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THE CHALLENGES OF DELIVERING NUCLEAR NEW BUILD EVEN WHEN THE UK GOVERNMENT WANTS IT

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The UK context

The public and political attitude to nuclear power in the UK has undergone a radical and rapid transformation over the last decade.

1990s – market liberalisation replaced a centrally planned approach to electricity (through the state-owned, monopolistic Central Electricity Generating Board for generation and transmission, and, in England and Wales, 12 local Area Boards for distribution and supply) with one based around competition in both generation and supply.

Large amount of new Combined Cycle Gas Turbine capacity built, gas and coal prices low, considerable North Sea gas reserves, falling greenhouse gas emissions as coal was replaced by gas.

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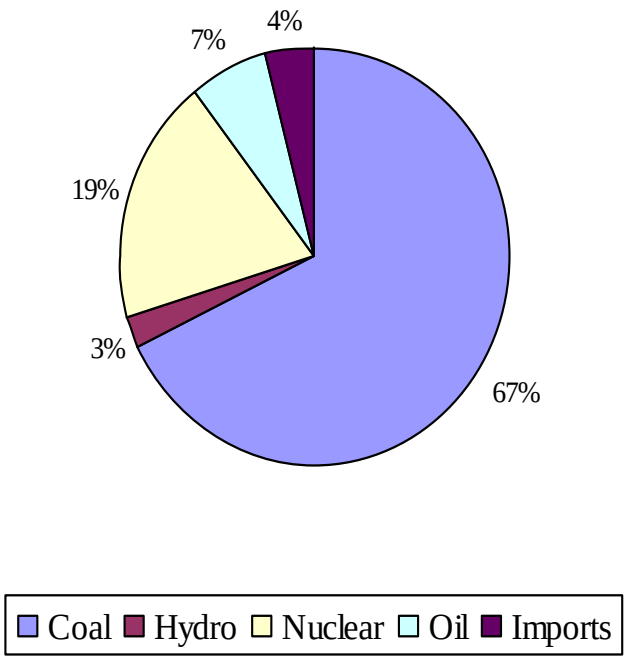
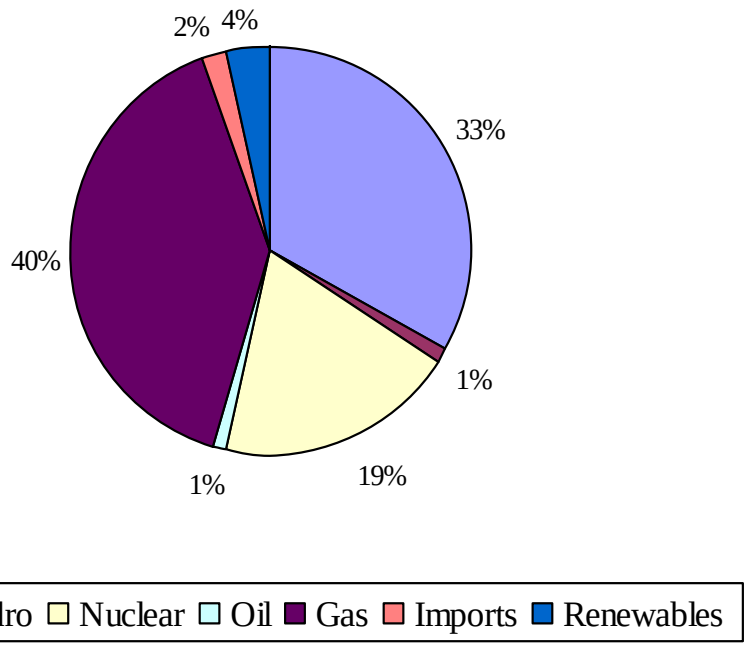
UK electricity production by fuel 1990-2000

UK electricity production by fuel 1990



UK electricity production by fuel 2000



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The UK context 1990-2005

2003 Energy White Paper:

"Nuclear power is currently an important source of carbon-free electricity. However, its current economics make it an unattractive option for new, carbon-free generating capacity and there are also important issues of nuclear waste to be resolved. This White Paper does not contain specific proposals for building new nuclear power stations. We do not rule out the possibility that at some point in the future new nuclear build might be necessary if we are to meet our carbon targets. Before any decision to proceed with the building of new nuclear power stations, there will need to be the fullest public consultation and the publication of a further White Paper setting out our proposals.

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The UK context 2005-2013

Middle years of 2000s saw a fundamental reappraisal of UK energy challenges.

Security of supply: North Sea gas becoming depleted, pending shortage of electricity generating capacity.

Economics: coal and gas prices increasing rapidly.

Environment: greenhouse gas reduction stalled owing to reemergence of coal as the major source of electricity generation and nuclear plant closure.

