

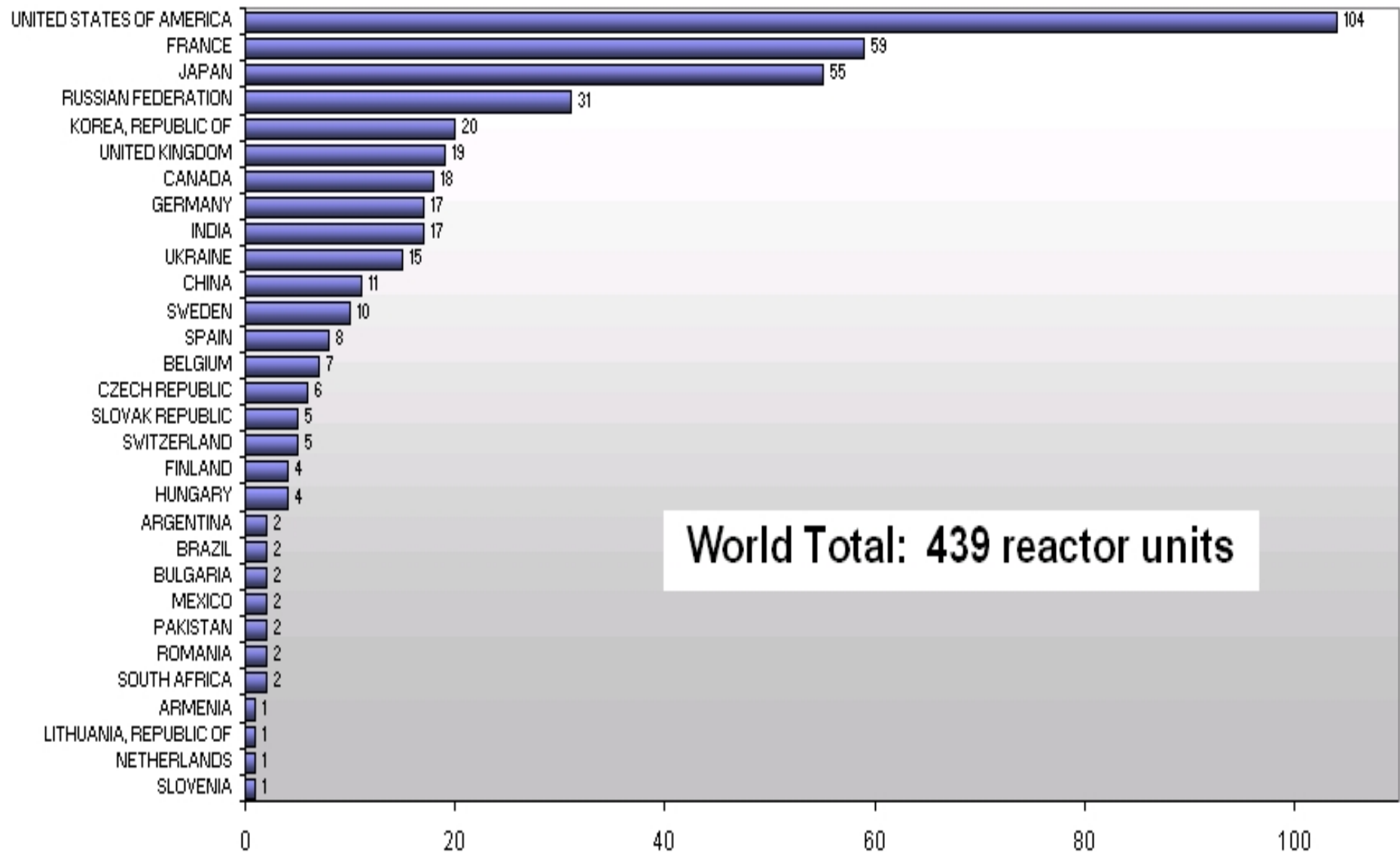
# PROSPECTS FOR NUCLEAR POWER

Mikko Kara, director, professor



# Number of Reactors in Operation Worldwide

(as of 8 of August 2007)



