Electricity Policy Research Group

UNIVERSITY OF CAMBRIDGE

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*

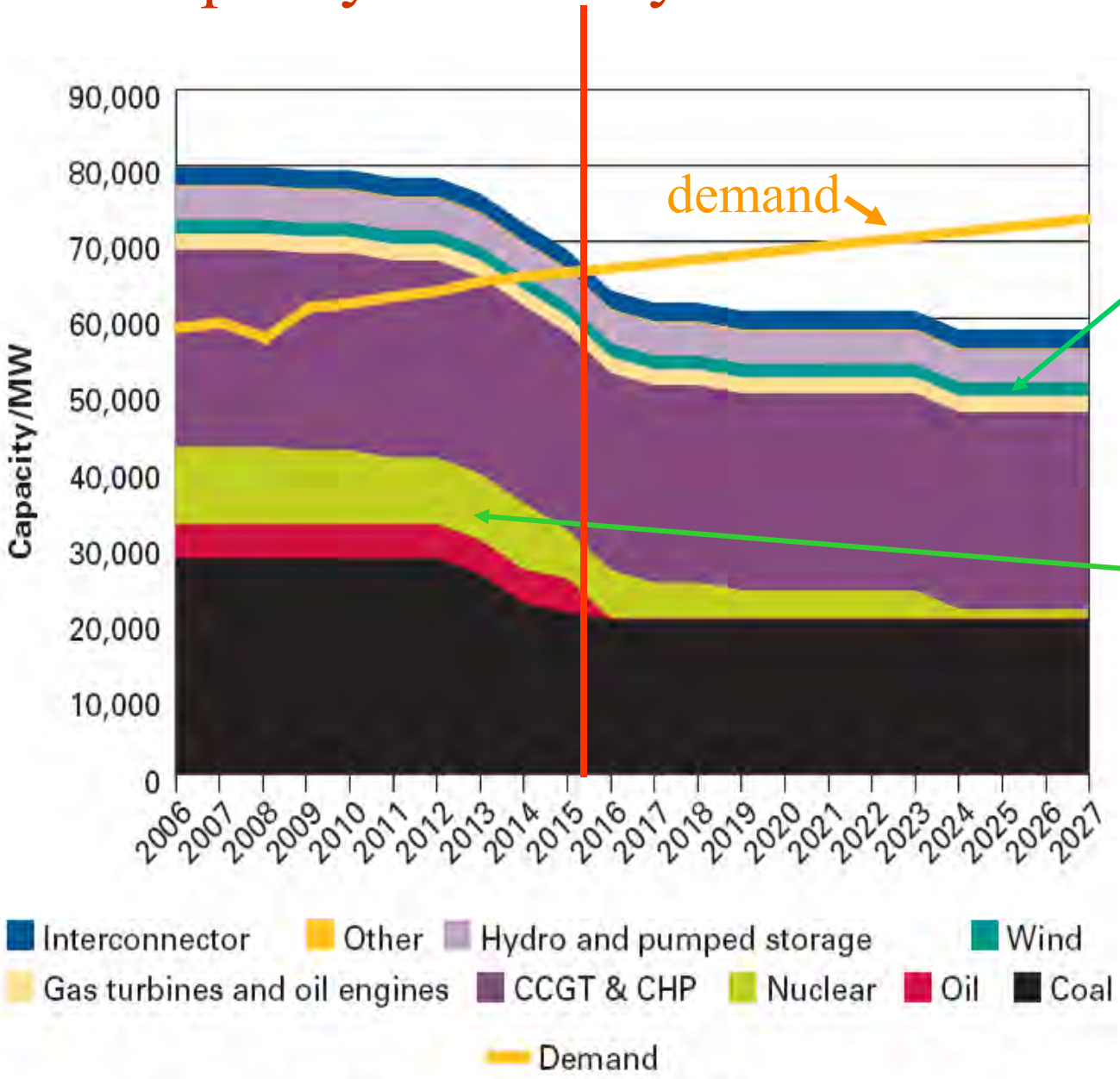
Can markets cope with these challenges?

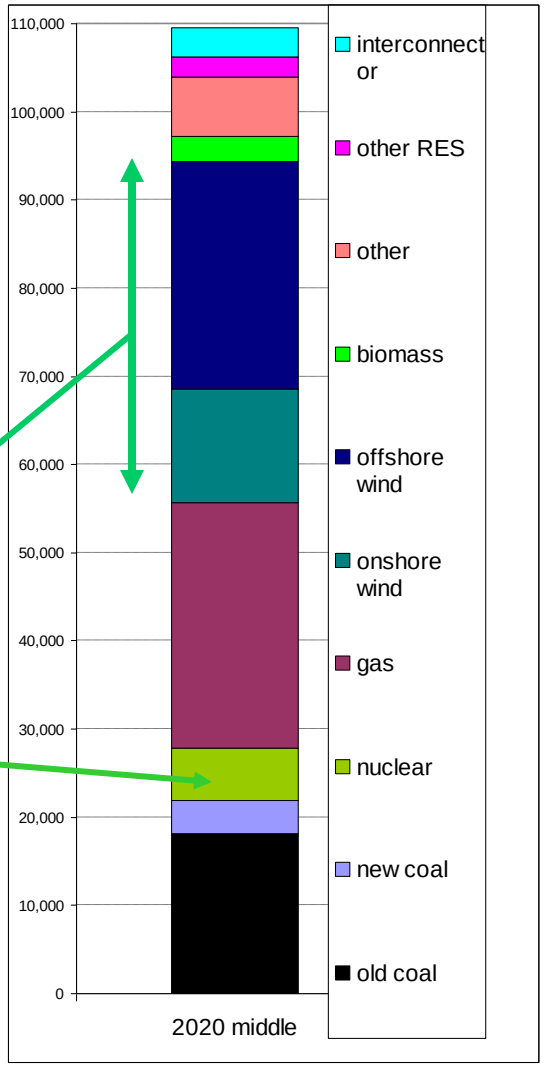
What are UK‘s problems?