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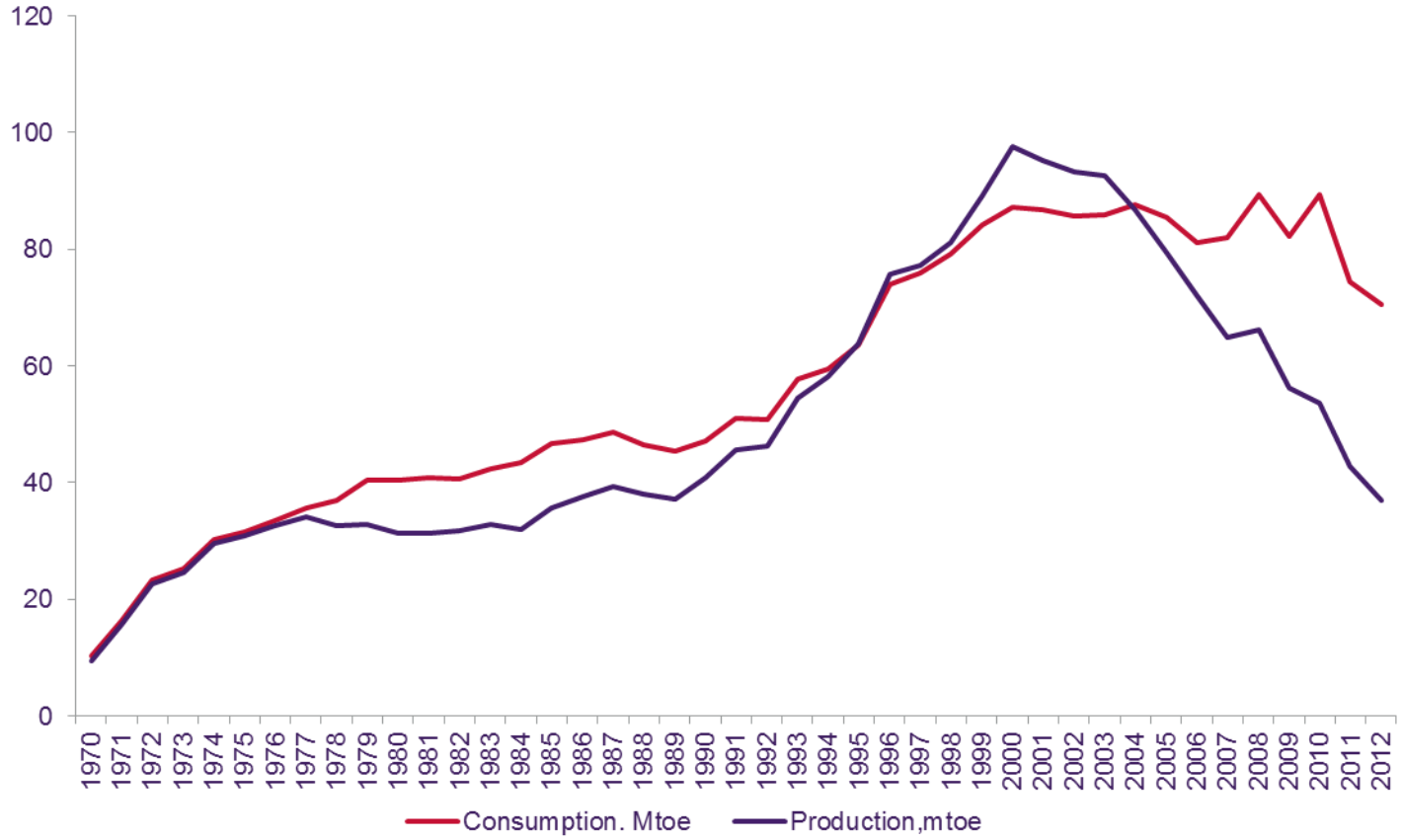
UK gas production and consumption 1970-2012