# Nuclear power in the world

- Performance has improved dramatically over time in all dimensions
- It is economical to extend the life of existing fleet and increase capacity of some units
- Growing interest in promoting investments, BUT economics, waste disposal and public acceptance are uncertain
- In USA 2005 Energy Act contains financial incentives to encourage “first-movers”
- Several companies are starting the licensing process

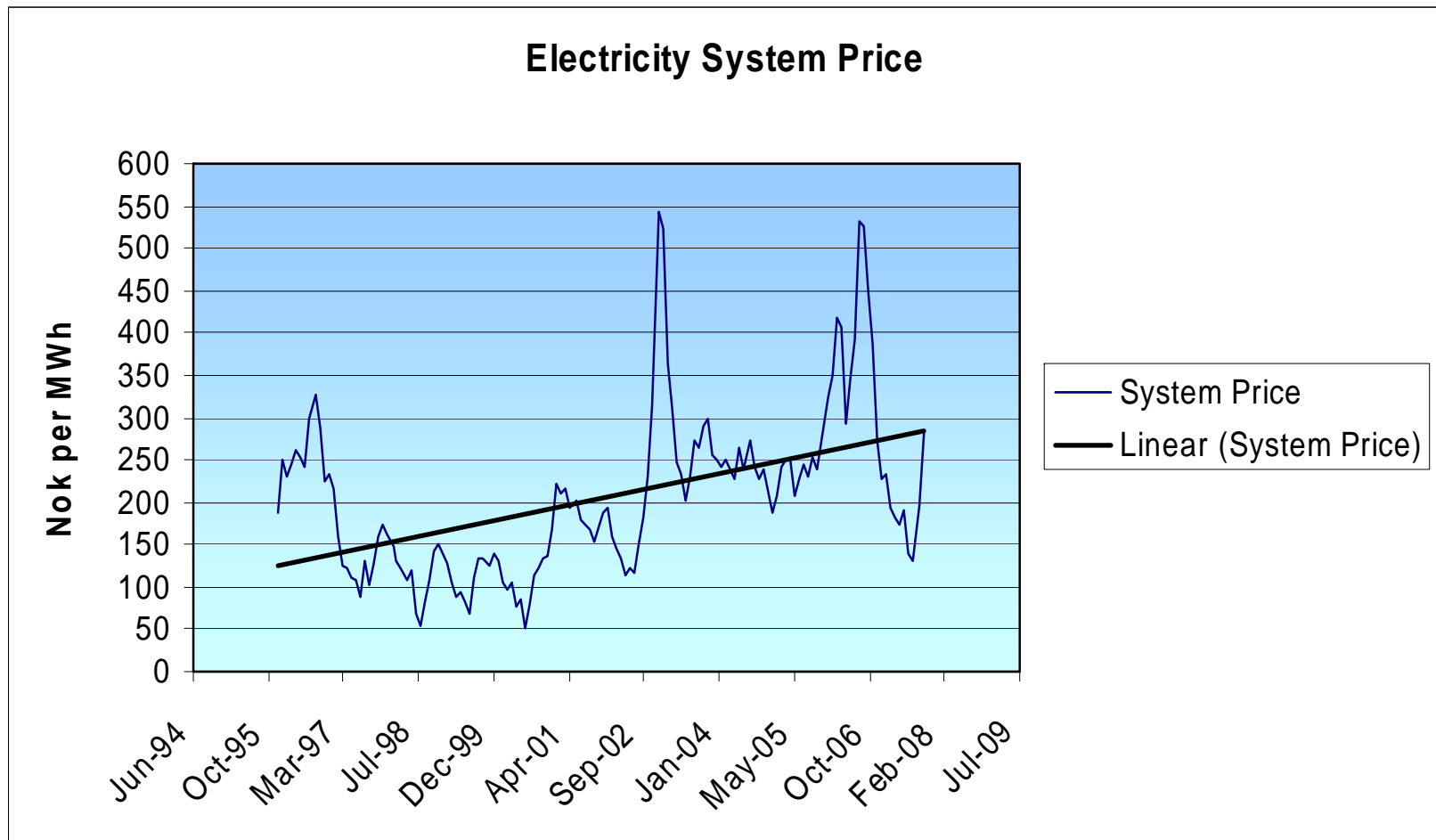


# Background considerations

- Need to distinguish existing fleet of plants from new investments
- CO2 price, coal price, natural gas price, subsidies,.. All are important drivers for private sector investors
- Economics is only one consideration for viability of investment in new nuclear plants:
  - Public and political acceptance
  - Effectiveness of new licensing process
  - Waste disposal policies



