



Risks and opportunities in the energy markets: the outlook for new nuclear

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<http://www.eprg.group.cam.ac.uk>

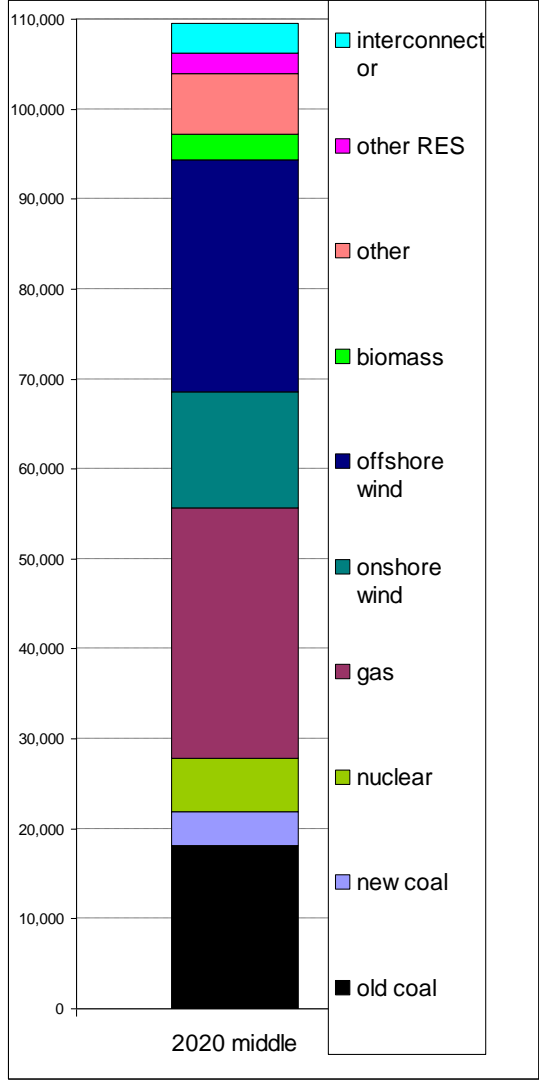
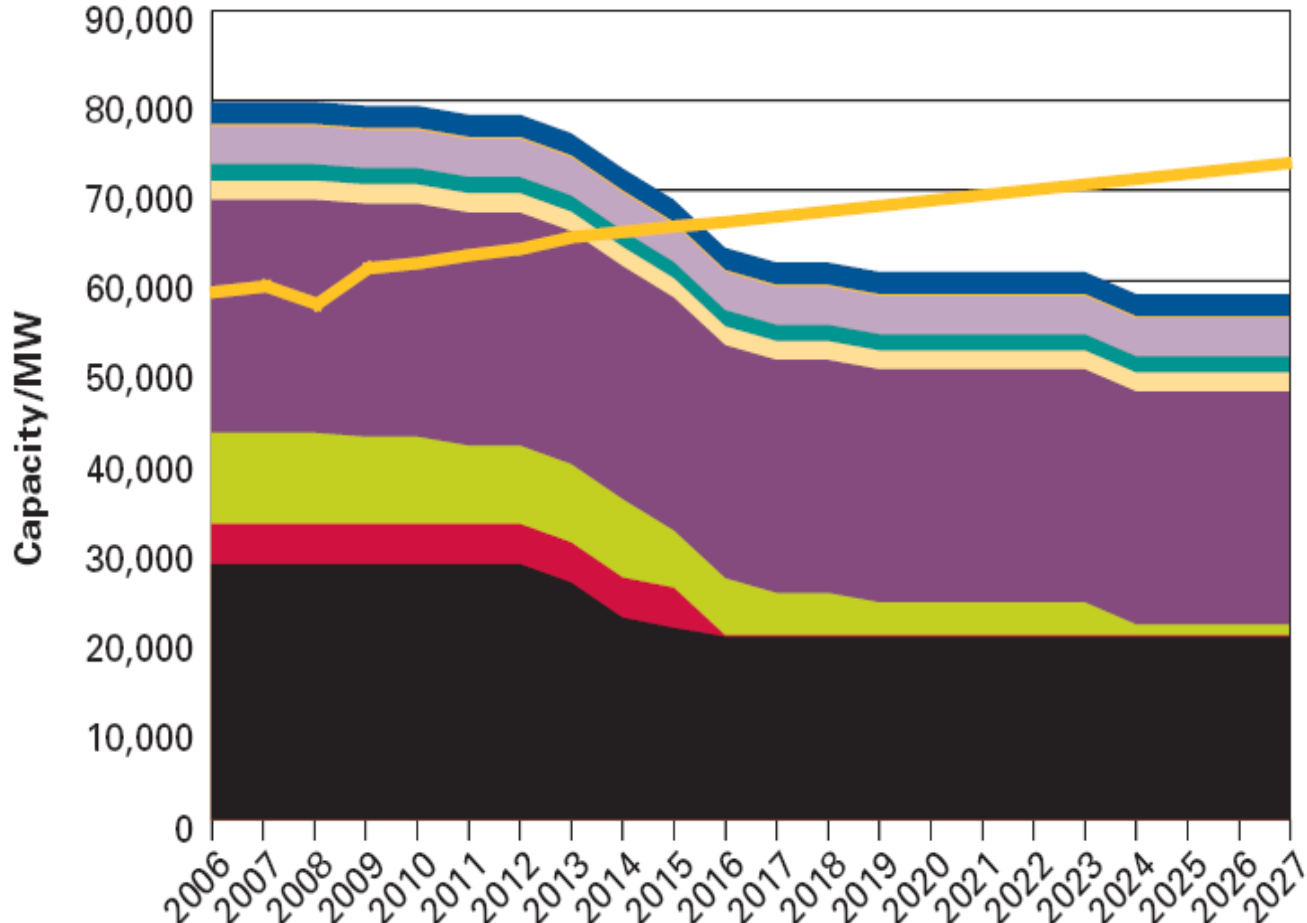
Energy market developments

- Huge oil price volatility: \$145-40/bbl
 - contract price of gas linked to and lags oil
 - UK gas prices 20p/th-110, now 60p/th
 - coal prices \$50-200/t; now \$100/t
 - 2nd period EUA prices € 12-30/t, now € 12/t
- Forward clean spark spread £6-9/MWh
- Forward dark green spread \$15-25/MWh