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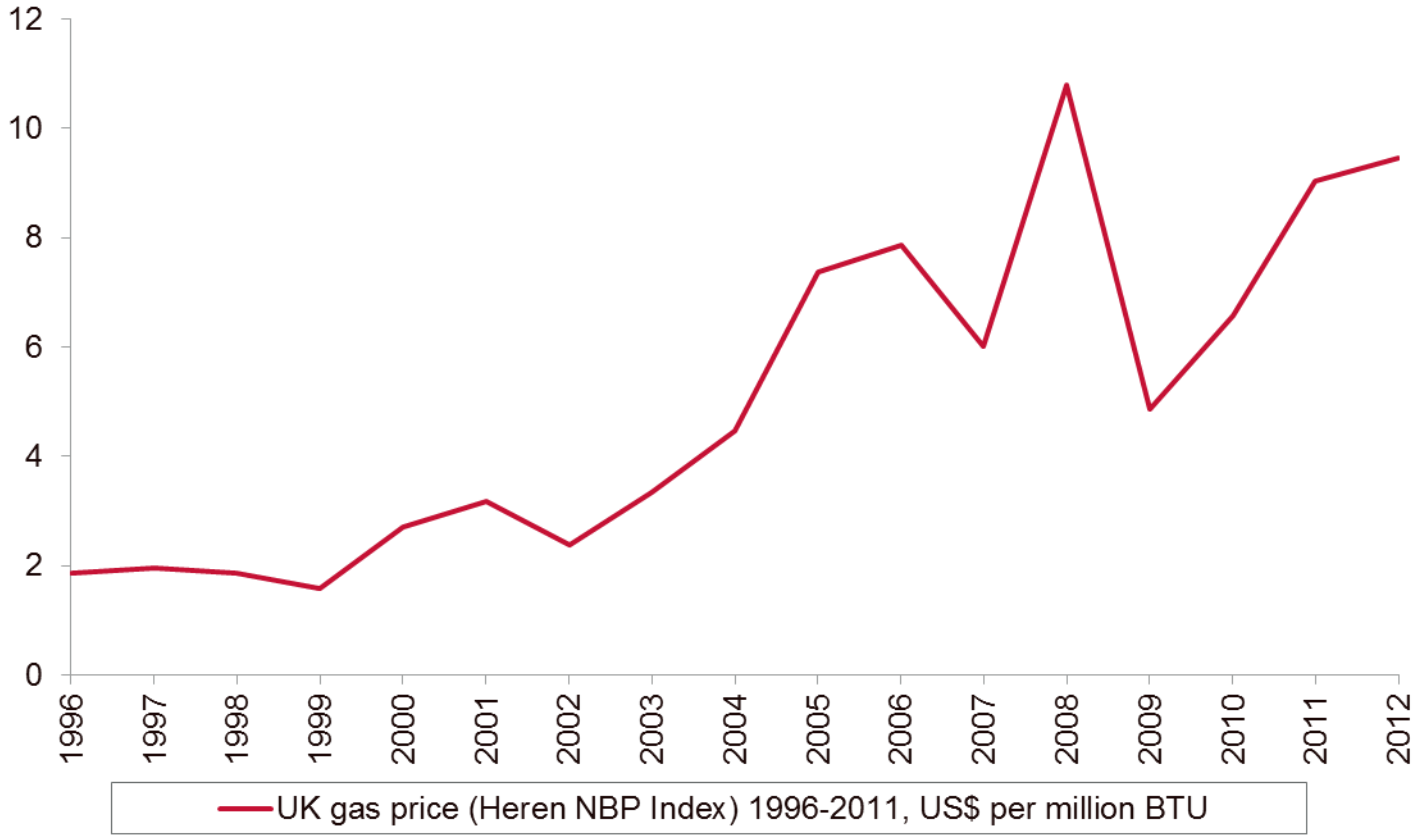
UK gas prices 1996-2012



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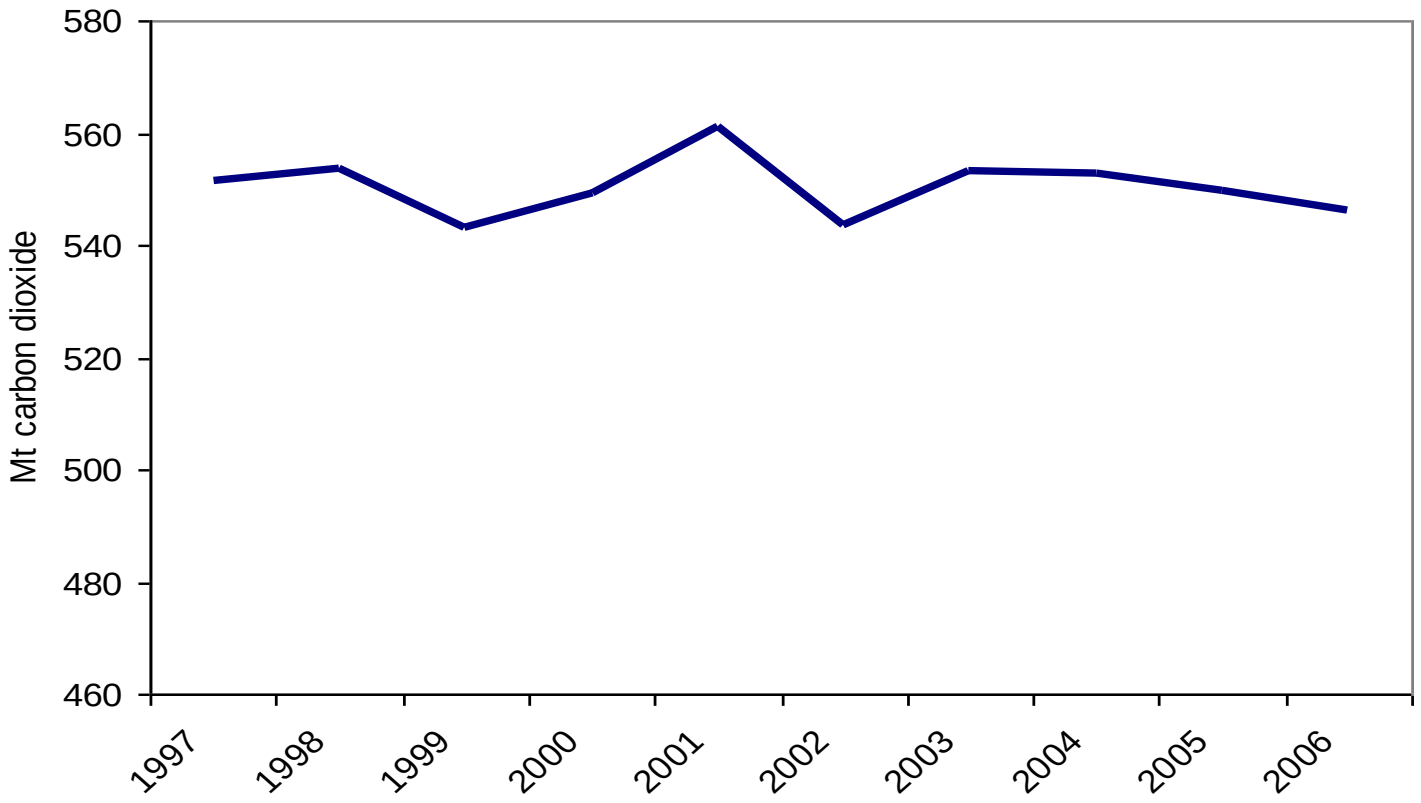
UK carbon dioxide emissions 1997-2006 ($MtCO_2$)



