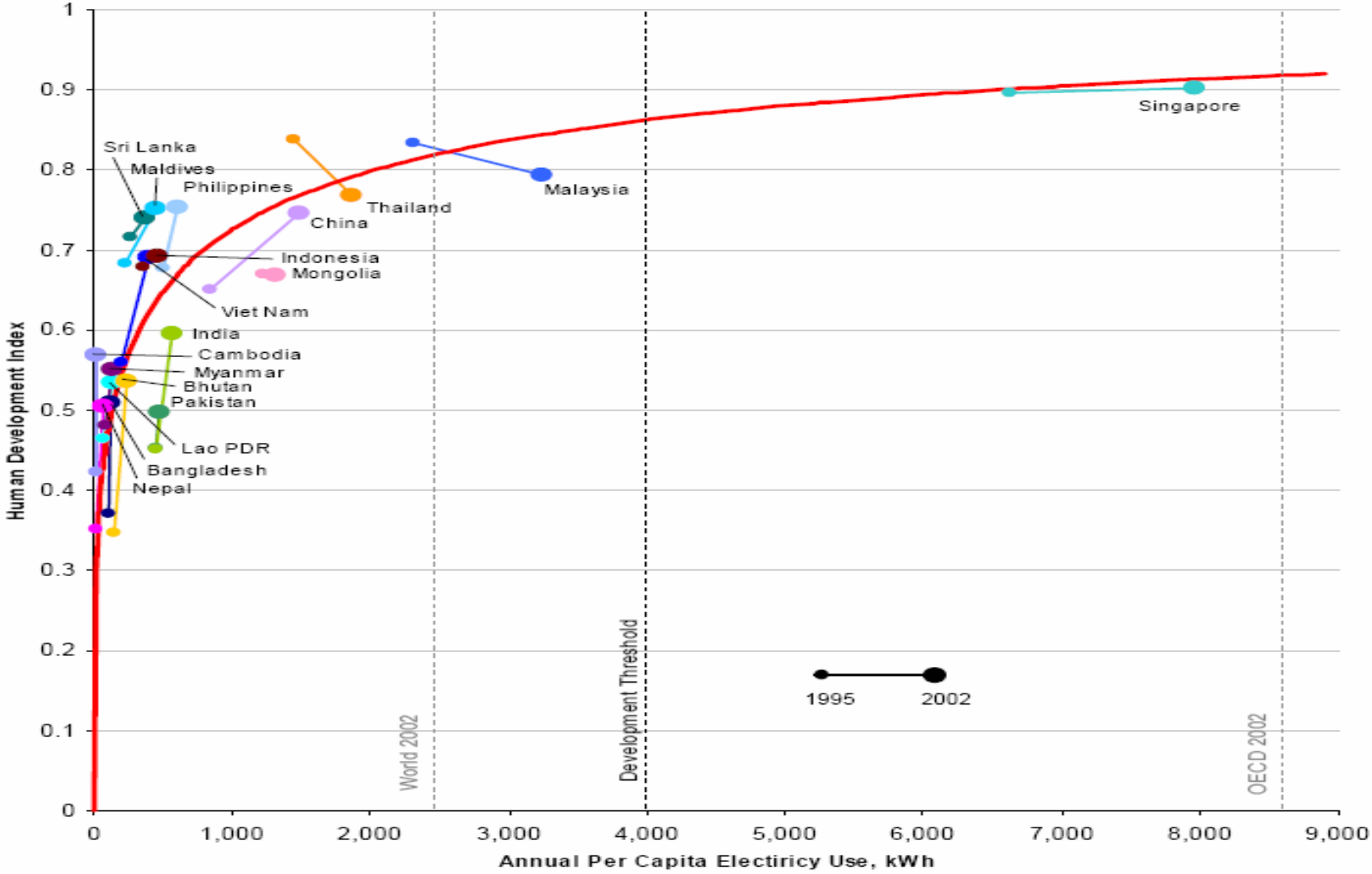
Nuclear share of electricity (2005)



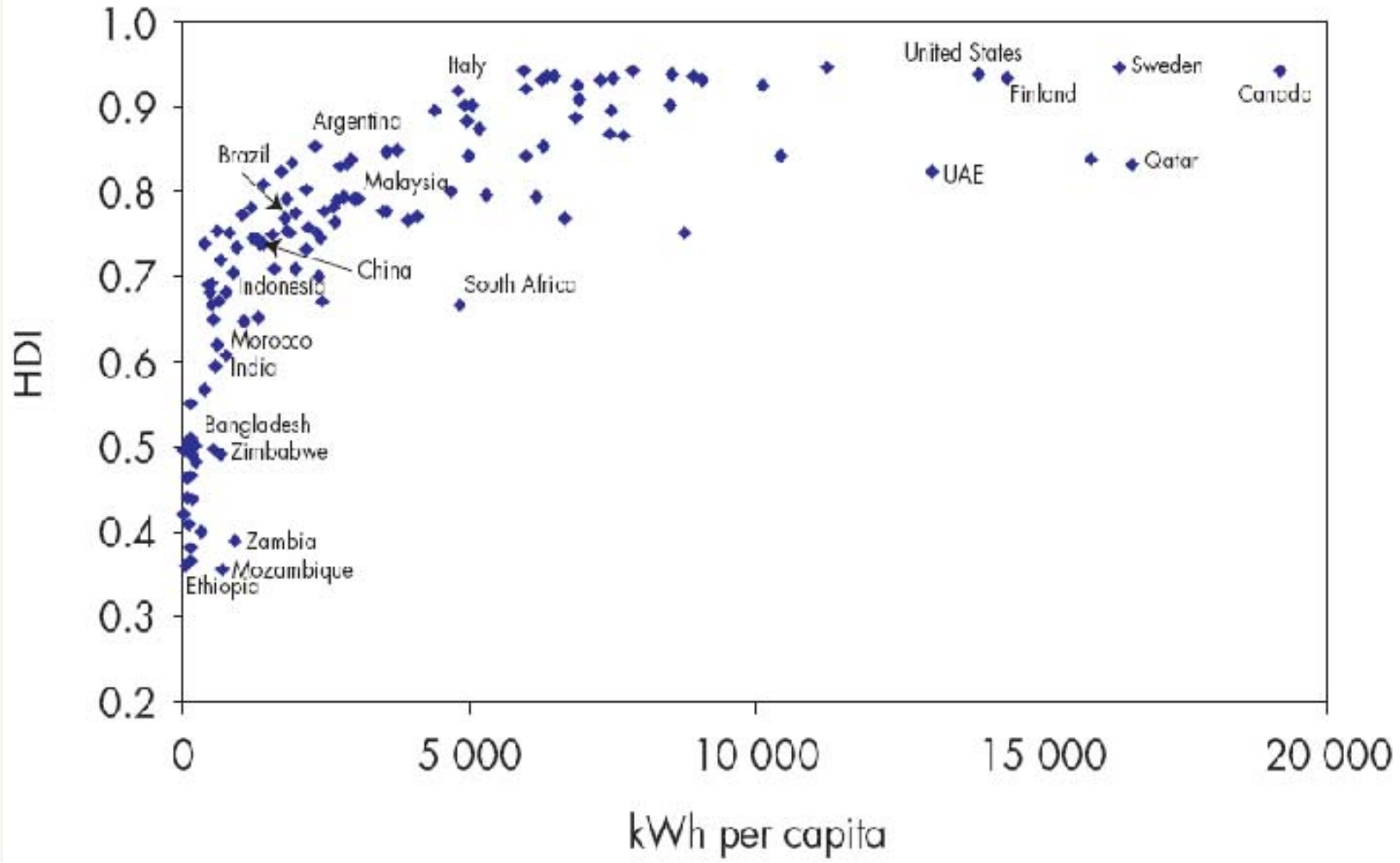
HDI and Electricity Use per Capita in 2004

- HDI (Human Development Index) combines indicators of health, education, and economic prosperity.
- Industrialized countries have an HDI above 0.9 (on a scale of 0 to 1) and per capita energy consumption above 4000 kWe-hrs.
- Developing countries like China, India, Pakistan and Indonedsia, are well below the industrialized country HDI and aspire to advance by rapid economic growth.
- Energy consumption per capita in the developing world is less than a fifth of that in the developed world. To alleviate poverty, we must help our poor people get access to cheaper electricity.

