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# The Economics of Alternate Fuels for Power Generation

Richard Green

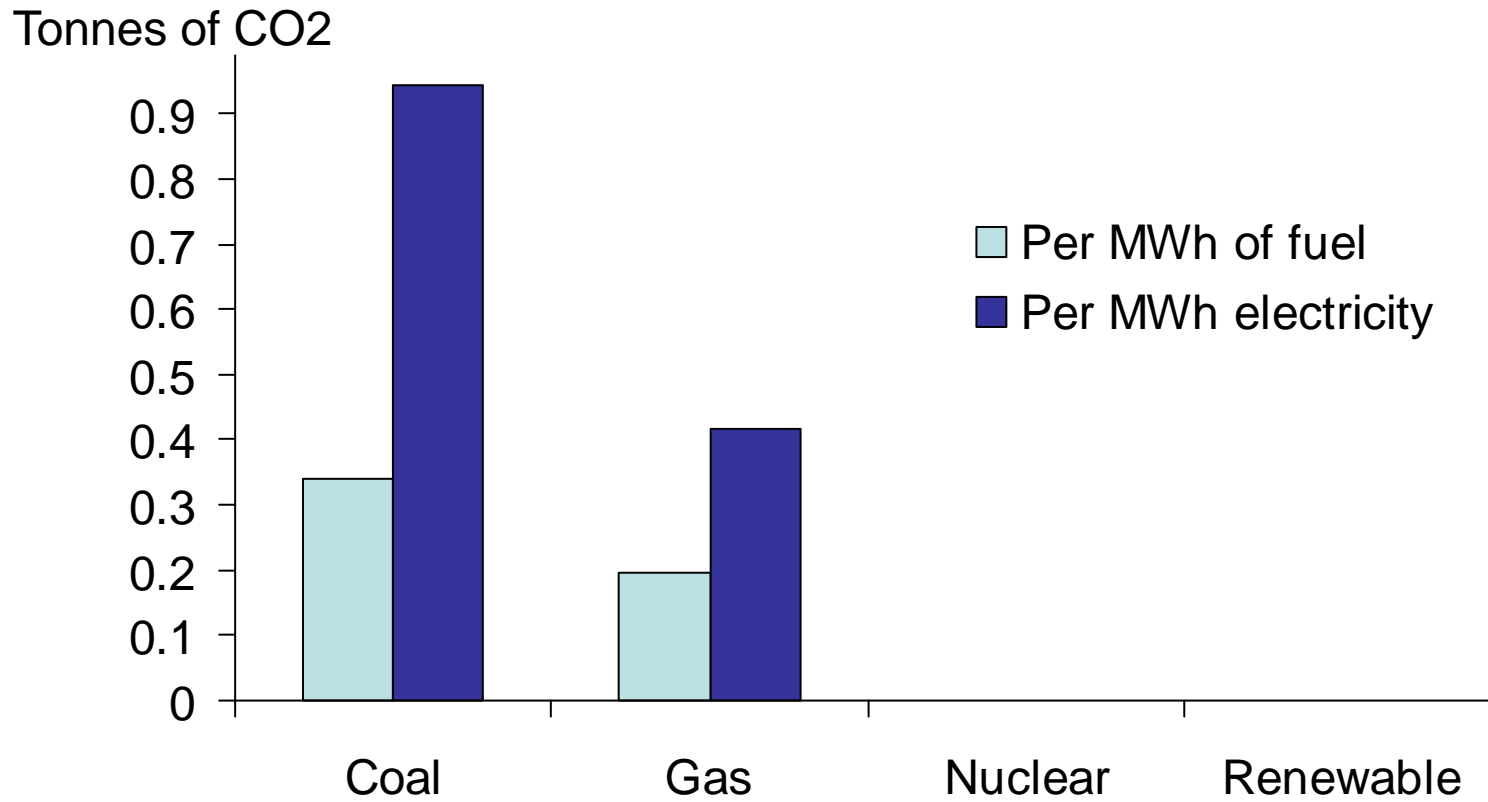
Institute for Energy Research and Policy

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# Carbon content of fuel at plant





## What does a power station cost?

- What does it cost to build?
- What does it cost to keep available?
- What does it cost to generate each unit?
- What does it cost to decommission?
- What does it cost the environment?