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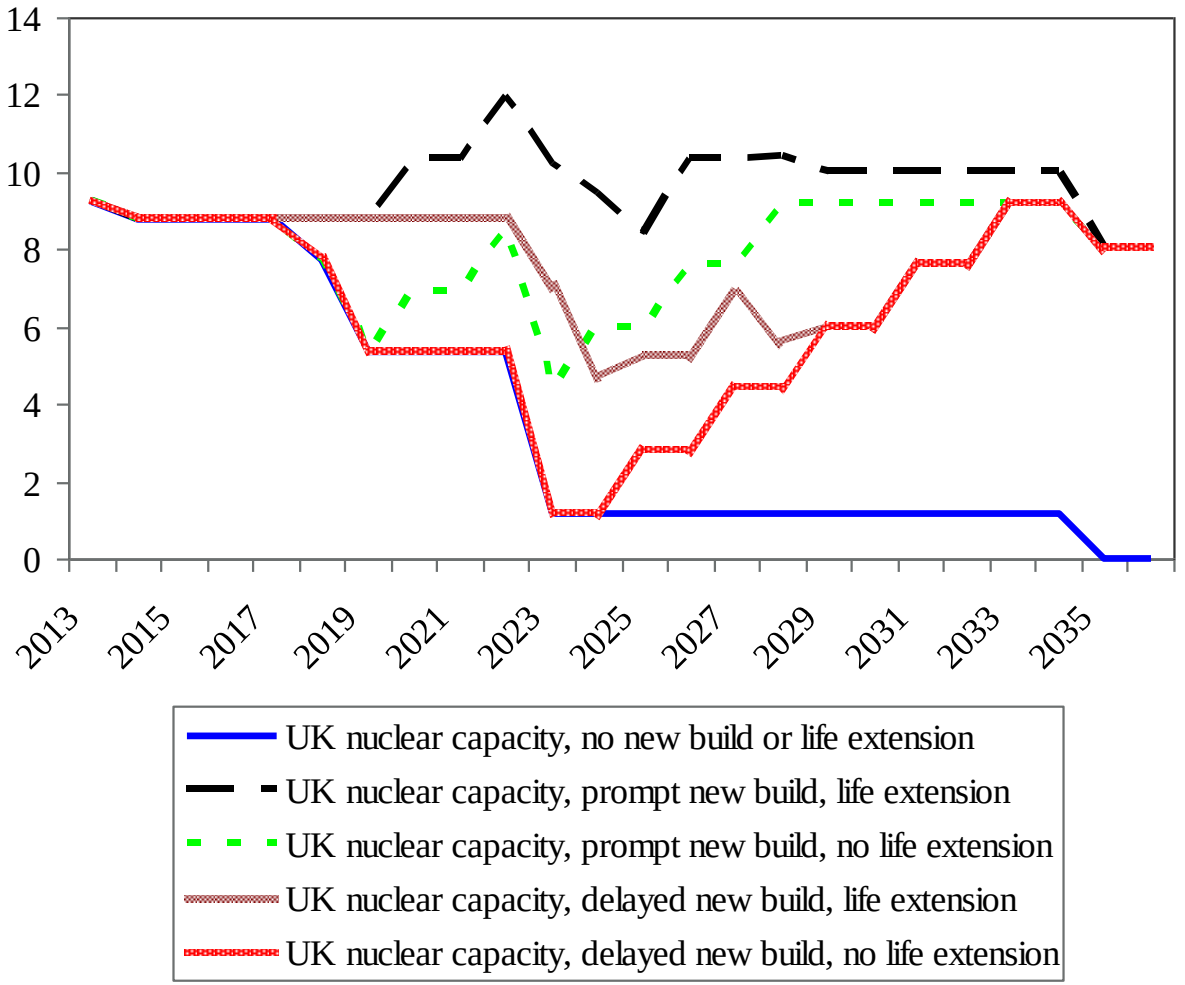
Getting quite urgent



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So what happened next?

Three consortia formed: NNB (EDF and Centrica – Centrica withdrew in 2013, EDF looking for new partner); Horizon Nuclear (E.On and RWE, sold to GE-Hitachi in 2012); NuGen (GDF Suez, Iberdrola and SSE – SSE withdrew in 2011, Toshiba-Westinghouse in negotiations for Iberdrola's share 2013).

Considerable progress on licensing, e.g.