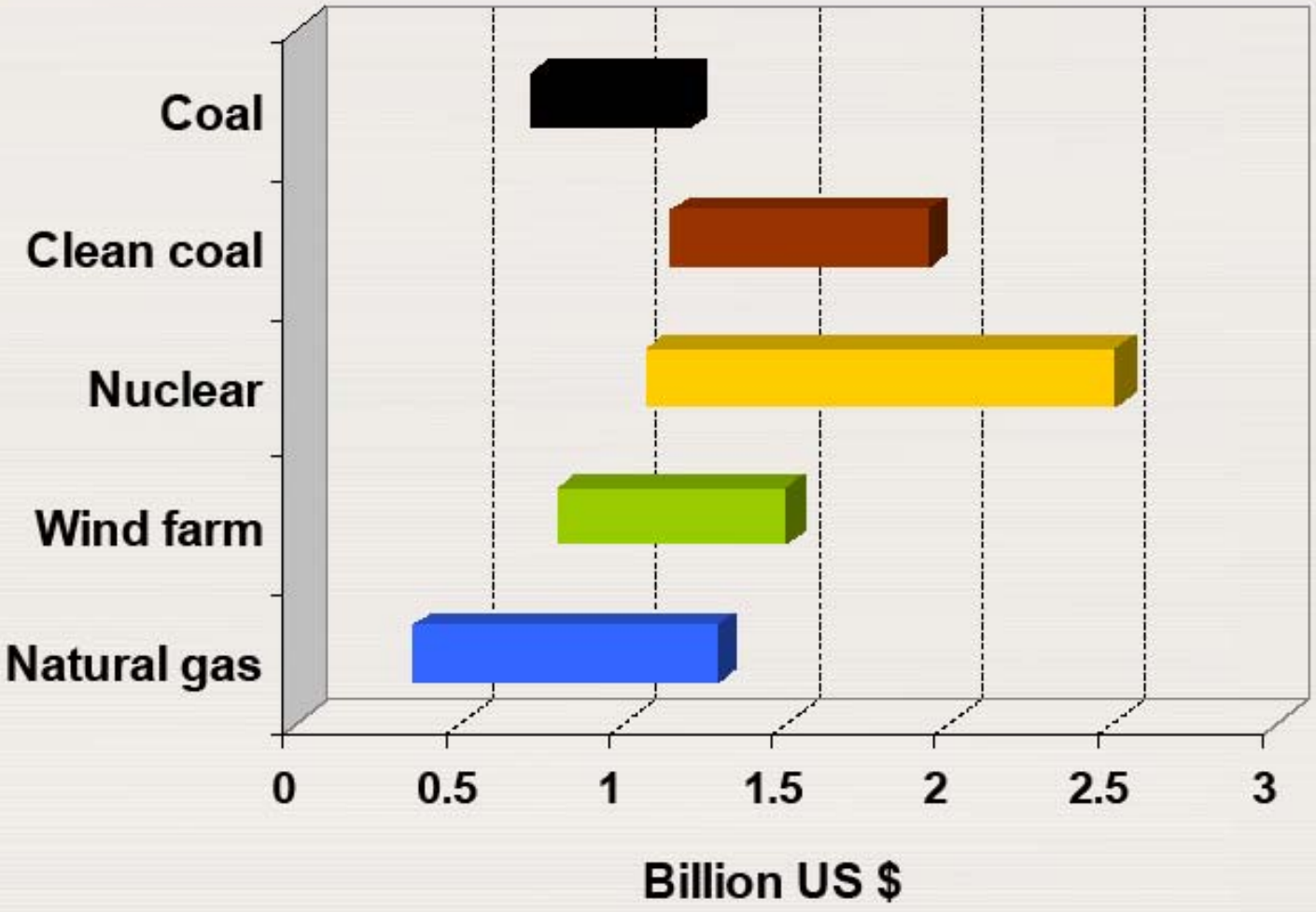
HDI vs Electricity Per Capita in Asia, 1995 & 2002



HDI and Electricity Use per Capita, 2004



Investment Costs for 1,000 MWe



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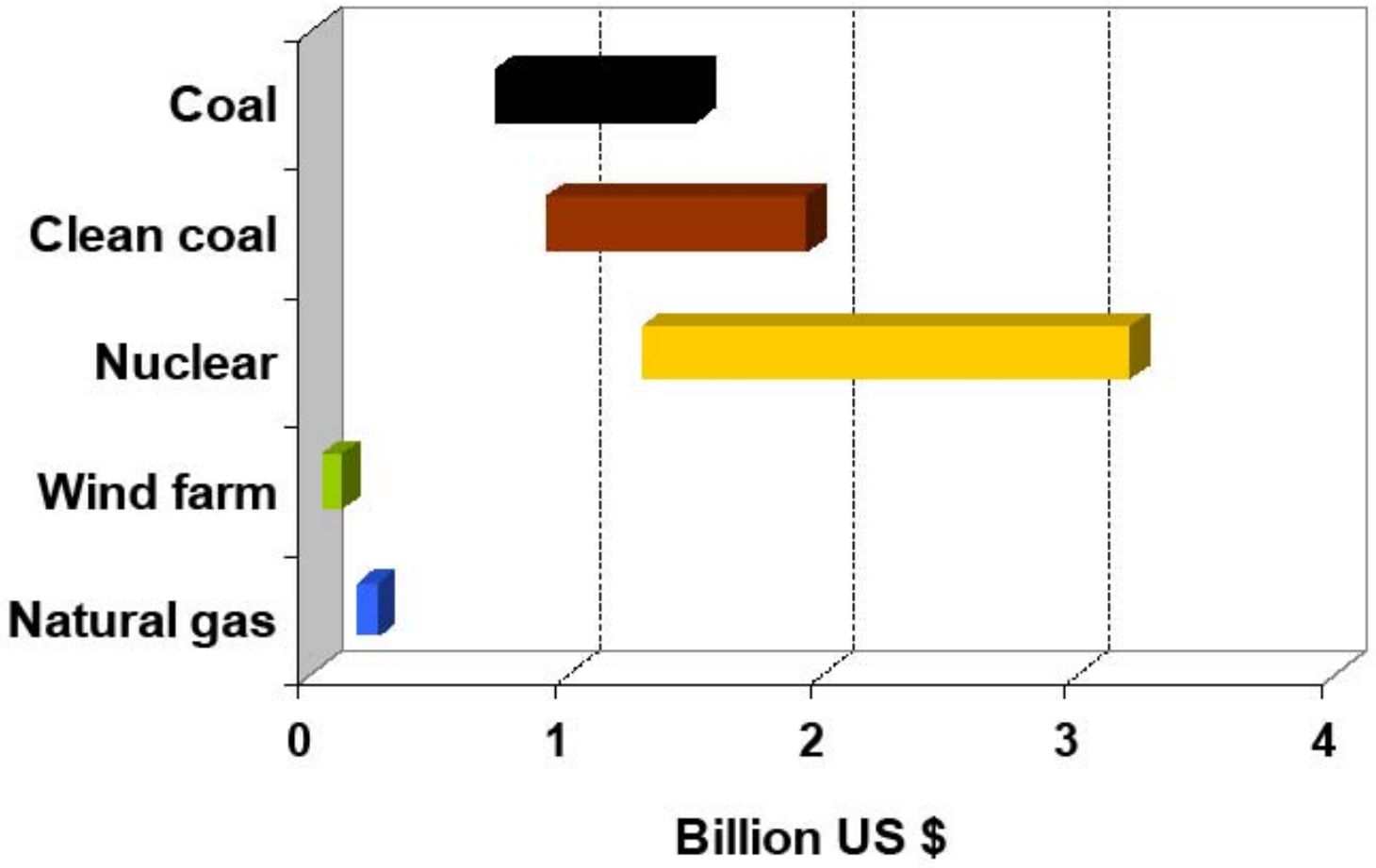
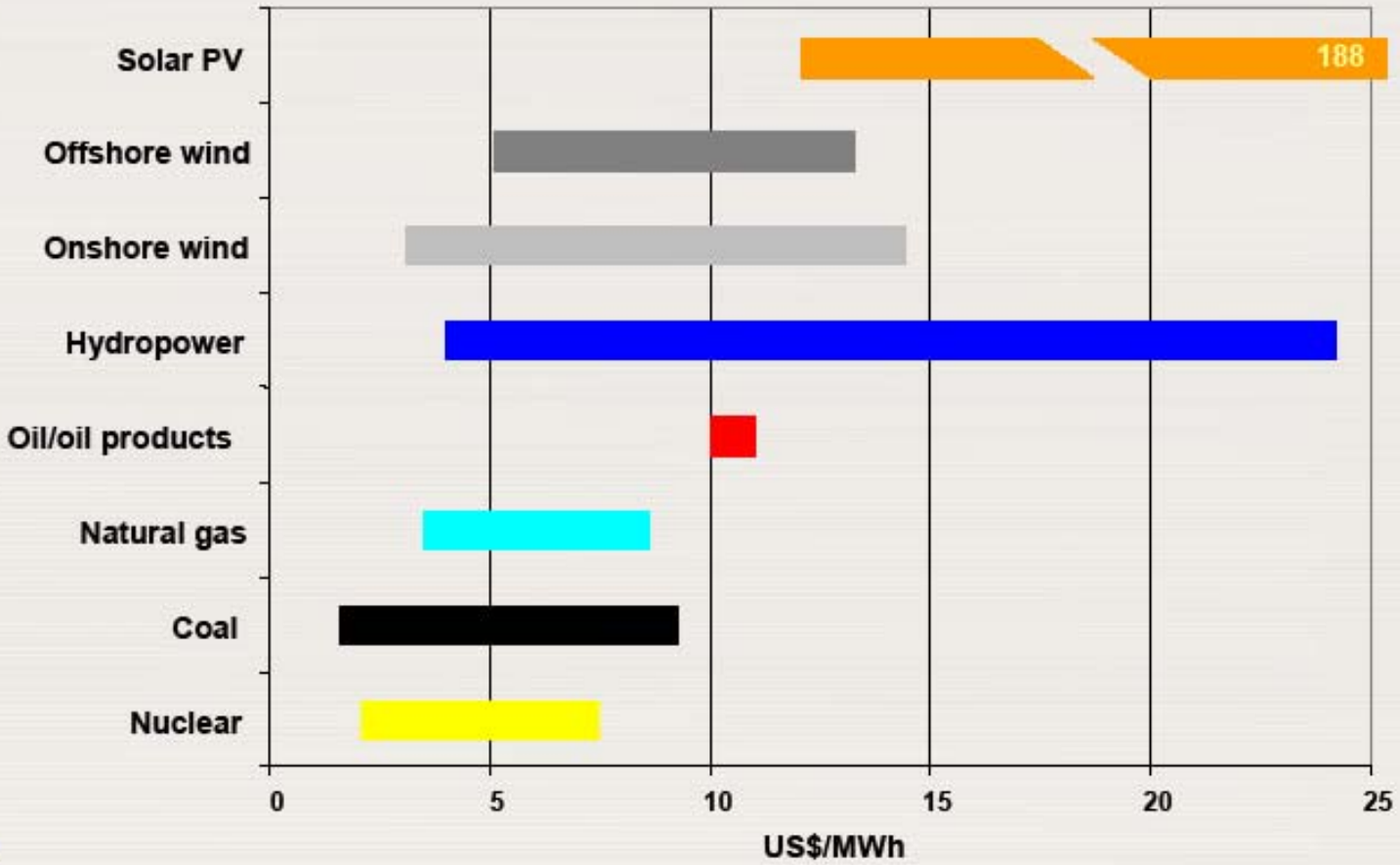
Typical Turn-key Costs



