

**COP11 – Montreal, Canada**

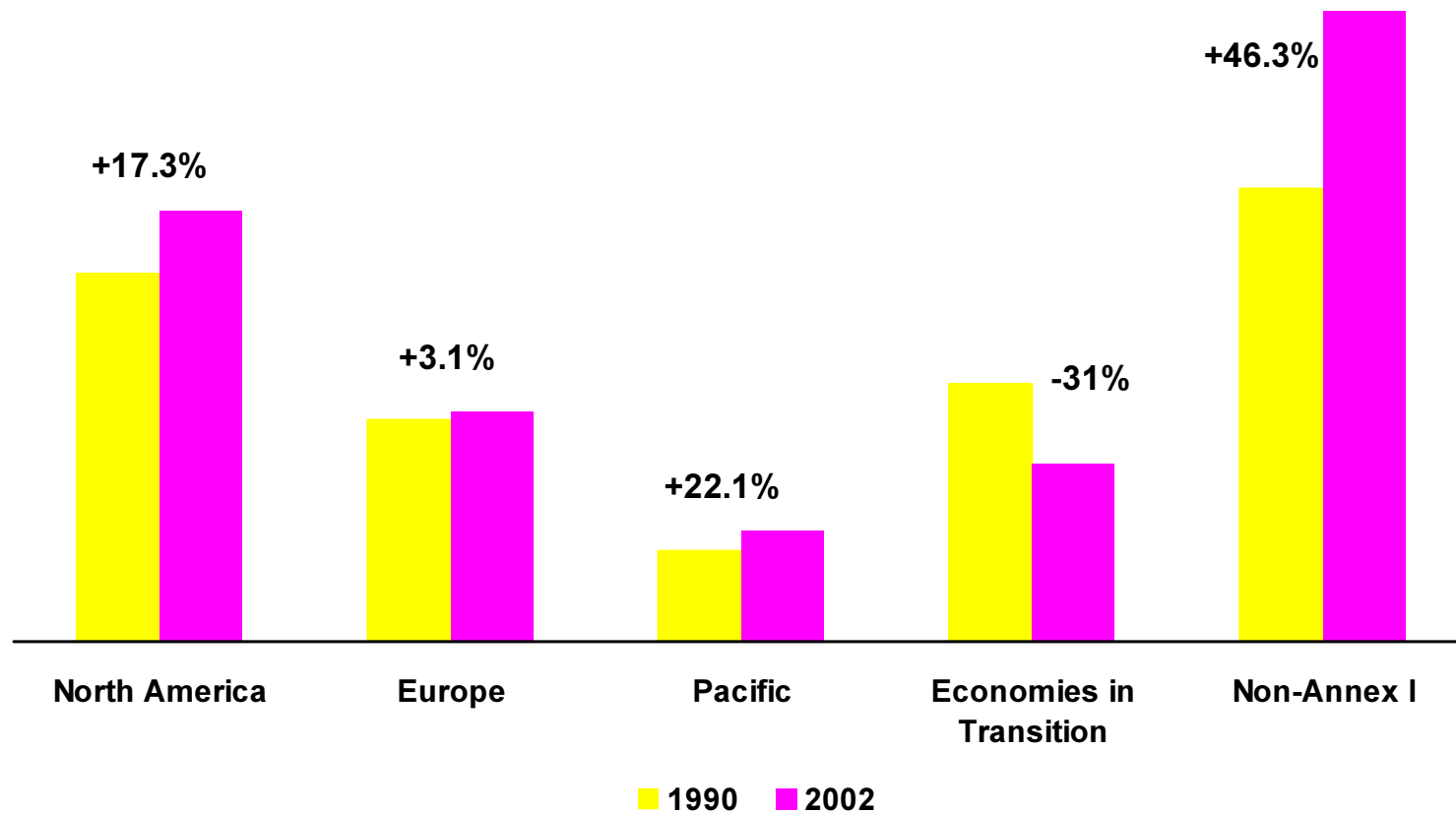
# **Nuclear Energy Climate Change and Economics**

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# Overview

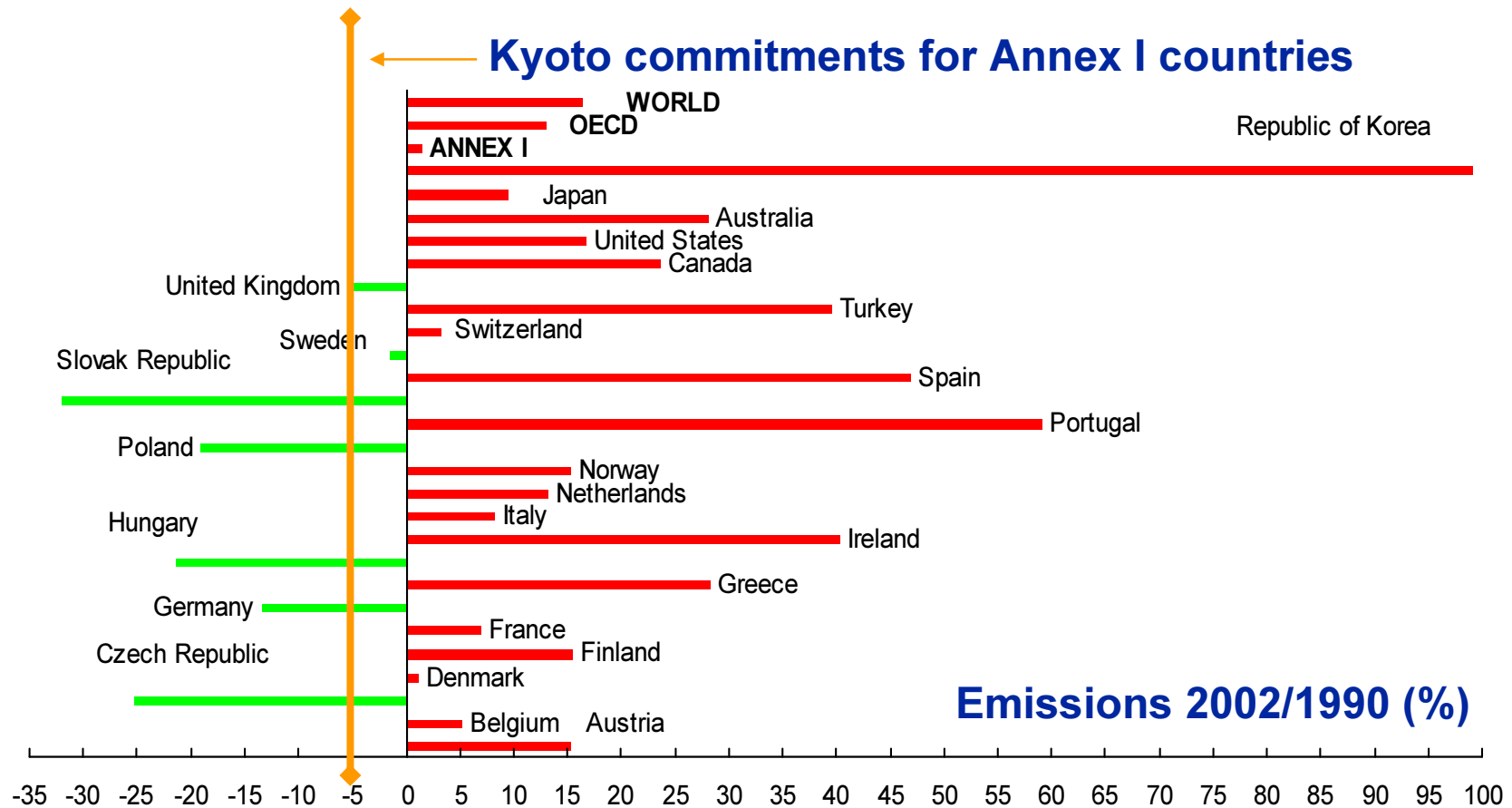
- ◆ **The Facts**
- ◆ **Nuclear Energy and Climate Change**
- ◆ **Nuclear Energy Economics**
- ◆ **Concluding Remarks**