'National Policy Statement' confirming that nuclear is a technology of national importance for which in principle planning permission is granted;

'Generic Design Assessment' has granted a license to EPR and is in process of assessing ABWR (AP1000 work has been suspended until evidence of a firm order);

'Strategic Siting Assessment' identifying eight sites suitable for nuclear new build before 2025;

Planning permission and environmental permits granted for nuclear new build at Hinkley Point in Somerset, southwest England (alongside existing Magnox (decommissioned) and AGR (operating) plants), process initiated at Sizewell in east England.

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So what happened next?

Major pieces of jigsaw in place October 2013 (i.e. nearly six years after the Nuclear White Paper) – possible financing deal with China, agreement of a strike price (£92.50 per MWh, falling to £89.50 if Sizewell C is built, inflation linked for 35 years). Still needs final agreement, e.g. European state aid provisions.

KEY TENSION:

Is electricity a commodity, to be provided in a marketplace, or a social/ industrial service, to be centrally directed to safeguard non-financial goals such as secure supplies and environmental emissions?

Put another way, who is the guarantor of last resort with regard to energy policy?

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Three radically different (and incompatible) views …

- Can nuclear consortia build power stations with no public subsidy? I don't know, we'll see.
- Britain could survive without nuclear power.
- Nuclear power is an essential part of the country's energy mix.

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2008 Nuclear White Paper

‘The Government has today concluded that nuclear should have a role to play in the generation of electricity, alongside other low carbon technologies… More than ever before, nuclear power has a key role to play as part of the UK’s energy mix.’

‘It would be for the private sector to initiate, fund, construct and operate new nuclear plants and cover the costs of decommissioning and their full share of long term waste management costs.’

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Social service or commodity?

Social service – Government owns the outcome, sets the parameters for plant mix, level of capacity margin, emissions etc. Fundamentally command-and-control, though not necessarily state-owned.

Commodity – industry and customers own the outcome, Government sets up a stable market (including a way of valuing externalities) and ensures fair competition etc but does not intervene for particular short-term goals.

Worst of both worlds – confused ownership, set up a market and talk about decisions being taken by investors but change the rules every 18 months or so in significant ways and perhaps 10 years or so in fundamental ways for social or other goals.

Liberalisation

- Liberalisation pretty good at ‘sweating assets’ and bringing down generation costs from existing plants.
- Big question mark over whether a liberalised market can deliver new investment quickly enough to prevent challenges to supply security.
- Particular questions over whether a competitive market can deliver enough low-carbon capacity.
- Very little new capacity added in 2000s.
- Now urgent need for new capacity – some 50-60 GW by 2025 according to DECC (perhaps).

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Liberalisation and gas

Seems pretty clear that in a pure liberalised market (assuming a carbon regime austere enough actually to deliver on legal targets is politically impossible) the fuel of choice in almost all circumstances would be gas/CCGT.

- Low capital costs.
- Limited economies of scale.
- Flexible output.
- History and prospect of new gas discoveries.
- Relatively low carbon emissions (c/w coal).
- Uncontroversial and ‘familiar’.
- ‘Safety in numbers’ – what can consumers do if the gas price rises?

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Liberalisation and gas

SO GOVERNMENT HAS TO WORK VERY HARD TO 'PERSUADE THE MARKET' TO PURSUE OTHER COURSES – and therein lies the rub.

Tension – for a market to work investors have to face the risk of their projects failing.

But investment in nuclear and large-scale renewables is so big that no company is likely to be big enough or brave enough to bear that risk by themselves, and will seek guarantees (e.g. loan guarantees, guaranteed prices in the medium to long term).

So the market may only build nuclear if so much of the risk is born by the consumer or taxpayer that failure becomes almost inconceivable.

Liberalisation and low carbon alternatives

- Renewables and nuclear have very high capital costs (though relatively low running costs).
- Governments have generally promoted renewables by large up-front subsidies and market distortions ('must take' contracts) which shield renewable generators from the inevitable costs associated with their intermittency.
- Wind, solar etc. described as 'new renewables' so justifying support.
- Slightly ironic – first electricity generated from wind turbine in 1887, from solar cell 1883, from tidal power 1910, from geothermal sources 1904.
- Since 1991, onshore wind energy has established itself as a mature technology.
- Hydro 1882 (same year as Edison's first power station at Pearl Street, New York).
- Interesting question as to why hydro flourished while others did not.

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Liberalisation and low carbon alternatives

- Nuclear much newer (first electricity generated in 1952) but for nuclear this route has not been politically acceptable. Mantra of ‘no subsidies’ for nuclear
- This has actually come to mean, ‘we have to find a definition of the word subsidy which excludes the support we’re going to have to give nuclear if we want it’.
- So long-term guarantees as to power prices appear essential, which sit uncomfortably in a market structure.