Range of Levelized Generating Costs of New Electricity Generating Capacities



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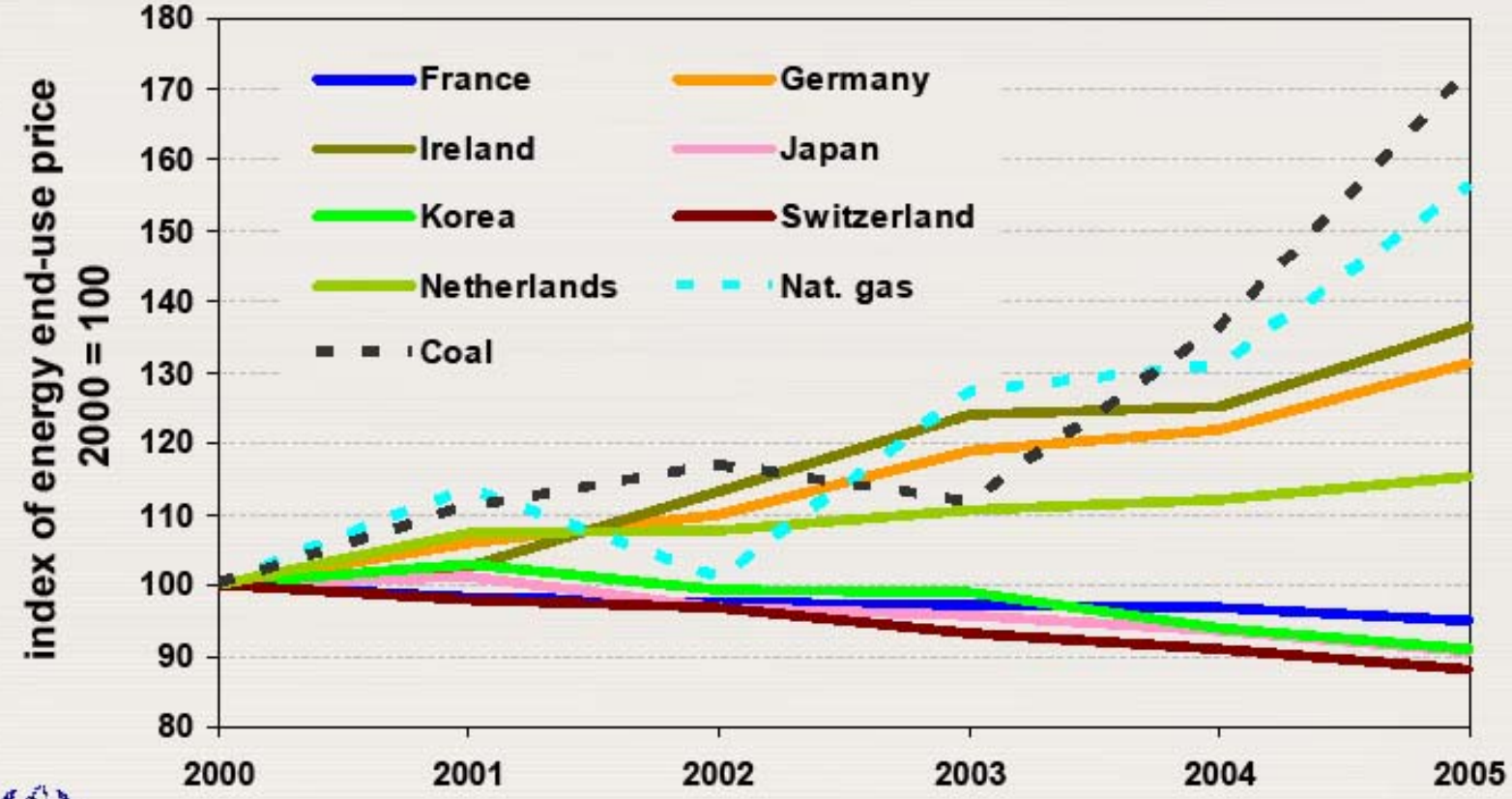
Source: Adapted from eight recent studies

Impact of non-fossil generation on electricity rates



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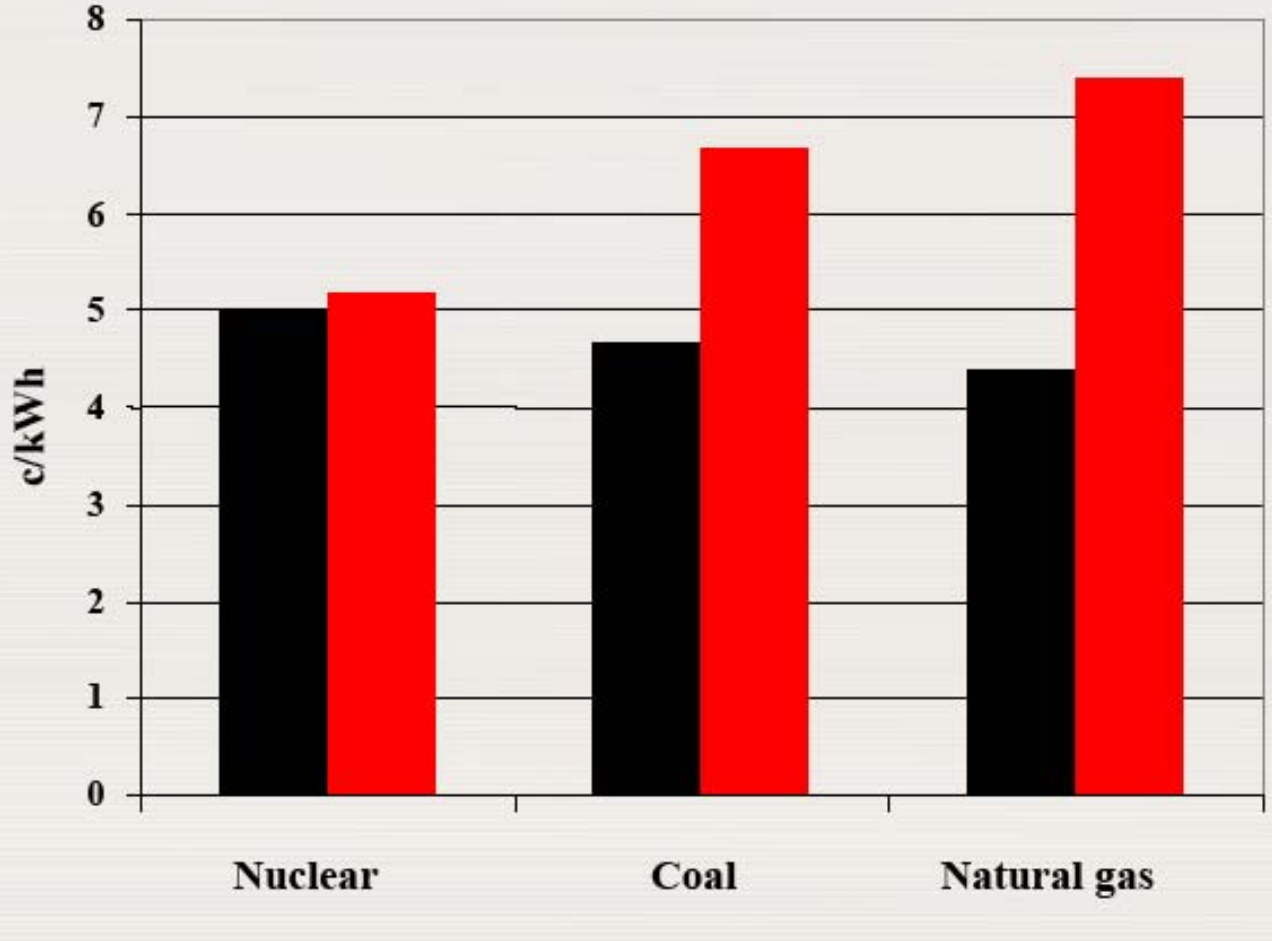
Impact of a doubling of resource prices



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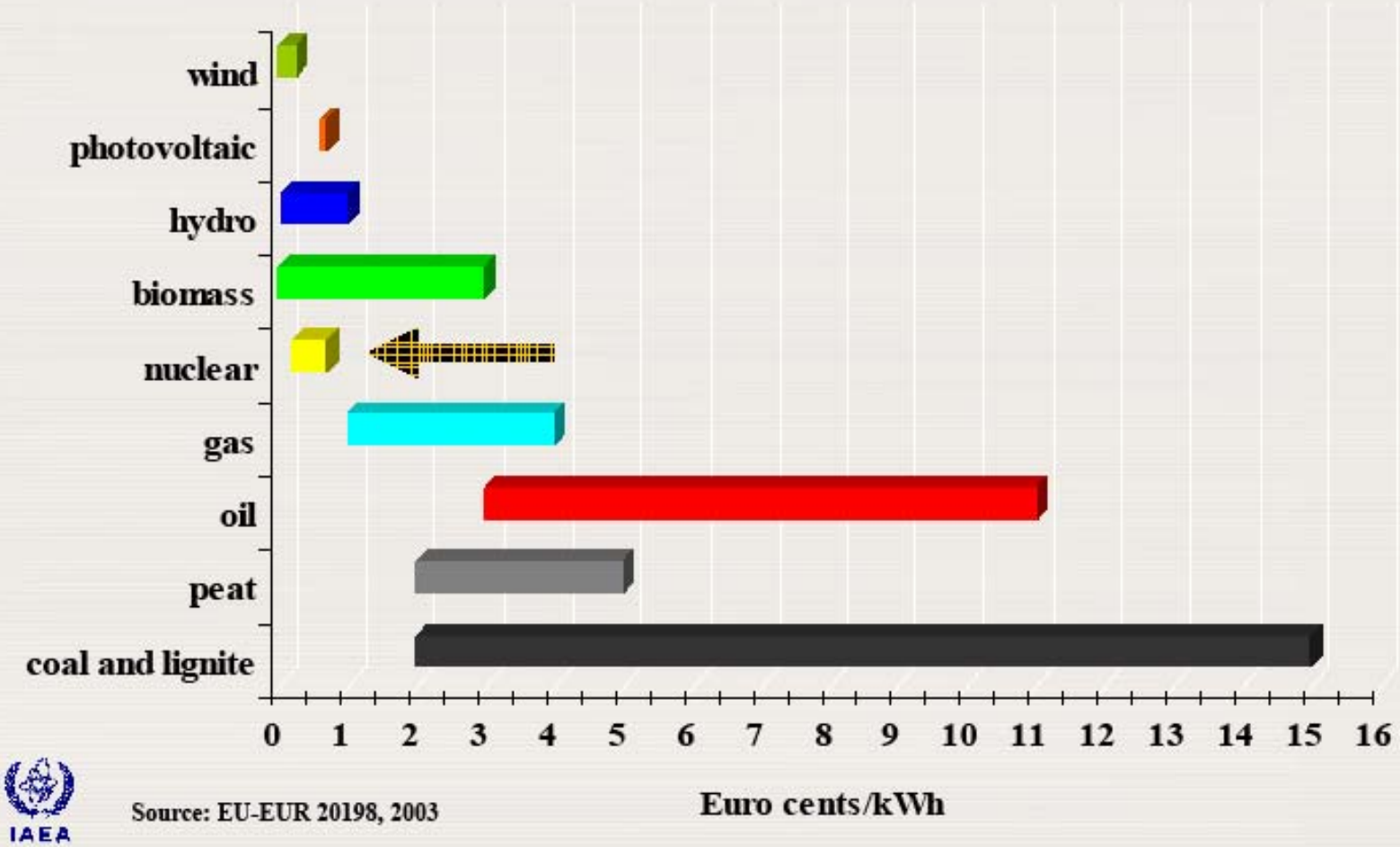
External Cost Figures for Electricity Generation in the EU for Existing Technologies