Electricity prices mirror gas prices

Huge generation investment required

Development of existing GB gen cap

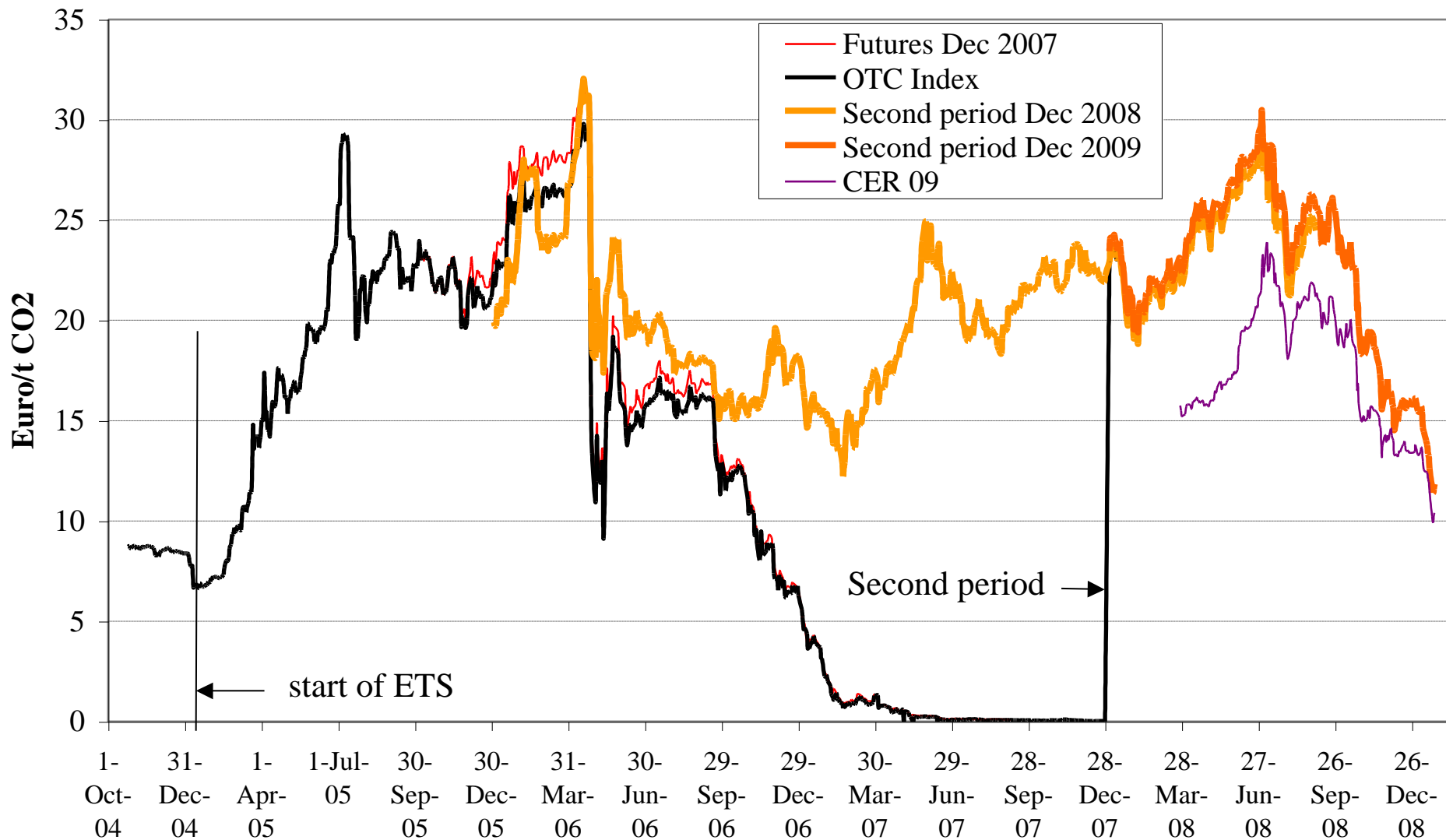


- Interconnector
- Other
- Hydro and pumped storage
- Wind
- Gas turbines and oil engines
- CCGT & CHP
- Nuclear
- Oil
- Coal
- Demand

SKM's
mid-scenario
projection

Source: Digest of UK Energy Statistics/DECC

EUA price 25 October 2004-22 Jan 2009



Nuclear power - the good news

- Climate change targets need zero-C electricity
 - nuclear power “economic” at € 30/t
 - cheaper than any unsubsidized new renewables
- Technology well established
 - although uncertainties over cost and build time
- Past build rates have been impressive
 - compared to renewables to date

A state-owned monopoly would build nuclear if the sole objective were reduced CO₂