## Cost components

	Fuel cost / efficiency	Operations & Maintenance Cost	Capital cost £/kW	Plant life (years)
Combined Cycle Gas Turbine	58% <sup>a</sup>	£7/kW-year + £2/MWh <sup>a</sup>	440 <sup>a</sup>	35 <sup>a</sup>
Coal (without CCS)	44.9% <sup>a</sup>	£24/kW-year + £2/MWh <sup>a</sup>	900 <sup>a</sup>	50 <sup>a</sup>
Nuclear	£5/MWh <sup>a</sup>	£57/kW-year <sup>a</sup>	1,407 <sup>a</sup>	40 <sup>a</sup>
Biomass	£27/MWh <sup>e</sup>	£45/kW-year <sup>e</sup>	1,485 <sup>e</sup>	25 <sup>c</sup>
Marine	Nil	£42/kW-year <sup>e</sup>	1,060 <sup>e</sup>	15 <sup>c</sup>
Wind – onshore	Nil	£44/kW-year <sup>a</sup>	819 <sup>a</sup>	20 <sup>a</sup>
Wind – offshore	Nil	£46/kW-year <sup>a</sup>	1,532 <sup>a</sup>	20 <sup>a</sup>
Micro-generation	80% <sup>d</sup>	£90/kW-year <sup>b</sup>	1,000 <sup>b</sup>	15 <sup>b</sup>

Sources: <sup>a</sup> DTI (2006); <sup>b</sup> Energy Saving Trust (2005); <sup>c</sup> Enviros (2005); <sup>d</sup> Newborough (2004); <sup>e</sup> Scottish Energy and Environment Foundation (2005);



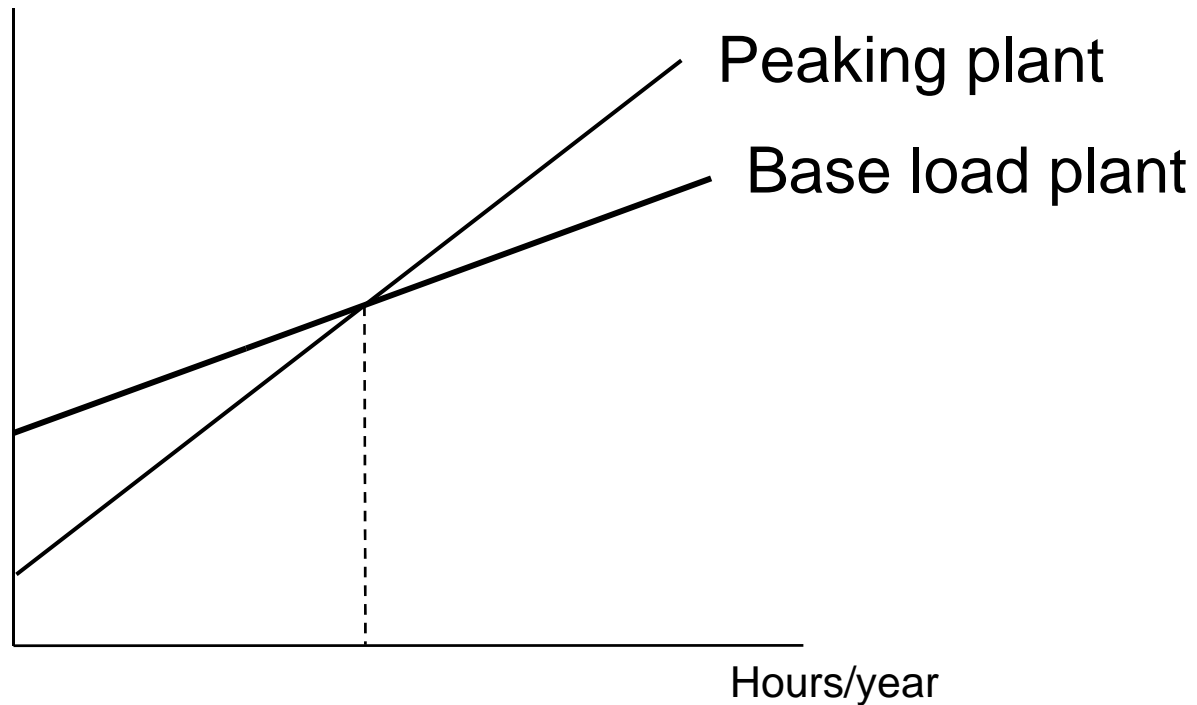
## What do the answers depend on?

- How much the station produces
- The cost of capital
- Fuel prices
- The cost of carbon
  - Price under the EU ETS
  - Permit allocation