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Source: EU-EUR 20198, 2003

Environment – Nuclear power

Advantages

- Low pollution emissions
- Small land requirements
- Small fuel & waste volumes
- Wastes are managed
- Proven intermediary storage

But…

- No final waste repository in operation
- High toxicity
- Needs to be isolated for long time periods
- Potential burden to future generations

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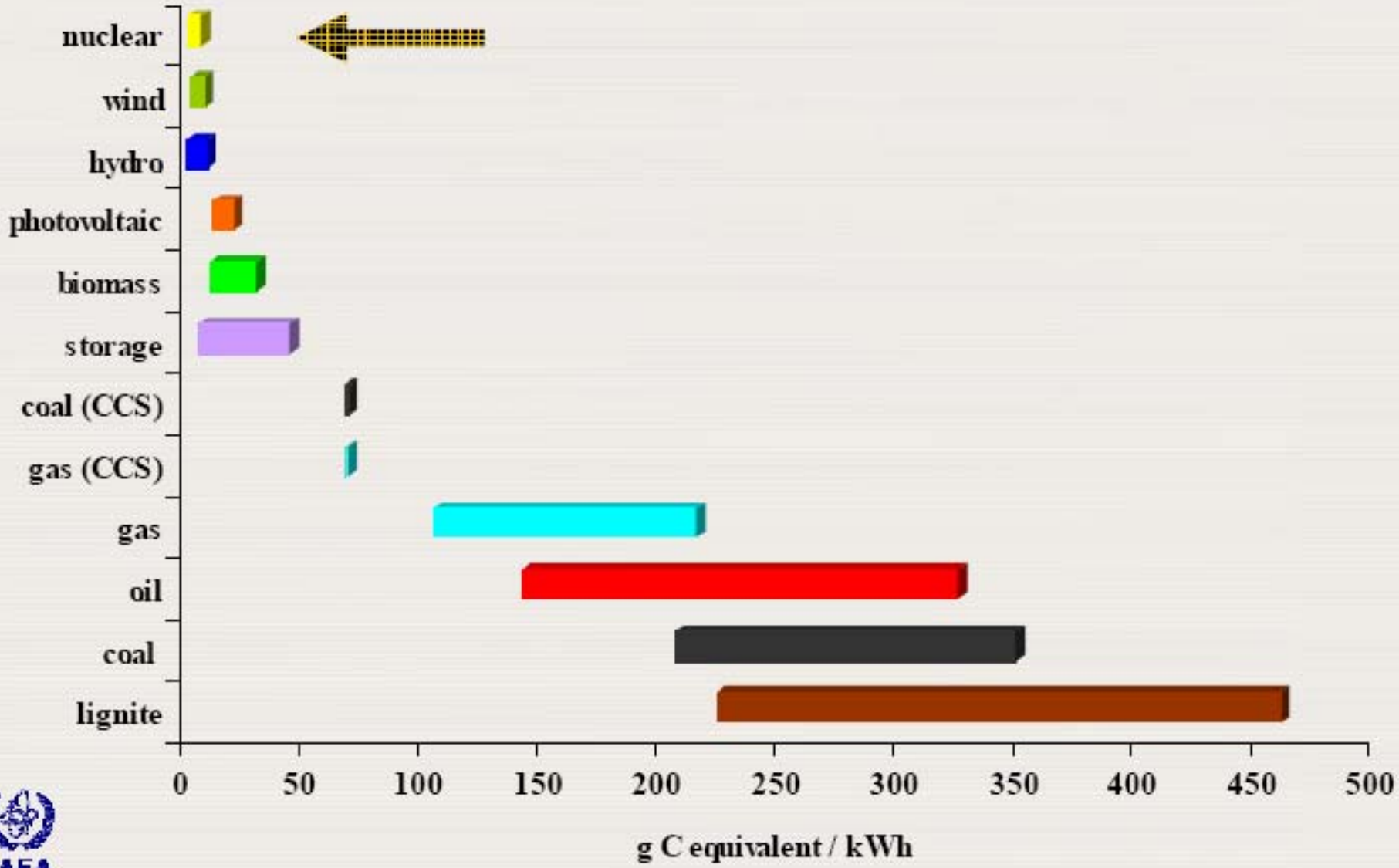
Greenhouse Gas Emissions (gC_{eq} per kWh)



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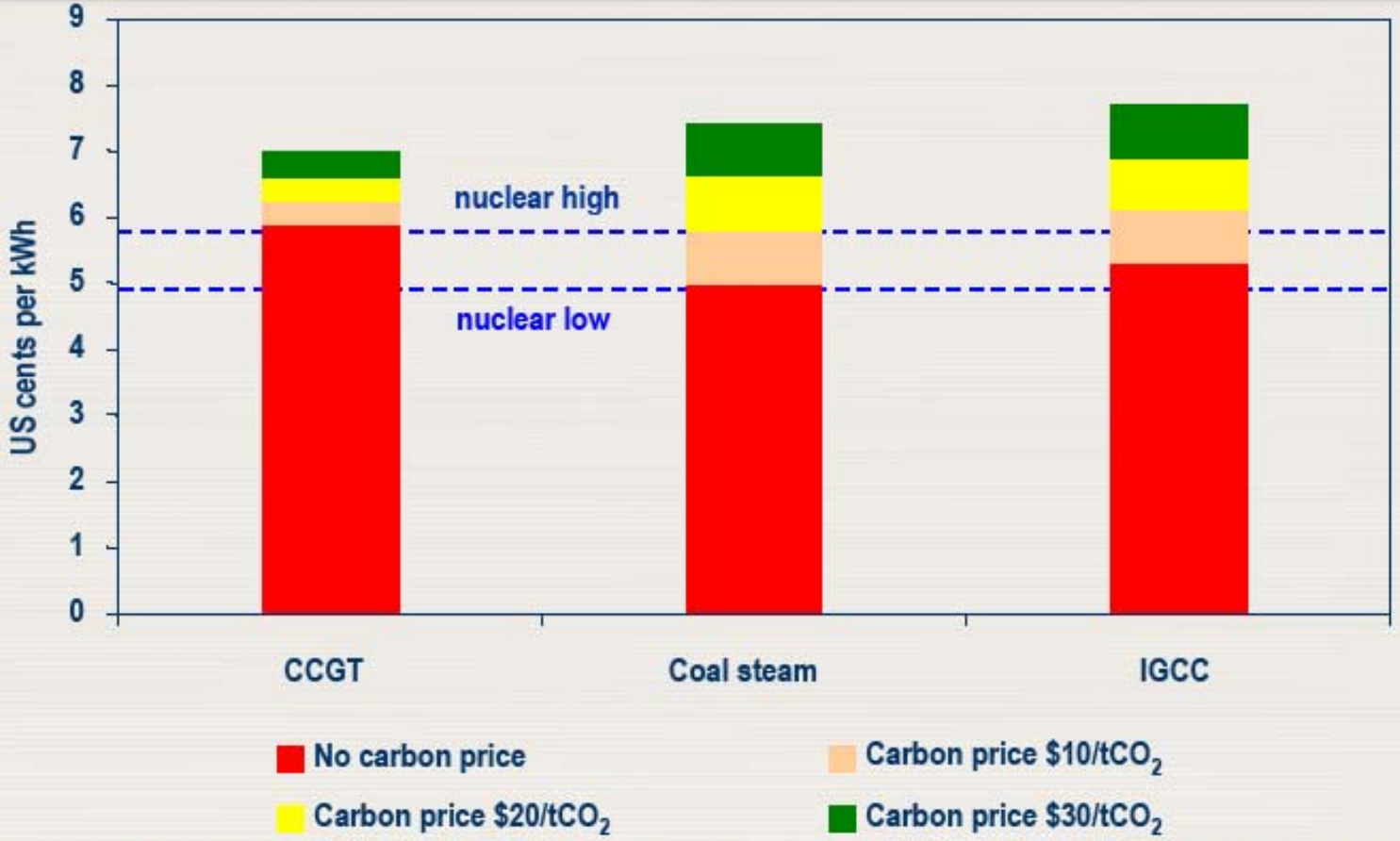
Impact of CO_2 Penalty on Competitiveness of Nuclear Power