2020 CCC's ESI carbon targets are challenging

Figure 5 CO₂ intensity per kWh of electricity generated, 2006-2050

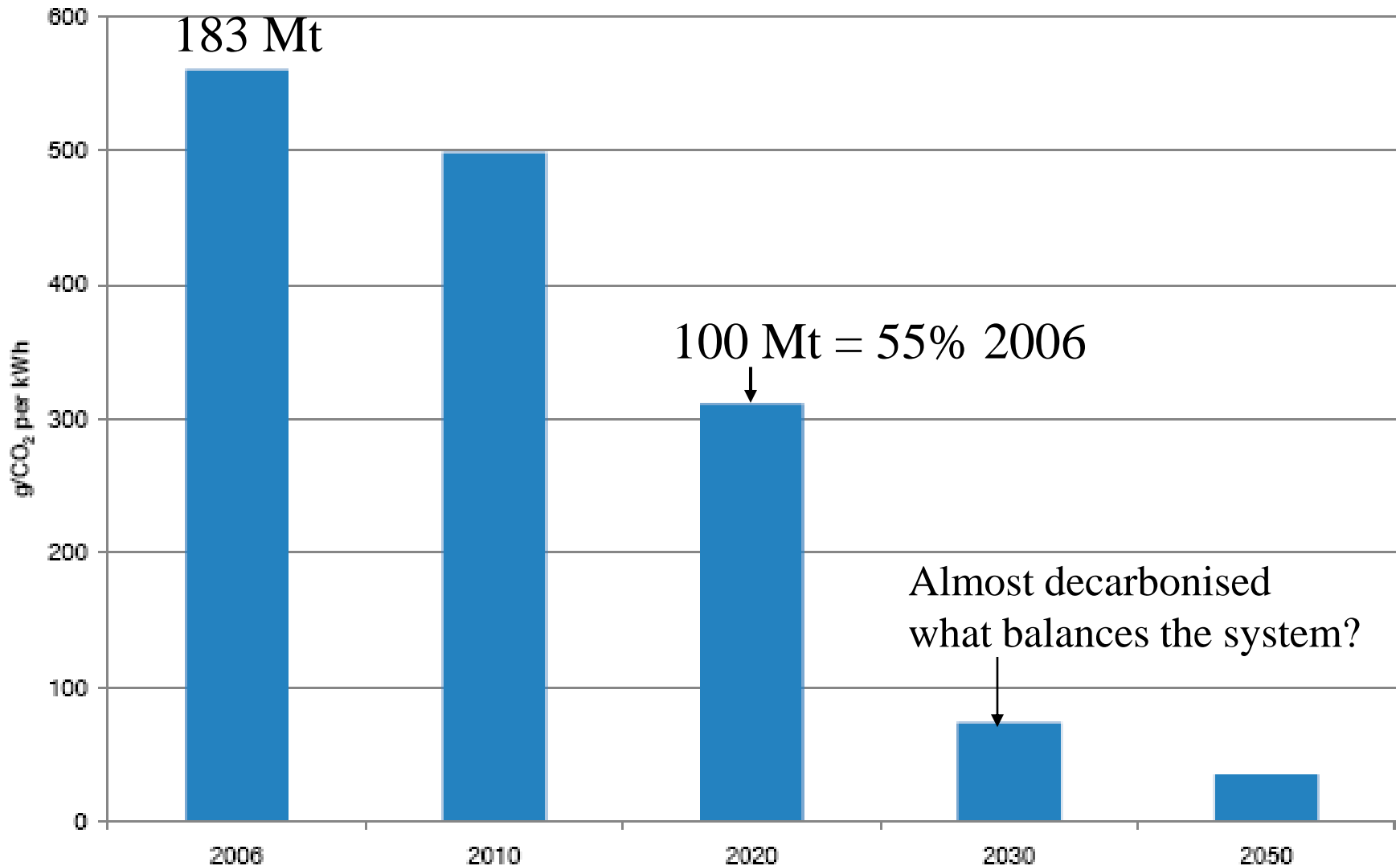
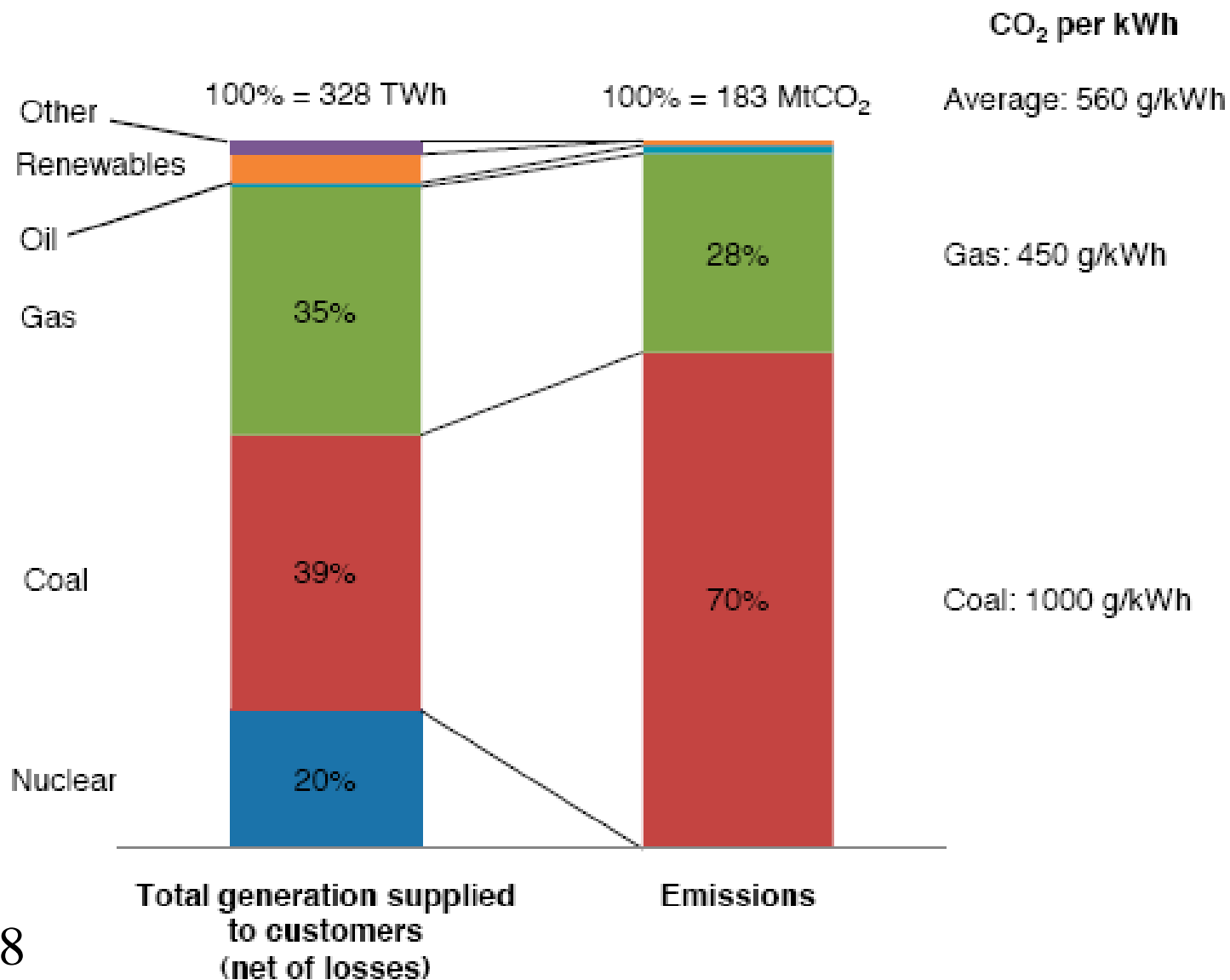


Figure 2.2 UK power sector generation and emissions, 2006



CCC 2008

Data for 2006, from the Digest of UK Energy Statistics (2008) and the National Atmospheric Emissions Inventory (2008)

Note: Generation and CO₂ from centralised generation only.

Table 7.6 Lifetime levelised costs of plant added by 2020 (£/MWh)

Technology	Conventional	2020 Renewable Scenarios		
		Lower	Middle	Higher
New coal	56.4	57.4	58.7	61.1
New CCGT	56.5	58.5	59.8	62.8
Nuclear	37.9	37.9	37.9	37.9
Onshore wind*	65.7	60.4	60.4	61.6
Offshore wind*	87.8	86.4	83.4	81.7
Biomass*	95.6	95.7	96.5	101.7