# Global Trends in CO<sub>2</sub> Emissions 1990 / 2002

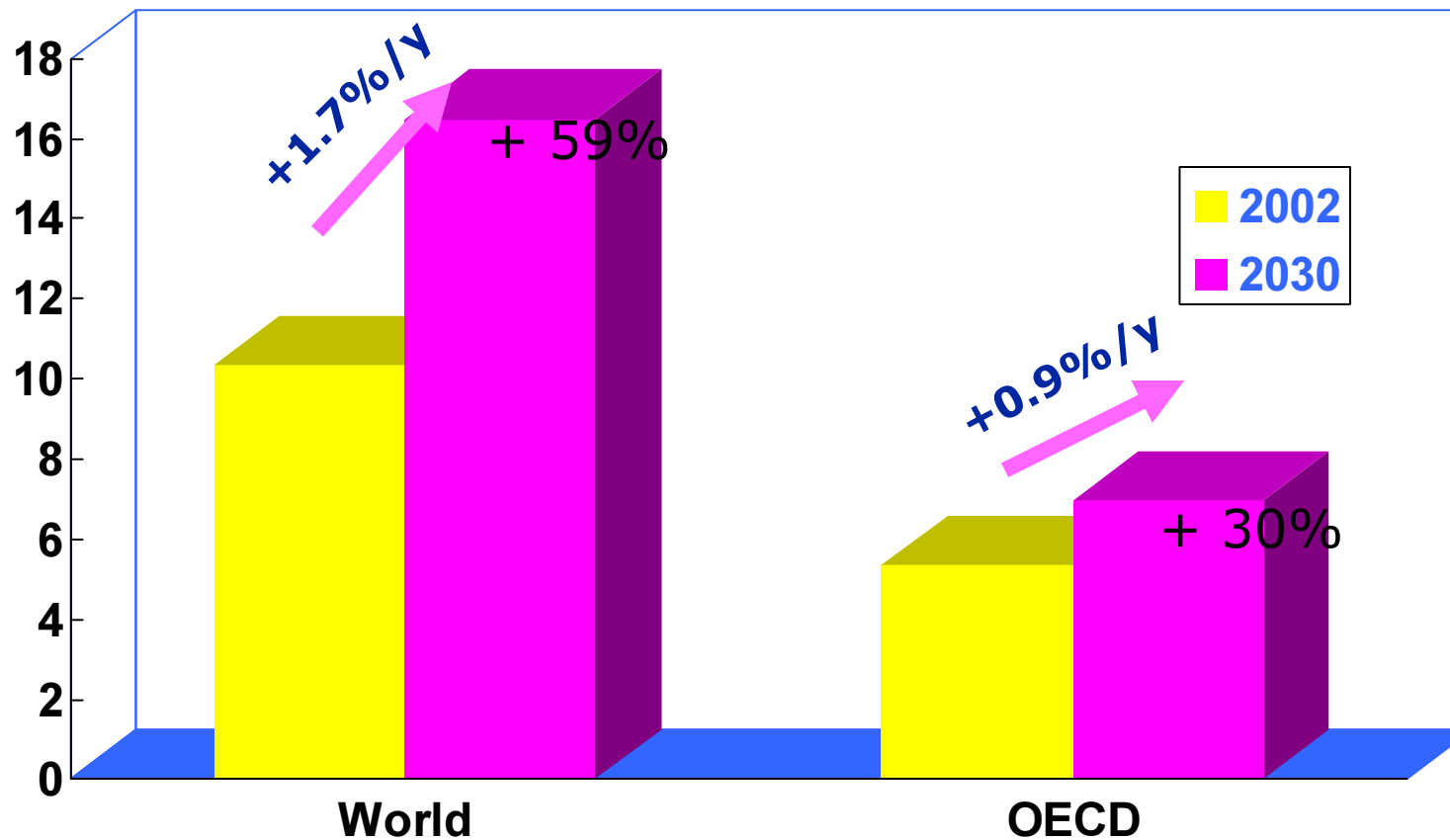


Source: OECD/IEA Statistics

# Evolution of CO<sub>2</sub> Emissions

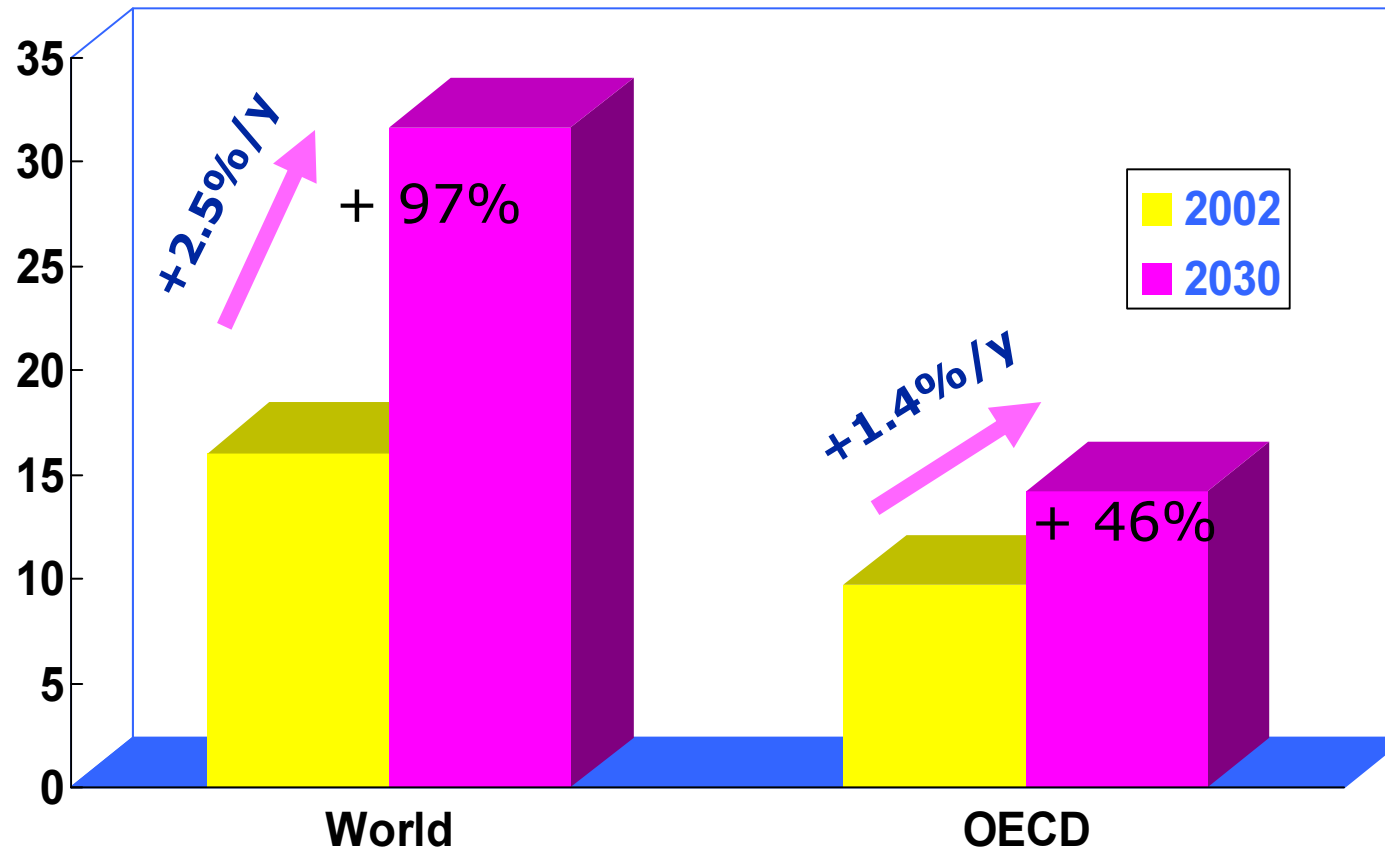


# Primary Energy Demand (Gtoe)



Source: IEA WEO 2004

# Electricity Consumption ( $10^3$ TWh/y)



Source: IEA WEO 2004