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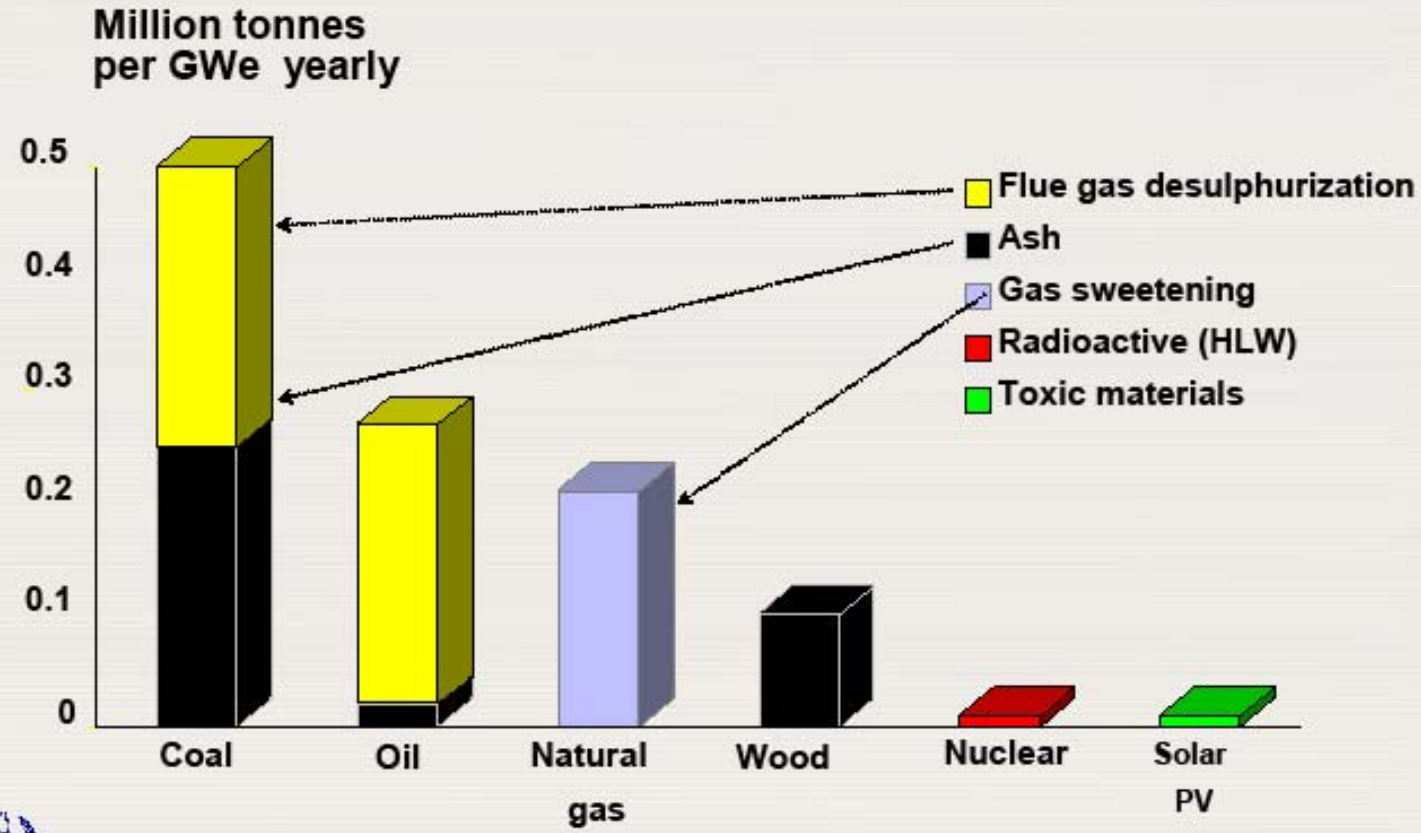
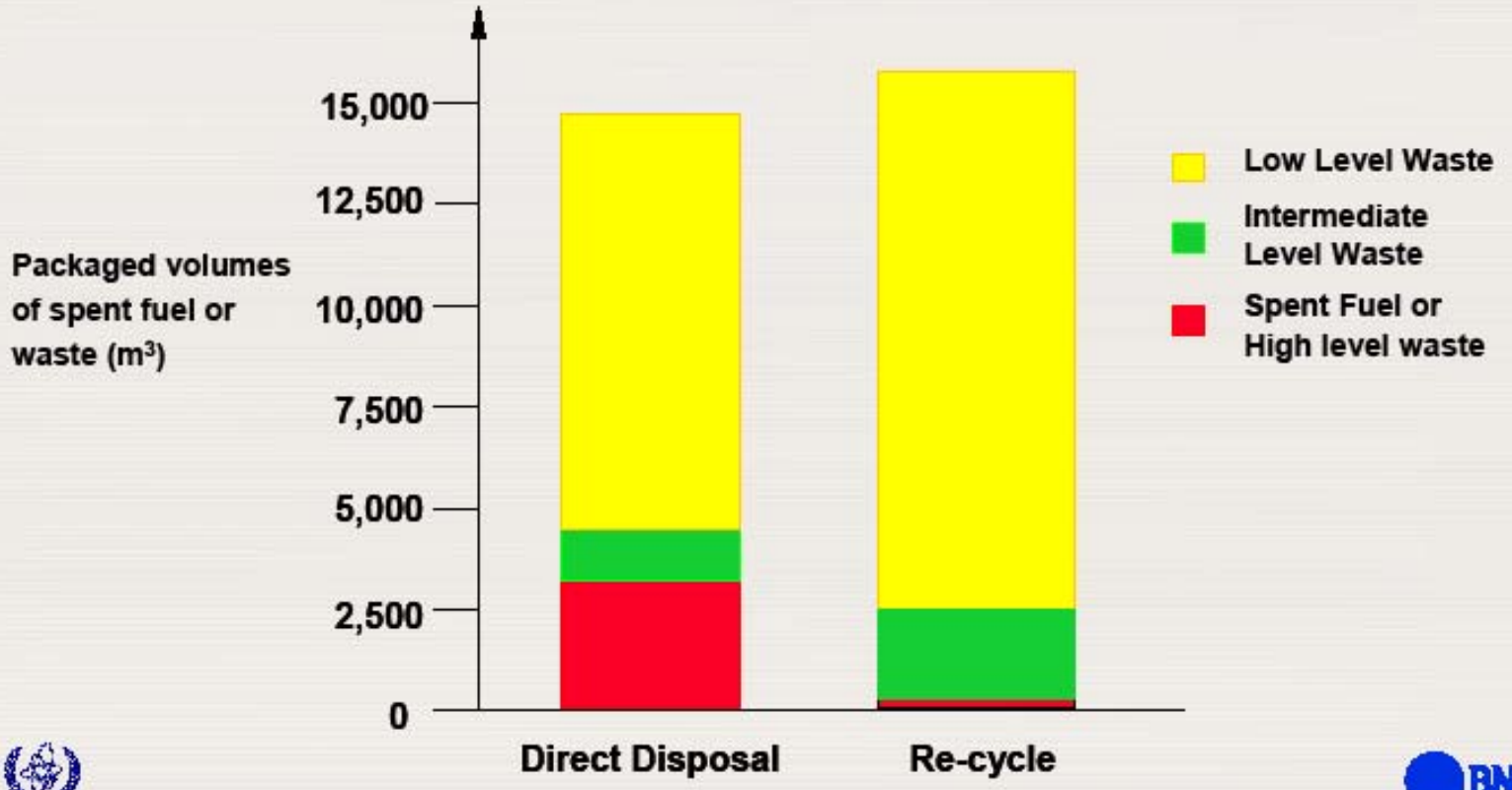
A relatively modest carbon penalty would significantly improve the ability of nuclear to compete against gas & coal

Wastes in Fuel Preparation and Plant Operation



Source: IAEA, 1997

Spent fuel and waste from a 1,000 MW nuclear power plant operating(1) for 60 years



1) Decommissioning waste volumes are included

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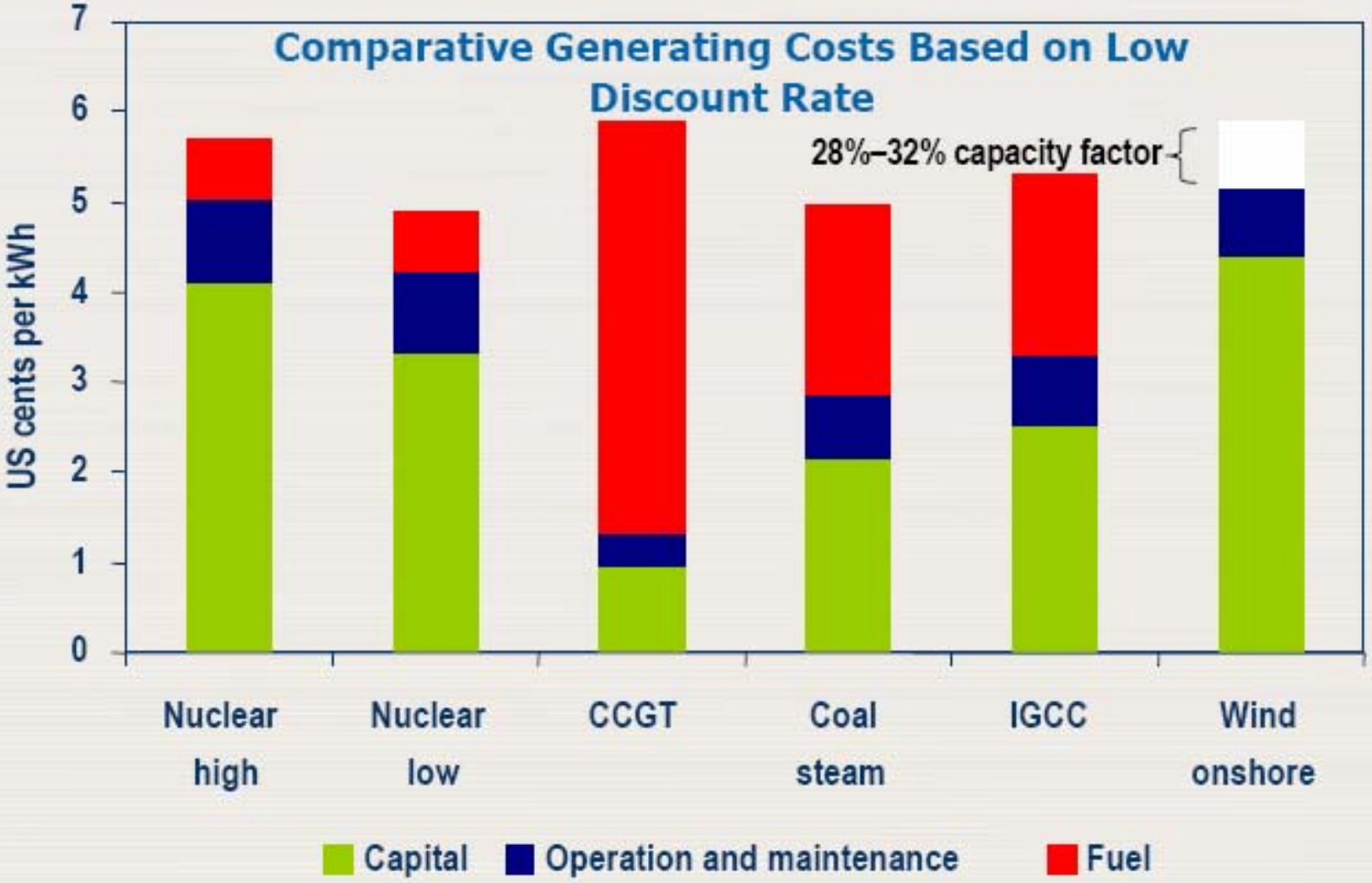
BNFL