- 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



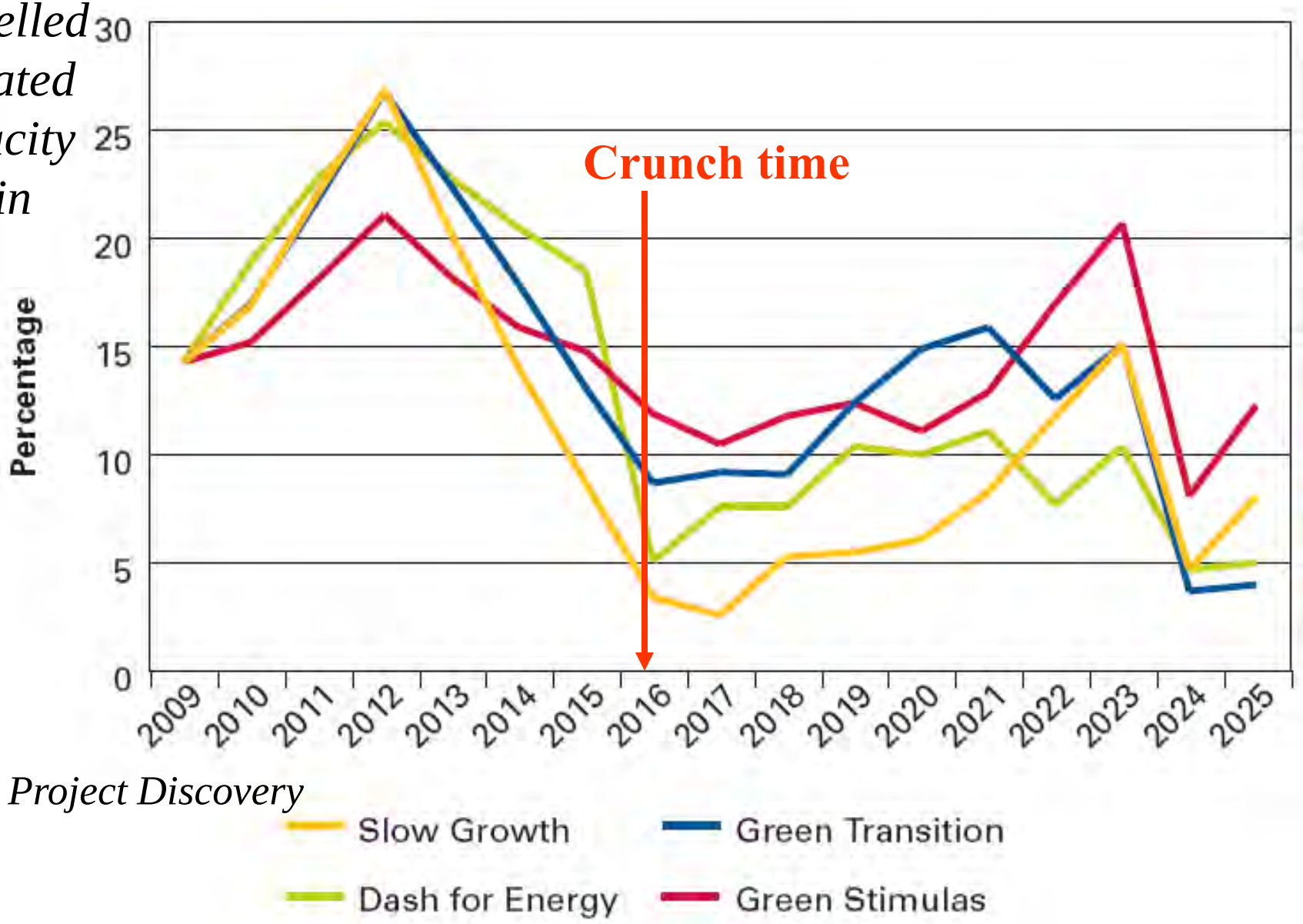


SKM (2008) mid-scenario projection

Source: Digest of UK Energy Statistics/DECC

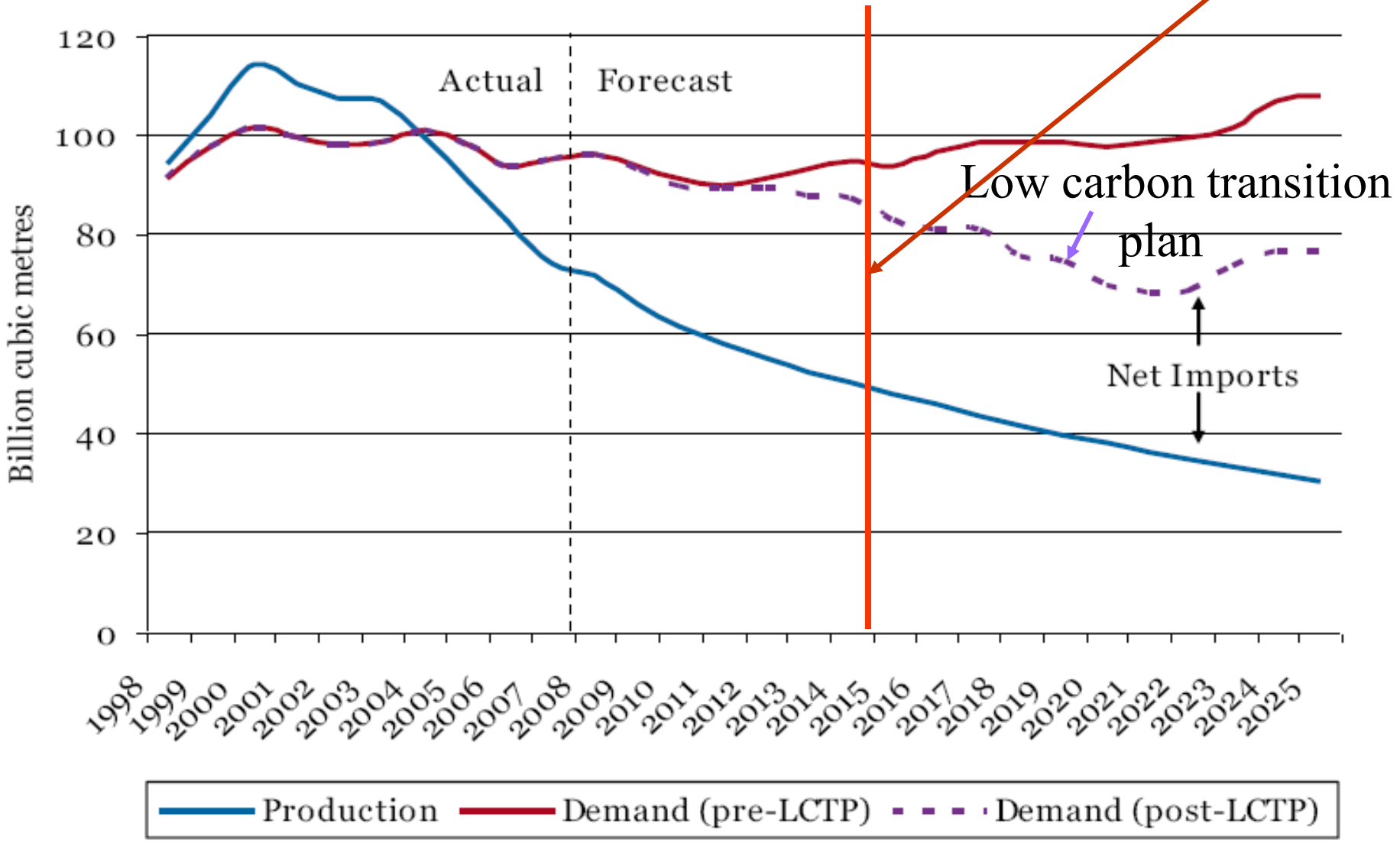
Under Ofgem's scenarios reserve margin falls in 2016