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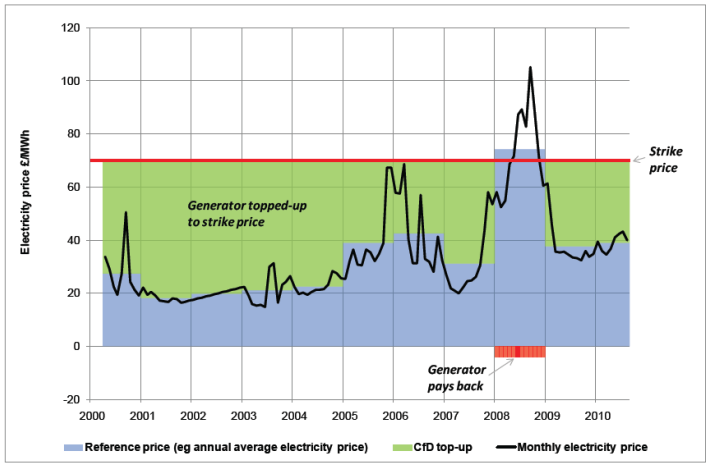
The latest attempt to fix the market

Clear that insufficient low-carbon technology was being built.

Government in effect is proposing reregulation by:

- guaranteeing long-term power prices (big debate over the level of the 'strike price' necessary)
- reintroducing capacity payments
- setting a floor price for carbon.

Figure 1: Example Contract for Difference Payment Schedule



Source: DECC

Second major recasting of the market after the Pool (1989) and NETA (2001).

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UK electricity market reform 2012/13 (1)

- Greater long term certainty around the additional cost of running polluting plant through a carbon price floor. ‘Proposals from the Treasury to provide greater support and certainty to the carbon price will increase investment in low carbon generation by providing a clearer long term price for carbon in the power sector.’

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UK electricity market reform 2012/13 (2)

- “Long term contracts for low carbon generation will make clean energy investment more attractive still. Through a proposed ‘contract for difference’ Feed In Tariff, the Government will agree clear, long term contracts, resulting in a top up payment to low carbon generators if wholesale prices are low but clawing back money for consumers if prices become higher than the cost of low carbon generation.”

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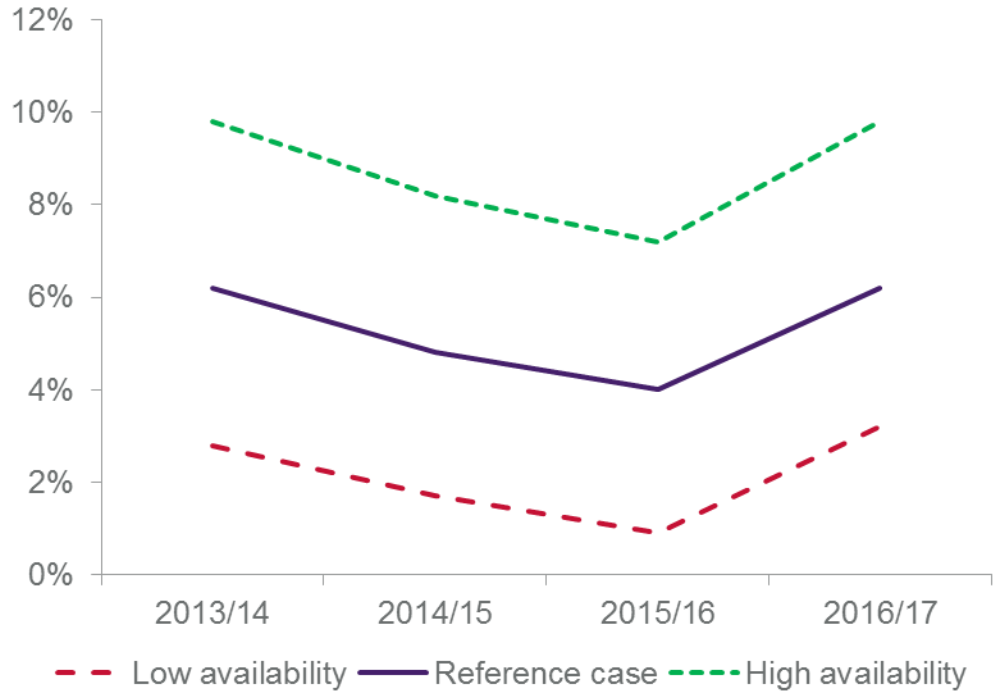
Projected capacity margins (conventional generation) up to 2016/17

- Effect of renewables coming onto system coupled with low wholesale prices owing to recession: some 4.5 GW of coal-fired capacity and over 2 GW of oil-fired capacity was closed earlier than expected in 2012/13.



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UK electricity market reform 2012/13 (3)

- Additional payments to encourage the construction of reserve plants or demand reduction measures (so-called ‘negawatts’) to ensure the lights stay on. A Capacity Mechanism will ensure there remains an adequate safety cushion of capacity as the amount of intermittent and inflexible low carbon generation increases.
- A back-stop to limit how much carbon the most dirty power stations – coal – can emit. An Emissions Performance Standard will reinforce the existing requirement that no new coal is built without carbon capture and storage.
- Market liquidity mechanisms.

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UK electricity market reform 2011

- EMR has two goals

- To persuade investors to build something that is not CCGT
- To persuade investors to build the CCGT they would have built if not for the above.

