Electricity Policy Research Group

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Regulation: how to balance market and control

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Young Leaders Forum

AlpineUniversity McKinsey & Co

Kitzbühel 7 May 2010

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

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Reform of electricity markets

- UK as a key example
  - first to liberalise: markets and private owners to guide decisions, not state and central planning
- now facing severe challenges
  - pending capacity shortages
  - shift to import gas dependence
  - need for ambitious decarbonization
  - the challenge of the EU *Renewables Directive*

Can markets cope with these challenges?

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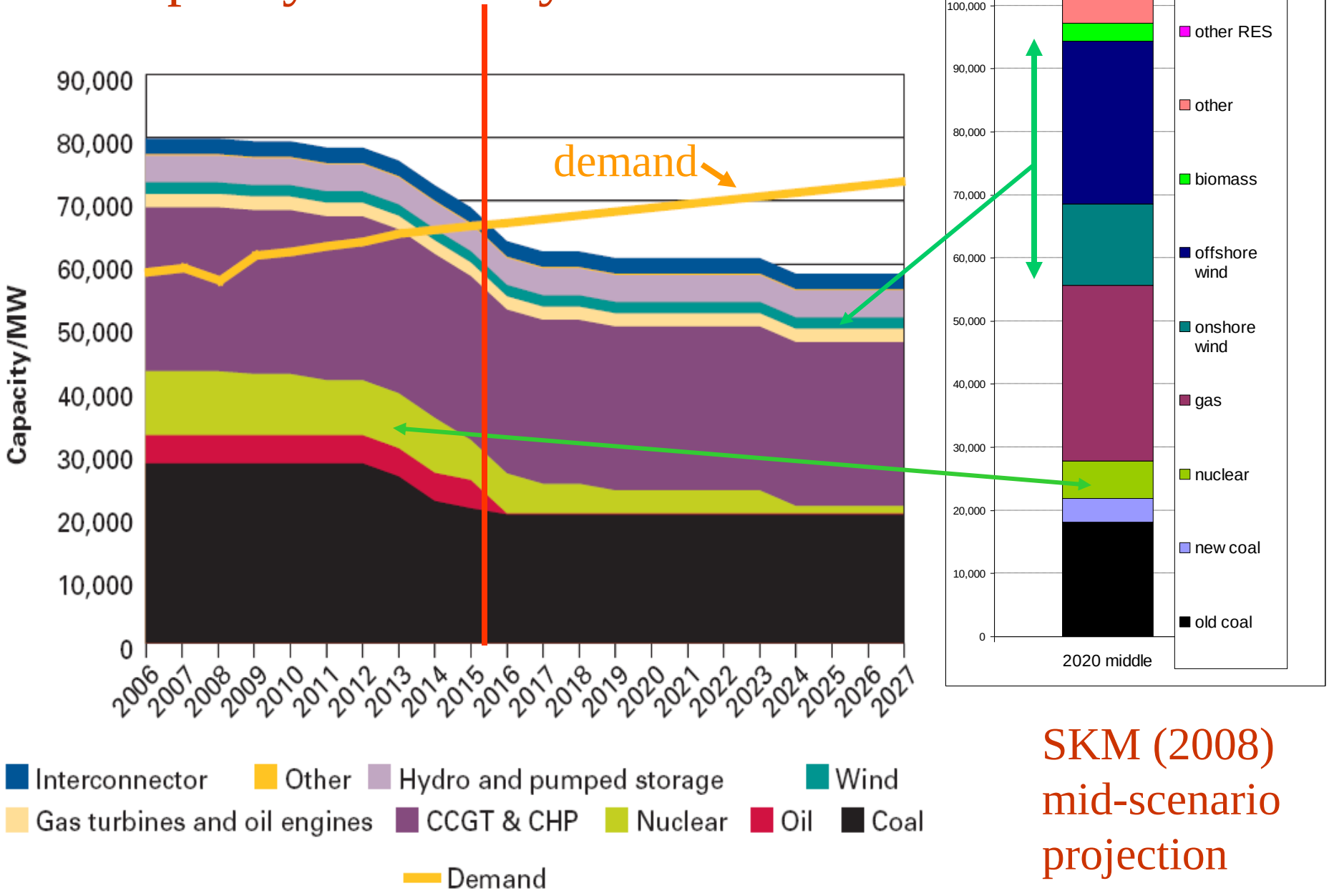
What are UK's problems?

- Security of supply: reserve margin falling fast
  - 12 GW coal decommissioned by 2015 because of LCPD (20% of peak demand)
  - 6.3 GW nuclear decommissioned by 2016
- Gas imports rising fast (50% peak by 2015)
- Climate change challenge
  - Renewables falling short of targets
  - Nuclear not attractive at current CO_2 price
- Cost rising: 2020 targets might cost £200 bn