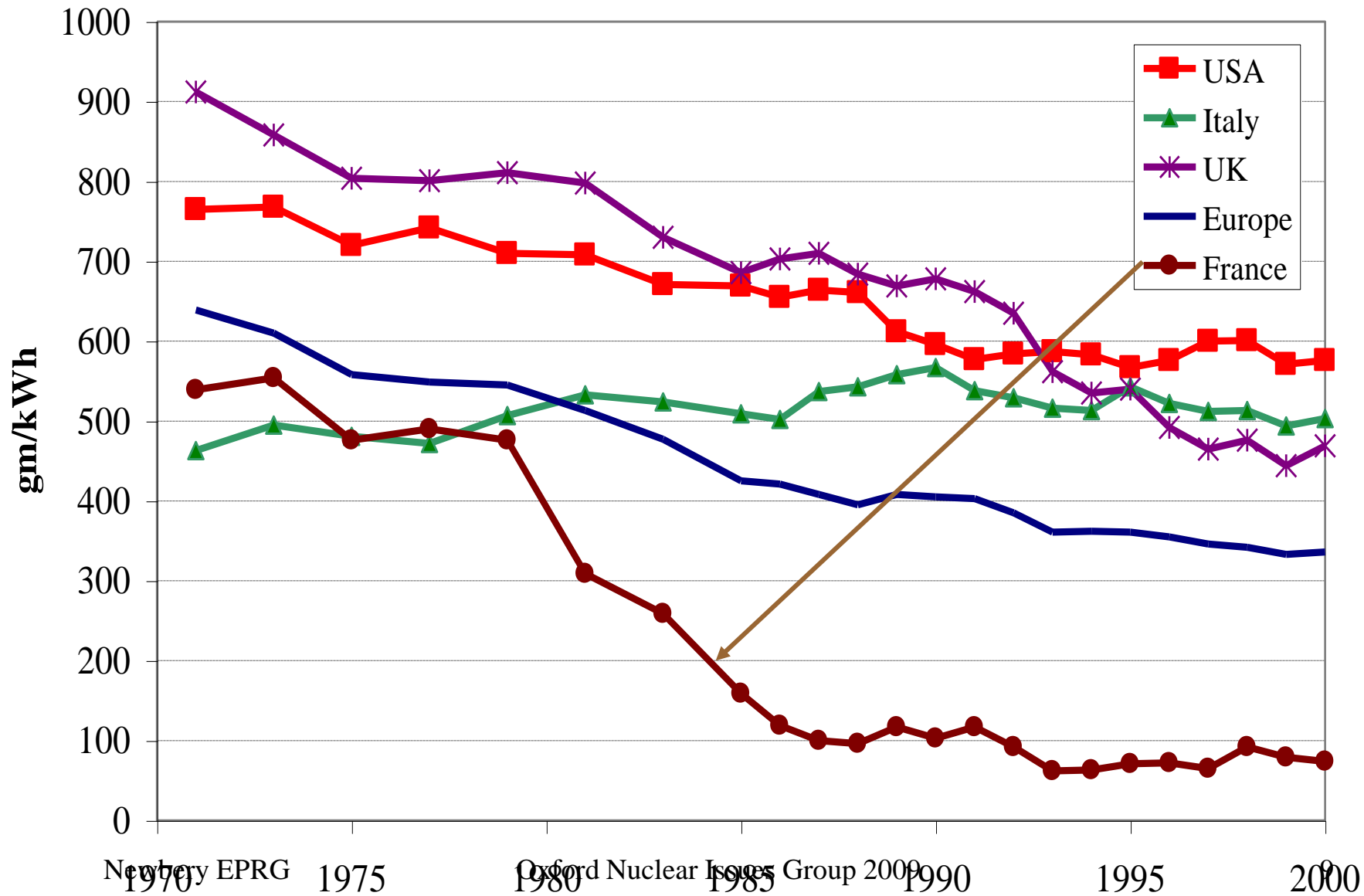
*Before any ROC subsidy, currently around £40-45/MWh

Table 7.2 2020 Price assumptions

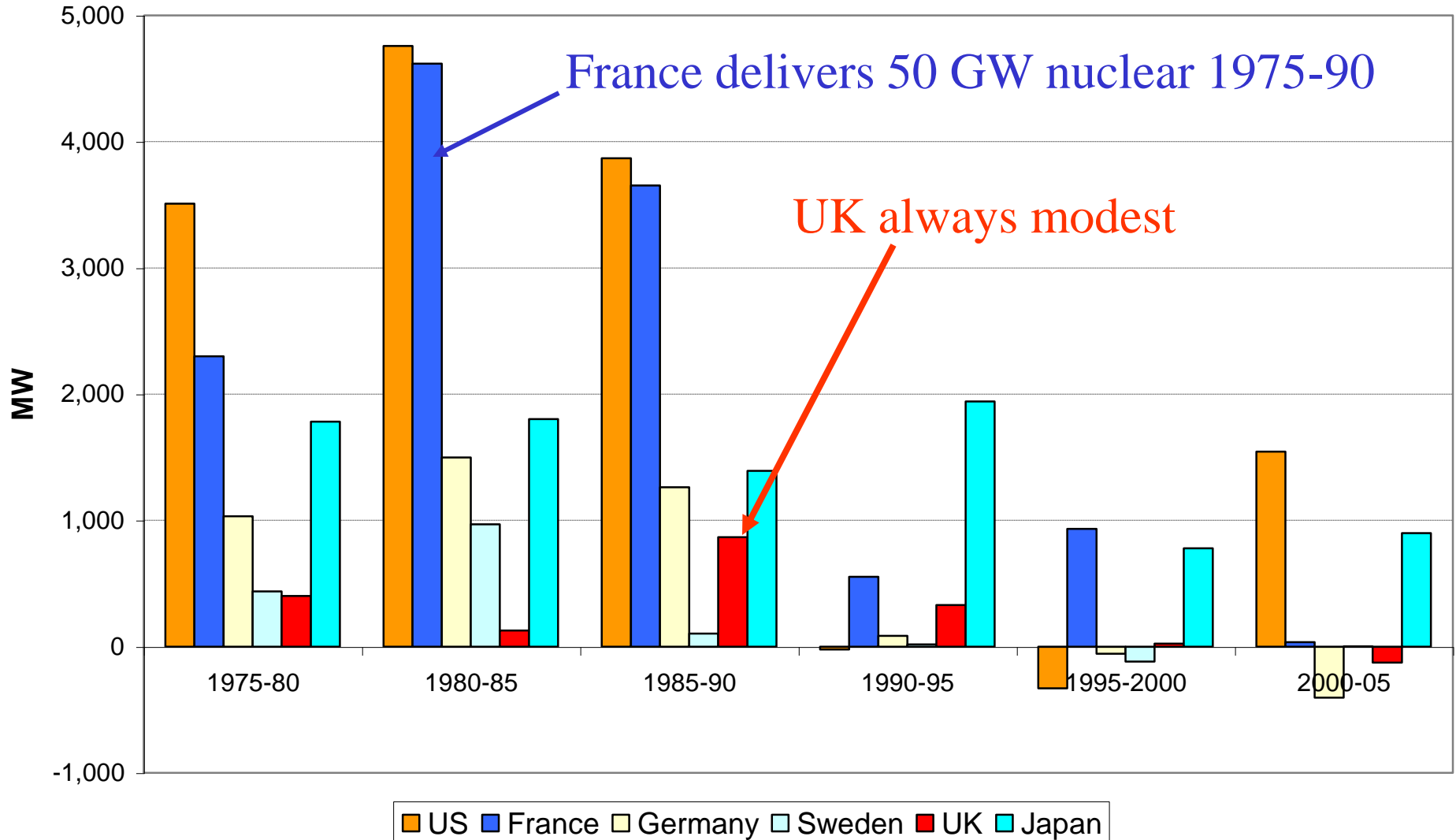
Type	Price
Gas (p/therm)	55
Coal (\$/te)	110
Oil (\$/barrel)	85
Biomass fuel (£/GJ)	3.6
Carbon permit (€/te CO ₂)	30