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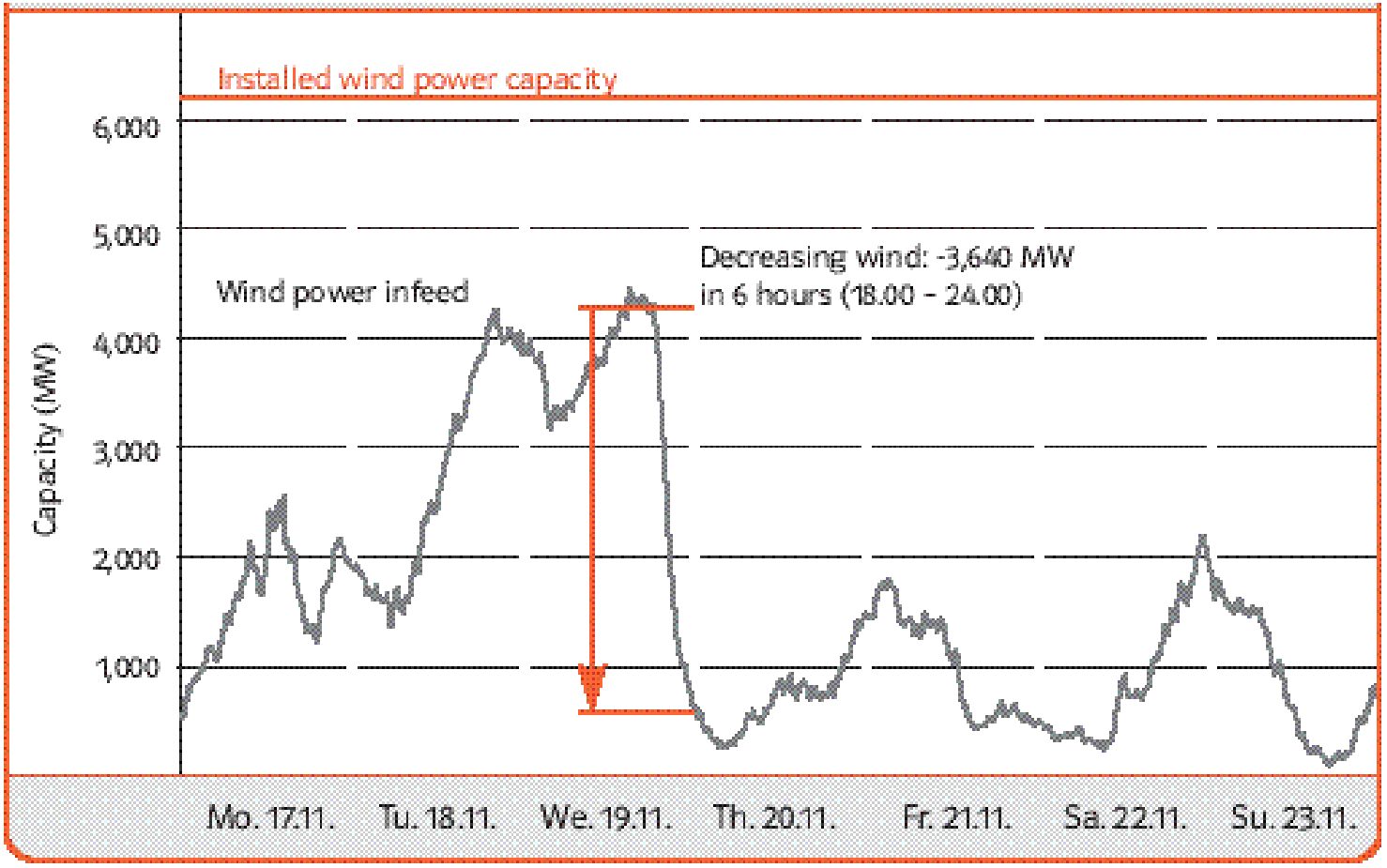
Variations in wind output, Germany 2003