IEA: Nuclear Power Generating Costs



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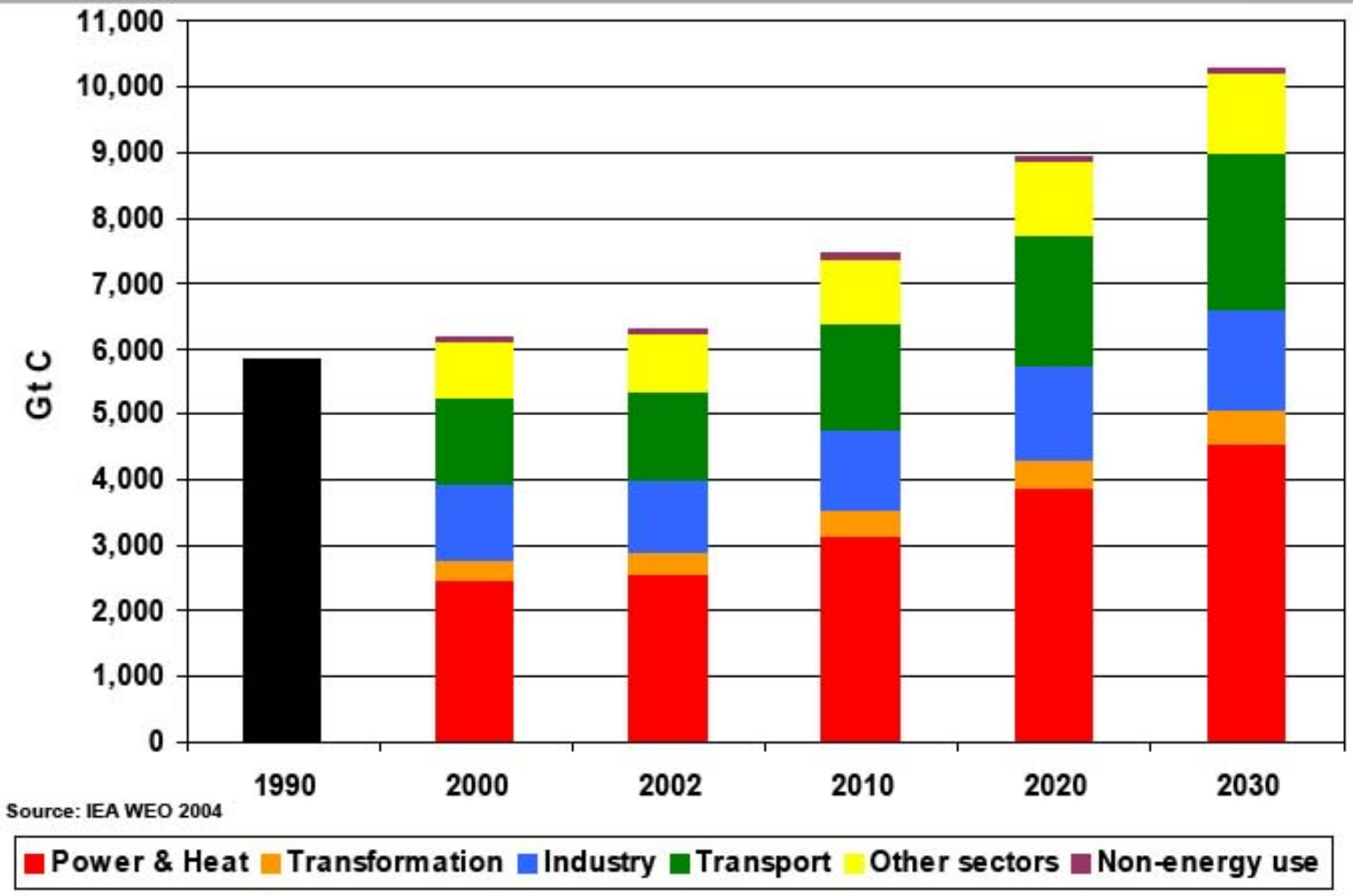
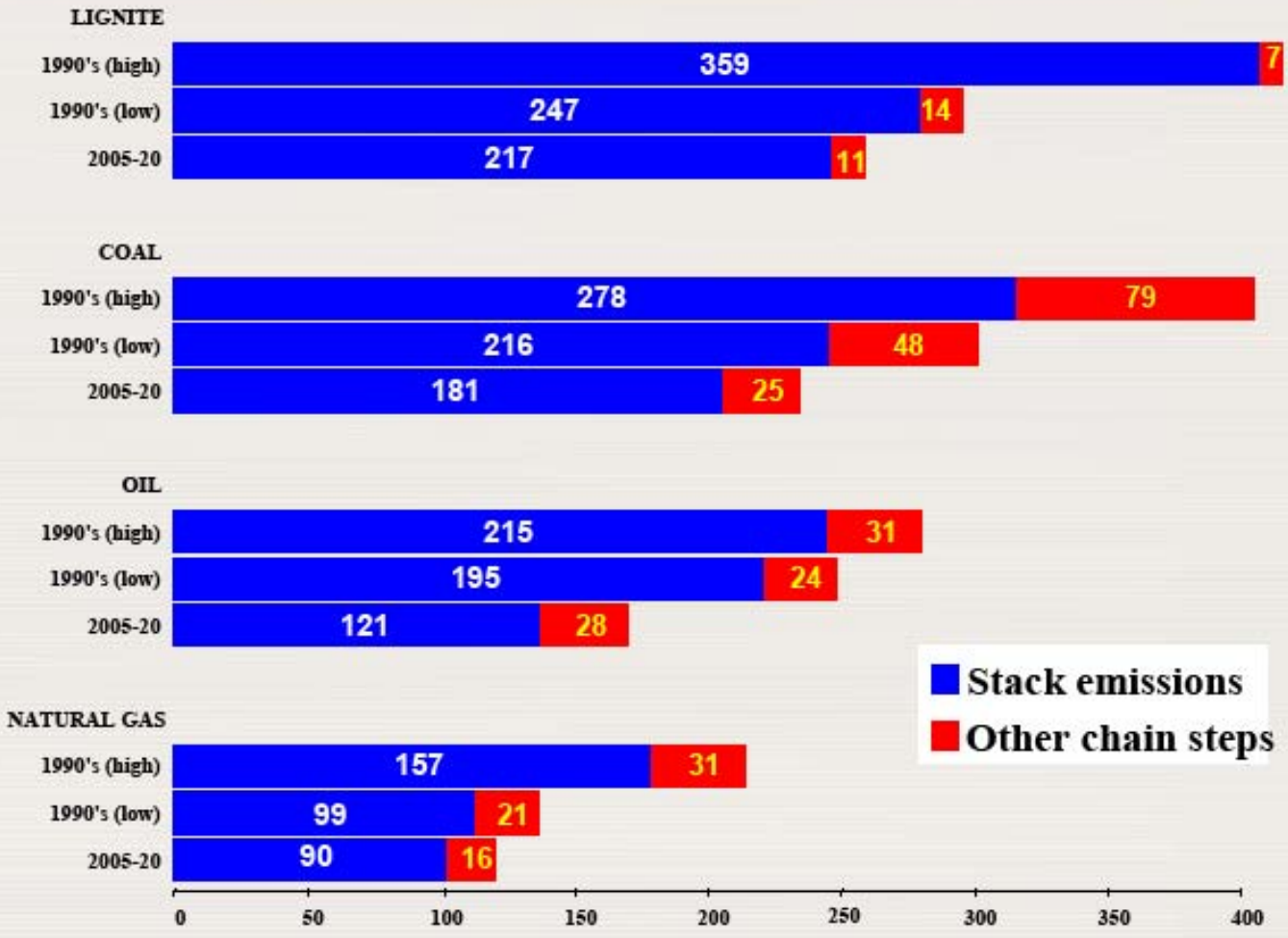
Nuclear can compete effectively against other fuel options