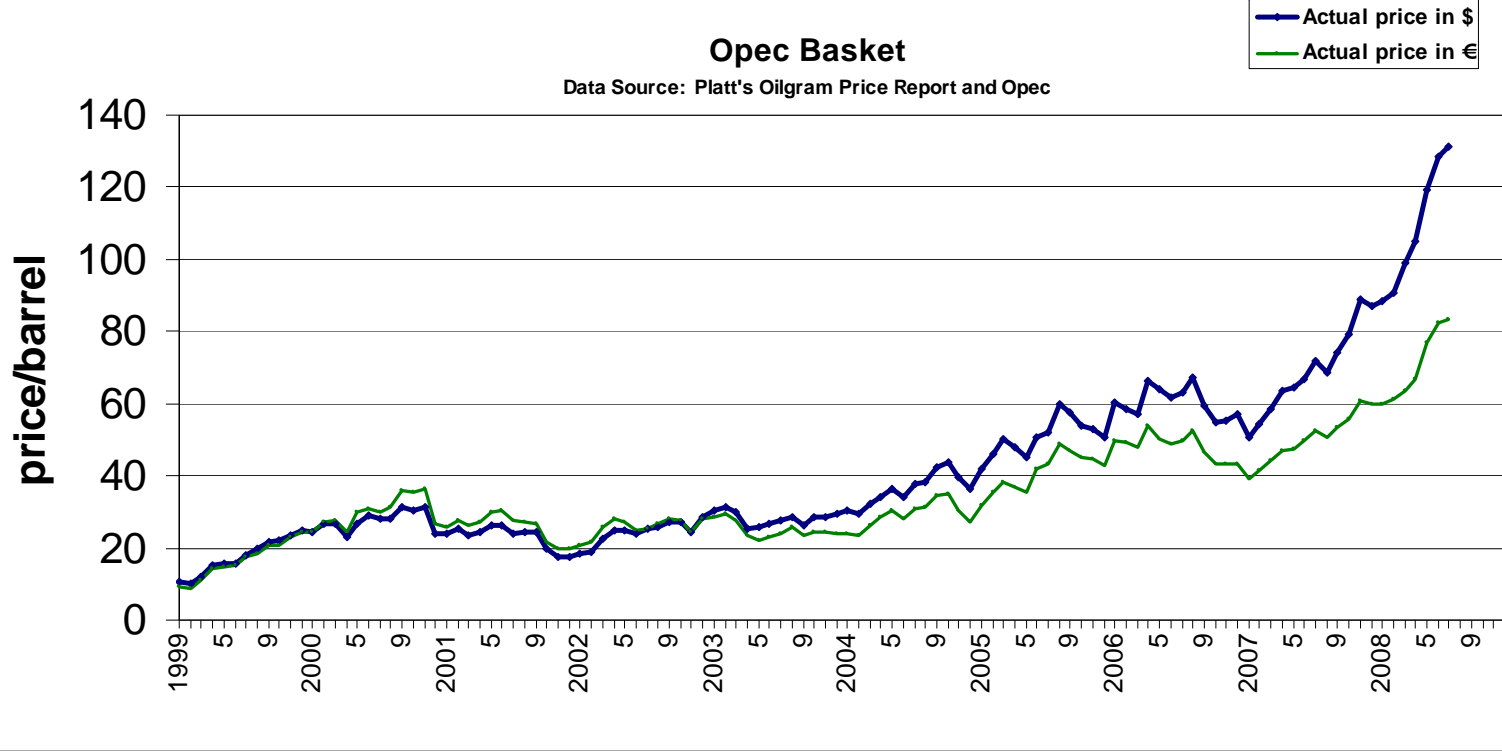
# Economy is the main driver



# PRICE DEVELOPMENT OF OIL

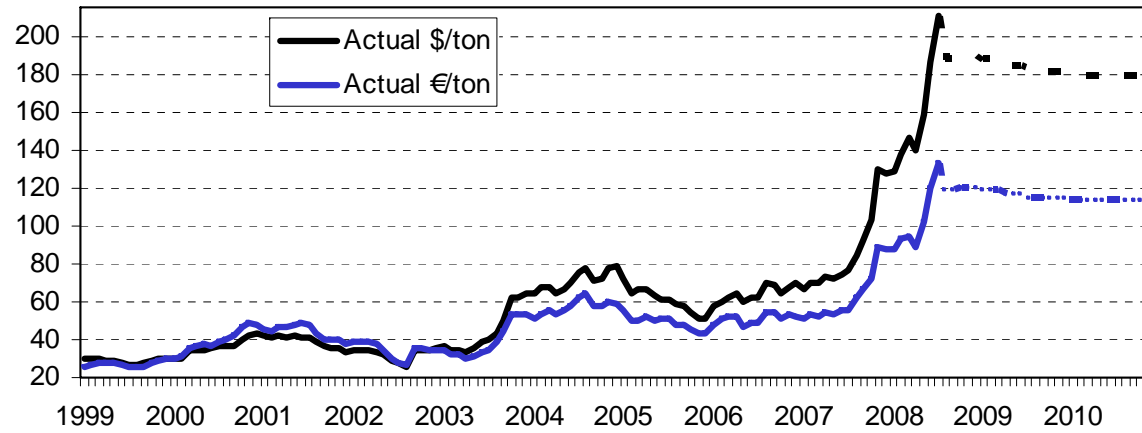
## Opec Basket

Data Source: Platt's Oilgram Price Report and Opec



# McCloskey's Steam Coal Marker Price

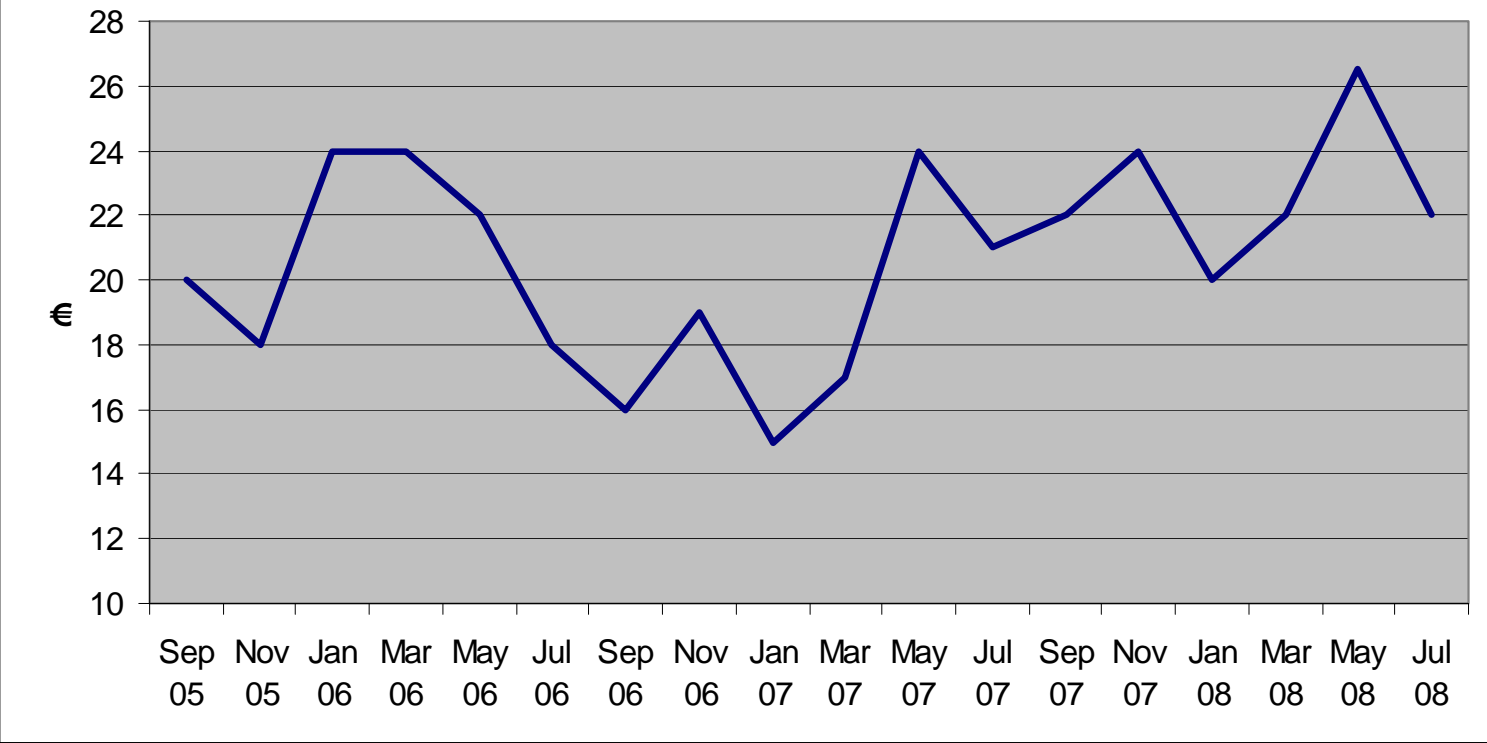
Spot CIF Price, NW Europe, \$/t basis, 6,000 kc/kg NAR