modelled de-rated capacity magin



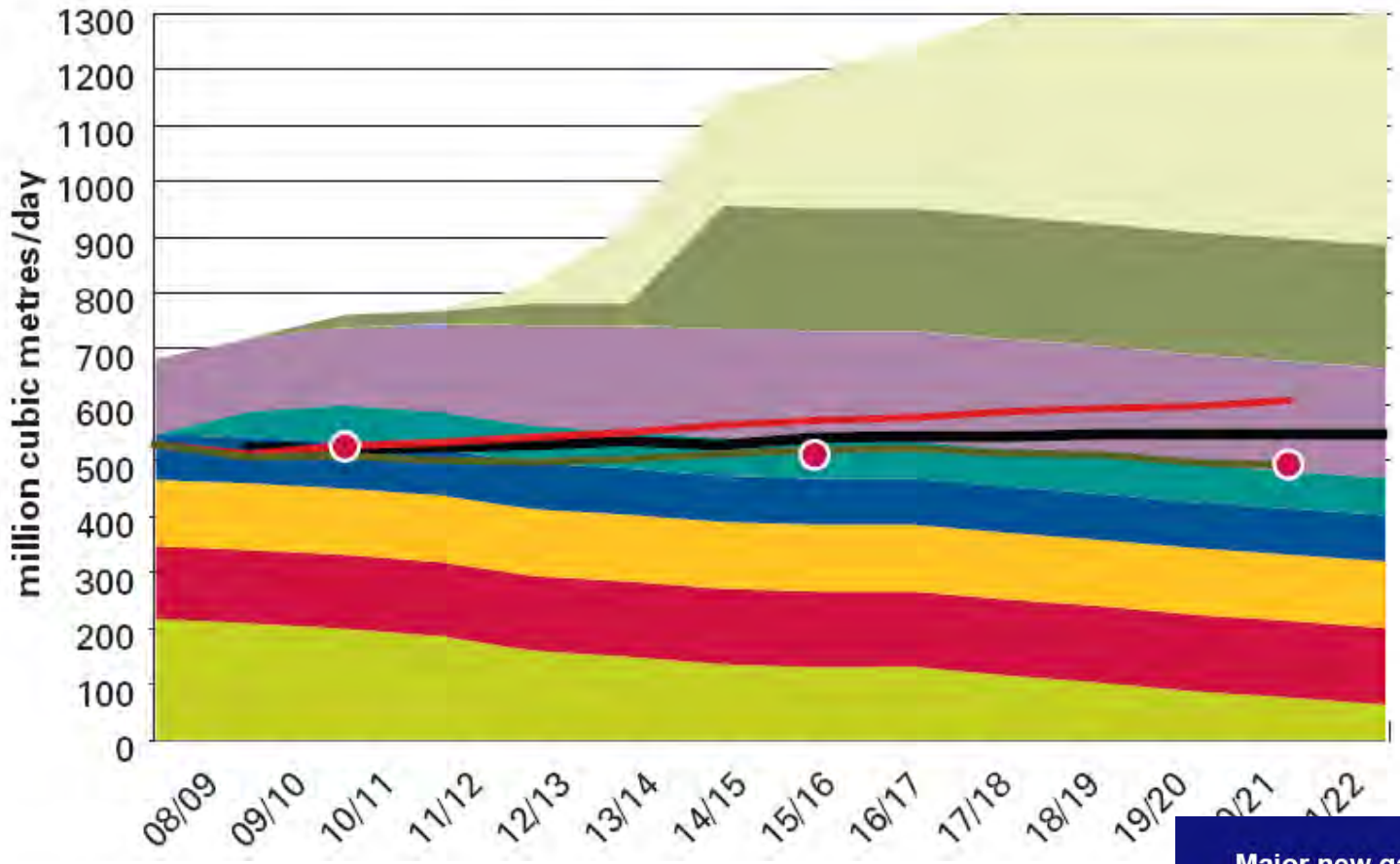
Ofgem *Project Discovery*

UK might import 50% of its gas by 2015



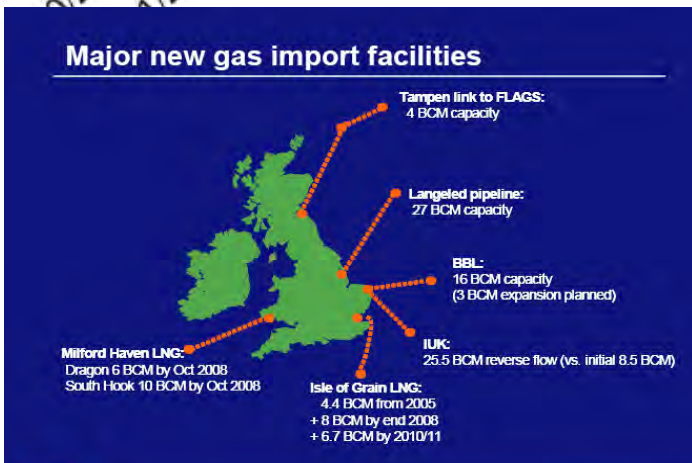
Wicks Report 2009

But gas import infrastructure has been forthcoming



Source: DECC
Energy Markets Outlook 2009

Peak Demand (top
Peak Demand
1 in 20 winter

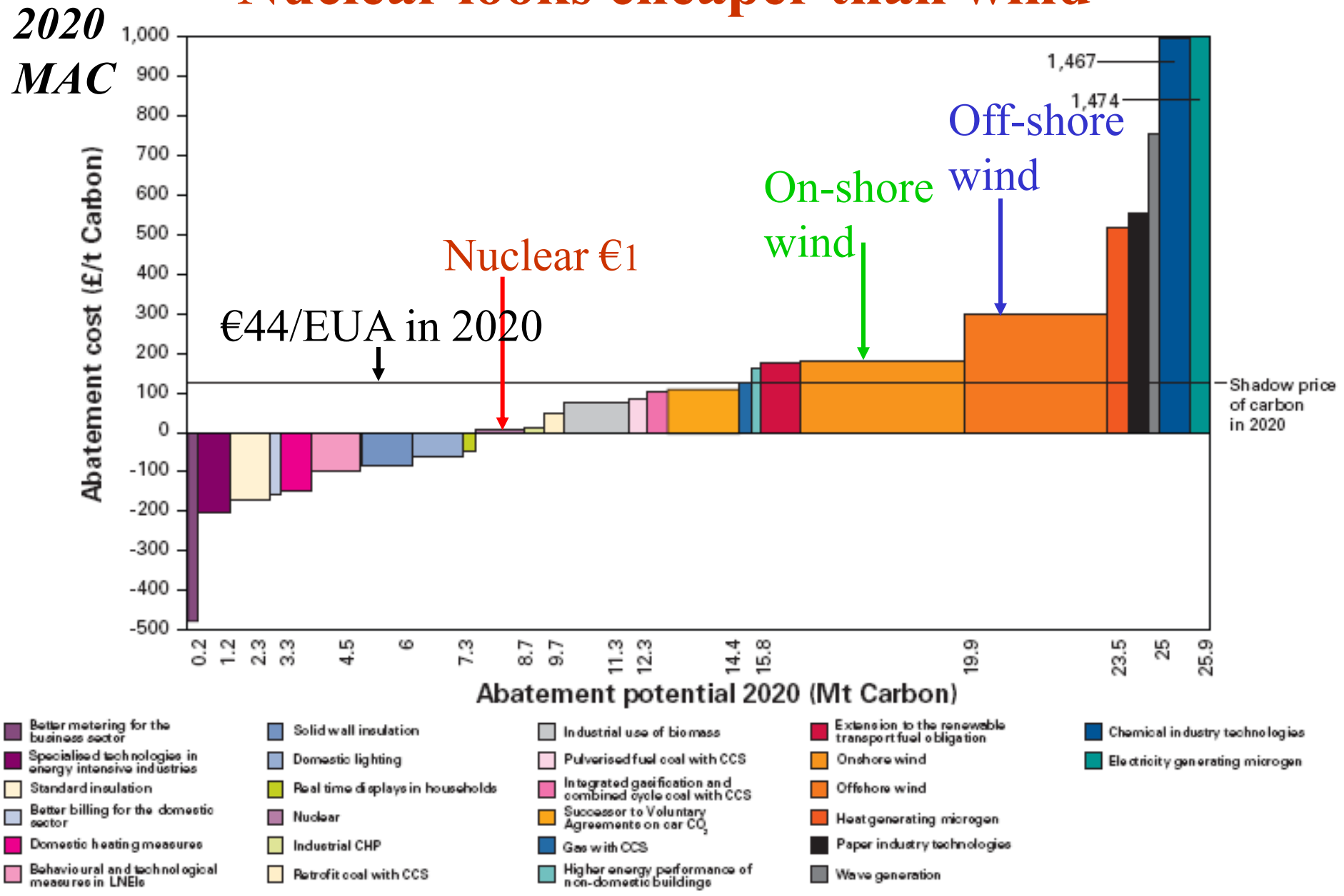


EU *Renewables Directive*

- 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

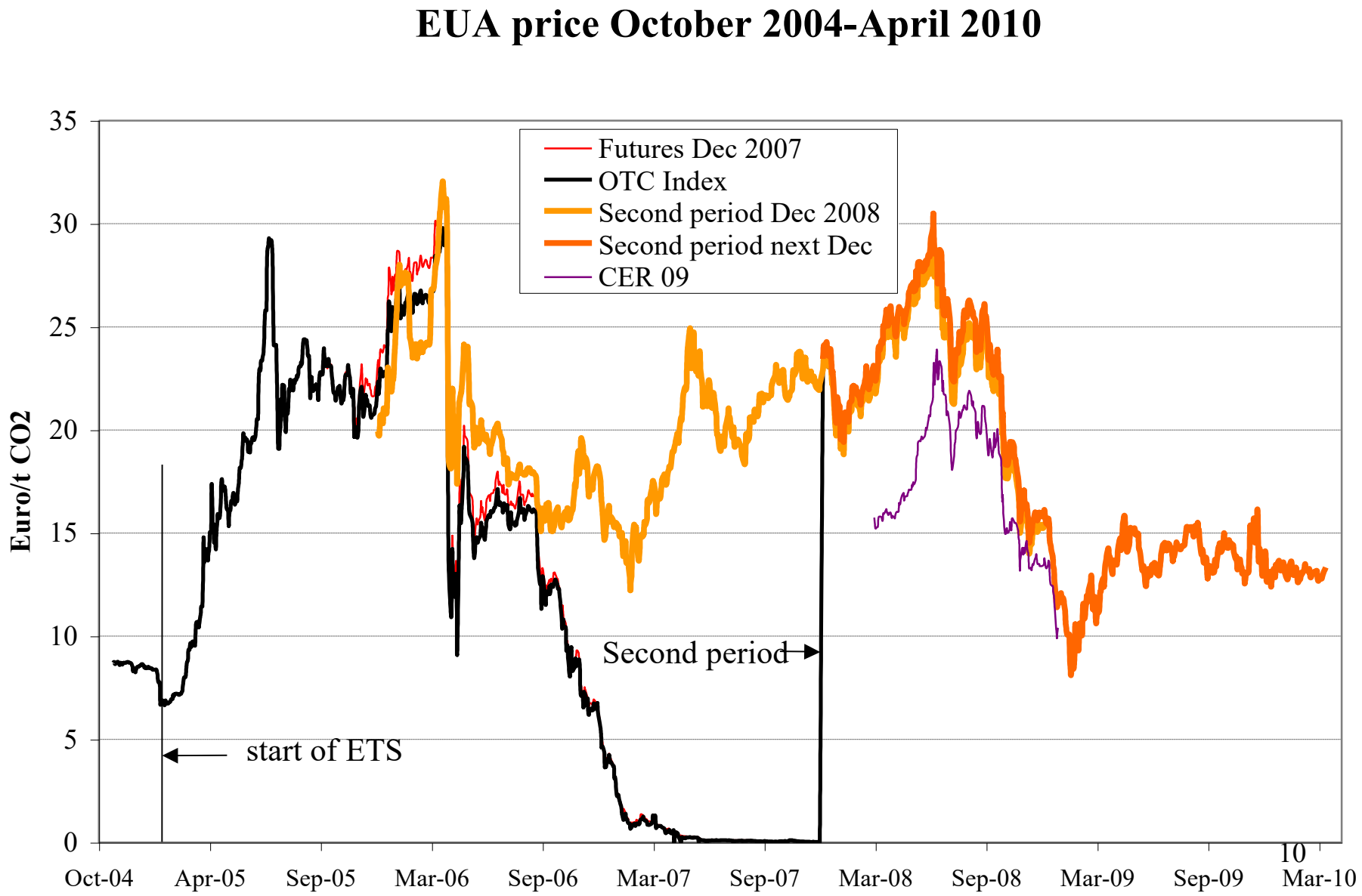
High future RES supply requires high current investment and learning