  = £760 per household/yr, current elec bill = £450/yr

More capacity needed by 2015

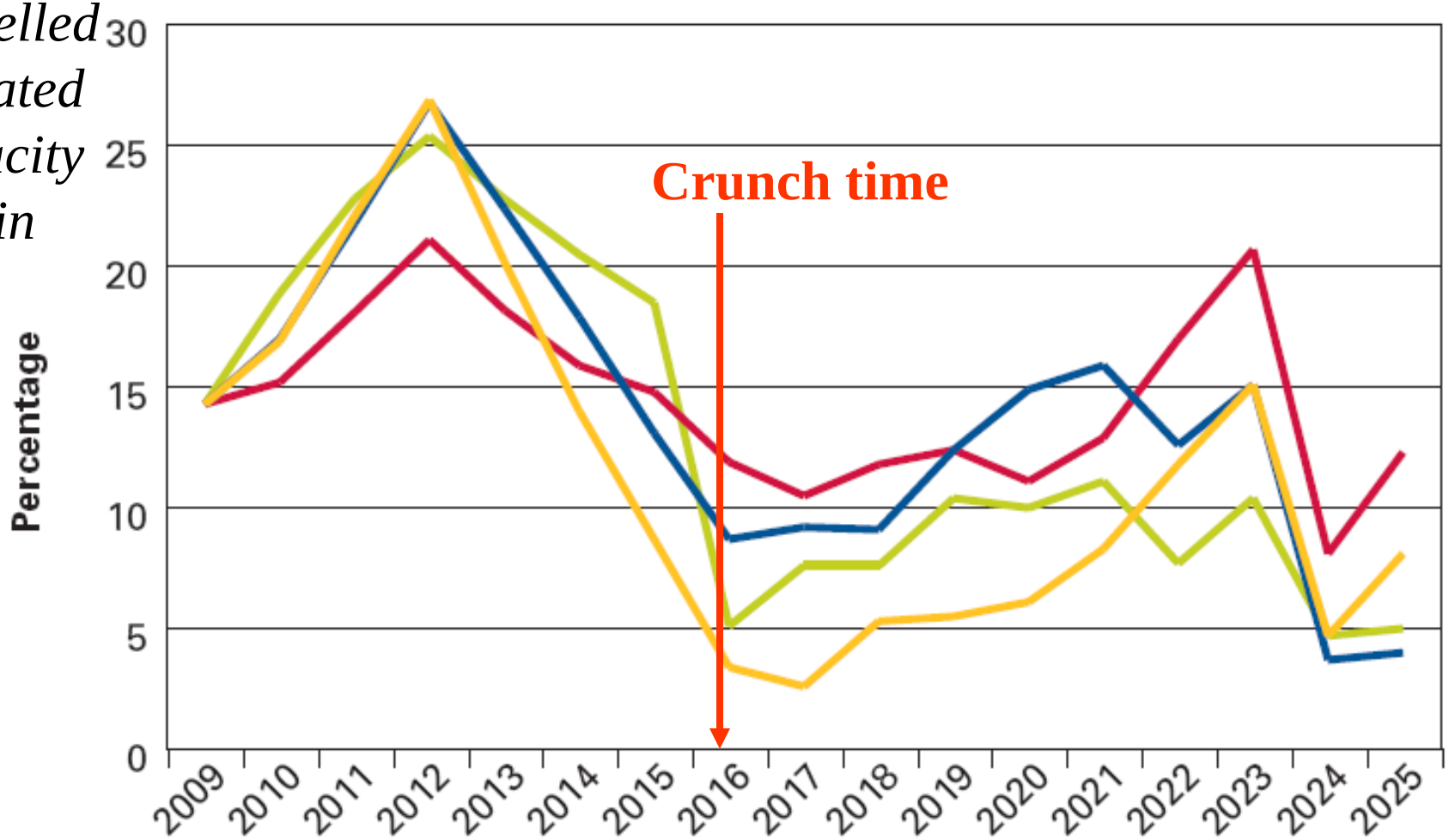


SKM (2008) mid-scenario projection

Source: Digest of UK Energy Statistics/DECC

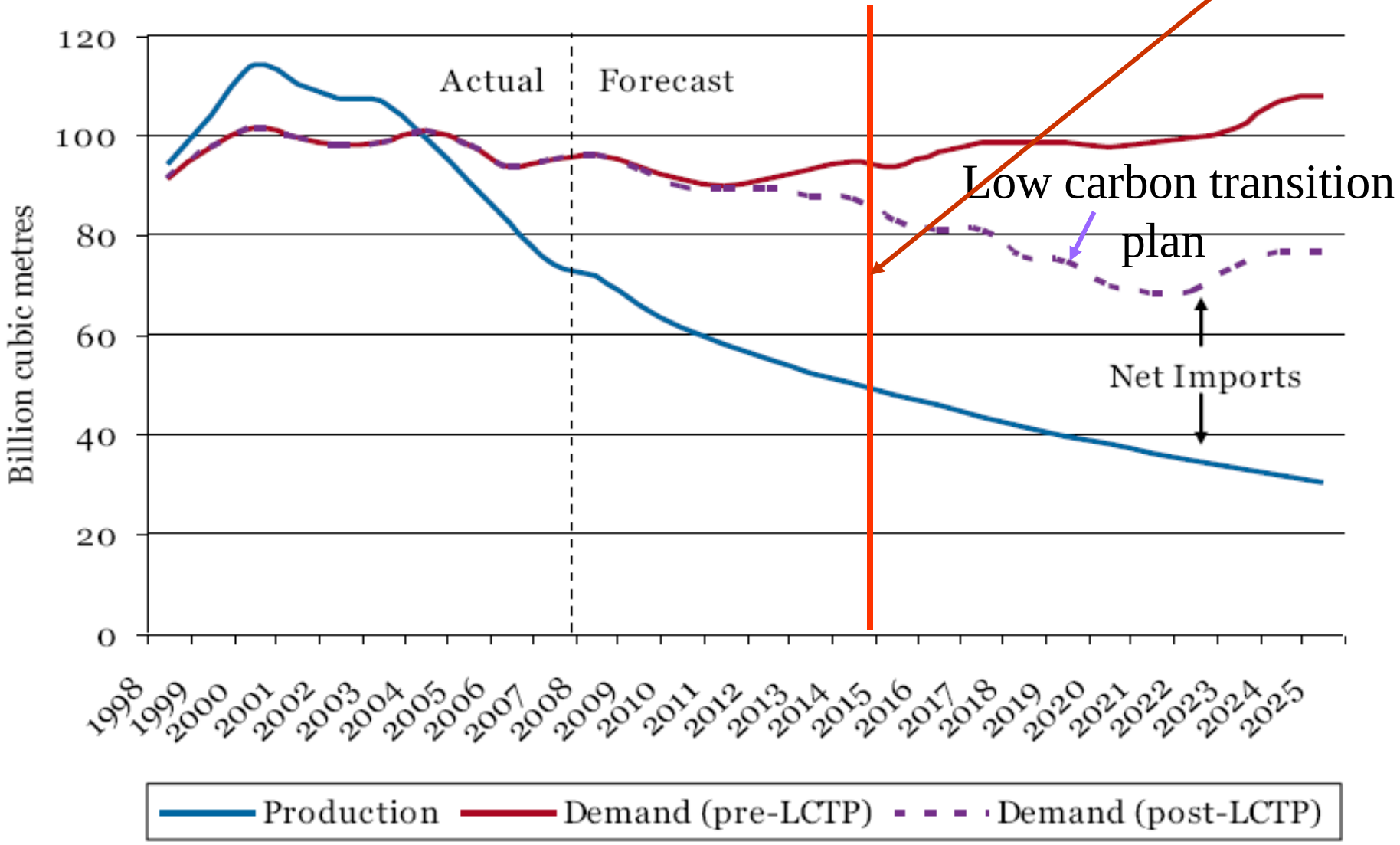
Under Ofgem's scenarios reserve margin falls in 2016

modelled de-rated capacity magin



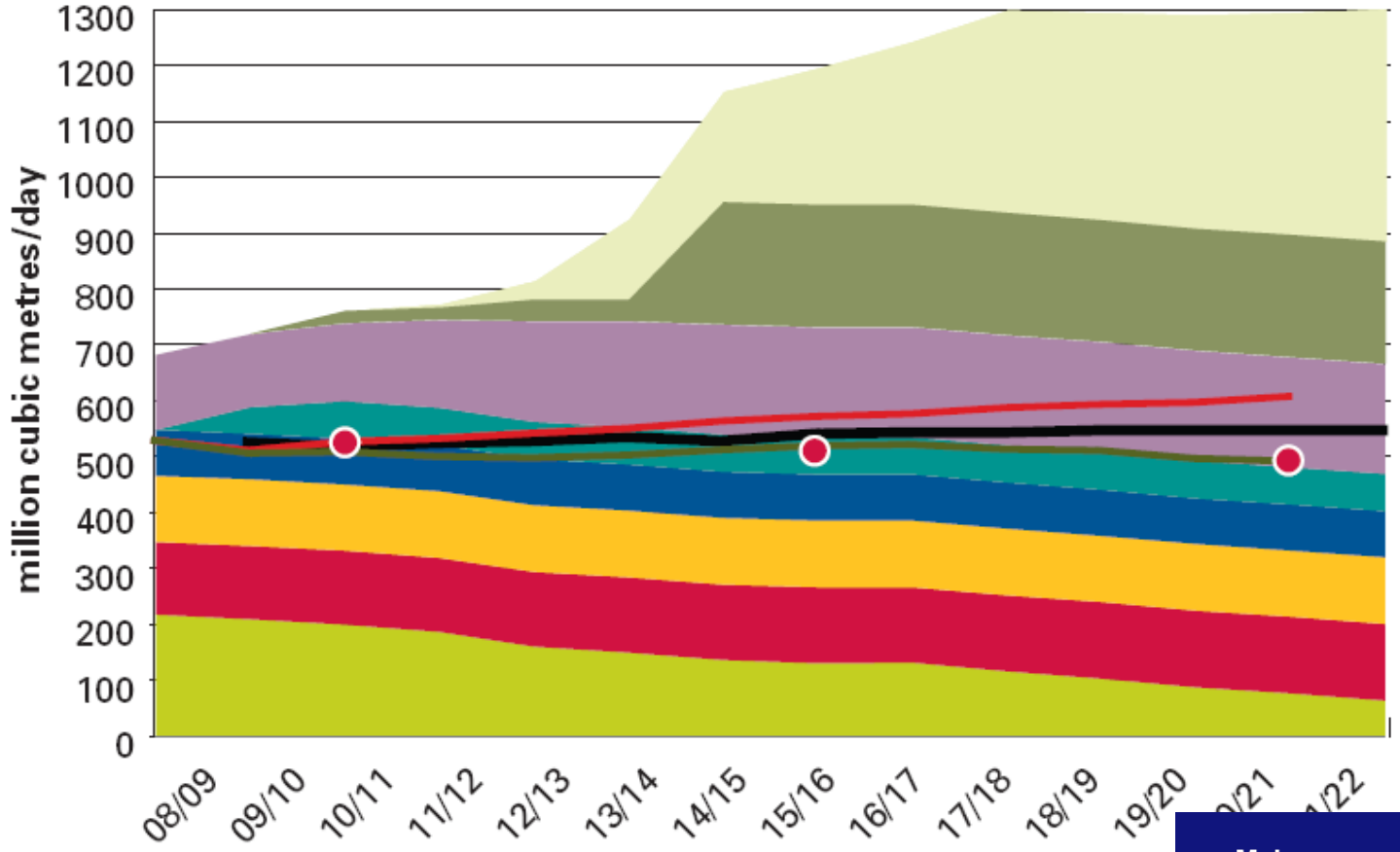
Ofgem *Project Discovery*

UK might import 50% of its gas by 2015



Wicks Report 2009

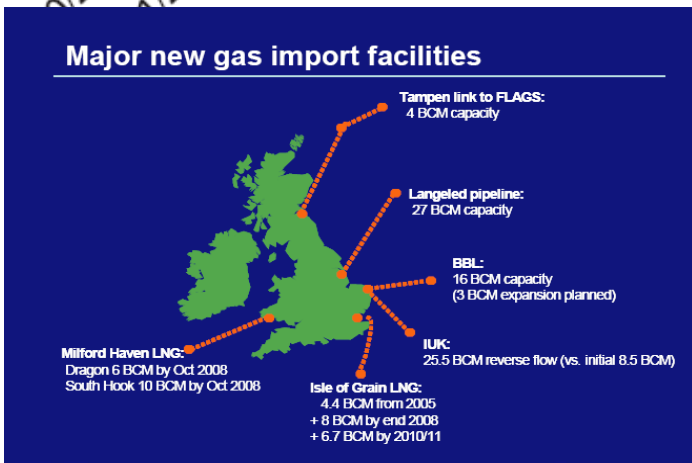
But gas import infrastructure has been forthcoming



Source: DECC
Energy Markets Outlook 2009

Peak Demand (top
Peak Demand
1 in 20 winter

UK Production (including biogas)
Import capacity of pipelines from Norway
Import capacity of pipelines from the Continent
Existing LNG import capacity
Under construction LNG import capacity
Existing and under construction storage peak supply capacity
Possible new LNG import capacity
Possible new storage peak supply capacity