# Investments for the Electricity Sector [2003-2030]

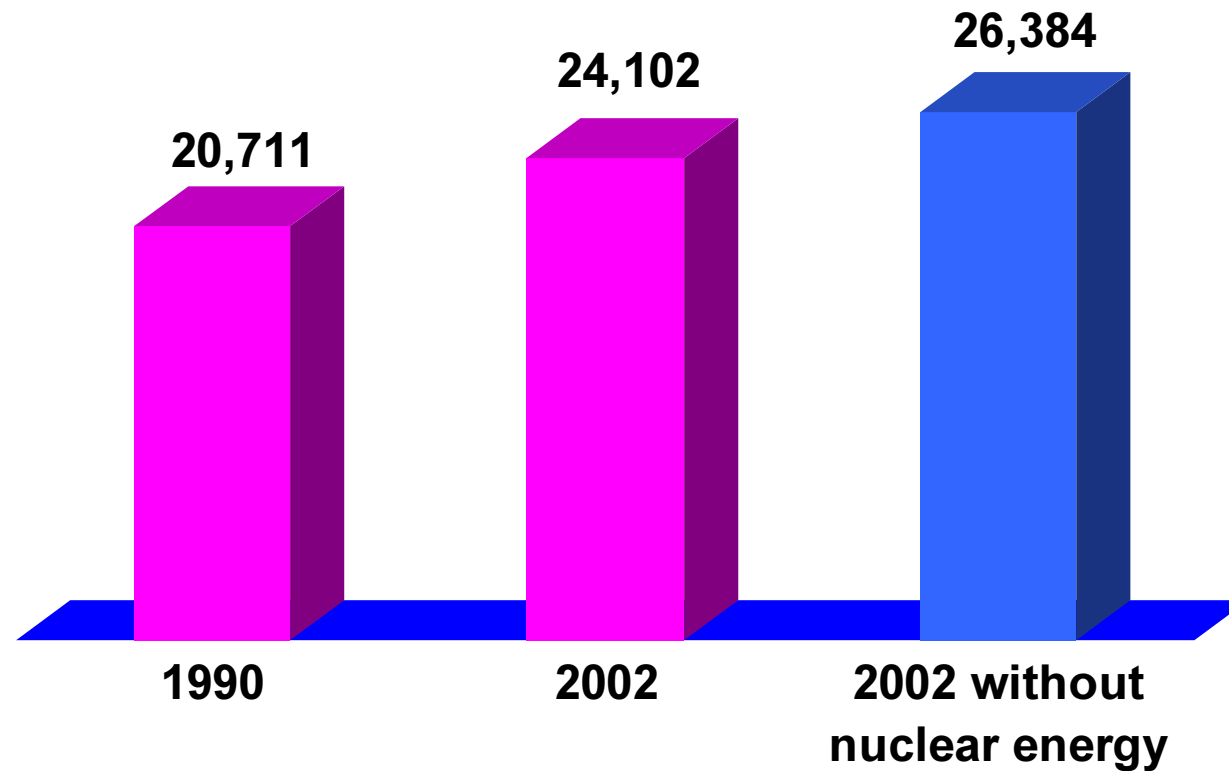
	<b>OECD</b>	<b>World</b>
<b>Additional capacity (GWe)</b>	<b>1975</b>	<b>4784</b>
<b>Investment for plants (billion \$)</b>	<b>2167</b>	<b>4607</b>
<b>Investment for transmission &amp; distribution (billion \$)</b>	<b>1774</b>	<b>5191</b>