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



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

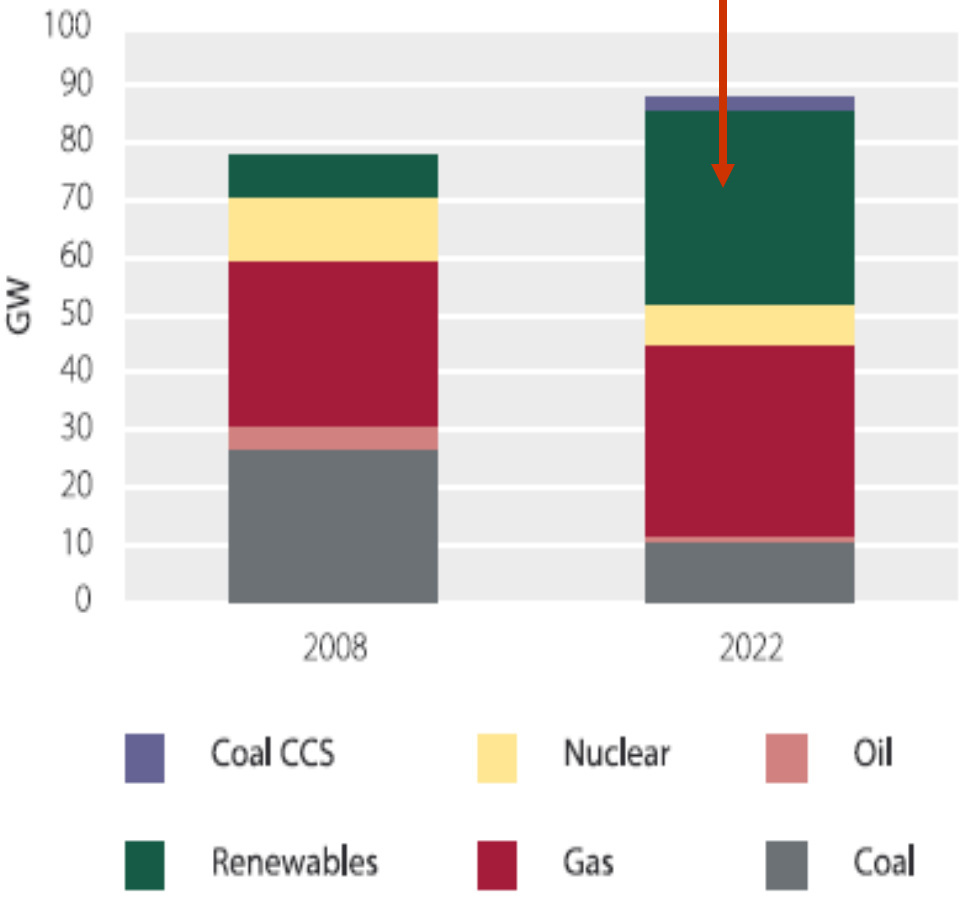
CCC'09 scales back wind ambitions

CCC 2020 scenarios: still lots of wind

Capacity

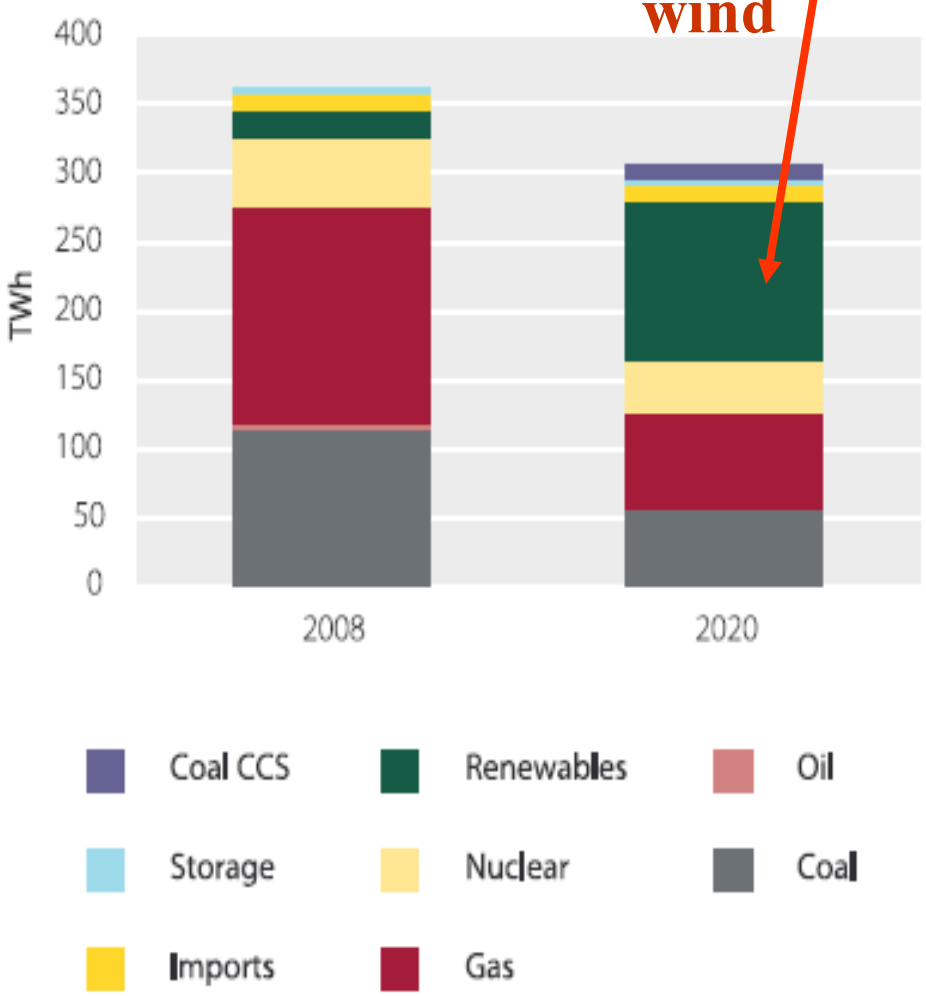