Carbon Emissions 1990 - 2030



Full Chain Greenhouse Gas Emissions, g C / kWh



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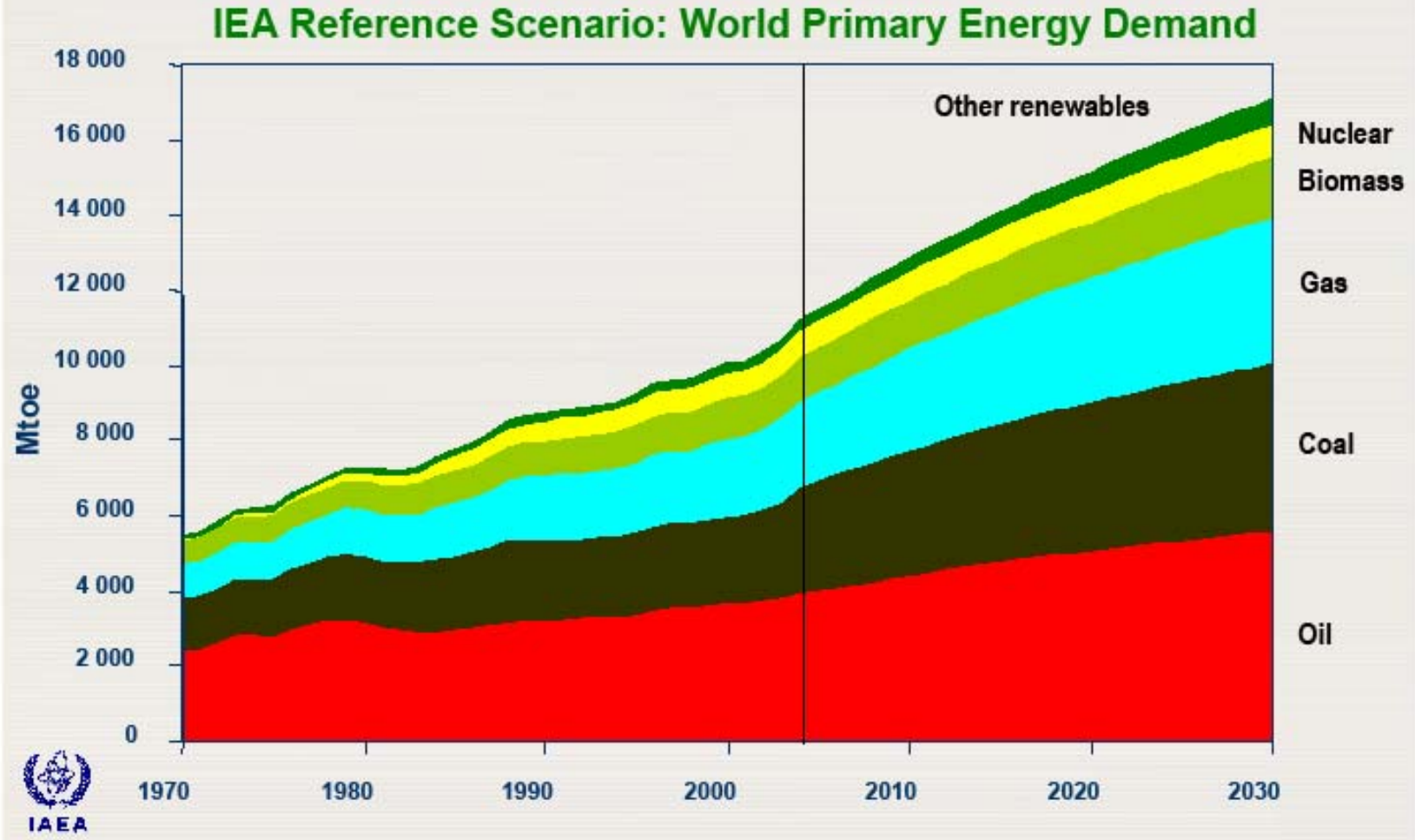
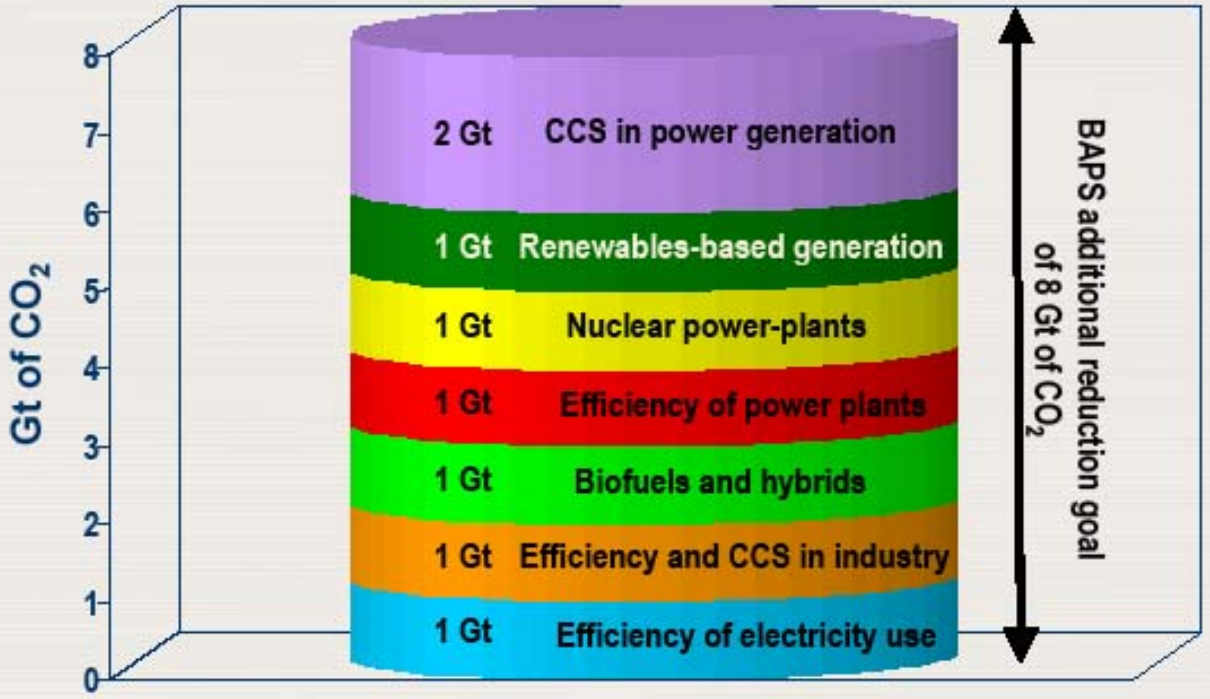
IEA World Energy Outlook 2006



The Alternative Policy Scenario:
Beyond APS CO_2 Emissions Savings



The scale and the speed of the necessary technological change represent a new order of challenge

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Summary of nuclear power today:

- A proven technology that provides clean electricity at predictable and competitive costs
- More the 12,000 years of accumulated reactor experience
- Operation of nuclear installations have safety as highest priority
- Lessons learned from past mistakes or accidents have been acted on
- The industry's safety record is second to none
- Nuclear takes full responsibility for all its waste

Challenges for 21st Century Energy Supplies

- Economic development translates into growing demand for energy services
- More than 1.6 billion people without access to modern energy services
- Demand is compounded by continued population growth
- Energy is central to achieving sustainable development goals
- Poverty eradication calls for affordable energy services
- Need to minimize of health and environmental impacts

Rising expectations

- A good and lengthening track record
- Growing energy needs
- Security of supply
- Plans for expansion in a number of countries
- New environmental constraints

One size does not fit all

- Countries differ with respect to
- energy demand growth
- alternatives
- financing options
- weighing/preferences
- accident risks (nuclear, mining, oil spills, LNG…),
- cheap electricity, air pollution, jobs, import
- dependence, climate change
- All countries use a mix. All are different.

It's the economics"

- Nuclear is expensive to build, cheap to run
- New nuclear most attractive where energy demand growth in rapid
- alternative resources are scarce
- energy supply security a priority
- reducing air pollution and GHGs a priority
- financing can look longer-term
- low financial risk premium

ECONOMICS OF NUCLEAR POWER

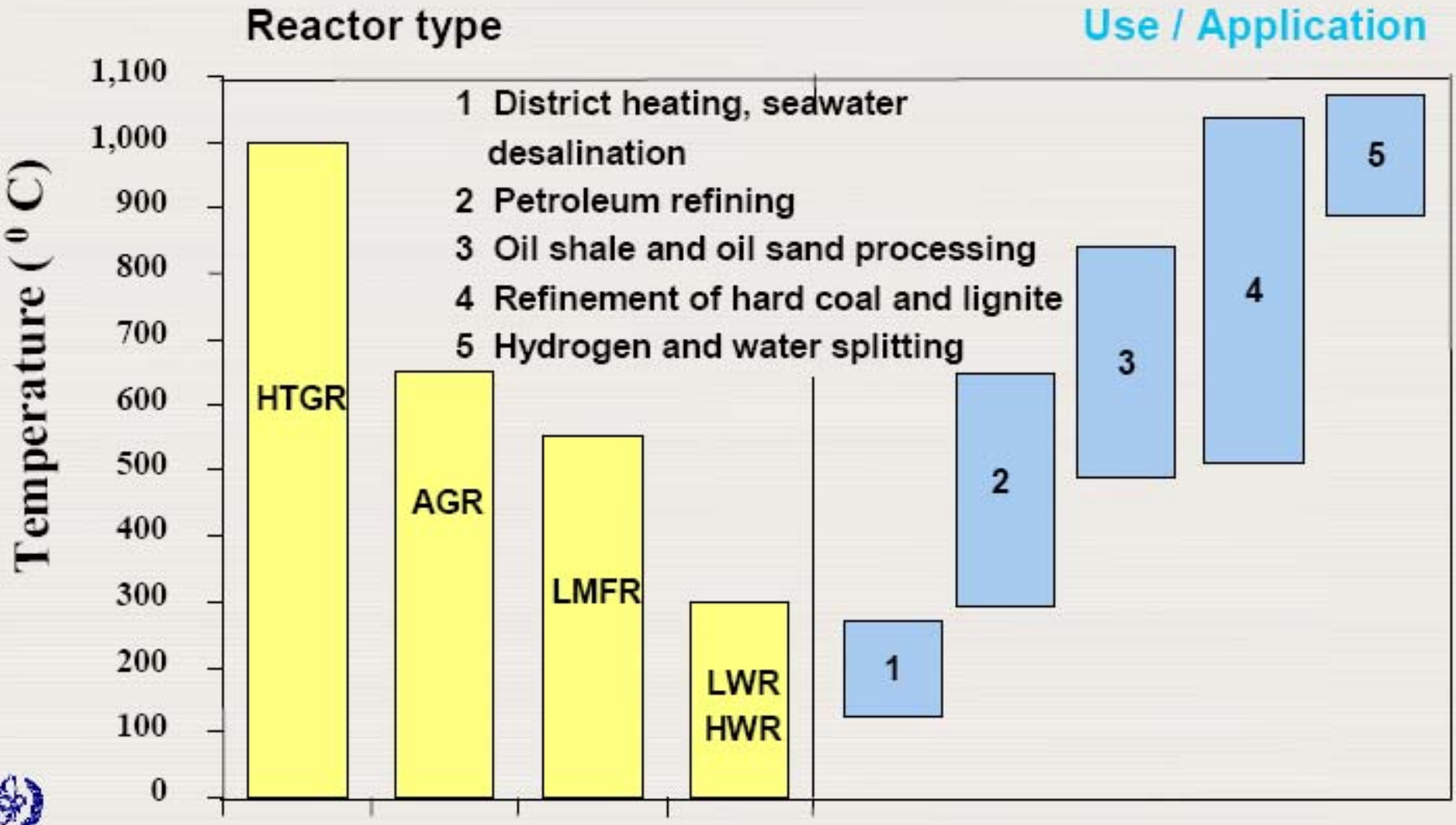
Advantages	But. . . .
NPP are cheap to Operate	High upfront capital cost can be difficult to finance
Stable and predictable costs	Sensitive to interest generating rates
Long life time	Long lead times (planning, construction, etc.)
Supply security (insurance premium)	Long payback periods
Low external costs (so far no credit applied)	Regulatory/policy risks

Where to Go?