Source: IEA WEO 2004

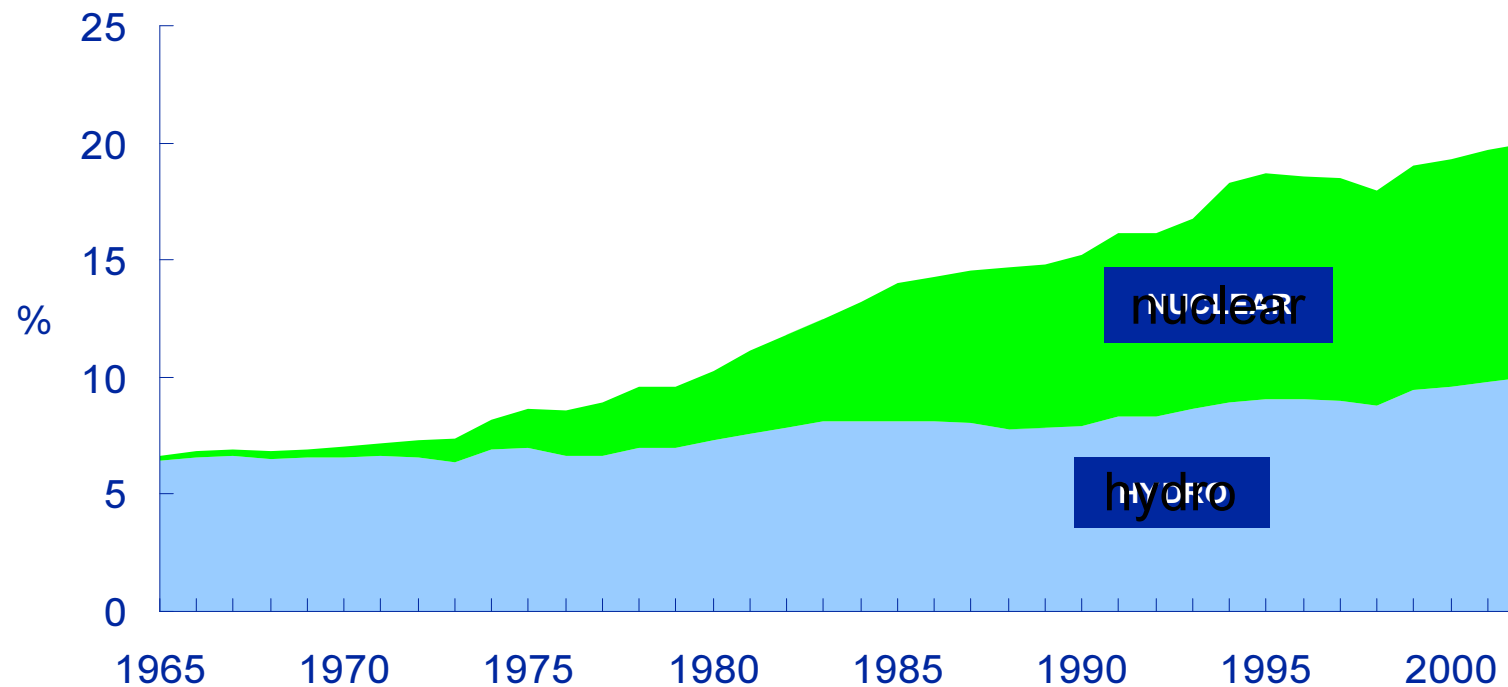
# The Kyoto Protocol & Nuclear Energy

- ◆ **Adopted in 1997 at COP3 – EIF in 2005**
  - **Legally binding emission targets for Annex I**
  - **Reduction by at least 5.2% up to 2008-2012**
- ◆ **Means to reduce emissions**
  - **Domestic measures**
    - Nuclear units help reducing GHG emissions**
  - **Flexibility mechanisms**
    - ❖ **Clean Development Mechanism (CDM)**
      - Nuclear excluded**
    - ❖ **Joint Implementation (JI)**
      - Nuclear excluded**
    - ❖ **Emission Trading**
      - Emission reductions due to nuclear may be traded**