27 GW wind

7 GW other RES



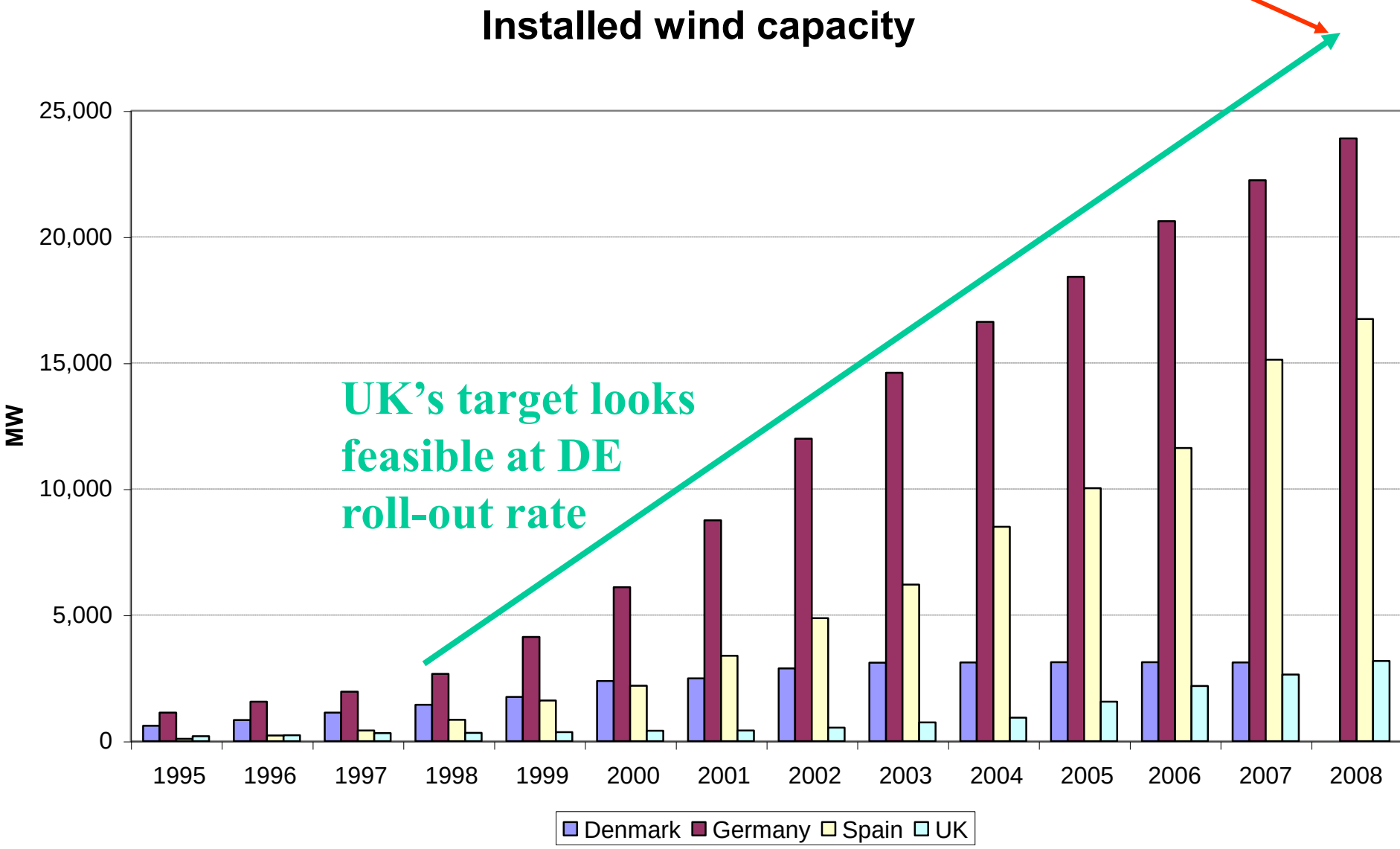
Generation

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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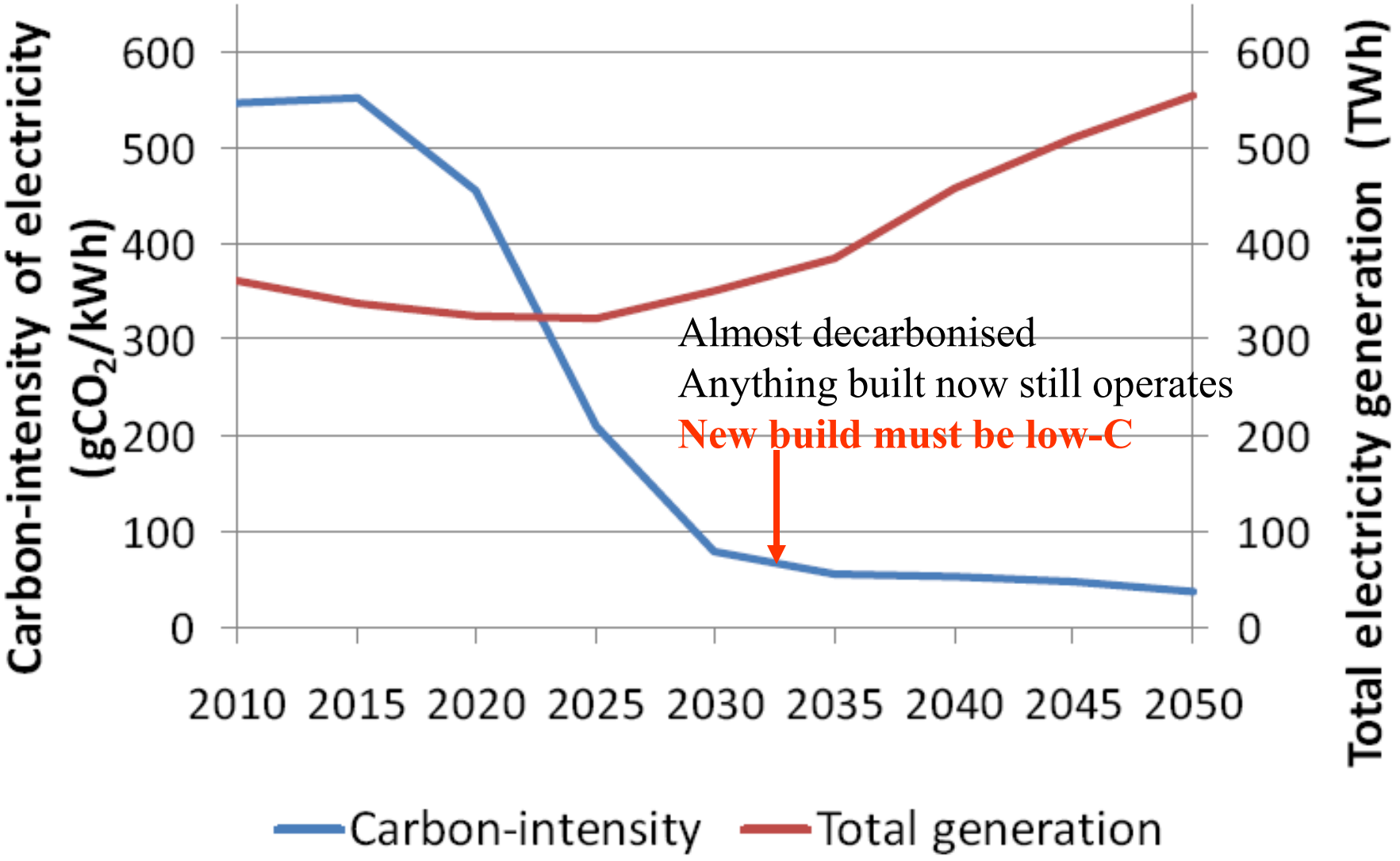
The climate change challenge