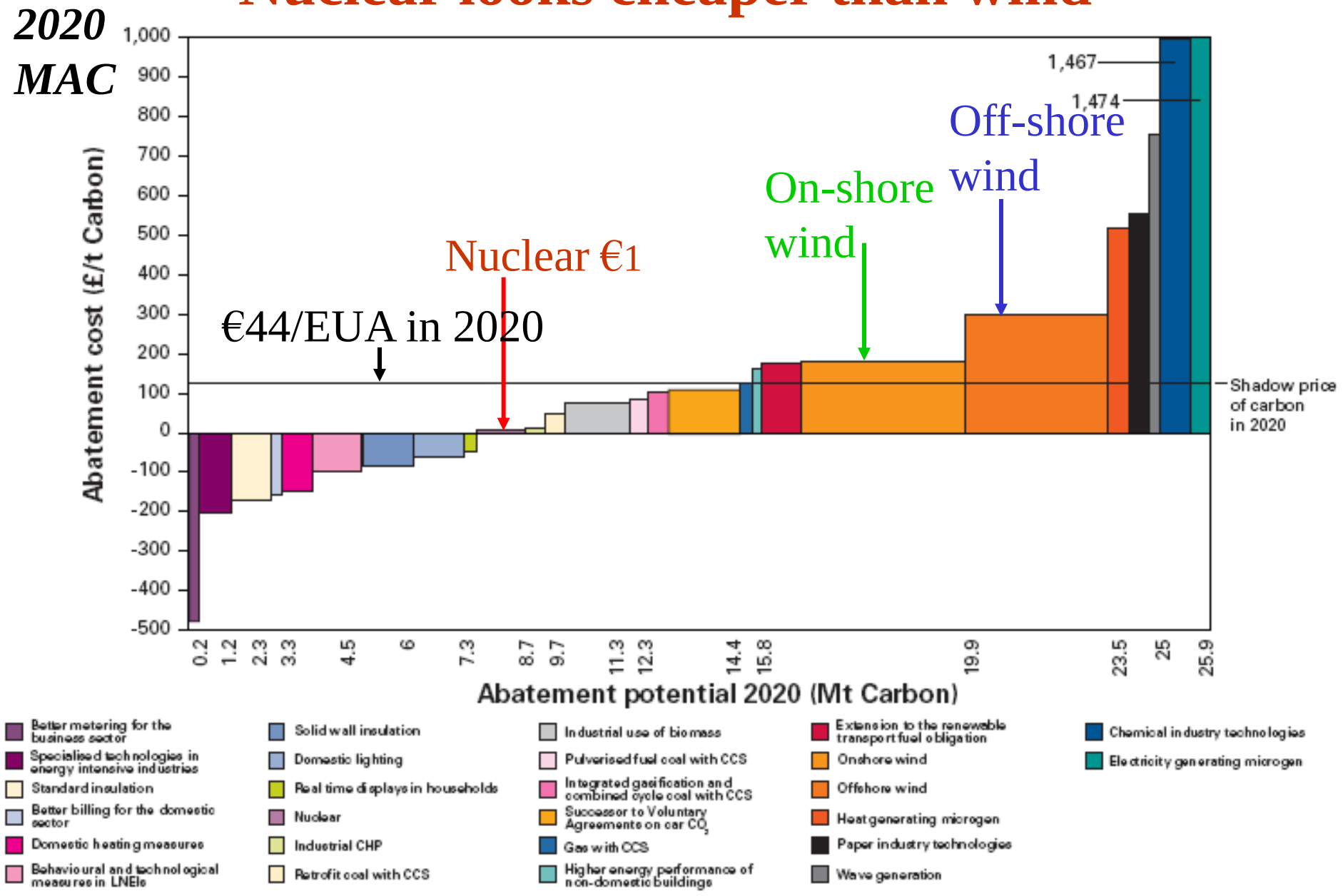


EU *Renewables Directive*

- Why? Why not just reduce CO_2?
- C price that supports nuclear is too low for RES - and EUA price is too low for nuclear!
- Considerable RES learning potential
  - requires RD&D - especially deployment
- Case for EU targets: burden sharing to deliver investment and learning

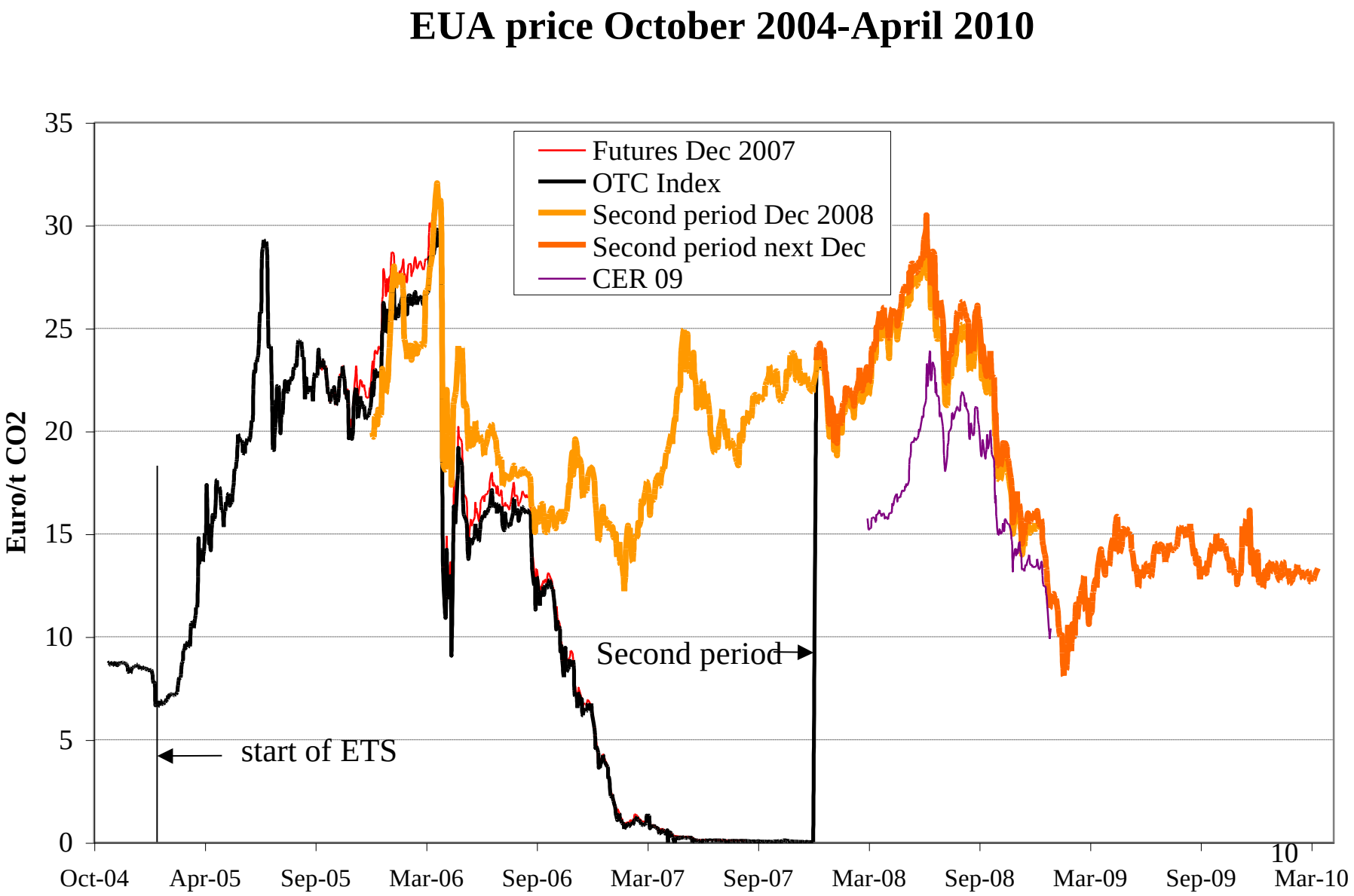
High future RES supply requires high current investment and learning

Nuclear looks cheaper than wind



Source: BERR 2008 *Meeting the Energy Challenge*: nuclear costs have risen since 07

CO_2 prices are volatile and now too low



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UK's 2020 renewables target

= 34% renewable **ELECTRICITY** (SKM low scenario)

= 110 TWh; wind = 33GW; total 105 GW

- 56 GW conventional @ 31% fossil fuel load factor
- 2008/9 wind support £46/MWh = €125/t CO_2 c.f. €14/t current EUA

- 33 GW wind > demand for many hours

  => volatile supplies and prices, congestion, ….