Source: SKM
BERR URN 08/1021

CO2 emissions per kWh 1971-2000

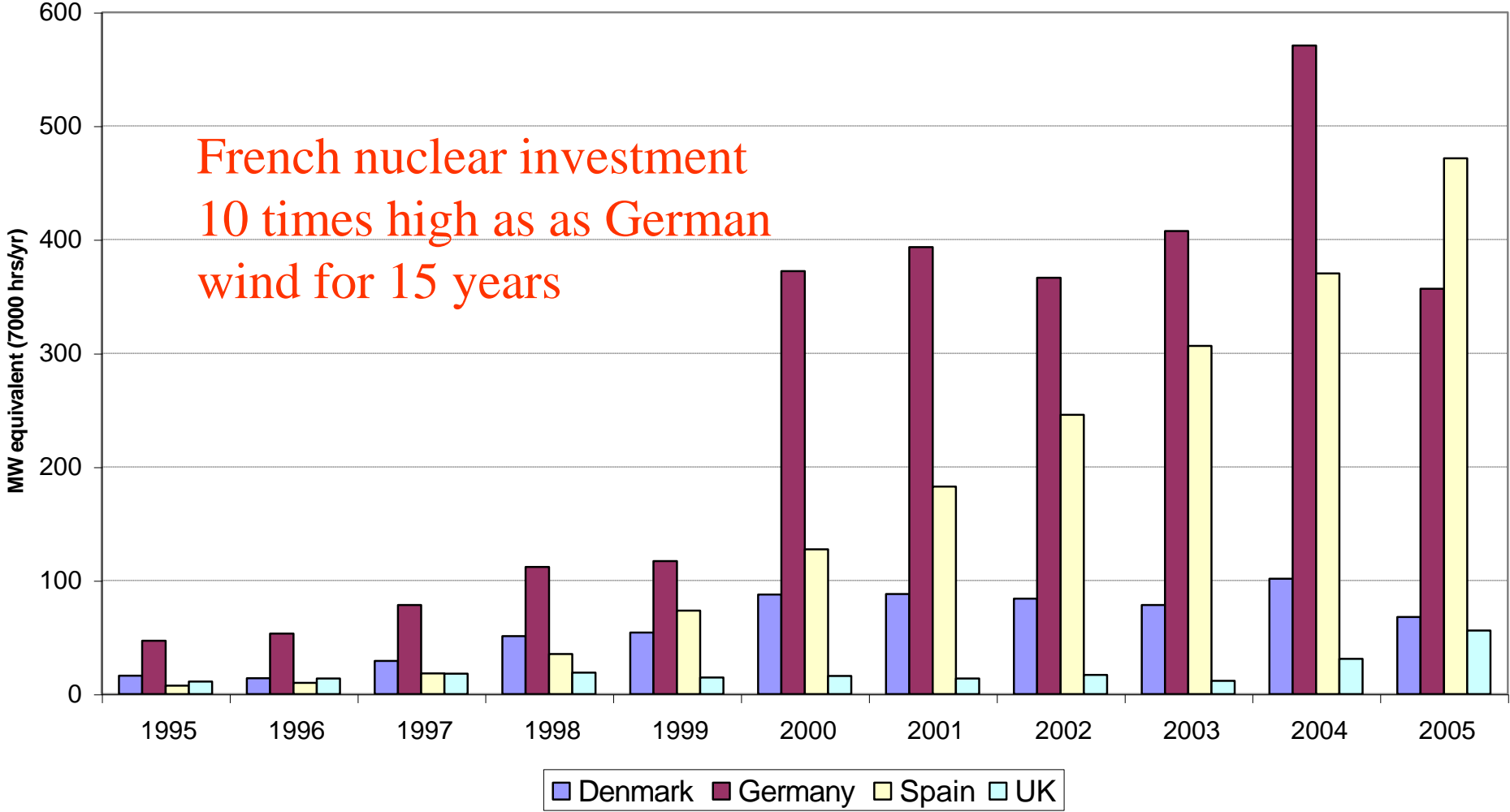


Average annual increment to nuclear capacity



Equivalent increment in effective wind capacity previous five years

French nuclear investment
10 times high as as German
wind for 15 years



Nuclear financial requirements

- Two phases: construction and operation
 - construction risky, operation less so
- Liberalised markets need predictable risk
 - electricity demand reasonably predictable
 - prices driven by marginal fuel + CO₂
- Which fuel? Gas or coal? What price CO₂?
 - Renewables makes market less predictable

ROCs amplify risk for renewables

Renewables amplify CO₂ risk

UK's 2020 renewables target

= 40% renewable **ELECTRICITY** (SKM mid scenario)

= 150 TWh; wind = 38GW; total 110 GW

– 56 GW conventional @ 31% fossil fuel load factor

– investment cost of renewables = **£60 bn + £13 bn grid**

– of non-renewables = **£12 b**, (£coal=3.9b; **nuclear = £3.9b**)