- 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

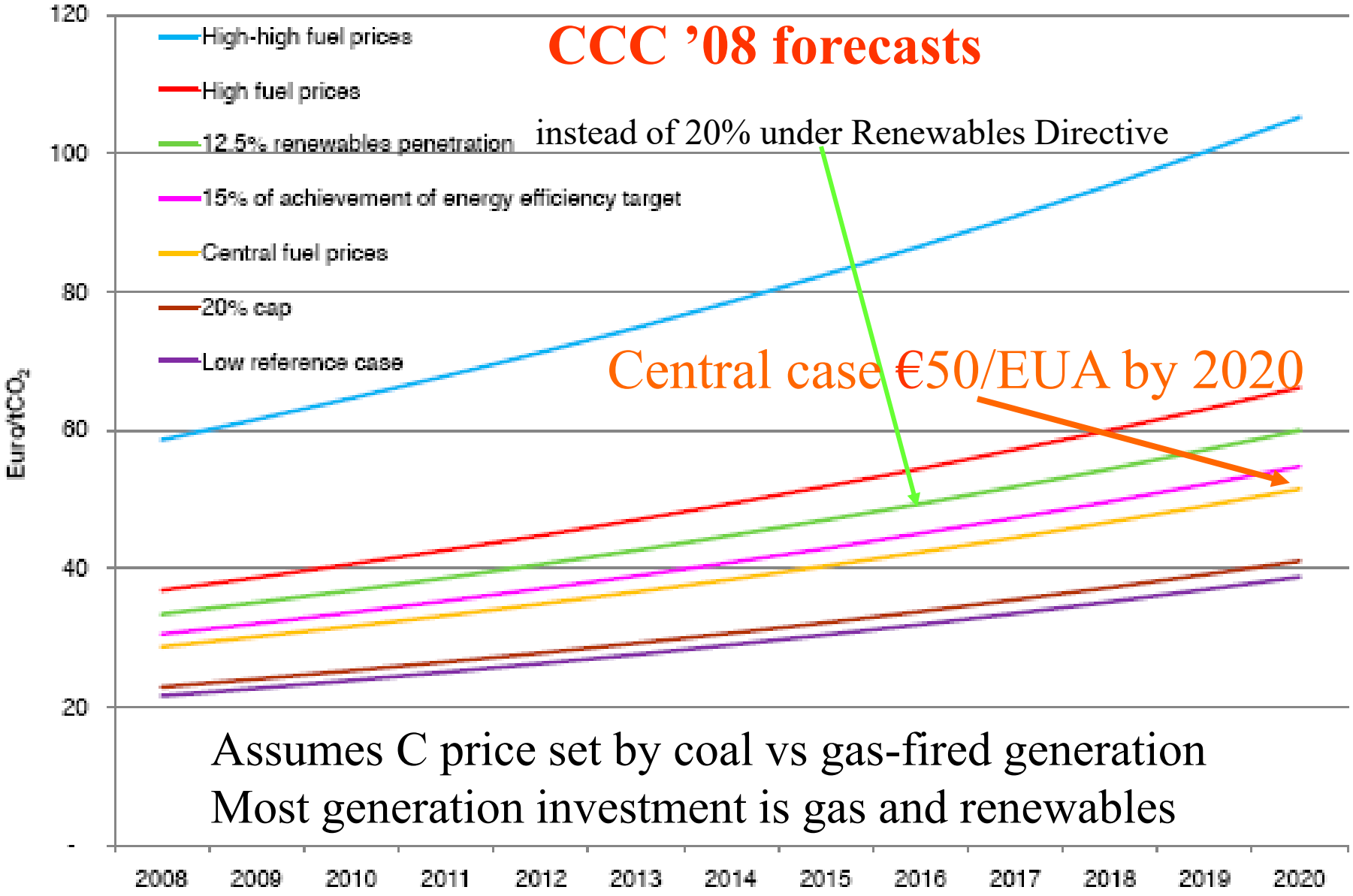
CCC 2008 report

- 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

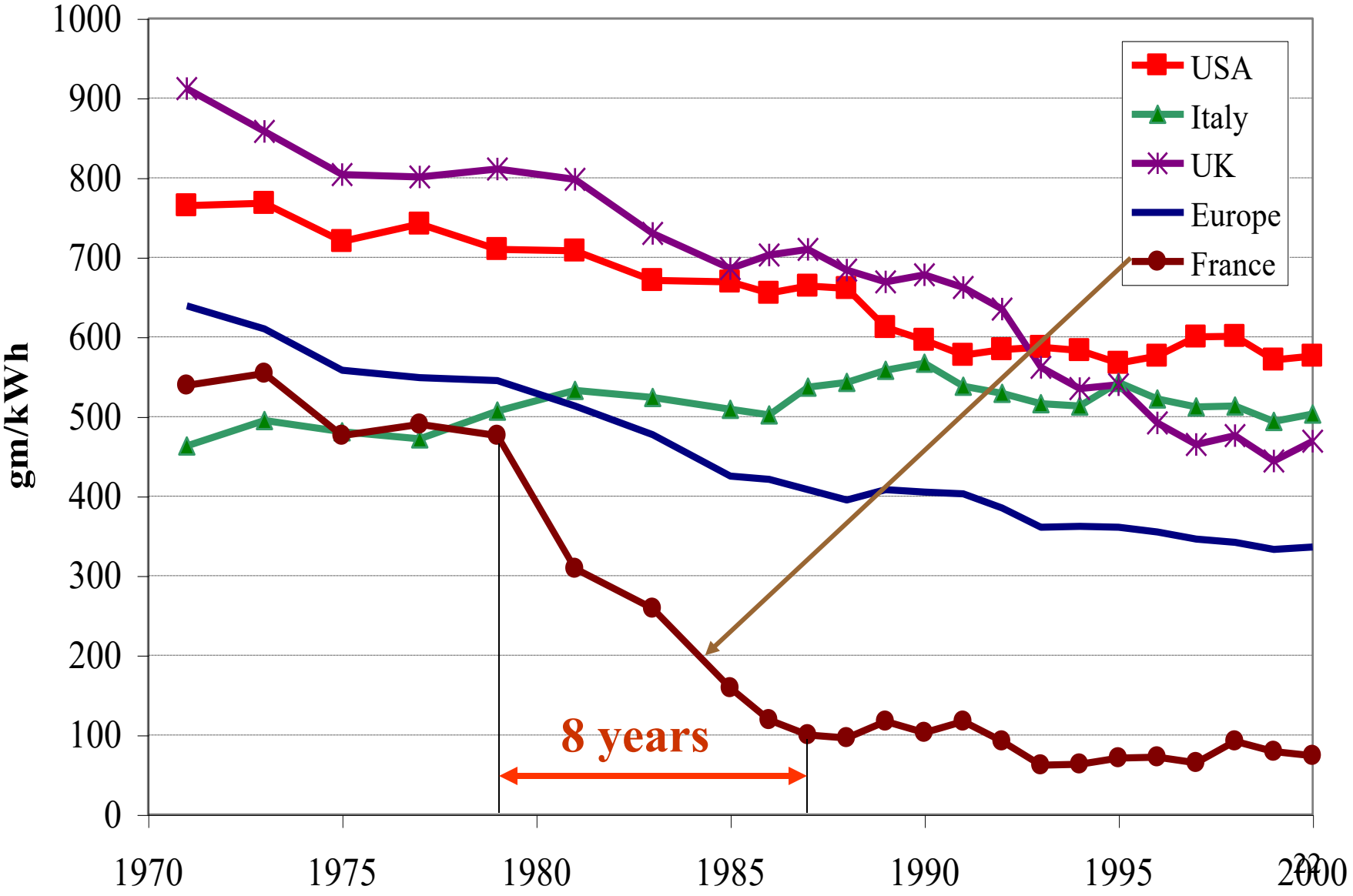
Source: SKM
BERR URN 08/1021

- but costs have risen since then

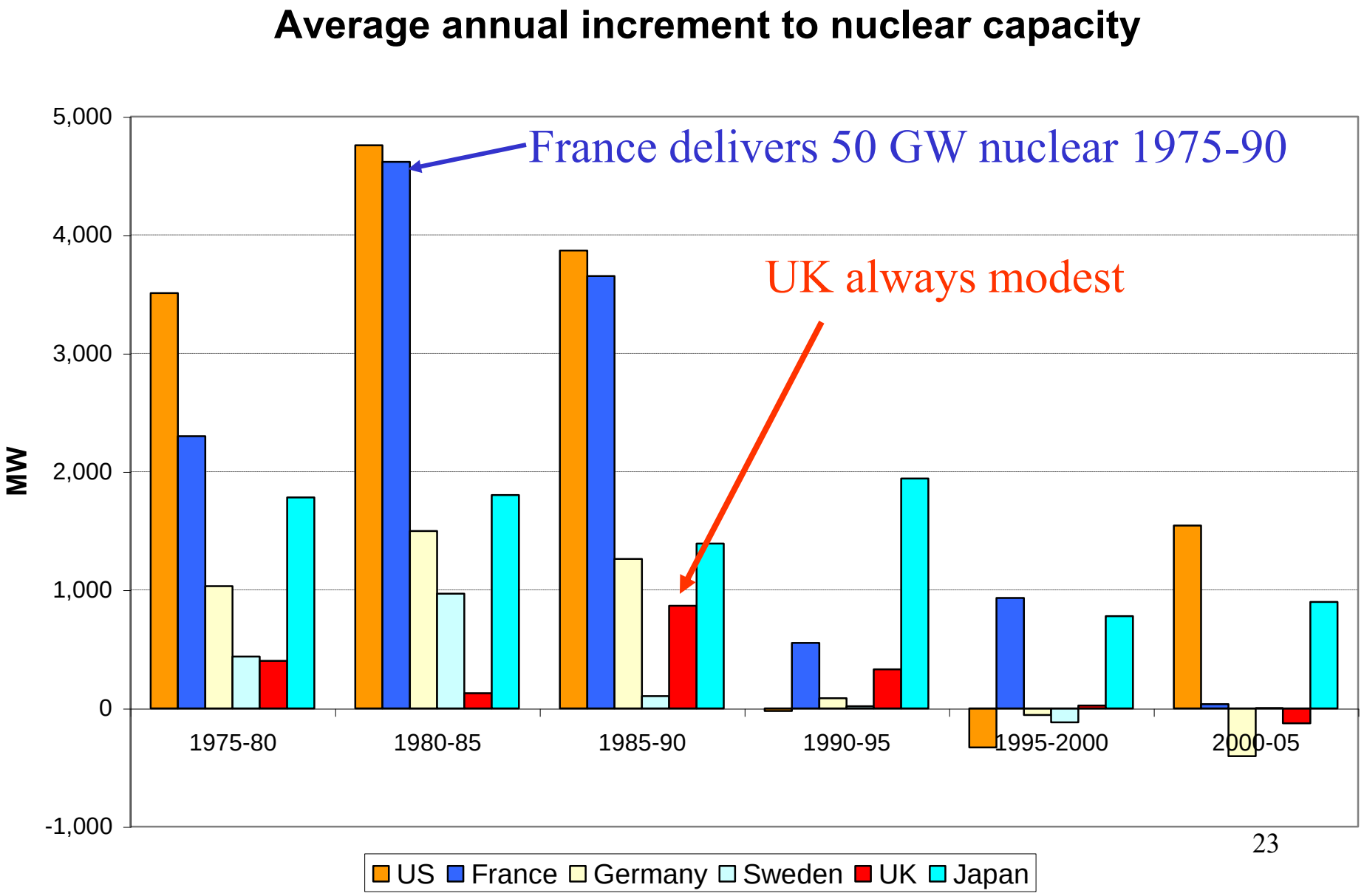