- Offshore wind dependent on electricity price
  - now looks less favourable even with ROC of £90/MWh
  - and challenges to jack-up barges -12 needed, 2 available

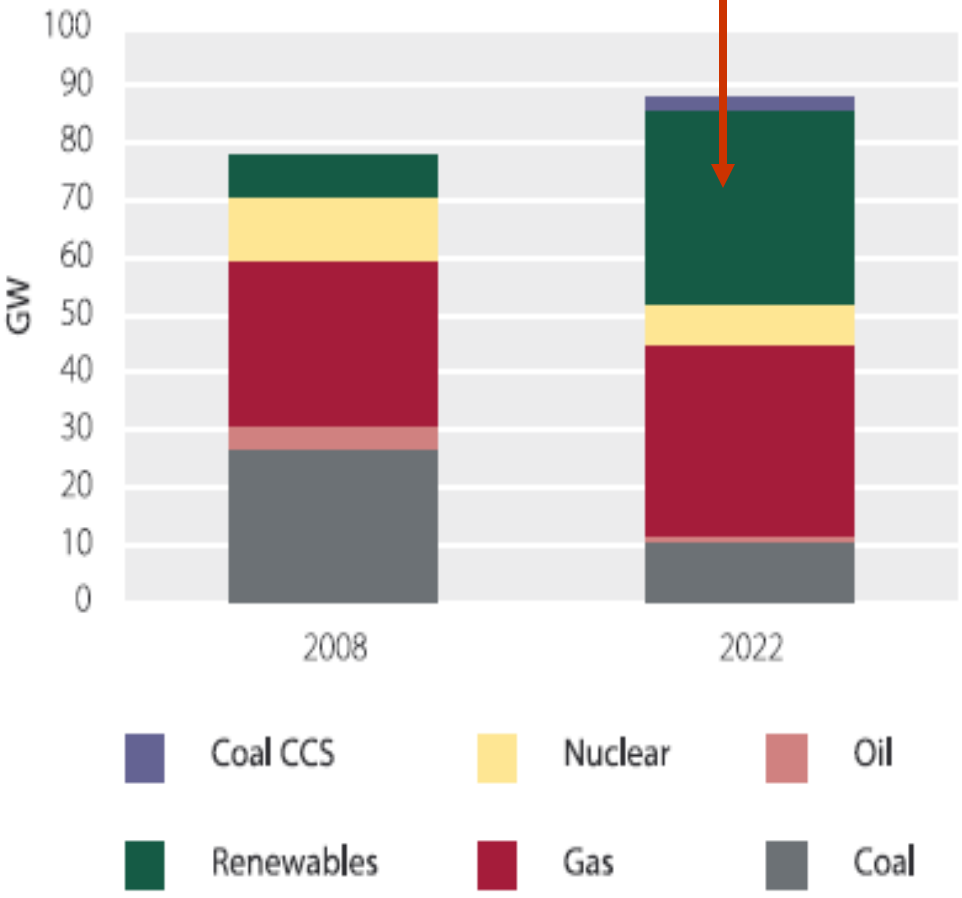
CCC'09 scales back wind ambitions

CCC 2020 scenarios: still lots of wind

Capacity

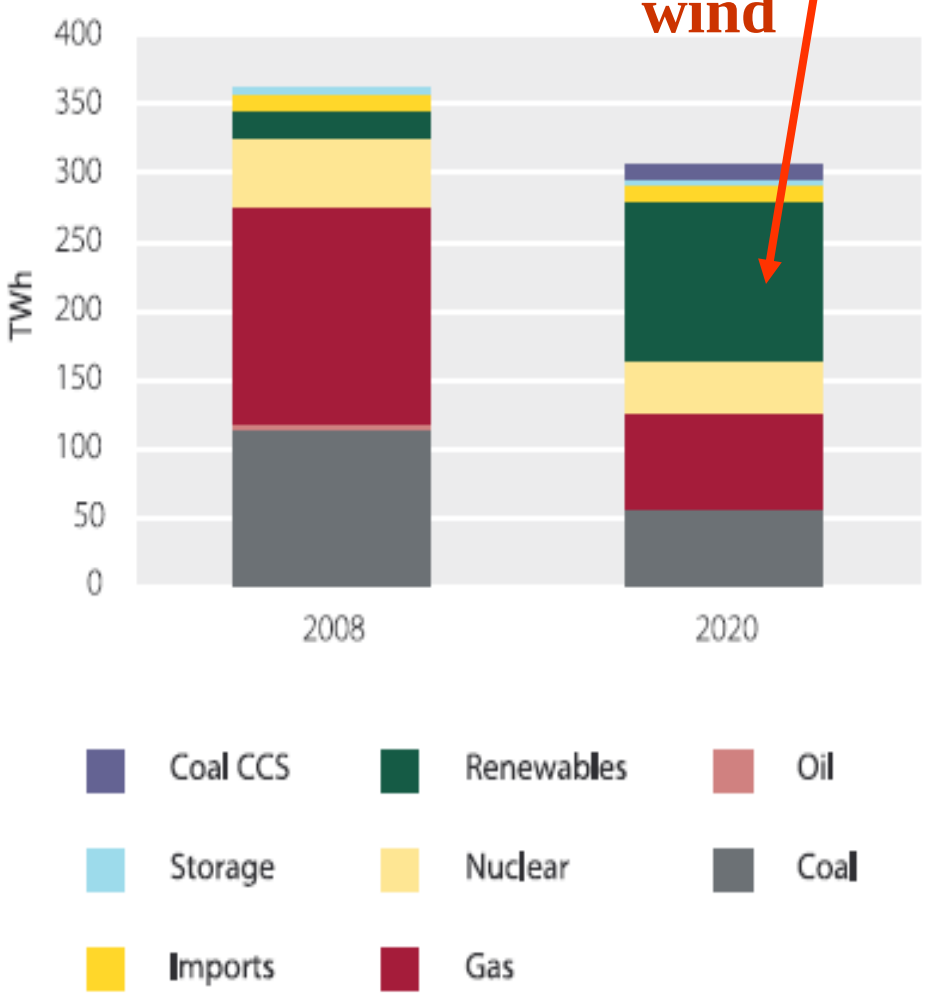
27 GW wind

7 GW other RES



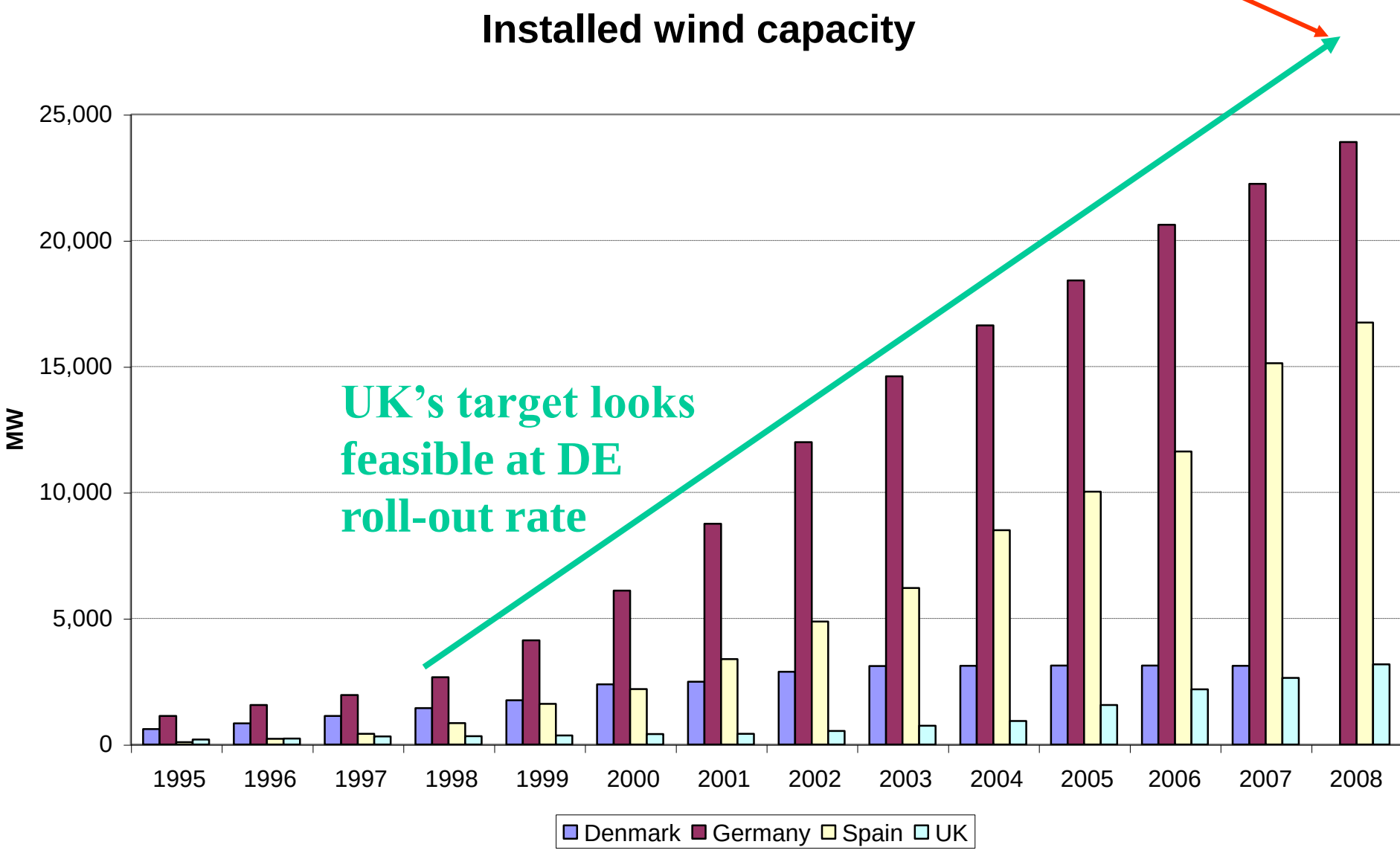
Generation

76 TWh wind



Committee on Climate Change 2009

CCC'09 UK 2020 target is 27,000 MW



Implications of substantial wind

- Greater price volatility and less predictability
- Reserves (much larger) require payment
  - flexible plant runs fewer hours
- Support schemes may deliver negative prices
- RES may depress EUA and electricity prices

These could prejudice existing plant economics

Worries about investment

- Low-carbon electricity is expensive
- Wind financed by ROCs - risky, unpredictable
  - and delays for planning and grid connections
- Nuclear power needs a higher CO_2 price
  - but more RES => lower CO_2 price
- Policy uncertainty => wait and see

But then too late - lights go off?