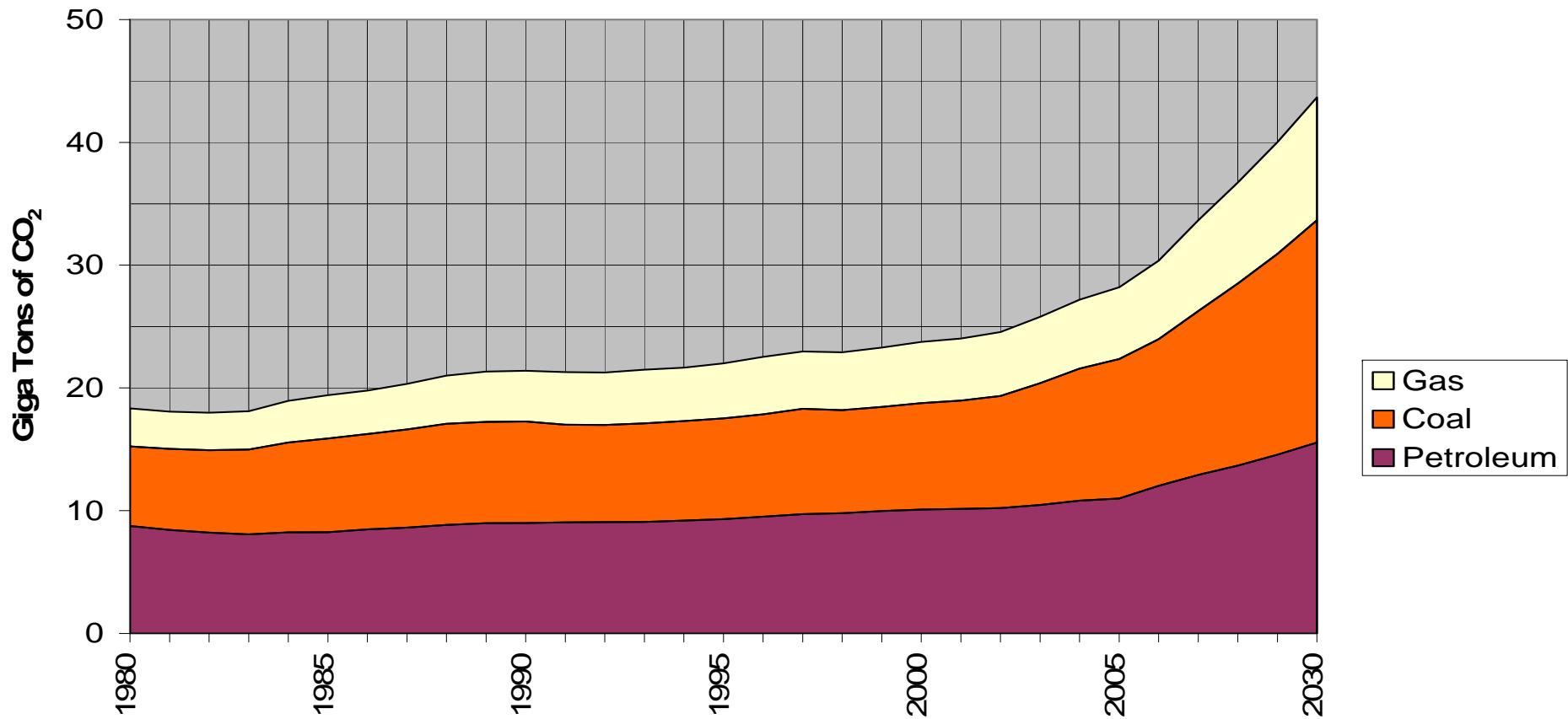
Source: The McCloskey Group



### EUA closing prices Point Carbon



# CO2 will be priced worldwide

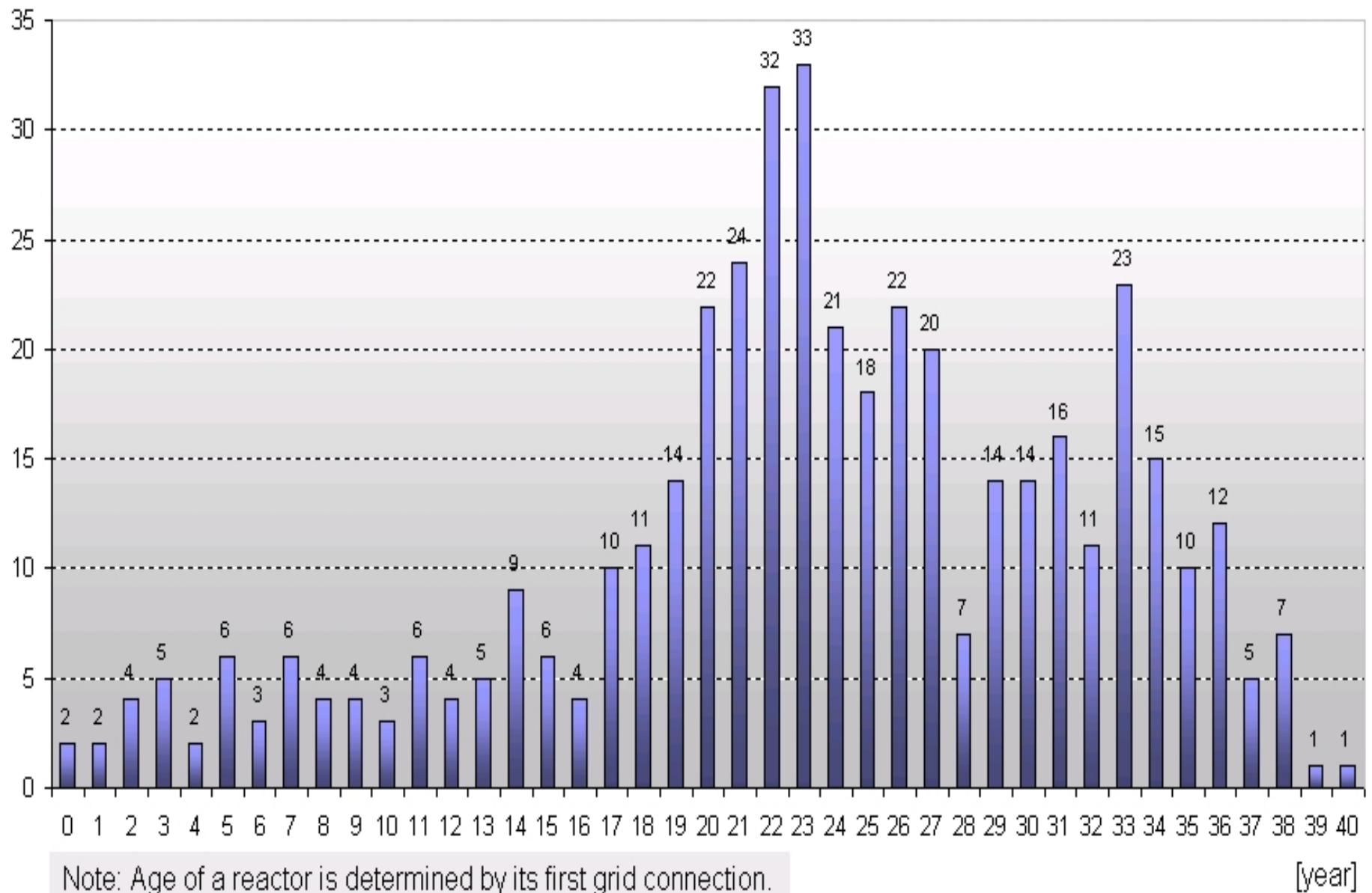


## Existing fleet of LWR

- Availability of the existing fleet of LWR's (USA) has improved significantly over time
- In USA plant capacity factor: 55%(1973)→89%(2005)
- Real nuclear O&M costs have declined over time
- The existing fleet of plants is getting old
- Compared to the market value of electricity on a going forward cost basis the existing fleet is very economical
- Life extension of existing fleet is typically economical
- Modest increases in capacity is feasible



## Number of Operating Reactors by Age (as of 26 of June 2007)



# Investment in new nuclear plants

- There are few new nuclear plants under construction in the world (30) and mostly in less developed countries
- Recent credible construction and cost data are limited
- Olkiluoto III in Finland is economically not a good example: 2 year delay, €1 bn over