Table 7.2 2020 Price assumptions

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

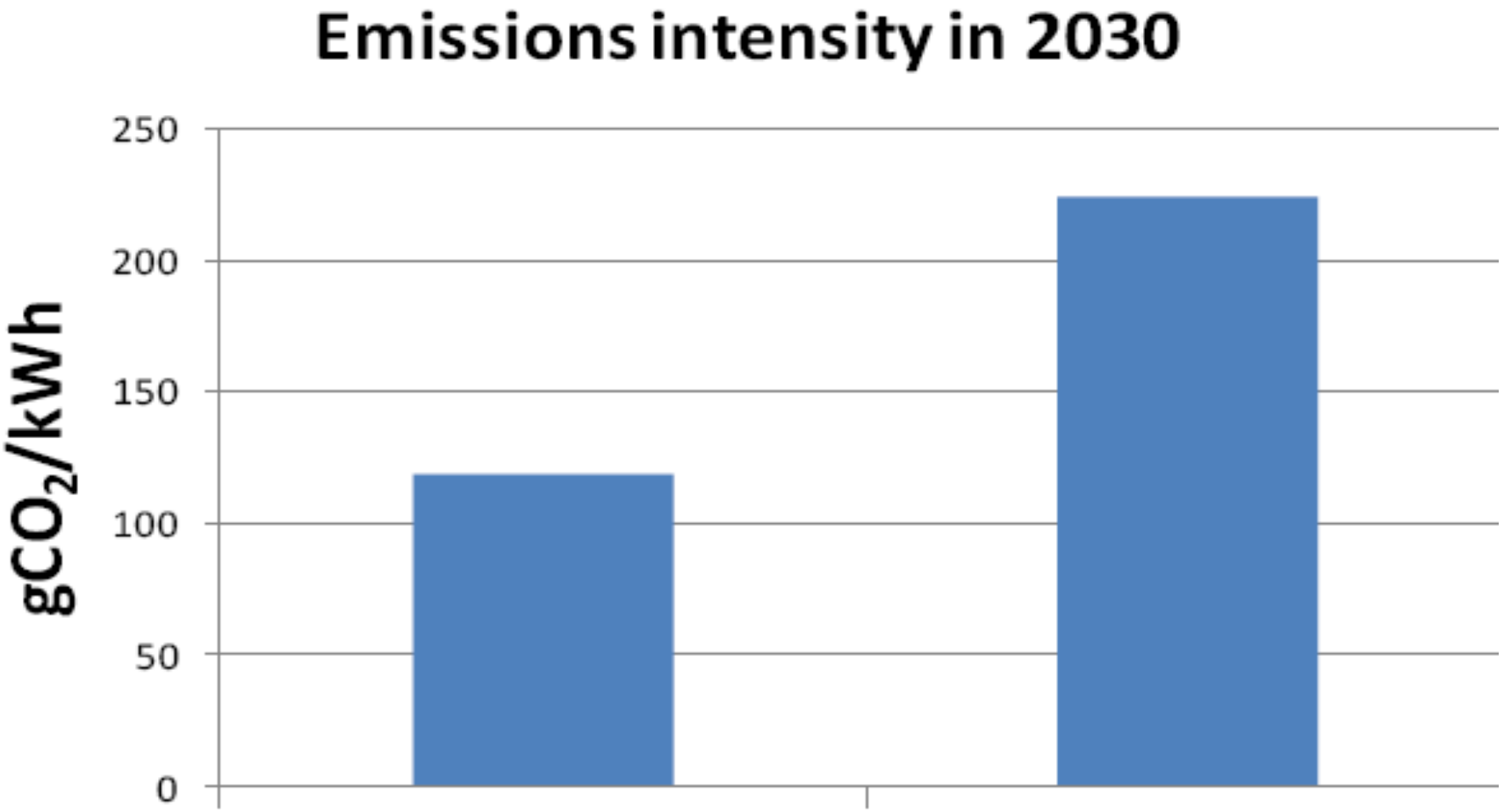


Implications of current EU policy

- 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

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