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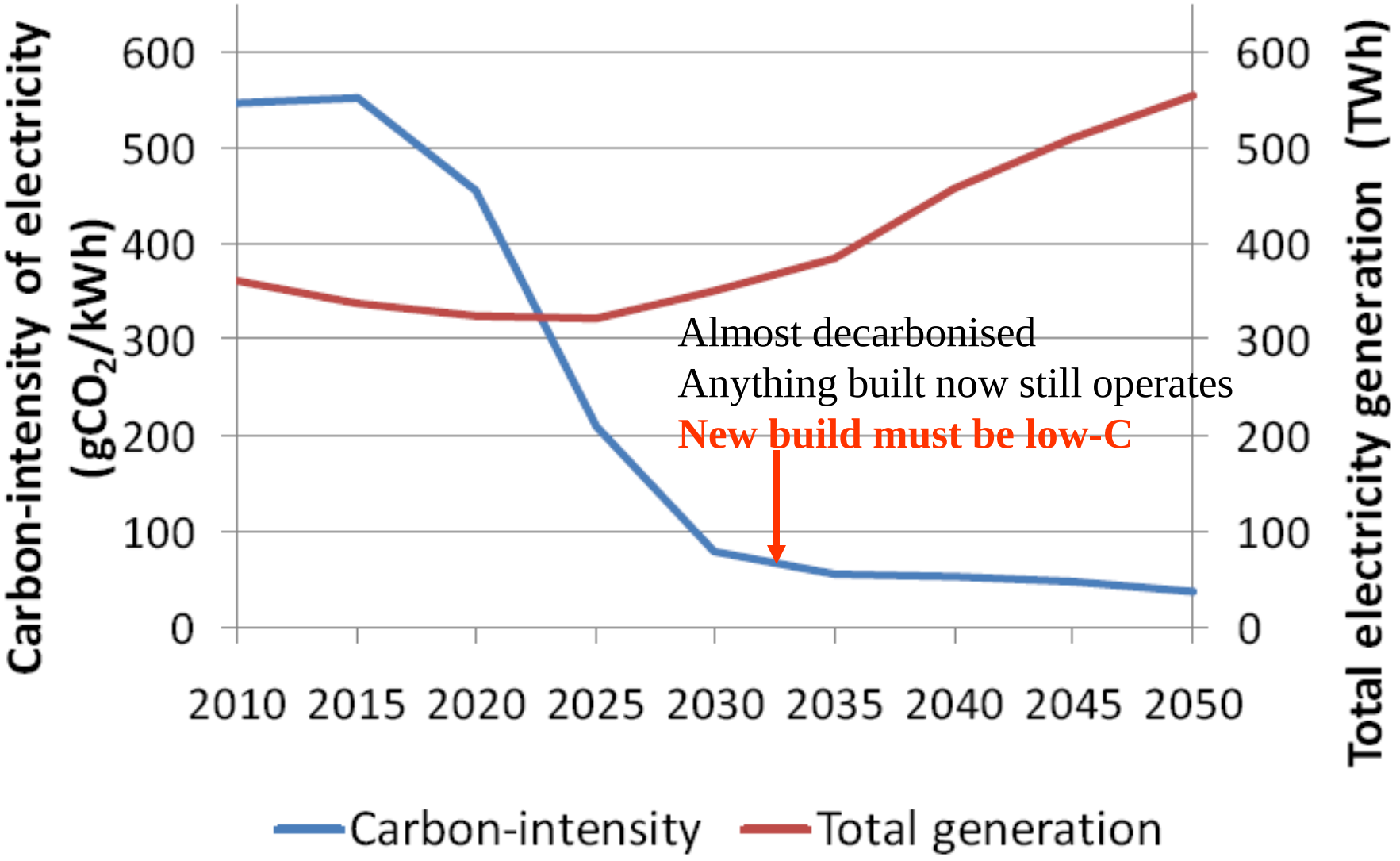
The climate change challenge

- World should not release all C from fossil fuels
- EU obligation: 80% GHG reduction by 2050
  - Easier to decarbonise electricity than fuel
  - switch much heating, transport to electricity
- Wide range of low-C electricity
- Long-term: nuclear limited by fuel supplies (?)
  - CCS + renewables seem essential from 2050-2100

High C price + massive R&D to cut RES costs

2020+ UK's carbon targets are challenging



Source: CCC Progress Report Oct 2009

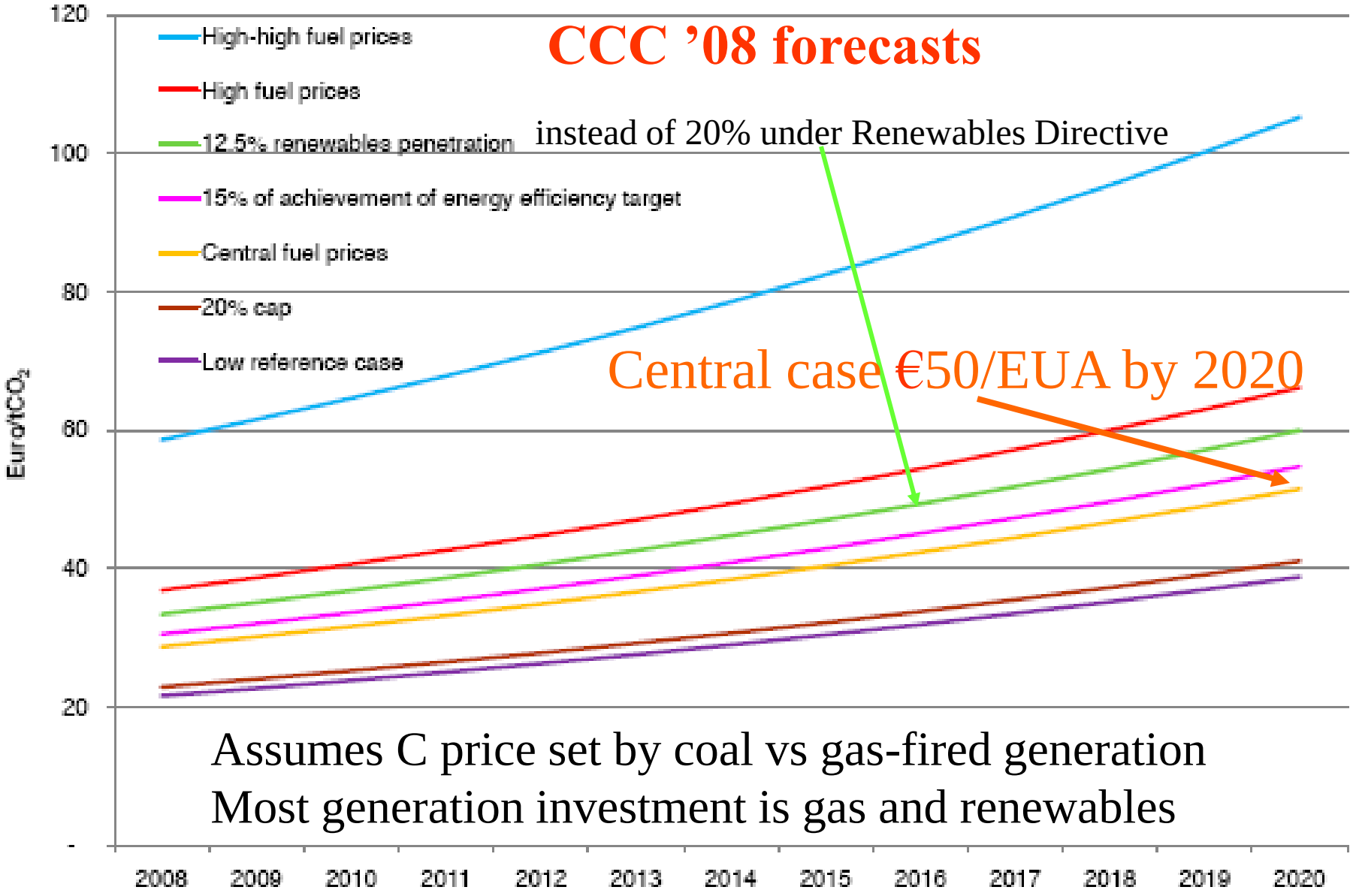
CCC 2008 report

- De-carbonising electricity is key
- What is economically justified?
  - RES *could* make a significant contribution
    - wind: proven, costs have fallen; maybe 30% by 2020?
  - Severn Barrage: needs v low discount rate
  - CCS: needed globally, demos needed urgently
  - Nuclear: cost competitive; economic case strong

    "once a significant C price is in place" or high fuel prices

    but constrained by supply (companies, engineers, finance)

Figure 4.8 EU ETS allowance price projections 2008–2020



Source: Outputs from DECC EU ETS marginal abatement cost model, based on CCC scenarios
Note: All price projections are based on central fossil fuel price projections except where stated

DECC (2008)

Case for nuclear power

- Can deliver bulk zero-C electricity
- Very little land take
  - in contrast to renewables
  - existing sites ready and willing
- Costs have risen since 2005
  - But so have all other capital intensive projects
- Least costly large scale zero-C option
  - Particularly at low discount risks

What are the risks facing investors?