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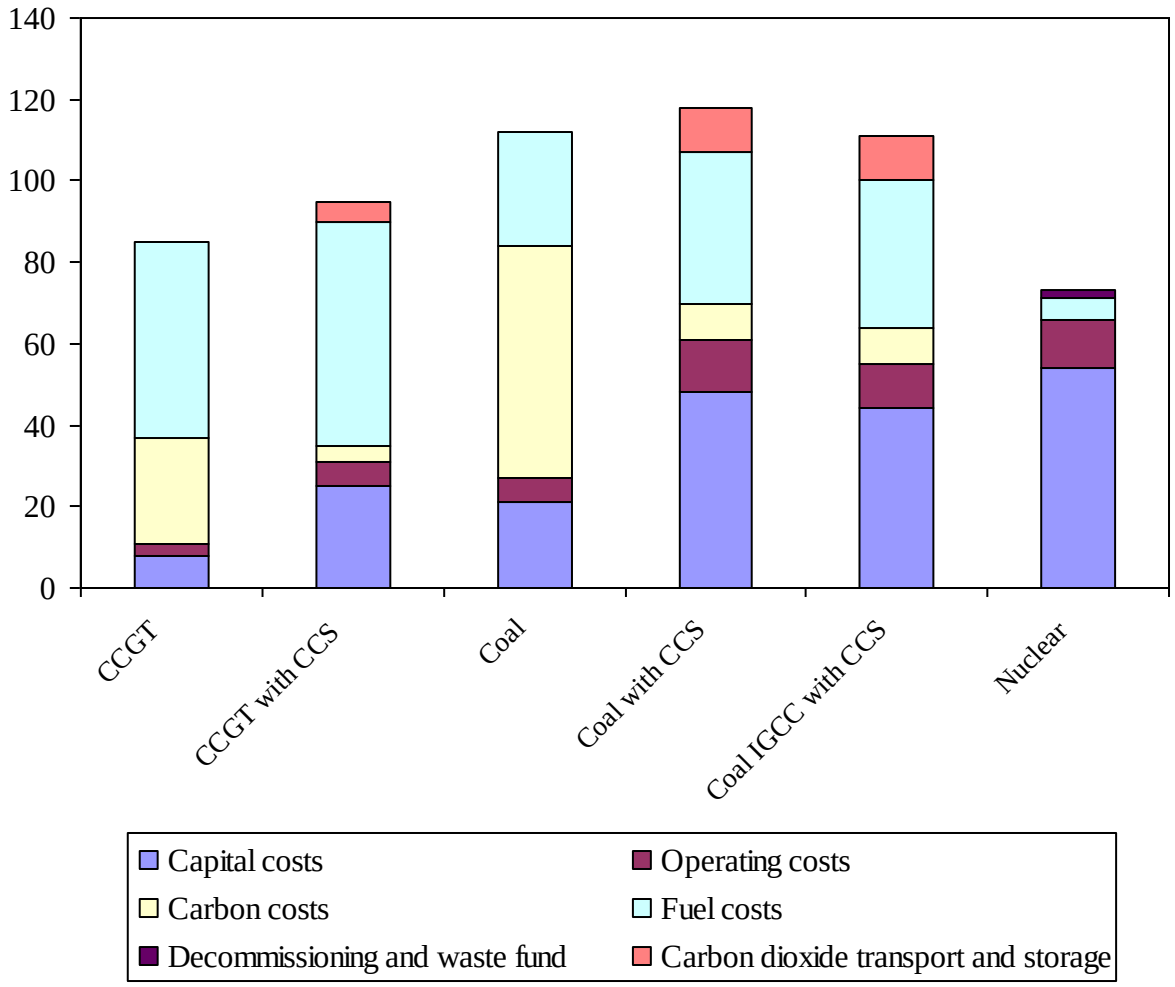
UK levelised electricity price model (October 2012)



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UK levelised electricity price model

- Nuclear £73 per MWh at 10% rate of return (for a mature series build – the first plants would be higher).
- CCGT without CCS £85 per MWh.
- Coal without CCS £113 per MWh – in effect prohibited under the carbon standard in EMR.
- CCGT with CCS £94 per MWh.
- Coal with CCS £116 per MWh.
- Onshore wind £95 per MWh – ignoring grid and other system costs.
- Offshore wind £130 per MWh.

BUT heavily dependent on high carbon price – some £32 per tonne carbon dioxide in 2020, £76 per tonne carbon dioxide in 2030 and £215 per tonne carbon dioxide in 2050 was assumed (against about £9 per tonne carbon dioxide on the European Trading Scheme in early 2013).

Other views

- Opponents are sceptical as to whether the industry could deliver on the prices being claimed, even with new EPR costing £7 billion (US$10.5 billion or $6.5 per kW) + £1 billion provision for waste management and decommissioning.
- Question as to whether 10% rate of return would attract private capital – at 15% rate of return levelised cost is (allegedly) c. £166 ($250) per MWh.
- Hence protracted negotiations between EDF and Treasury over ‘strike price’.

Summary (1)

- Levelised costs of nuclear are likely to be lower than alternatives over the 120 years lifetime of the project (assuming 10 for planning and construction, 60 for operation and 50 for decommissioning and waste disposal), against likely projections of fossil fuel prices and a real evaluation of the costs of renewables to include the costs of intermittency.
- But in a market this is not really the point. Even if there are enough investors with a long-term perspective (pension funds, large-scale electricity consumers, huge electricity companies), the risks associated with nuclear (poor history and reputation with regard to construction cost and schedule overruns, e.g. Olkiluoto-3 and Flamanville-3, low power prices in the long term because of cheap gas) are both bigger and sooner than those associated with CCGT.

Summary (2)

Two questions emerge.

- In order to ensure the societal benefits of a nuclear power programme, would government have to intervene in the market so heavily that in effect the risks of investment were nationalised but the potential benefits privatised?
- And even if it did, how credible would potential investors regard a regime which in principle could be undermined by future changes in the market rules or by changing government attitudes to nuclear power, such as was seen in Germany after the Fukushima accident in 2011? (Experience of the last 25 years suggests such a regime might be expected to undergo major changes roughly every 12 years; a nuclear plant order in 2013 might well still be generating electricity in 2080.)

Summary (3)

- Very soon government has to decide what it's going to abandon – its carbon policy (and to a lesser extent its power to protect secure supplies) or its market mantra.
- Difficult to do the latter, e.g. European competition policy. Maybe less difficult to do the former.
- Are the challenges of providing secure, environmentally sensitive long-term electricity supplies are simply too complex to be delivered within a market context?

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An opportunistic regulatory cycle

(Graham Shuttleworth, NERA, 2000)