# World CO<sub>2</sub> Emissions (Mt CO<sub>2</sub>)



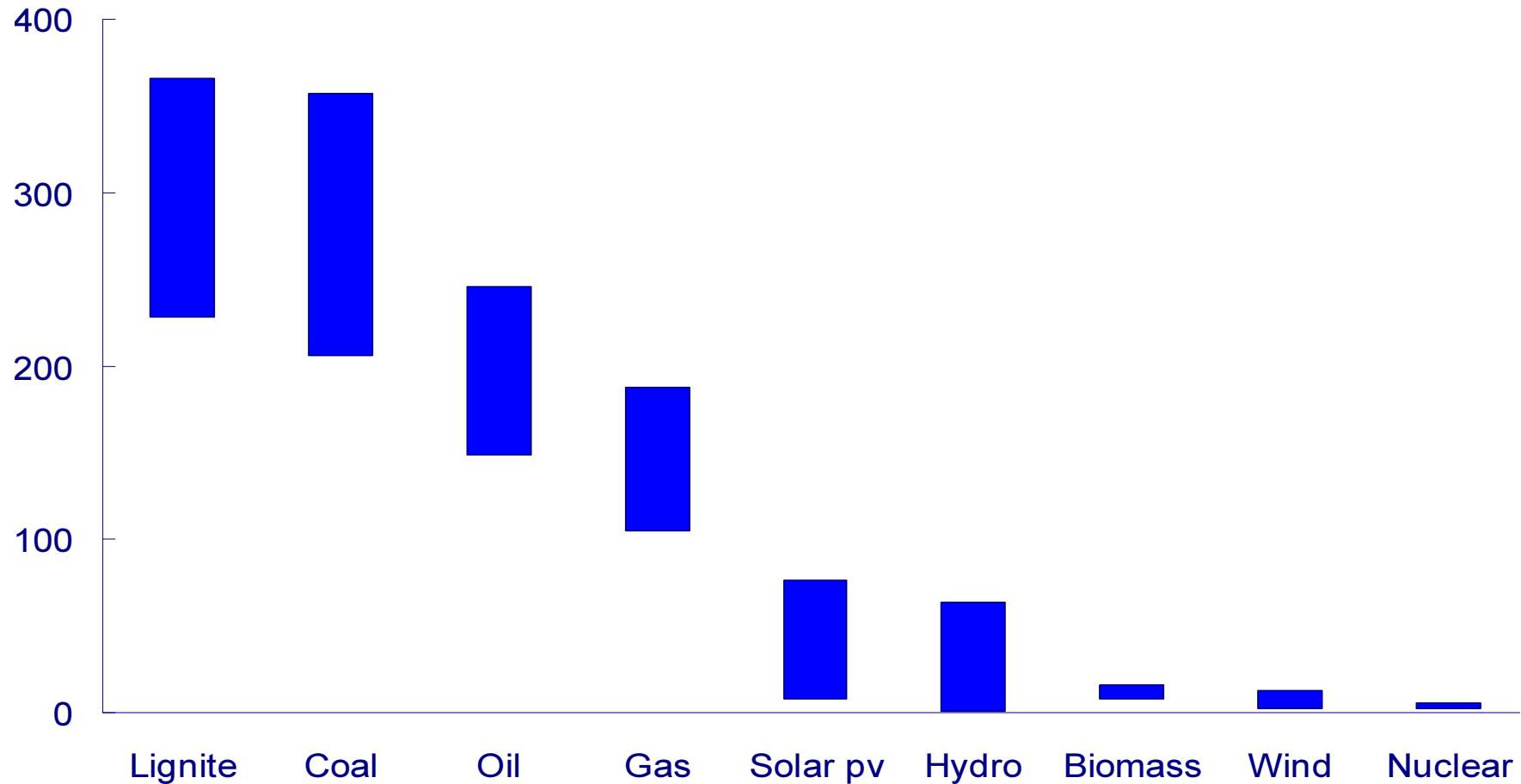
# CO<sub>2</sub> Avoided by Hydro and Nuclear Energy (% of total CO<sub>2</sub> emissions from the energy sector)



# The Role of Nuclear Energy

- ◆ Nuclear energy is nearly carbon free
- ◆ Nuclear power plants in operation in OECD countries allow to reduce their GHG emissions by 10% (1.200 Mt CO<sub>2</sub>/year)
- ◆ Nuclear energy is among the cheapest ways to reduce GHG emissions

# Greenhouse Gas Emissions from Electricity Production Chains (g C/kWh – equiv.CO<sub>2</sub>)





## Projected Costs of Generating Electricity

2005 Update

This sixth study in a series on projected costs of generating electricity presents and analyses cost estimates for some 130 power and co-generation (heat and power) plants using coal, gas, nuclear and renewable energy sources. Experts from 19 member countries, 2 international organisations and 3 non-OECD countries contributed to the study.

Levelised lifetime costs were calculated with input data from participating experts and commonly agreed generic assumptions, using a uniform methodology. The study shows that the competitiveness of alternative generation sources and technologies depends on many factors and that there is no absolute winner. Key issues related to generation costs are addressed in the report including methodologies to incorporate risk in cost assessments, impact of carbon emission trading and integration of wind power into electricity grids. The projected costs presented are generic and do not reflect the full range of factors (e.g., security of supply, risks and carbon emissions) that investors and other decision makers need to take into account. This report will be, however, a reference for energy policy makers, electricity system analysts and energy economists.



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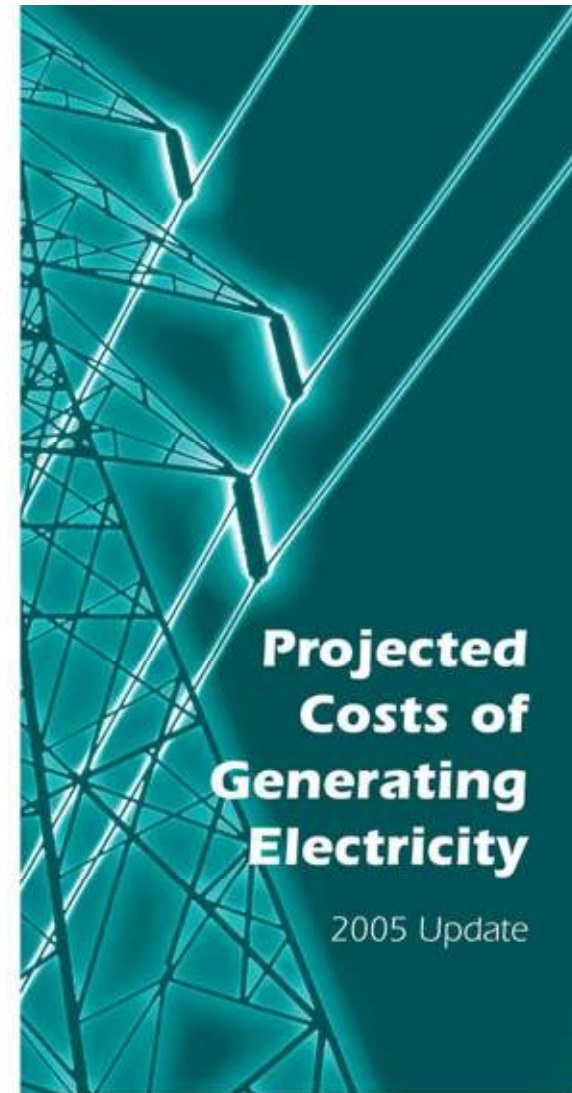