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

		2020 Renewable Scenarios		
Technology	Conventional	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

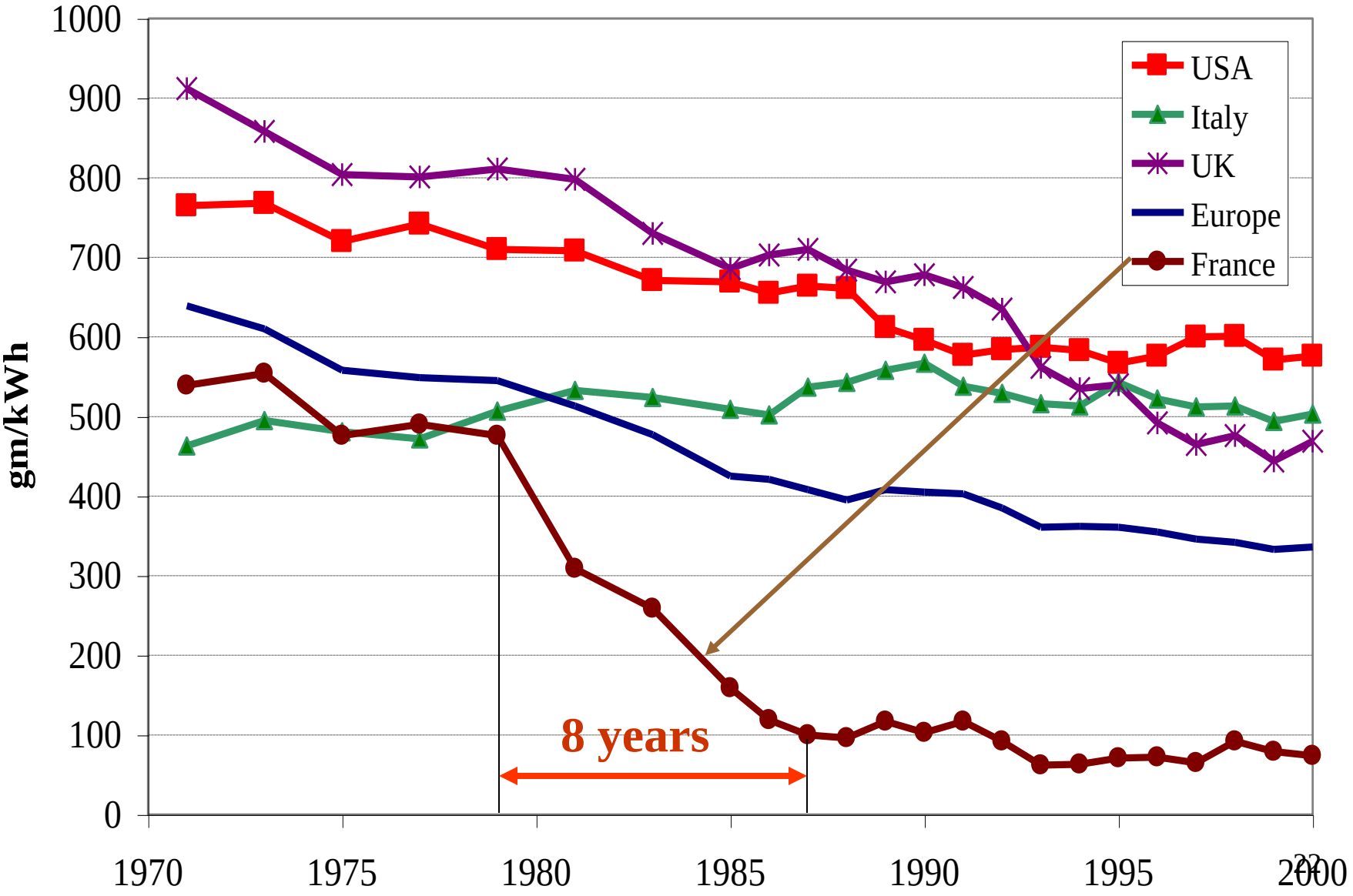
Source: SKM
BERR URN 08/1021

- but costs have risen since then

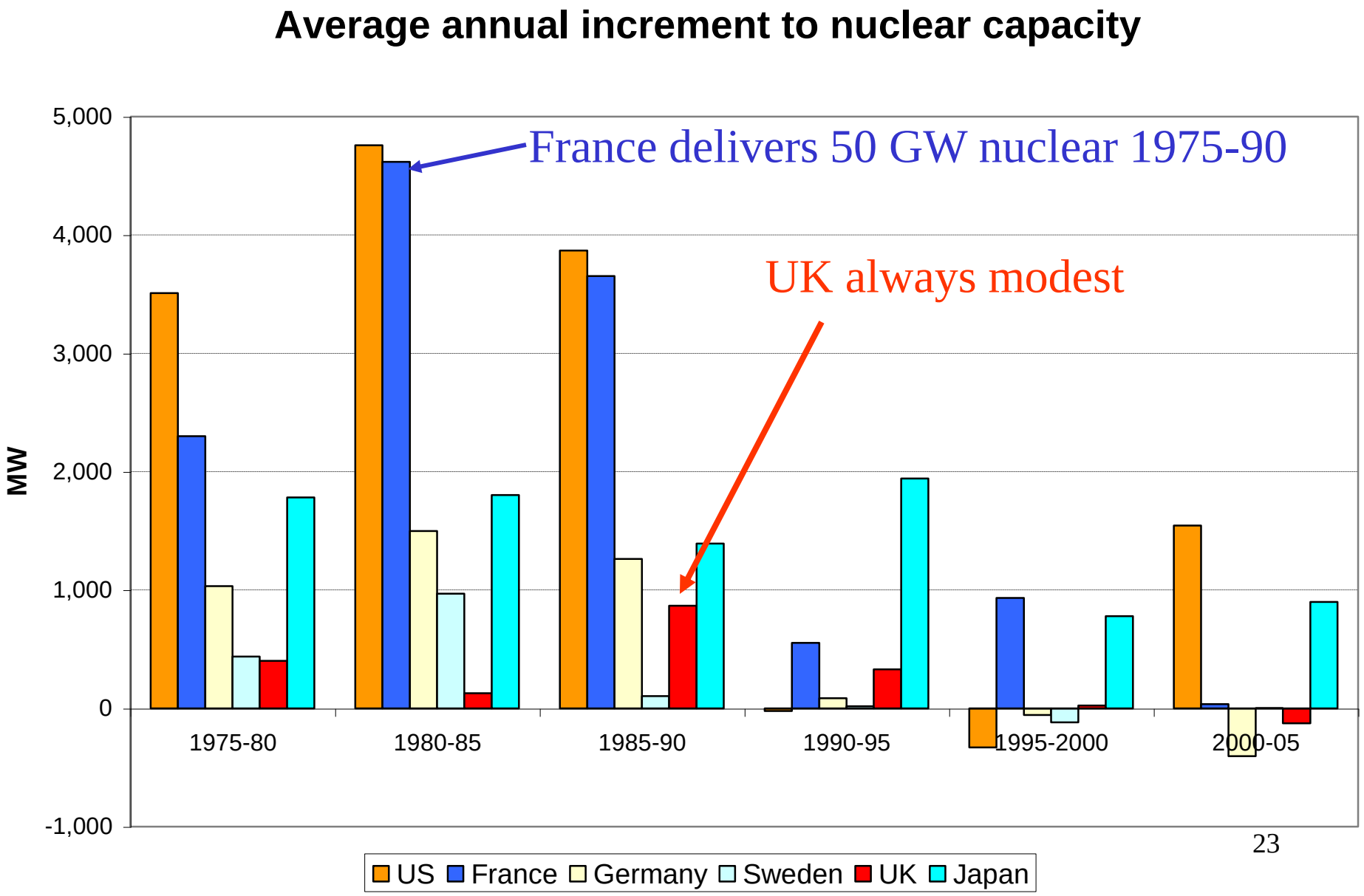
Table 7.2 2020 Price assumptions

Type	Price
Gas (p/therm)	55
Coal ($/te)	110
Oil ($/barrel)	85
Biomass fuel (£/GJ)	3.6
Carbon permit (€/te CO2)	30