= £80/t CO₂ c.f. £10/t current EUA

- 38 GW > demand for many hours

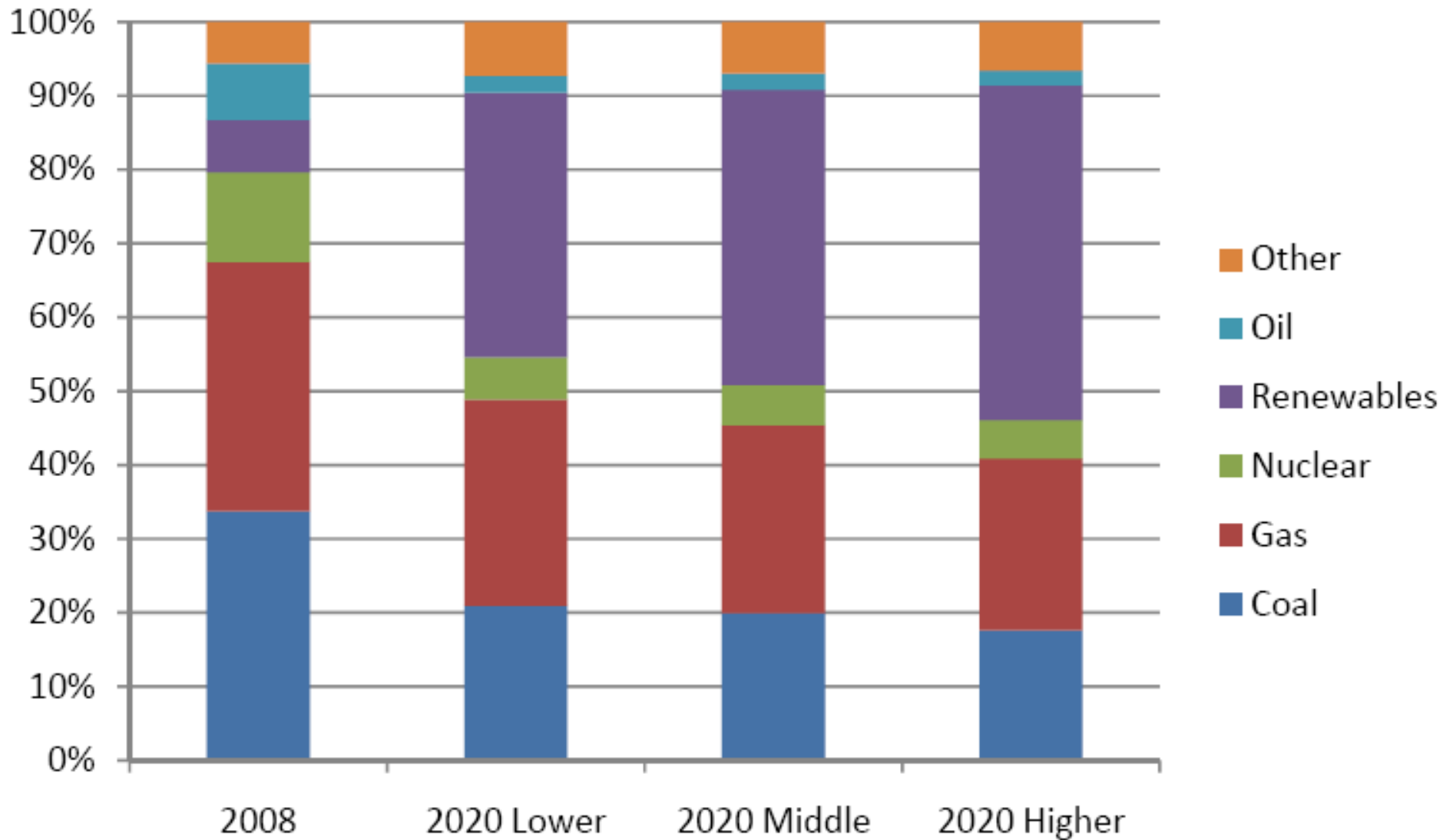
=> volatile supplies, prices, congestion,

- Offshore wind dependent on electricity price

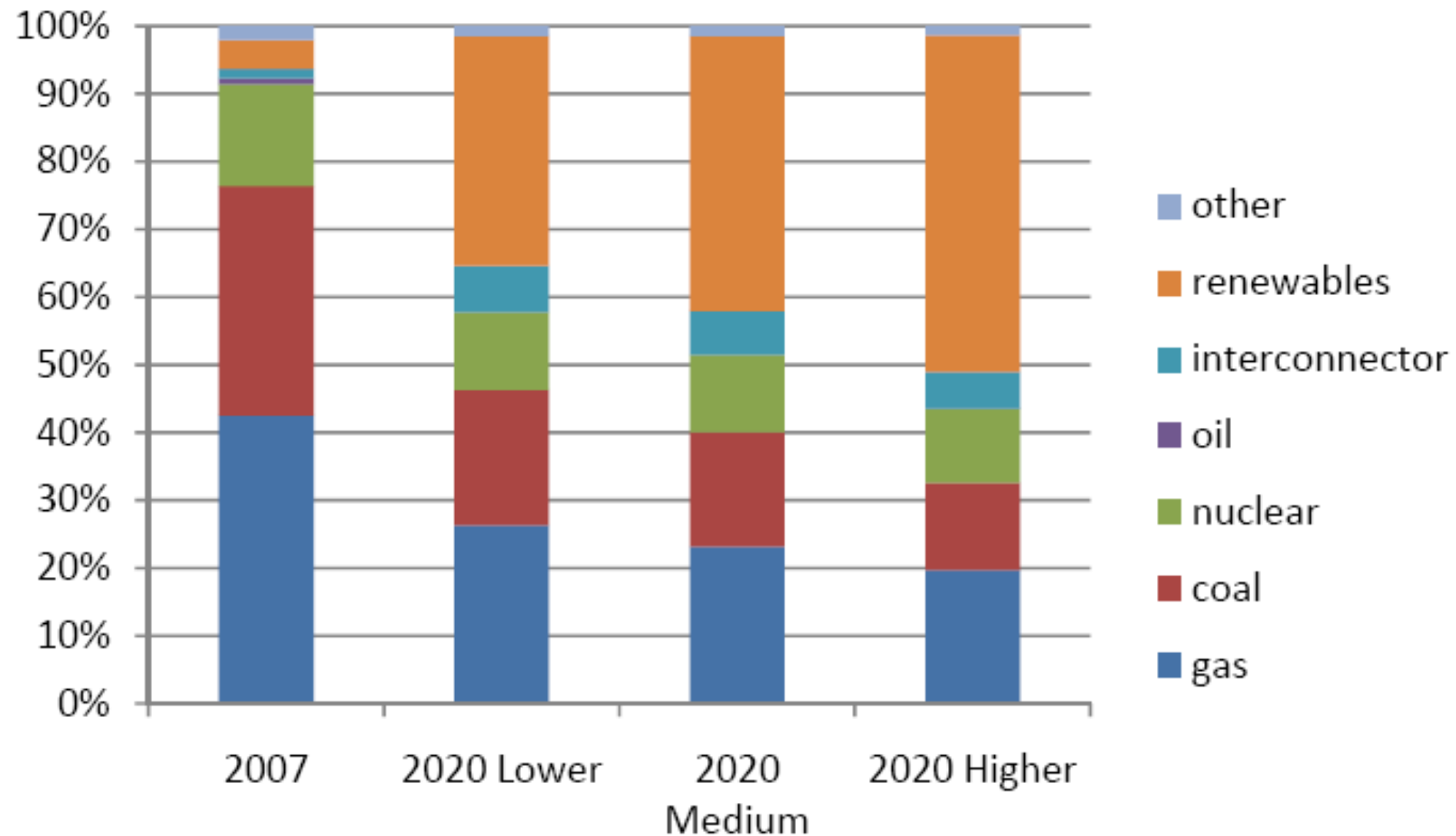
– now looks unfavourable even with banded ROCs

– FIT cheaper than HMG's banded ROCs (Redpoint)