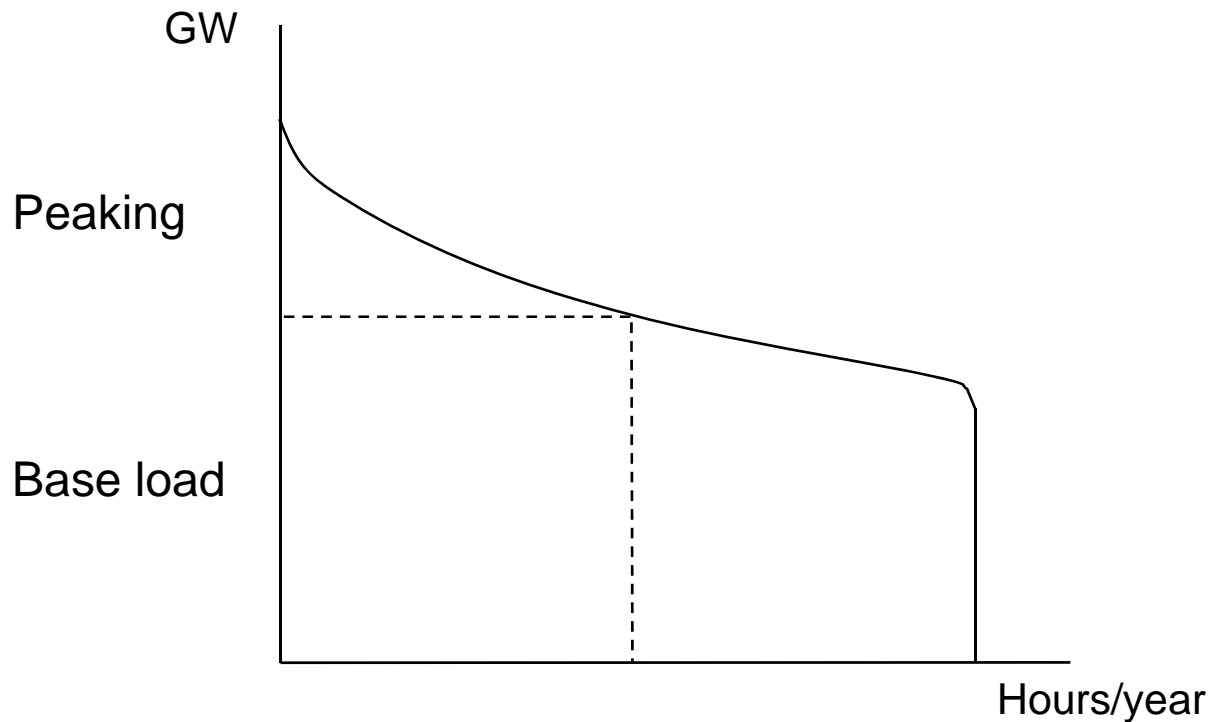
# Costs over a year

£/MW-year



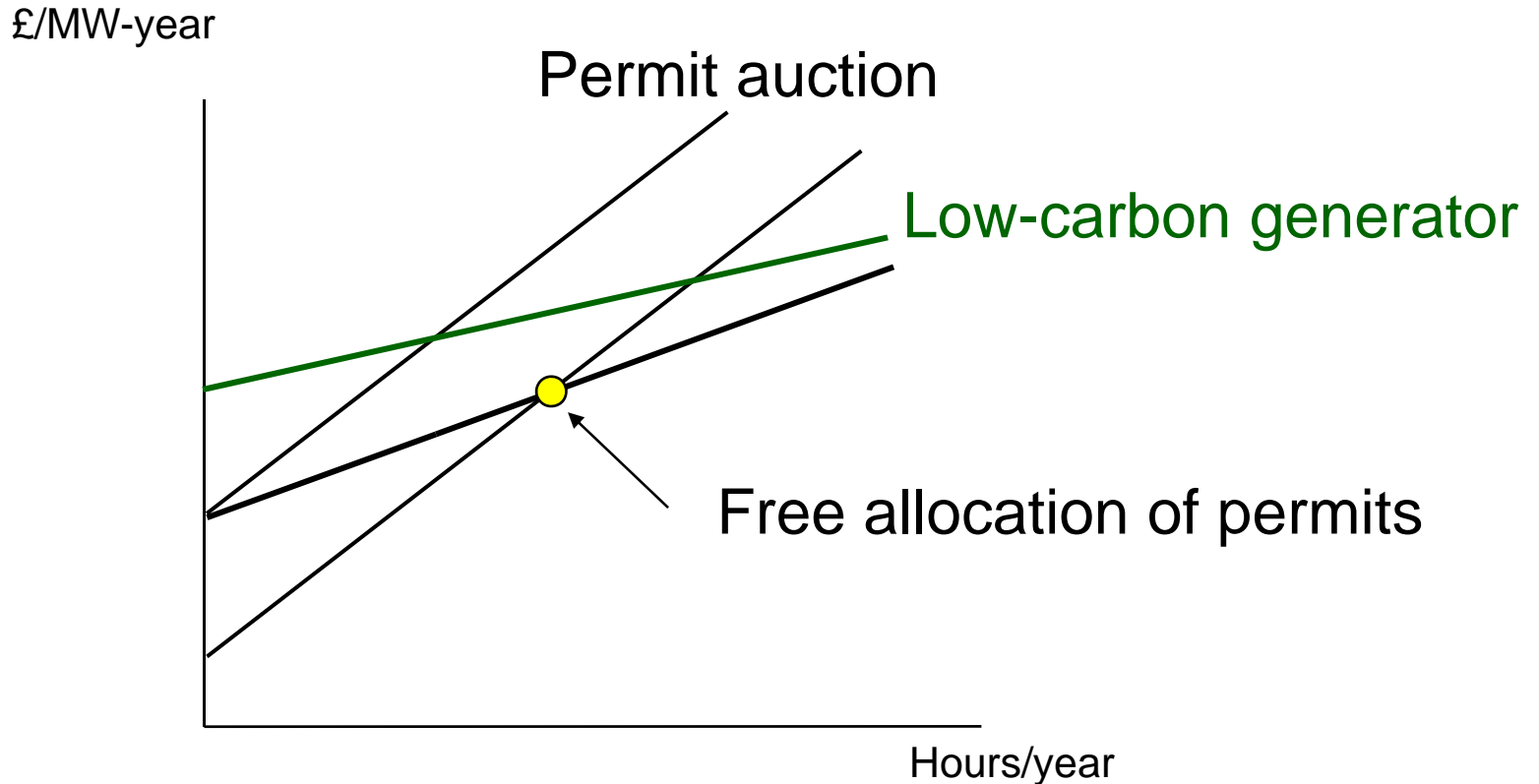


# The load-duration curve