CO2 emissions per kWh 1971-2000



Rapid fall in CO_2 from nuclear power

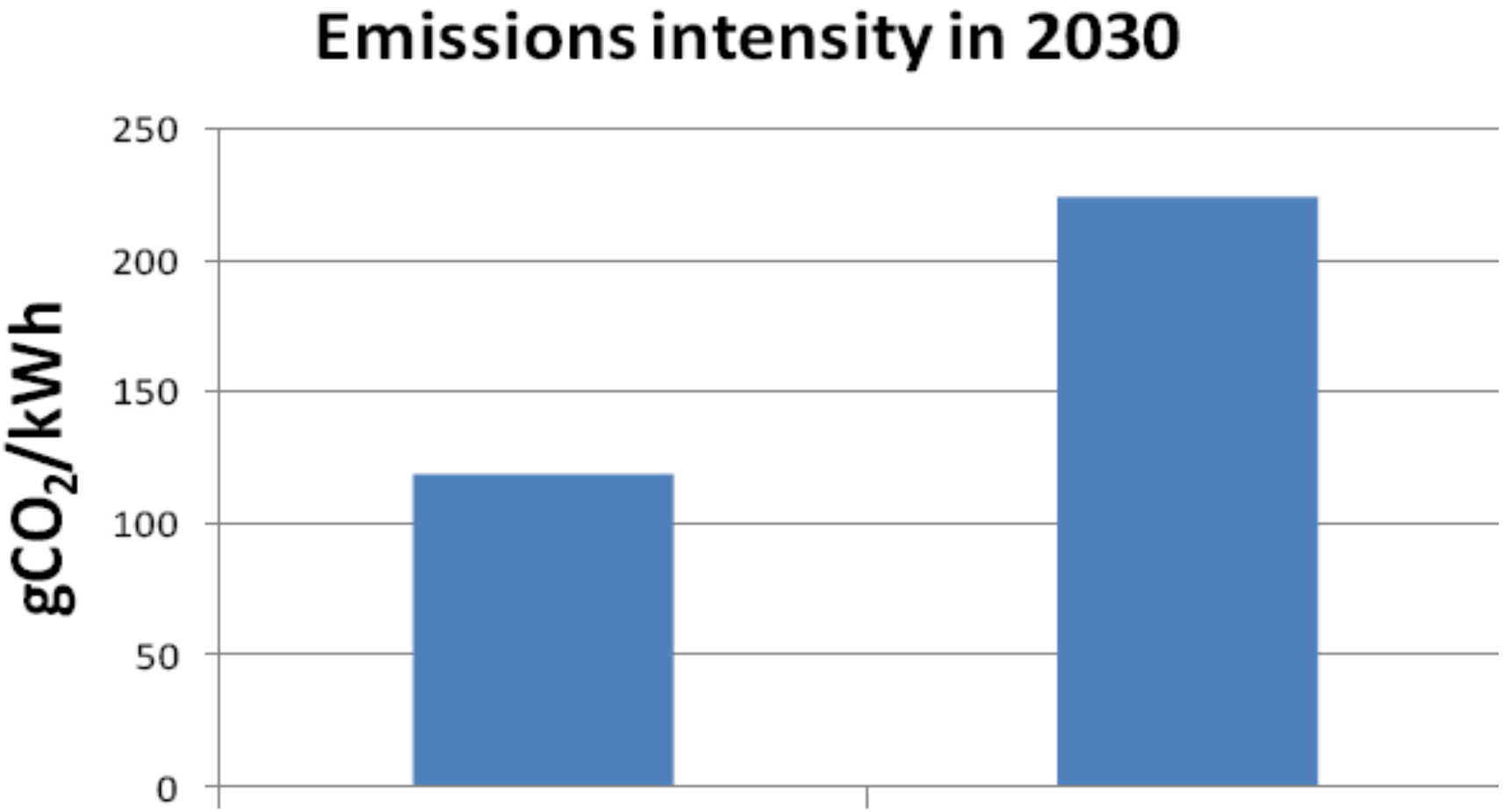


Implications of current EU policy

- Massive increase in RES required by 2020
  - much will be wind and thus intermittent
  - will need support
- CCS to be demonstrated and supported
  - not commercially viable at even desirable C prices
  - Gas can replace some coal to reduce CO_2
- Nuclear: cost competitive with the right C price but not current EUA price

Most (?) new generation will need support and a higher CO_2 floor price

Uncertainty undermines carbon target



Source: CCC '09

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Cost issues

- Investment to 2020 may be £200 bn (€230 bn)
  - £7,600 (€8,750) per household = £760/yr
  - current electricity bill £445 (€512)
- Concerns over fuel poverty
  - 4 mn HH taken out of poverty with a fall of £100
  - 0.5 mn fell back into poverty when prices rose £20
- Concerns that no CO_2 saved by RES under ETS

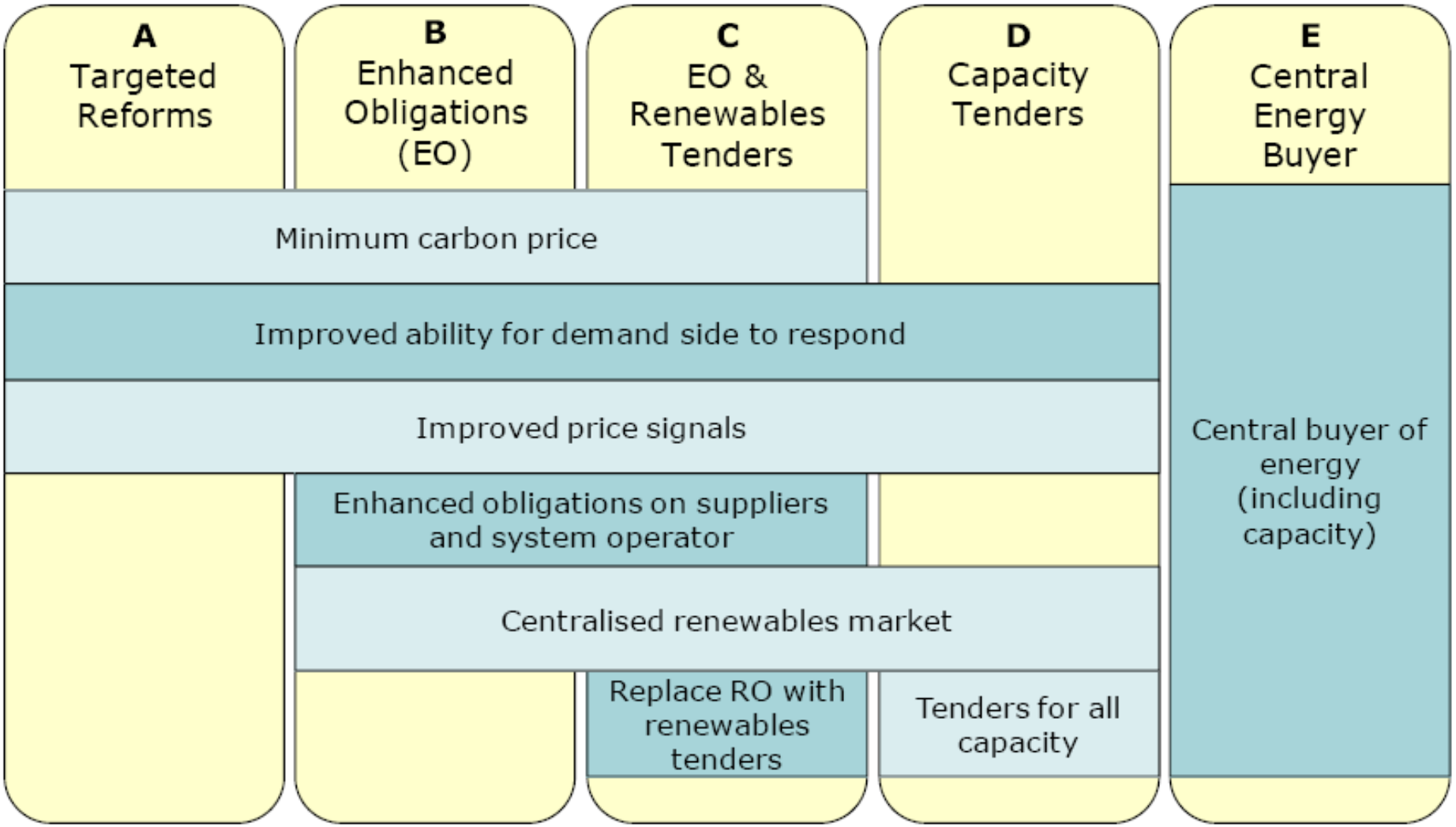
Danger of loss of support for current policies

The need for reform

- General agreement that current market design will not deliver policy objectives
- Considerable disagreement on what to do

Market solutions or back to central planning?

Options under consideration



Source: Ofgem *Project Discovery Final* Feb 2010

The case for the market

- Compare CEGB with Scottish companies
  - CEGB unbundled, Scots remained integrated
  - privatised CEGB improved performance, Scots not
  - State-owned nuclear also improved: markets work
- The gas market coped well with a disruption to the Norway pipeline last winter
  - the market seems to be delivering investment
- Tender auctions for off-shore grid working

Tender auctions for RES FIT better than ROCs

The case for reform

- C price floor to reduce low-C investment risk
  - CCC, DECC, politicians accept supporting C price
  - ideally at EU level, Plan B with a UK carbon tax
- Competition lowers costs: ROCs amplify risk

  => tender auctions for RES: FIT with long contract
- Grid access delays wind; poor locational signals

  => 'Connect and manage' or full nodal pricing?

Challenge - keep competition and reduce risk

Reforms to cope with wind

- Short-term wind data used to optimise dispatch

=> cheaper with central dispatch?

- Better signals to guide location of wind farms
- Dispatch optimised to handle congestion, losses

=> does this mean nodal pricing?

- encourage contracts: hedge much higher peak prices
  - to support flexible plant that runs at low load factors
- PJM demonstrates that nodal pricing can work
  - Repeated in NY, New England, California, ...

What might go wrong?

- Miss RES target without planning reform
- Nuclear power might be opposed or fail to secure adequate CO_2 price
- High cost (£200 bn?) causes political revolt
- Failure to reach climate change agreement undermines EU carbon pricing

=> dash for gas to deliver security

Markets and contracts

- Bids determine dispatch and locational prices
  - how then can wind tender for a FIT contract?

  => Grid offers nodal Financial Transmission Rights
    - volume rises over time with new transmission capacity
- wind currently can bid negative prices

  => pay for availability not dispatch in FIT
- High RES undermines spot price, deters nuclear and peaking plant?