- Competitive, regulatory and contractual environment is very uncertain and varies widely across the world i.e. USA has not yet adopted policies to place a price on CO<sub>2</sub> emissions
- EPR/France/ Flamanville, worries over reactor project skills (Nuclear Safety Authority)



# Construction cost estimates

- Construction cost estimates should include all costs: engineering, construction management and owners costs ( 20%)
- The best estimates are drawn from actual experience rather than engineering cost models
- Estimates for PC and IGCC can be verified from actual experience – limited data for nuclear-
- Best estimate 1500 €/kW with 5 year construction period is a good base for nuclear power plant
- **Nobody has ever overestimated the construction cost of a nuclear power plant at the pre-construction stage**

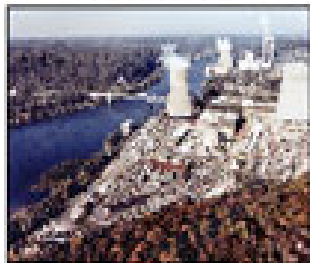


# Development of nuclear: **economy-** **>safety->waste**

## The Evolution of Nuclear Power

### Generation I

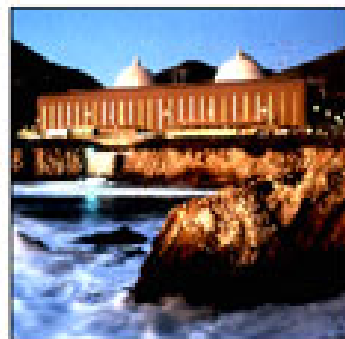
Early Prototype Reactors



- Shippingport
- Dresden, Fermi I
- Magnox

### Generation II

Commercial Power Reactors



- LWR-PWR, BWR
- CANDU
- VVER/RBMK

### Generation III

Advanced LWRs



- ABWR
- System 80+
- AP600
- EPR

Near-Term Deployment

Generation I-III  
Evolutionary  
Designs Offering  
Improved  
Economics

### Generation IV

- Highly Economical
- Enhanced Safety
- Minimal Waste
- Proliferation Resistant

Gen I

Gen II

Gen III

Gen III+

Gen-IV

1950

1960

1970

1980

1990

2000

2010

2020

2030

# Conclusions

- Economy will be the main driver for nuclear power
- Worldwide CO2 pricing enhances nuclear investment
- Present fleet generates good windfall profit vs. CO2
  
- Without new investments nuclear capacity declines quickly after 2030
- Credible and economic nuclear waste disposal policy needed
- Regulatory, licensing environment, skills etc. are a challenge for each near term new project