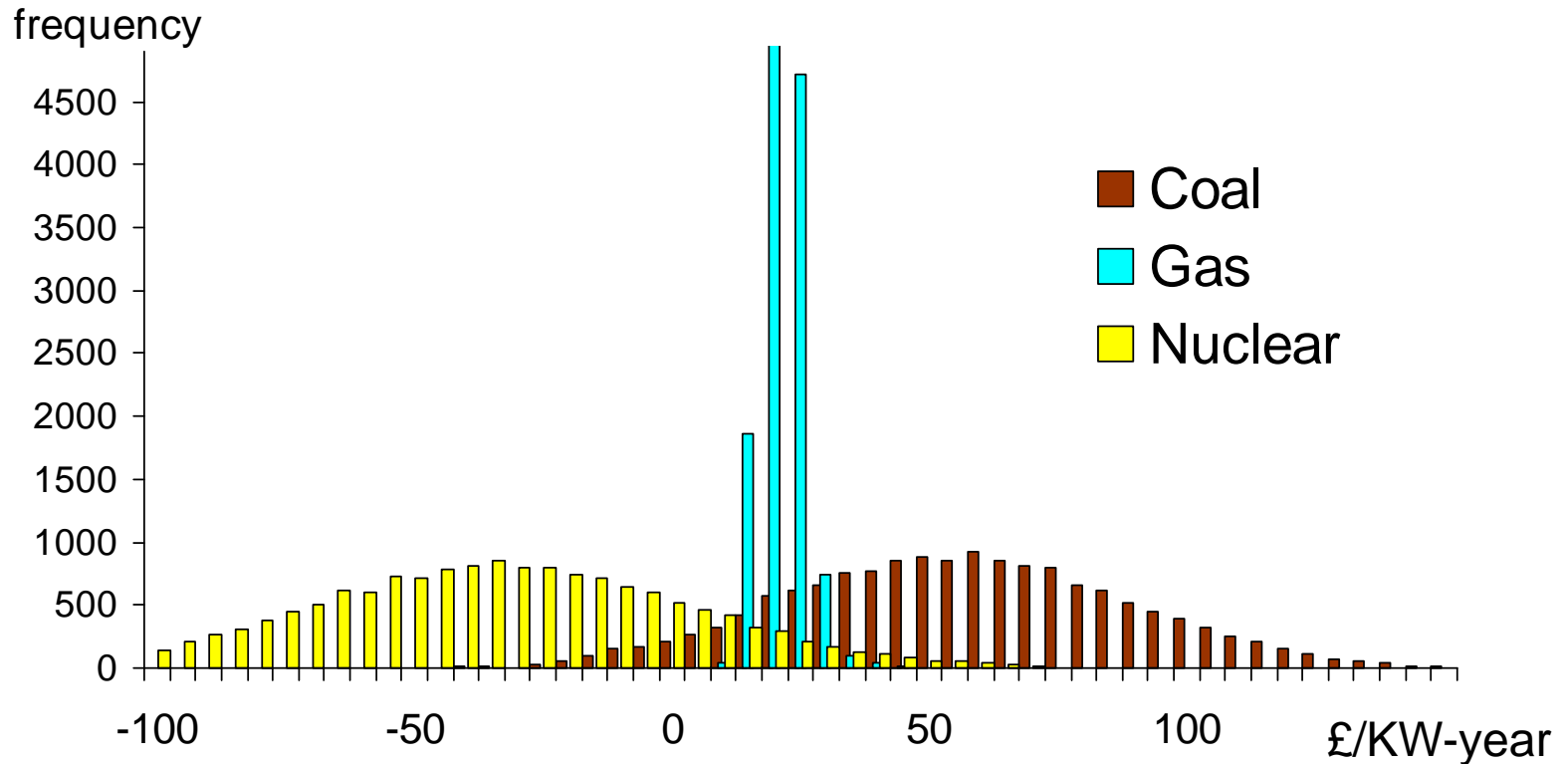
# The impact of permits





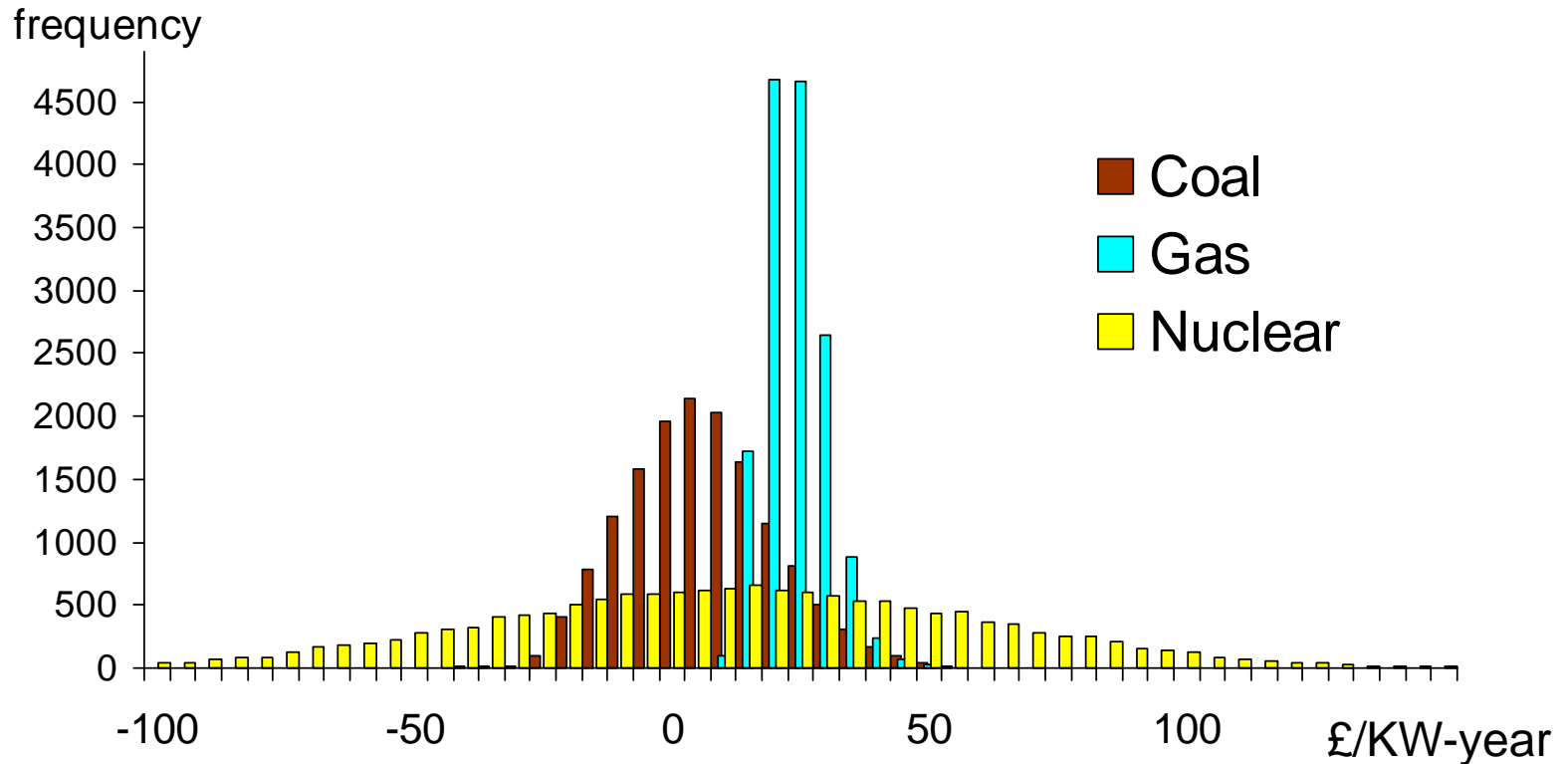


# Profits with no carbon policy





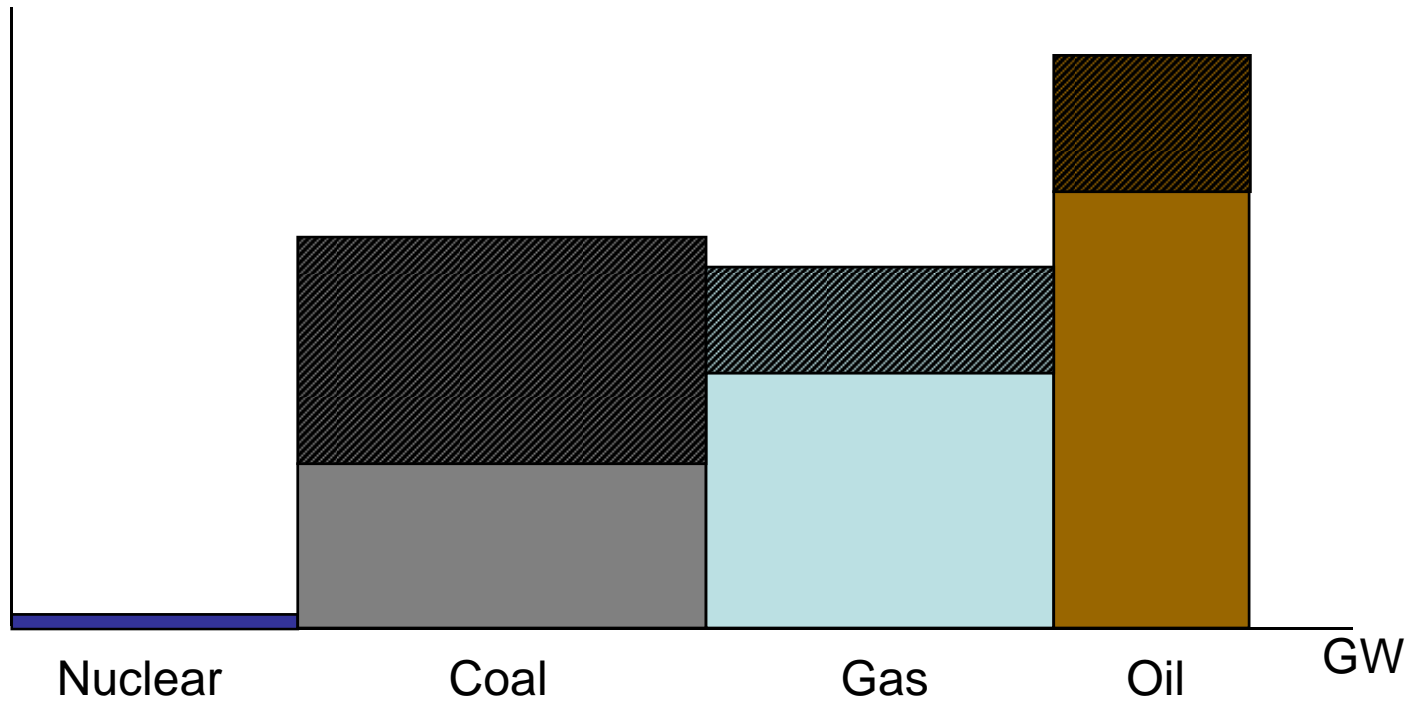