- Non Producer of Carbon Dioxide
  - Geothermal, Wind, Solar, Hydro, etc.
  - Nuclear Power
  - Rechargeable batteries, hydrogen cells, etc.
- Producer of Carbon Dioxide
  - Oil, Natural Gas, Coal,
  - Biomass, Alcohol, Methyl esters, etc.

WINNER IS NUCLEAR POWER

NUCLEAR POWER:
More than just electricity generation



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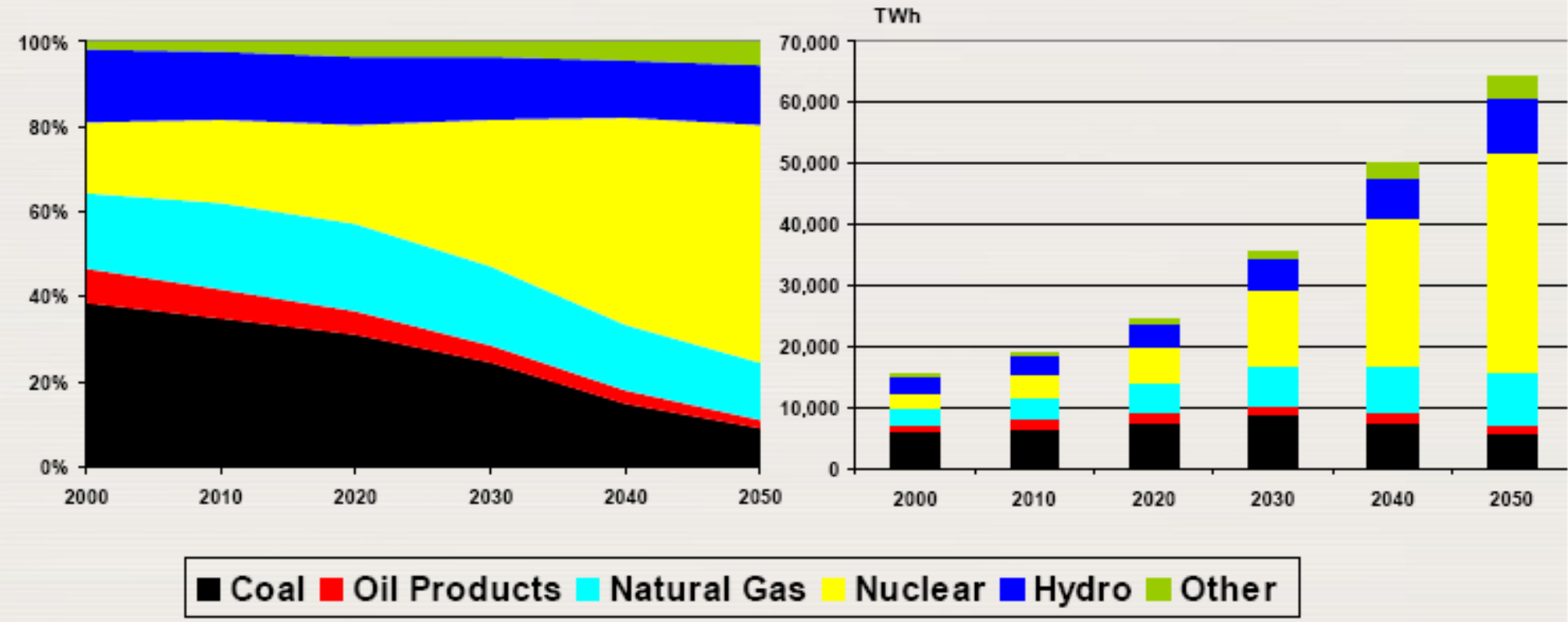
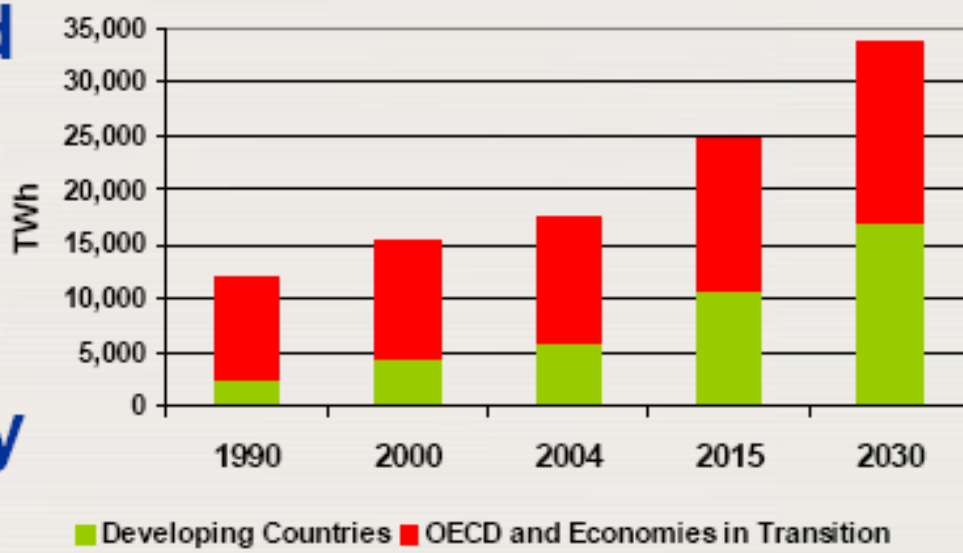
Long-term sustainable electricity scenarios



Conditions of today are distinctly different from the mid-1980s:

- Strong energy demand growth
- Fossil fuels no longer cheap
- Energy supply security concerns



- Attractive life cycle costs of nuclear power
- Pollution control and climate change
- Excellent operating experience
- Renewables and efficiency improvements: Low hanging fruit already harvested

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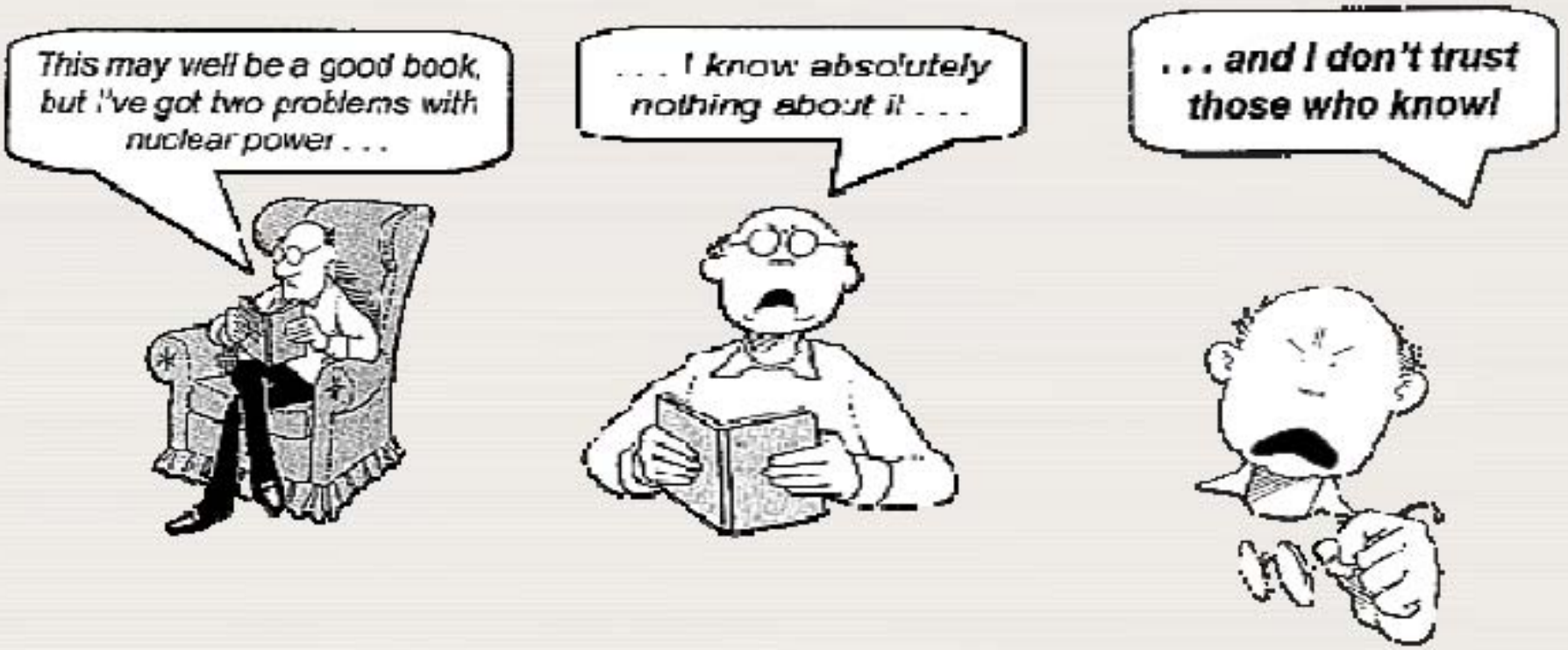
Nuclear Energy and Society



Bjorn Wahlström

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