INTERNATIONAL  
ENERGY AGENCY

Projected Costs of Generating Electricity – 2005 Update



OECD



# Projected Costs of Generating Electricity

2005 Update

# What is the Study ?

- ◆ 6<sup>th</sup> edition in a series initiated in 1982
- ◆ Joint IEA/NEA endeavor
- ◆ Based on national data
- ◆ Relying on a common approach

## *Providing*

- ◆ Reference information
- ◆ Analysis of cost elements
- ◆ Support to decision making

# Framework

- ◆ **Cost data provided by participants**
  - **Technical characteristics**
  - **Construction costs and schedule and O&M costs**
  - **Fuel price projections**
- ◆ **Common levelised cost methodology**
- ◆ **Common assumptions**
  - **Discount rates [5%, 10%]**
  - **Economic lifetime [40 years – for most plants]**
  - **Load factor for base-load plants [85%]**

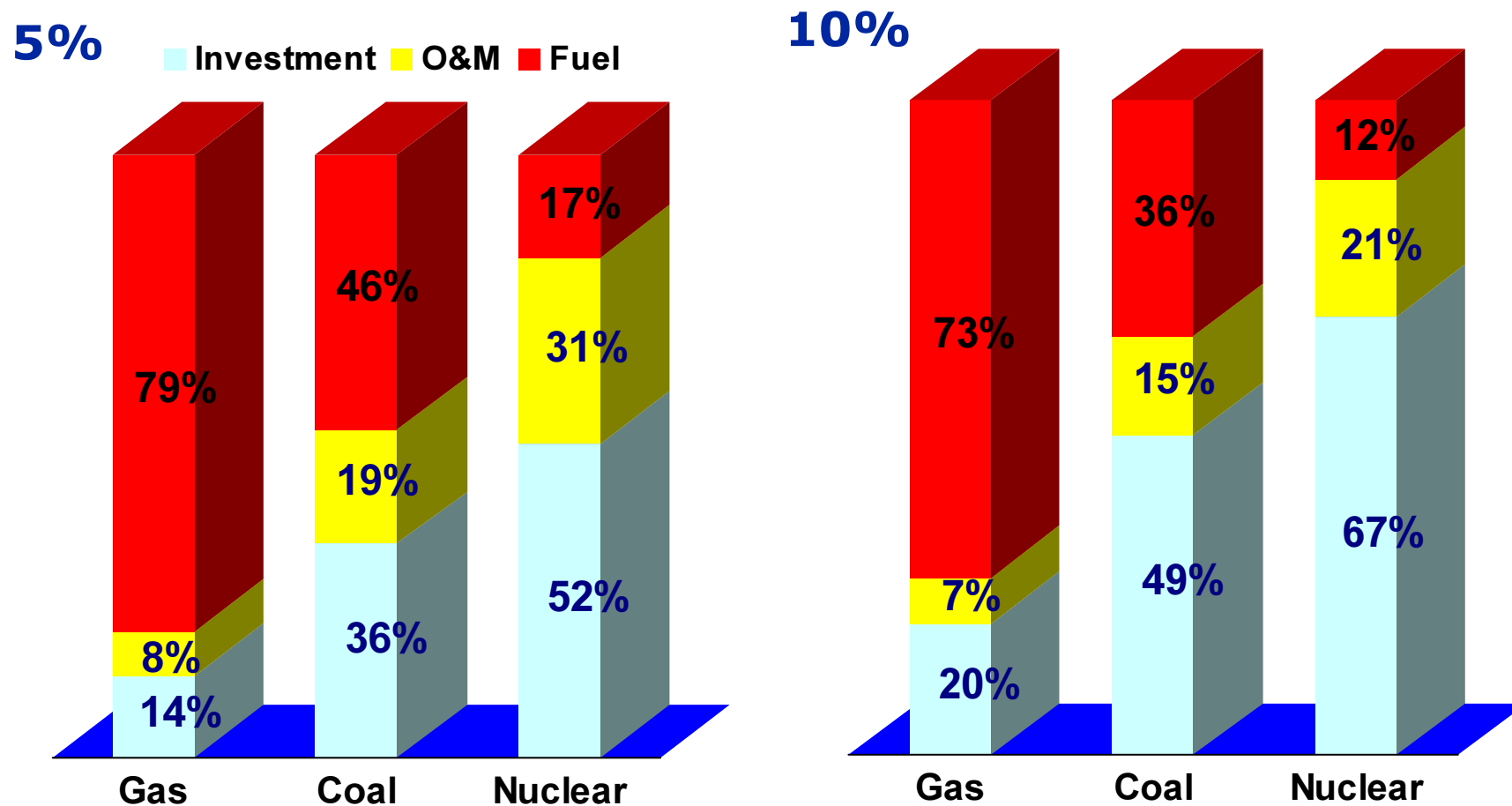
# Scope of the Study

- ◆ ~ 130 power plants in 21 countries
  - Coal, gas, nuclear
  - Cogeneration
  - Wind, hydro, solar
  - Others (biomass, waste incineration, ...)
- ◆ Cost elements supported by electricity producers
  - Investment, including refurbishment, decommissioning and interest during construction
  - O & M
  - Fuel, including waste management and disposal