# Profits with carbon trading





# Marginal cost of generation

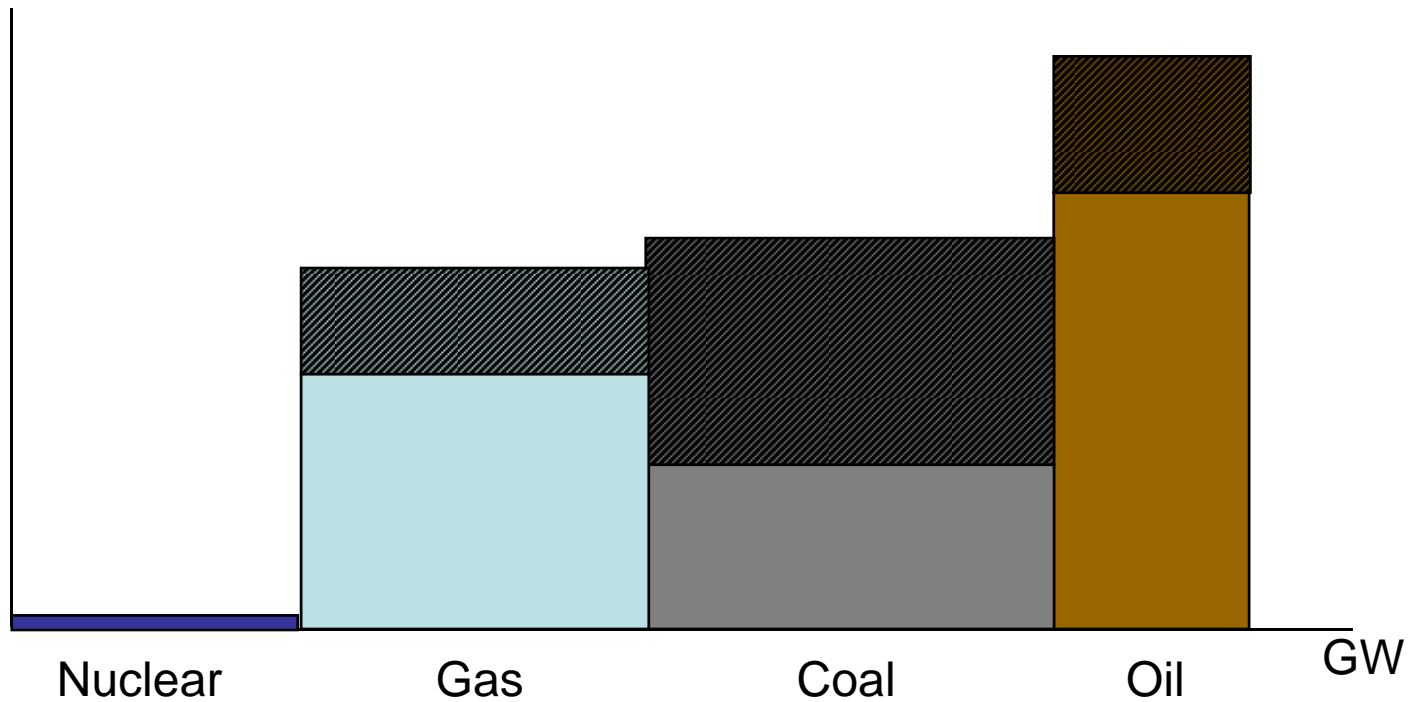
£/MWh





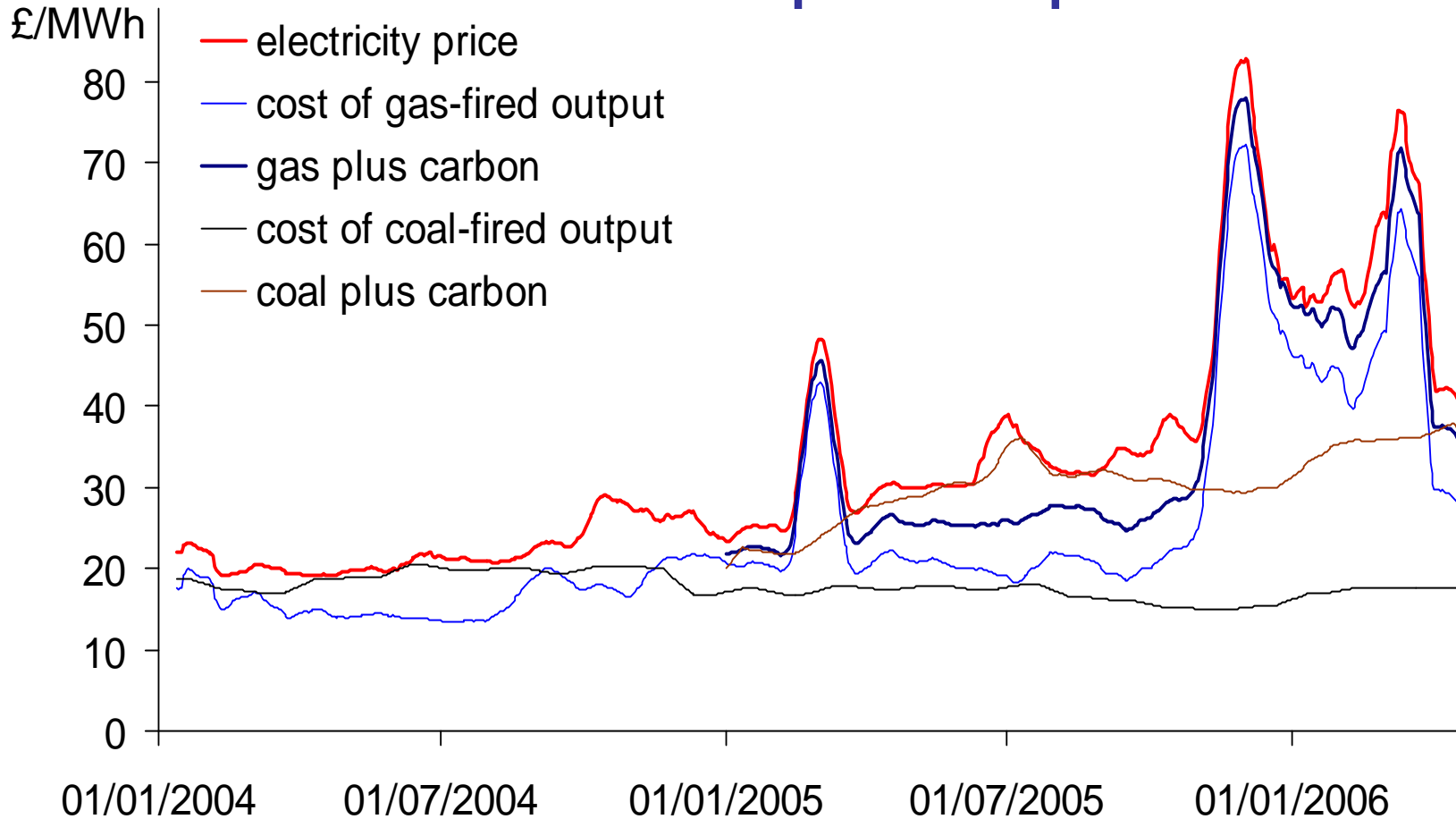
# Marginal cost of generation

£/MWh





# UK fuel and power prices





# The cost of low-carbon power

- Supergen scenarios for 2020
  - “Environmental Awakening”
    - 360 TWh, micro-generation and renewables
  - “Supportive Regulation”
    - 415 TWh, nuclear renaissance
  - “High Carbon”
    - 435 TWh, gas-fired plant