SKM's projected capacity mix



SKM's projected output mix

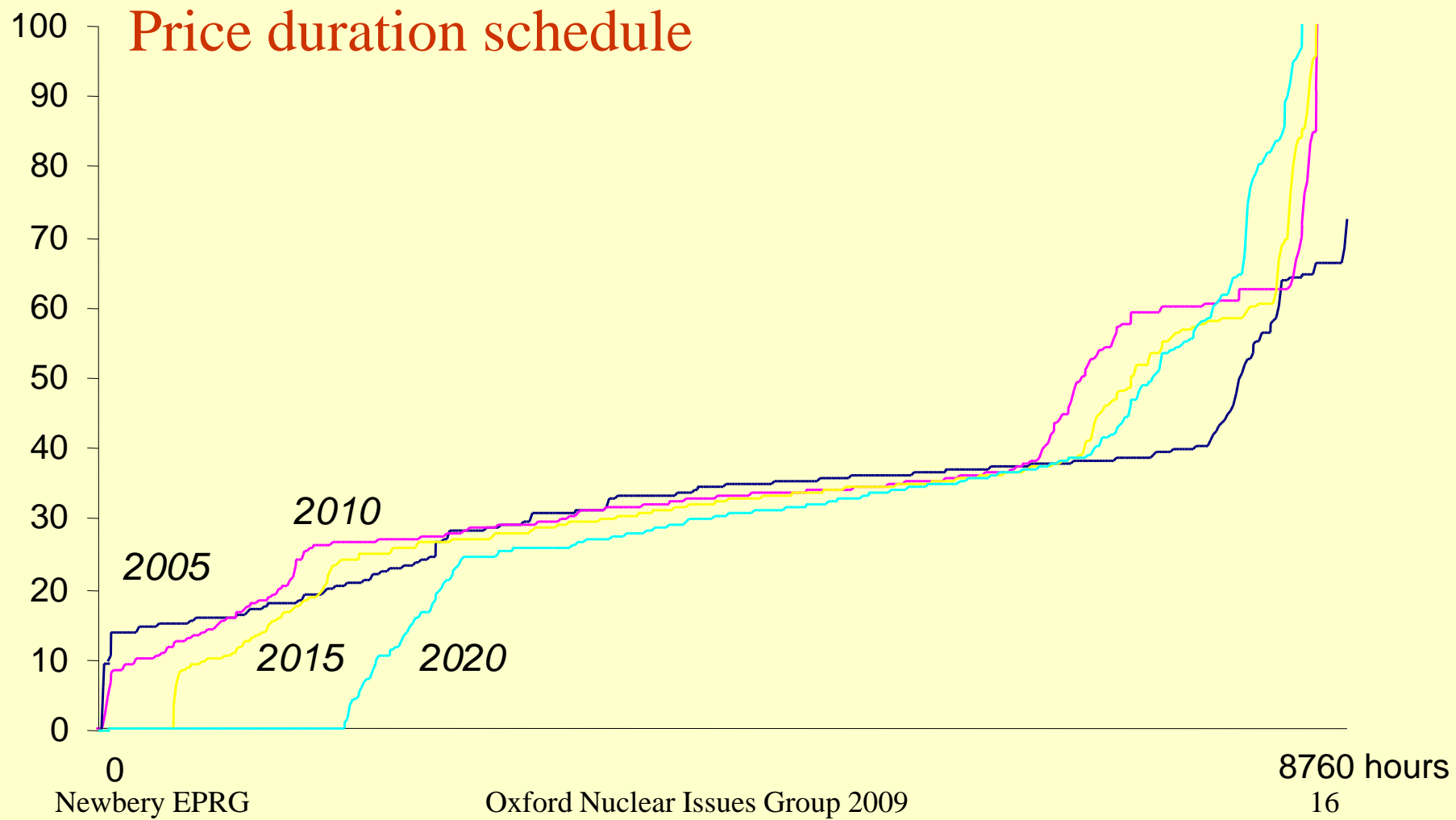


Simulation – more volatility, harms baseload (nuclear)

Euro/MWh

Illustrative

Price duration schedule



Newbery EPRG

Oxford Nuclear Issues Group 2009

8760 hours
16

Is nuclear viable in liberalised markets?

- Credit supply drying up
 - low risk free rate (indexed bonds)
 - but high cost of capital to most companies
- Low debt-equity needed for construction
- electricity price-cost margin very volatile
 - issue electricity indexed bonds?
 - or require long-term carbon price guarantee?

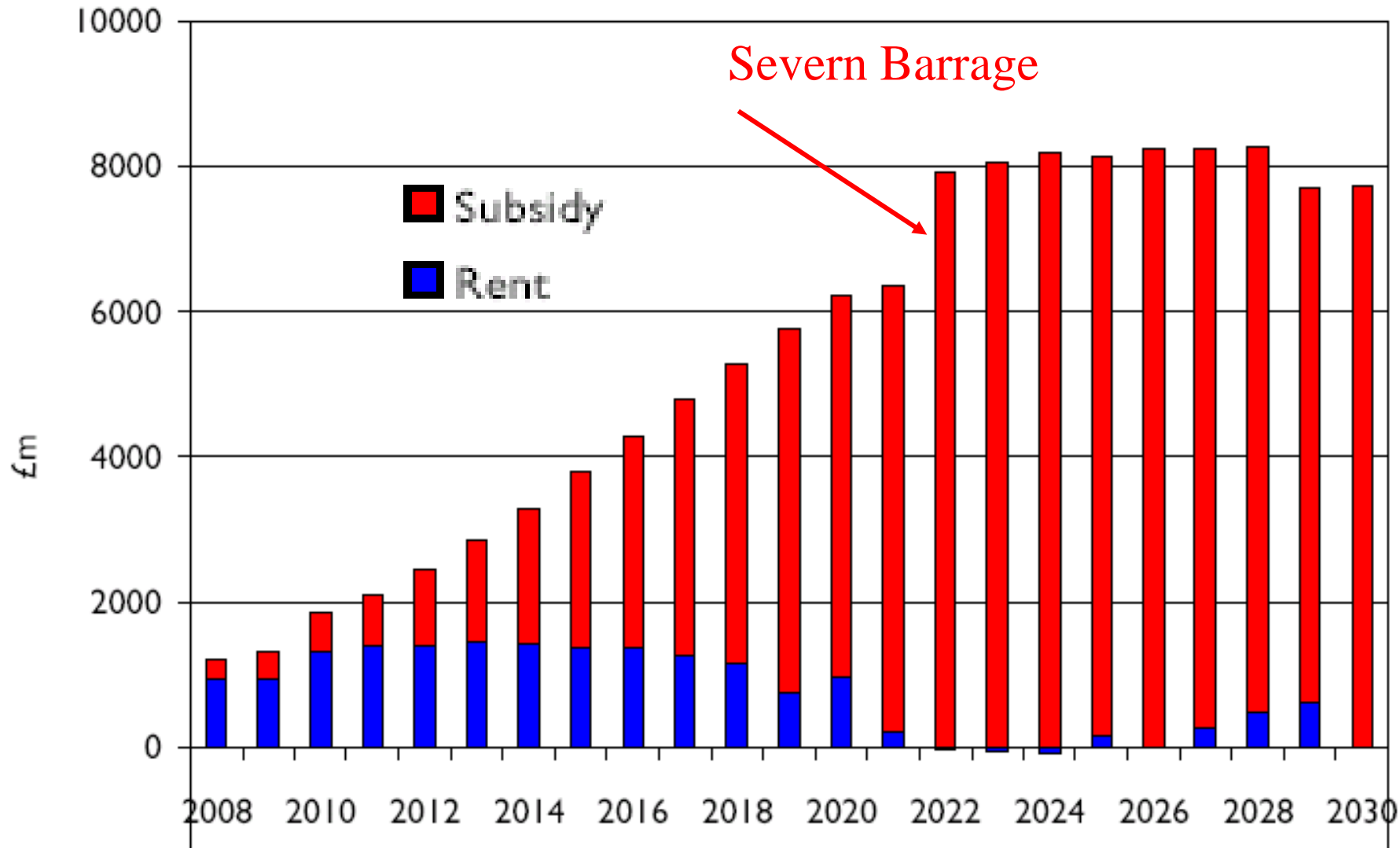
Is any electricity investment viable without an offtake contract?