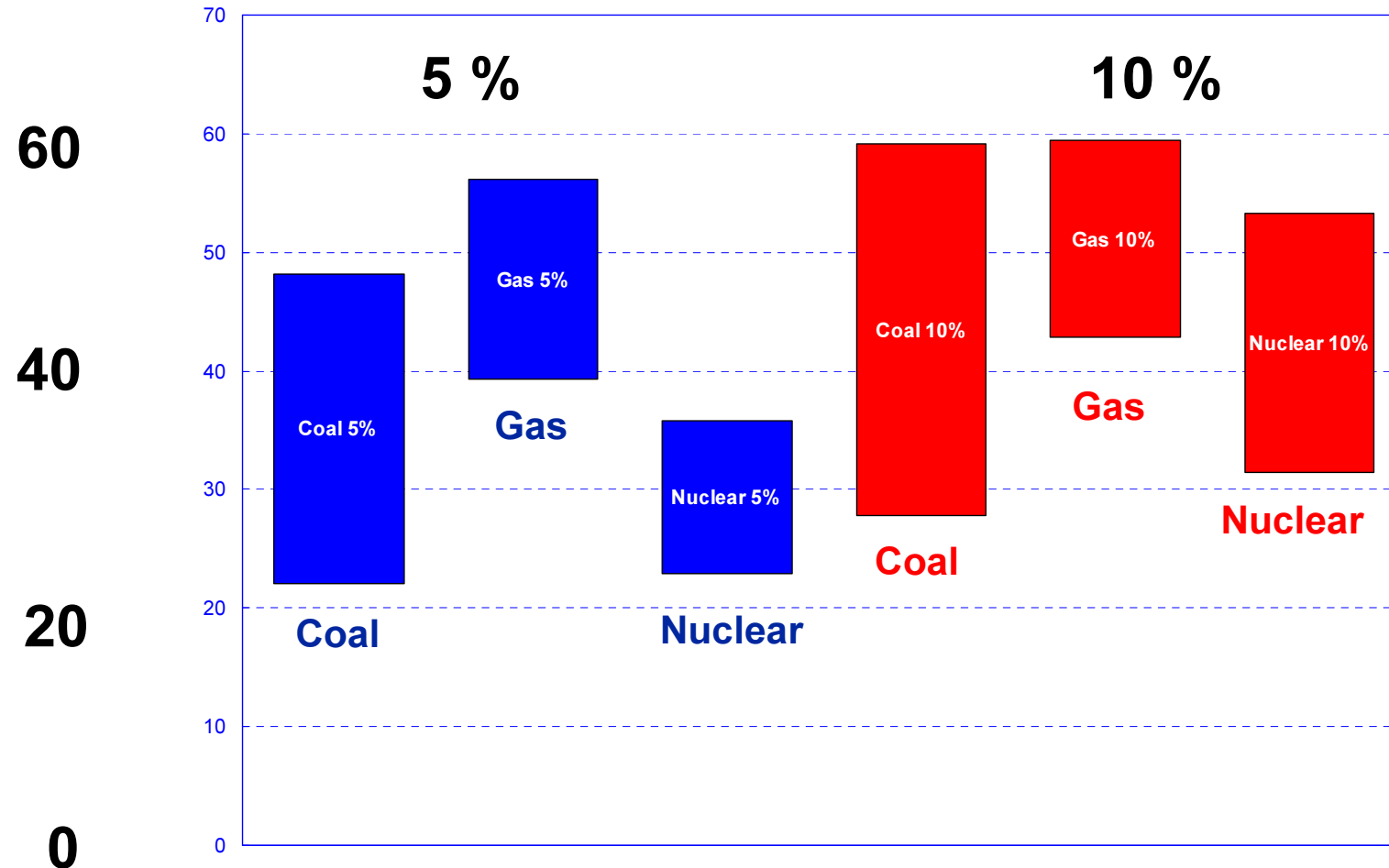
# Out of the Scope

- ◆ **Transmission & distribution costs**
- ◆ **Business risks**
- ◆ **Externalities**
  - **Impacts of CO<sub>2</sub> or carbon value**
  - **Damage from residual pollution**
  - **Value of security of supply**
- ◆ **Site/project specific factors**