  =>SO ensures adequate peak and hence baseload price

Essential elements of reform

- Under-write C price to support nuclear
  - firm commitment for continuing programme
- Replace current RES ROC scheme
- Restore Pool as liquid wholesale market
  - all plant bids in, central dispatch, nodal pricing
  - determines capacity payment for contracted RES
  - capacity and ancillary service markets for flexible plant (with call options for hedging)
- Reaffirm independence of regulator

Appendix: acronyms and background slides

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Acronyms-1

CBT: Cross-border tariffication

CCC: Committee on Climate Change set up by the Climate Change Act

CCS; carbon capture and storage

DECC: Department of Energy and Climate Change

EUA: EU (emissions) allowance = 1 tonne CO_2

FIT: Feed-in tariff = long term off-take contract

IC: interconnector

ISO: independent system operator

G, T: generation, transmission

GHG: Greenhouse gas - such as CO_2, carbon dioxide

LCPD: Large Combustion Plant Directive

Acronyms-2

MS: member state

NRA: National regulatory agency

OASIS: open access same time information system

Ofgem: electricity and gas regulator

PJM: Pennsylvania New Jersey Maryland region

RD&D: Research development and deployment

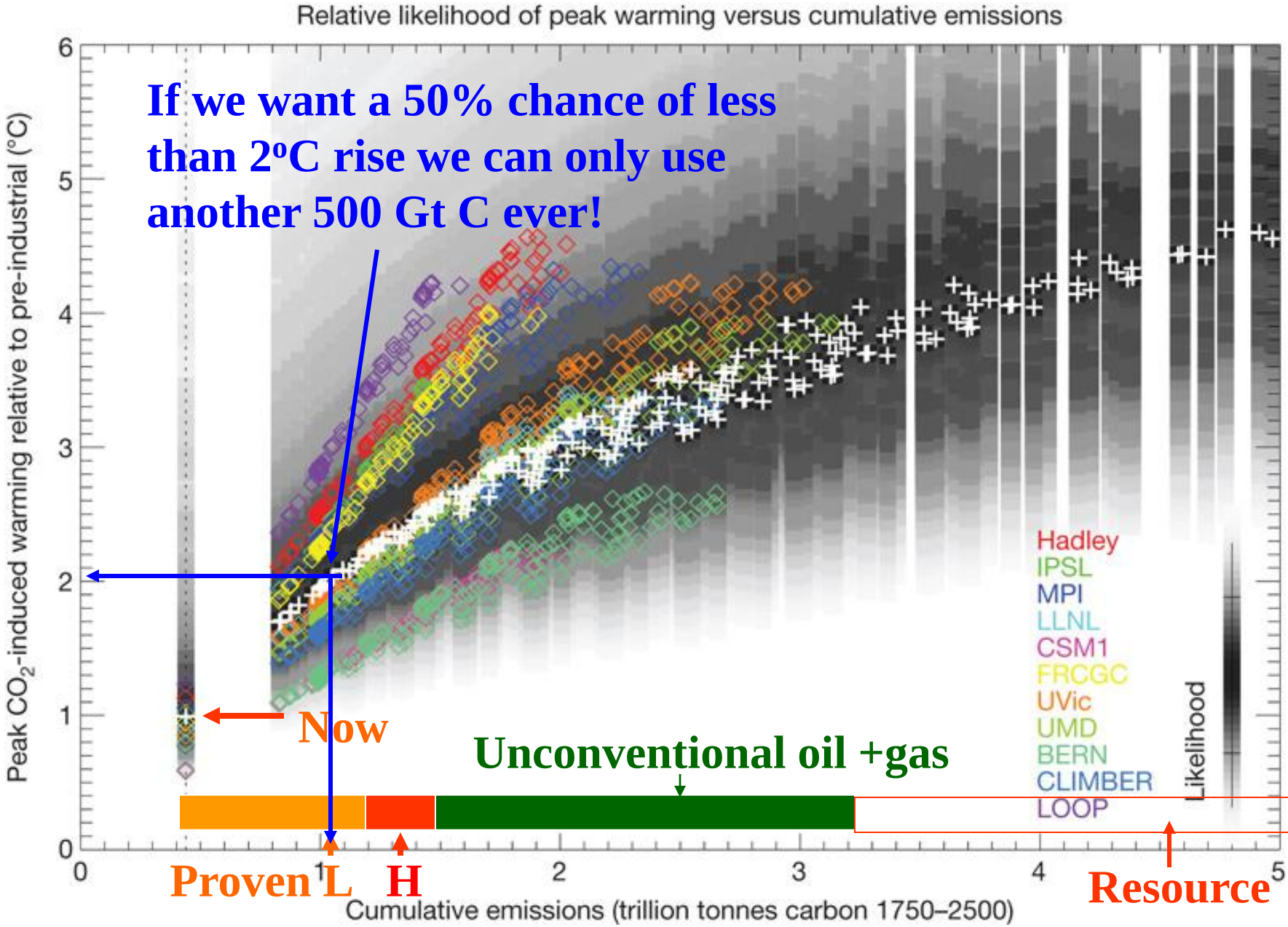
RES: renewable electricity supply

ROC: Renewable Obligation Certificate (1 MWh RES)

RTO: regional transmission operator

TO, TSO: Transmission (system) operator

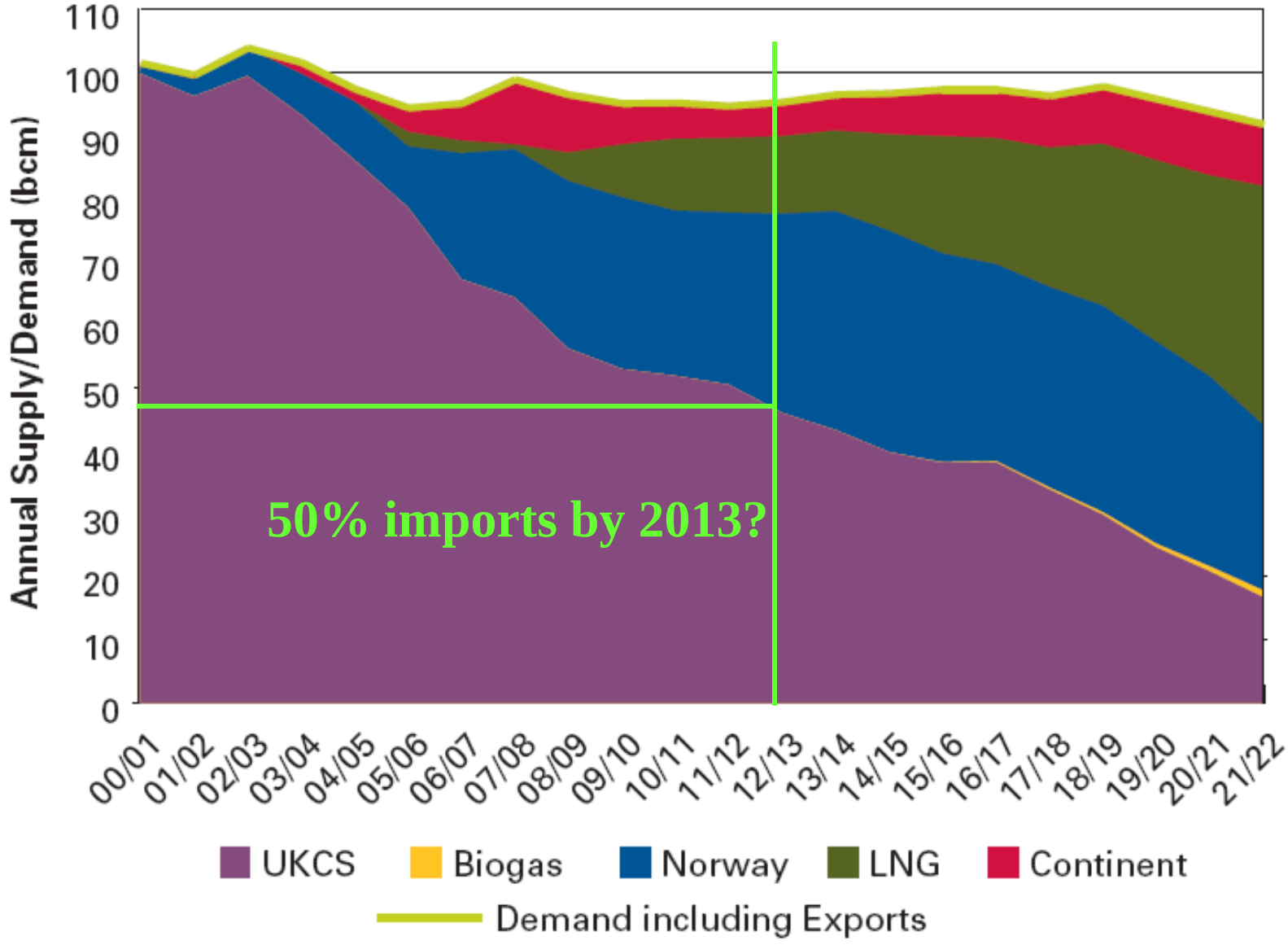
Peak CO_2-warming vs cumulative emissions 1750–2500



MR Allen *et al.* *Nature* **458**, 1163-1166 (2009) doi:10.1038/nature08019

nature

Chart 5.12: National Grid Base Case Annual Supply–Demand Match



Source: National Grid (July 2009; consistent with Figure 16 in TBE 2009). in DECC *Energy Markets Outlook 2009*