Politics and constraints

- Aim: **Security, Sustainability, Affordability**
- choose any two of three?
 - Or minimise cost of achieving efficient level of security while meeting CO₂ and renewables objectives
- Currently costs all levied on consumers
 - and excessive because of ROCs etc

This could create more uncertainty

Total net subsidy for Renewable electricity: **banded ROC**



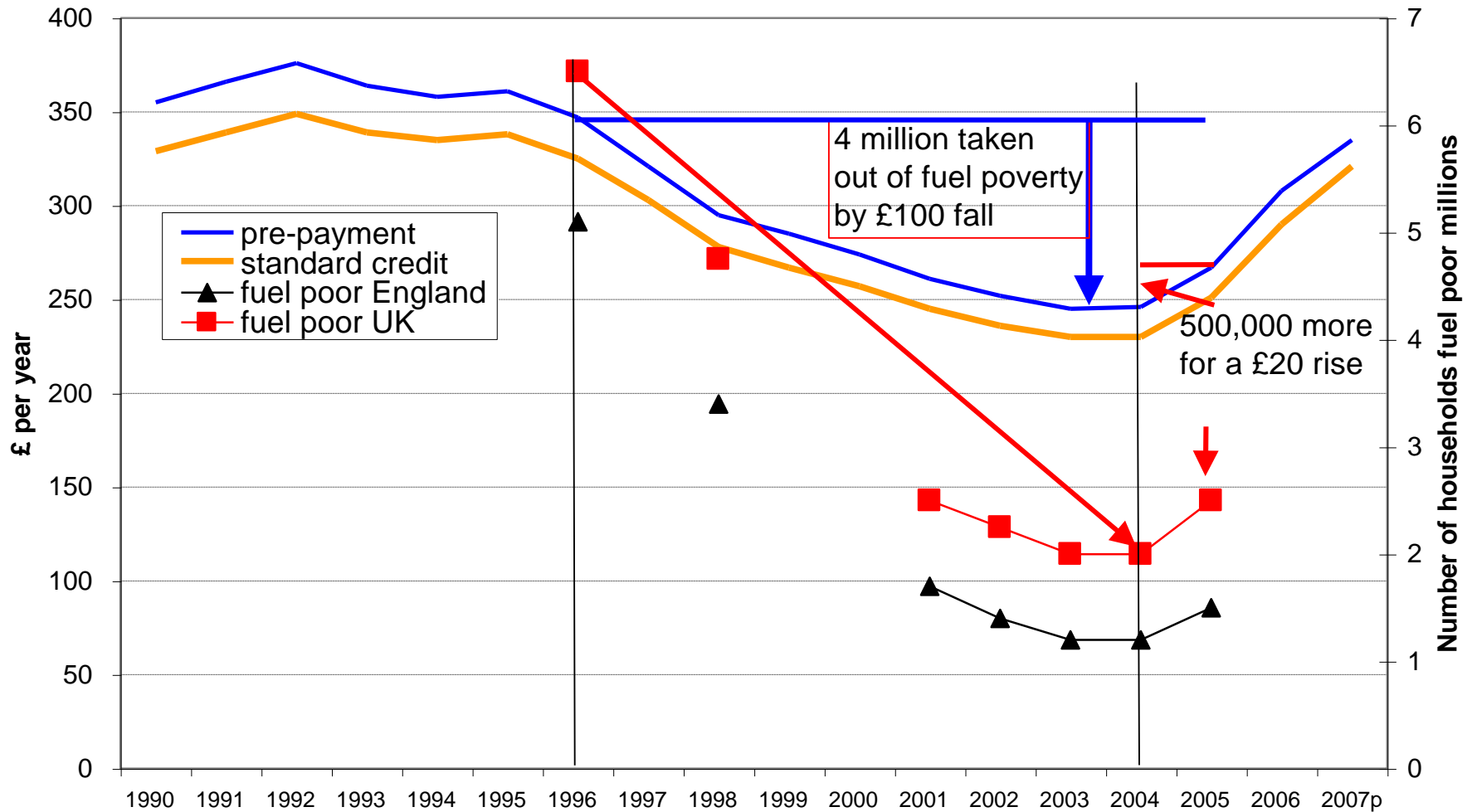
Costs of renewables (Ofgem)

- 150 TWh renewables by 2020?
- 2006/7 14.6 TWh = £10/year/HH (household)
HH 29% total =£250 m; **total £870m**
- BERR predicts **£32-53/HH/yr**
 - HH = £0.8-1.32 b/yr; total = £2.8-4.6b/yr
- SKM's estimate = **£60-90/HH**

Even the low estimate is a 6-fold increase

Fuel poverty

Annual average domestic standard electricity bill



Towards a Single Buyer?

- The cost of off-shore is huge
 - unsustainable in current conditions?
 - Precipitate move to long-term contracting?
 - Spot market too risky to support investment?
 - Balancing market works overtime with wind
- Any investment without a long-term contract?
 - But then need a Single Buyer?
 - With short-fall in spot market revenue via capacity payment charged through grid?

How long before a viable market design?

Conclusions

- Renewables and other targets undermine liberalised market
 - => threatens *all* generation investment
- Current support for renewables risky and costly
 - => required shift to long-term contracting marks end of liberalised market?

Nuclear power needs an attractive offering to compete politically with renewables:

attractive real return with sensible C price



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