# Generation Cost Structure



# Cost Ranges\* [USD/MWh]



\* Excluding the 5% highest and 5% lowest values

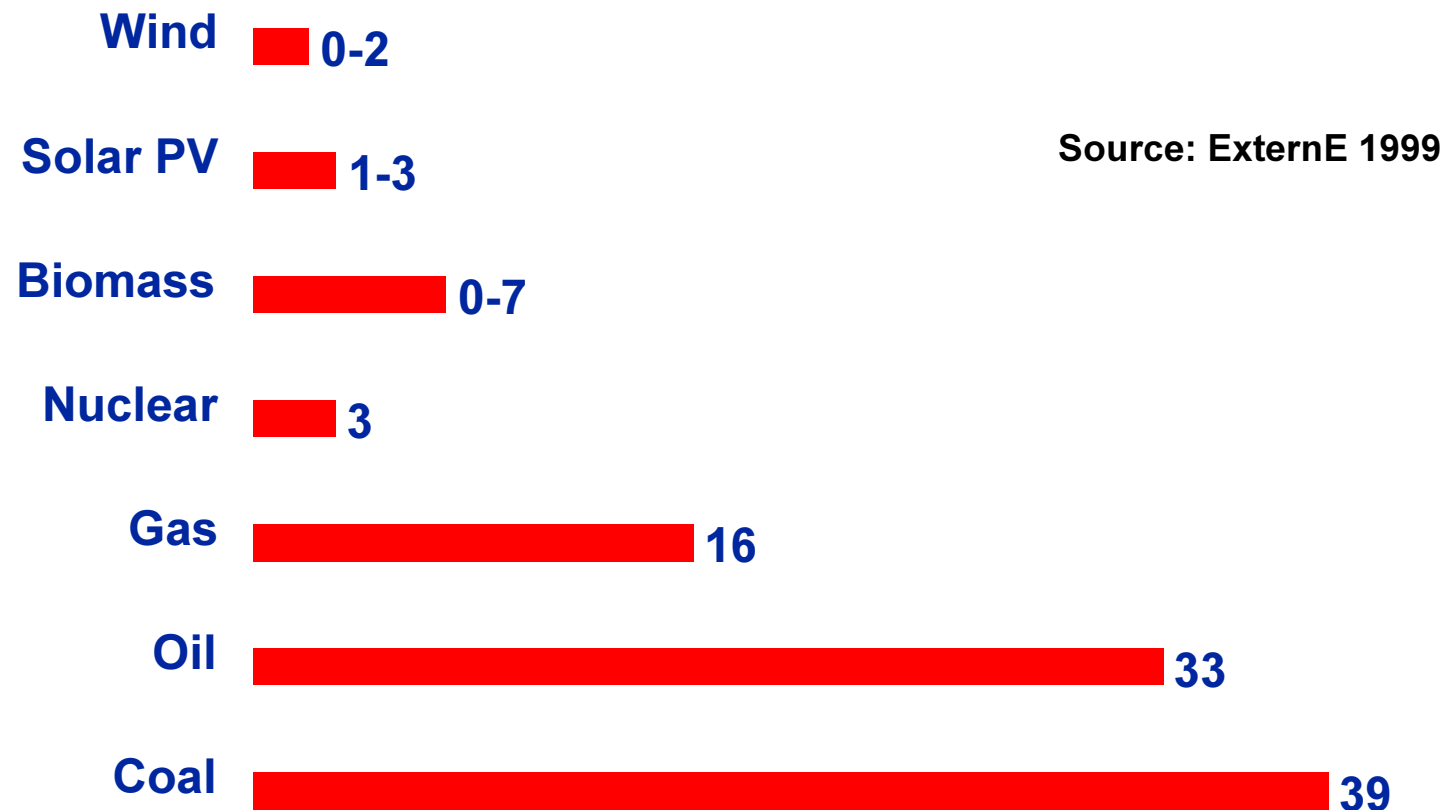
# Externalities

*Costs that are born by the society as a whole rather than by consumers*

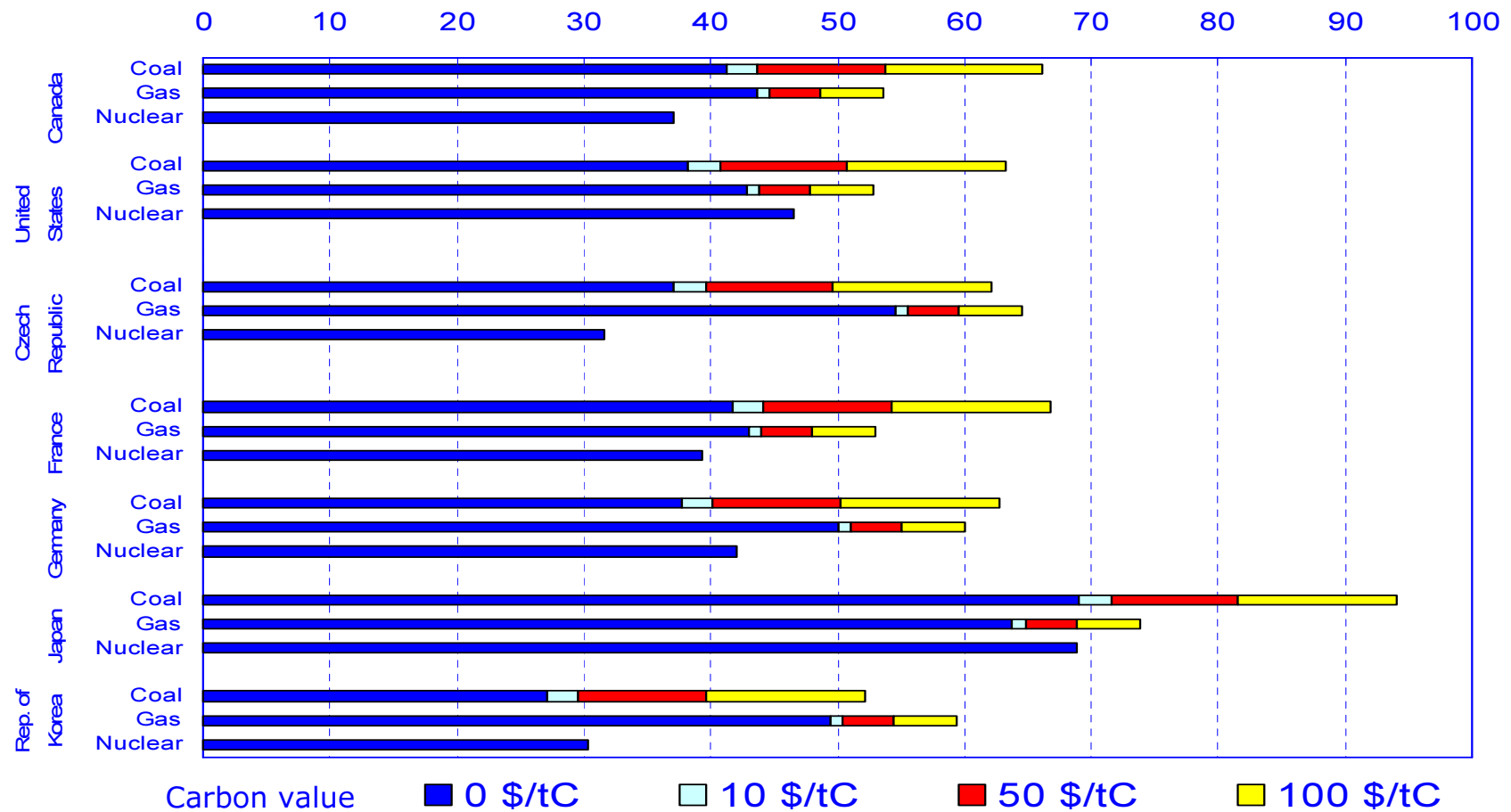
*Detrimental to global economic, social and environmental optimisation*

- ◆ **Health and environmental impacts of release of waste - CO<sub>2</sub>, radioactive waste**
  - Routine operation
  - Decommissioning & dismantling (*included*)
- ◆ **Insurance (severe accidents)**
- ◆ **Policy factors not reflected in market prices**
  - Security of supply
  - Social acceptance

# External Costs of Electricity Generation (m€/kWh)



# Impact of Carbon Values on Generation Costs at 10% [USD/MWh]



## Concluding Remarks (1)

- ◆ **No technology/source is always cheaper for base load electricity generation**
- ◆ **Electricity generation costs are decreasing owing to technology progress and competition**
- ◆ **Nuclear competitiveness increases**
  - **Gas less attractive due to high expected prices**
  - **Wind power improving, still seldom competitive**
- ◆ **Reduction of nuclear investments costs remains a key issue**
- ◆ **Security of supply and climate change concerns enhance the attractiveness of nuclear energy**

## Concluding Remarks (2)

- ◆ **Without nuclear energy GHG emissions from the power sector would be ~16% higher**
- ◆ **Internalising carbon value enhances the competitiveness of nuclear energy**
- ◆ **In the long term, nuclear energy has the potential to alleviate the risk of global climate change**
- ◆ **The nuclear option deserves to be considered by policy makers in the post-Kyoto period**

# Thank you