Scenarios by Elders et al, economic analysis by Yago et al



## Impacts on the electricity industry

	Investment (£bn)	Revenues (£/MWh)	CO <sub>2</sub> saved (m tonnes)
Environmental Awakening	43	52	73
Supportive Regulation	34	49	43
High Carbon	15	40	-

Figures are based on DTI “Central favouring coal” prices (a medium-high gas price)



## Impact on the economy

- Electricity price rises by £9-13/MWh
- 2005 industrial price averaged £50/MWh
- 2005 domestic price averaged £82/MWh
- Electricity and gas average 2.5% of consumers expenditure – might rise to 3%
- Fuel poverty (expenditure share over 10%) might rise by ¼ million to 2¾ million



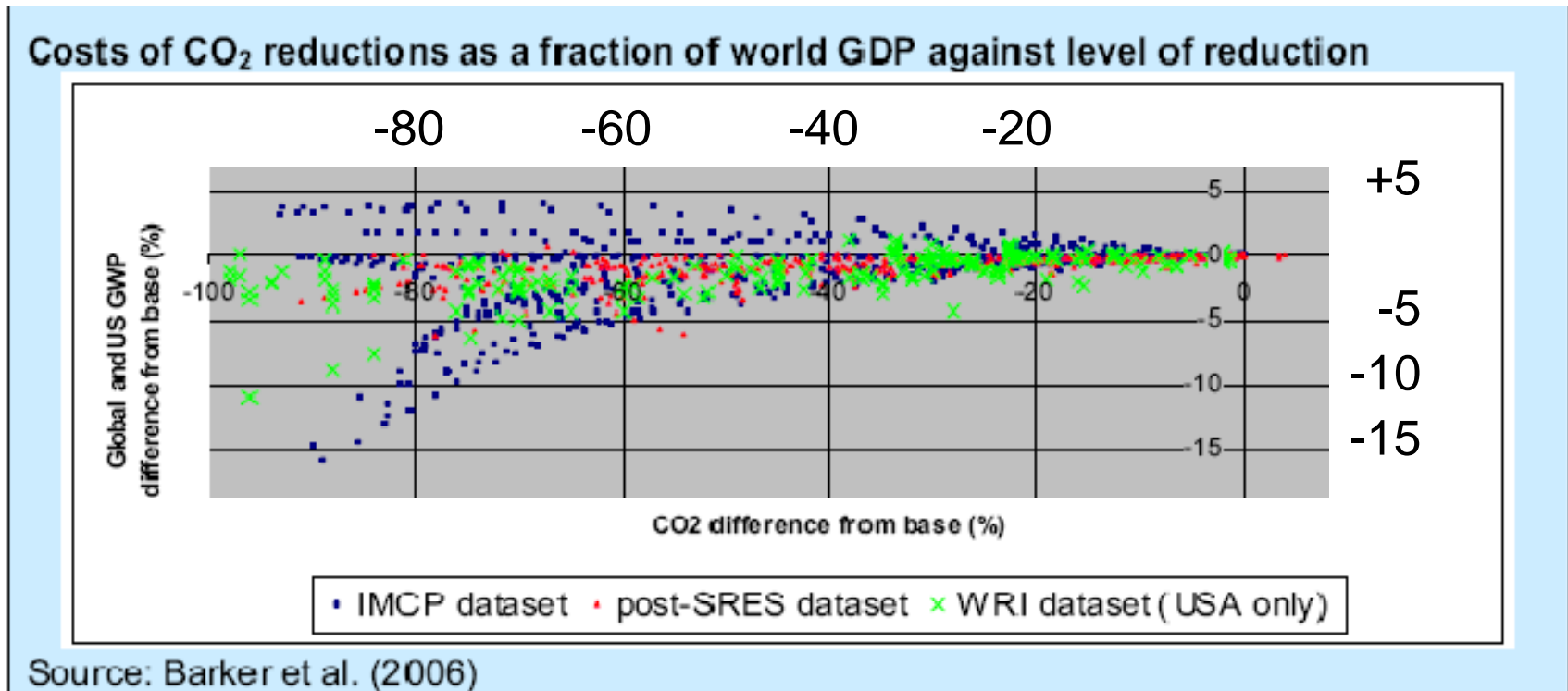


## Impact on industrial costs

Increase in costs	Sectors affected
Less than 1%	90% of the economy
1% to 2%	Engineering, textiles, chemicals
2% to 3%	Industrial dyes and gases, inorganic chemicals, metals, pulp and paper
Over 3%	Cement



# The big picture



The Stern Review, figure 10.1



## Conclusions

- Low-carbon generators will cost more than high-carbon, ignoring carbon costs
- System integration presents challenges
- Overall cost increases manageable



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