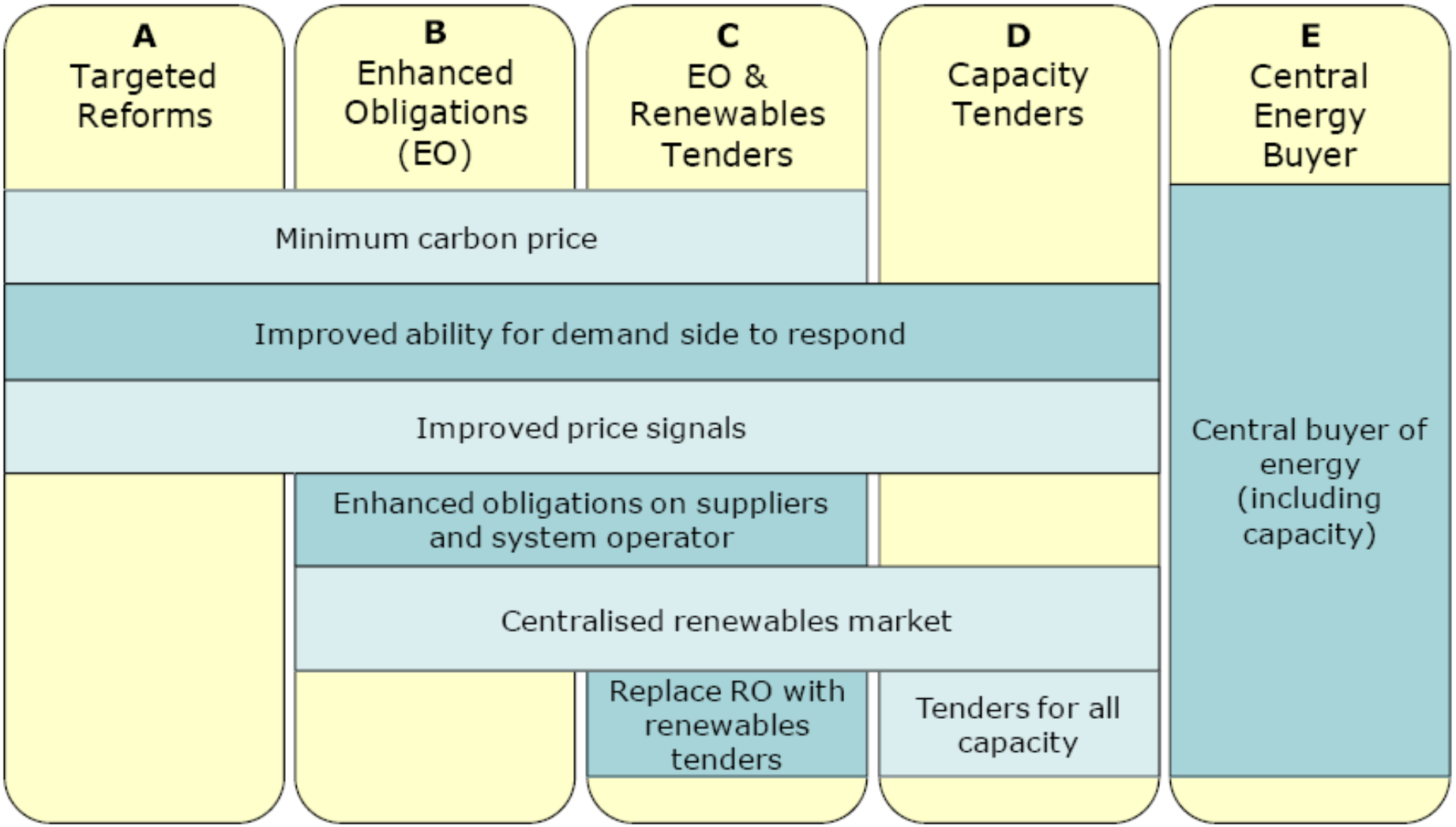
Danger of loss of support for current policies

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

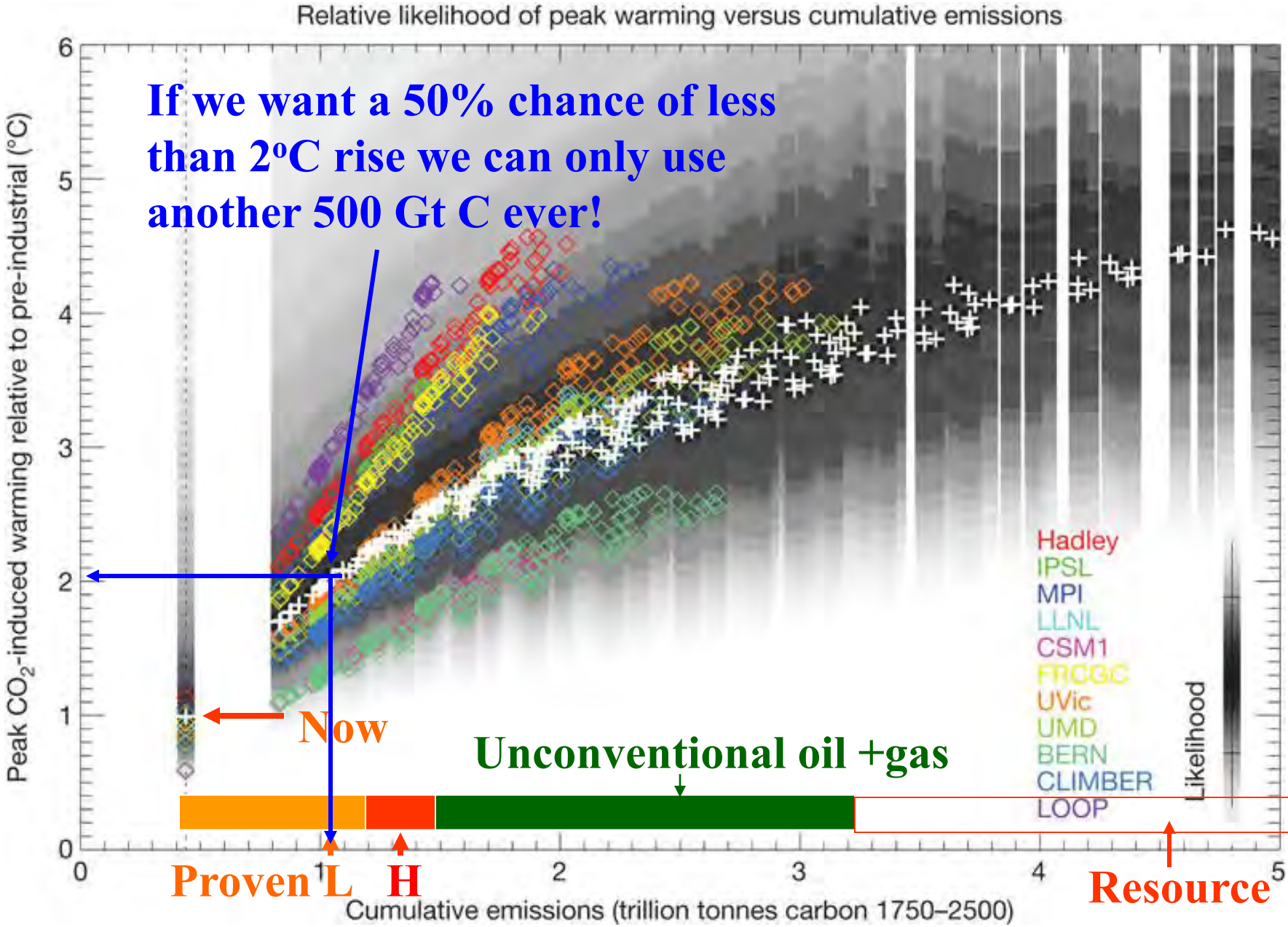
RES: renewable electricity supply

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

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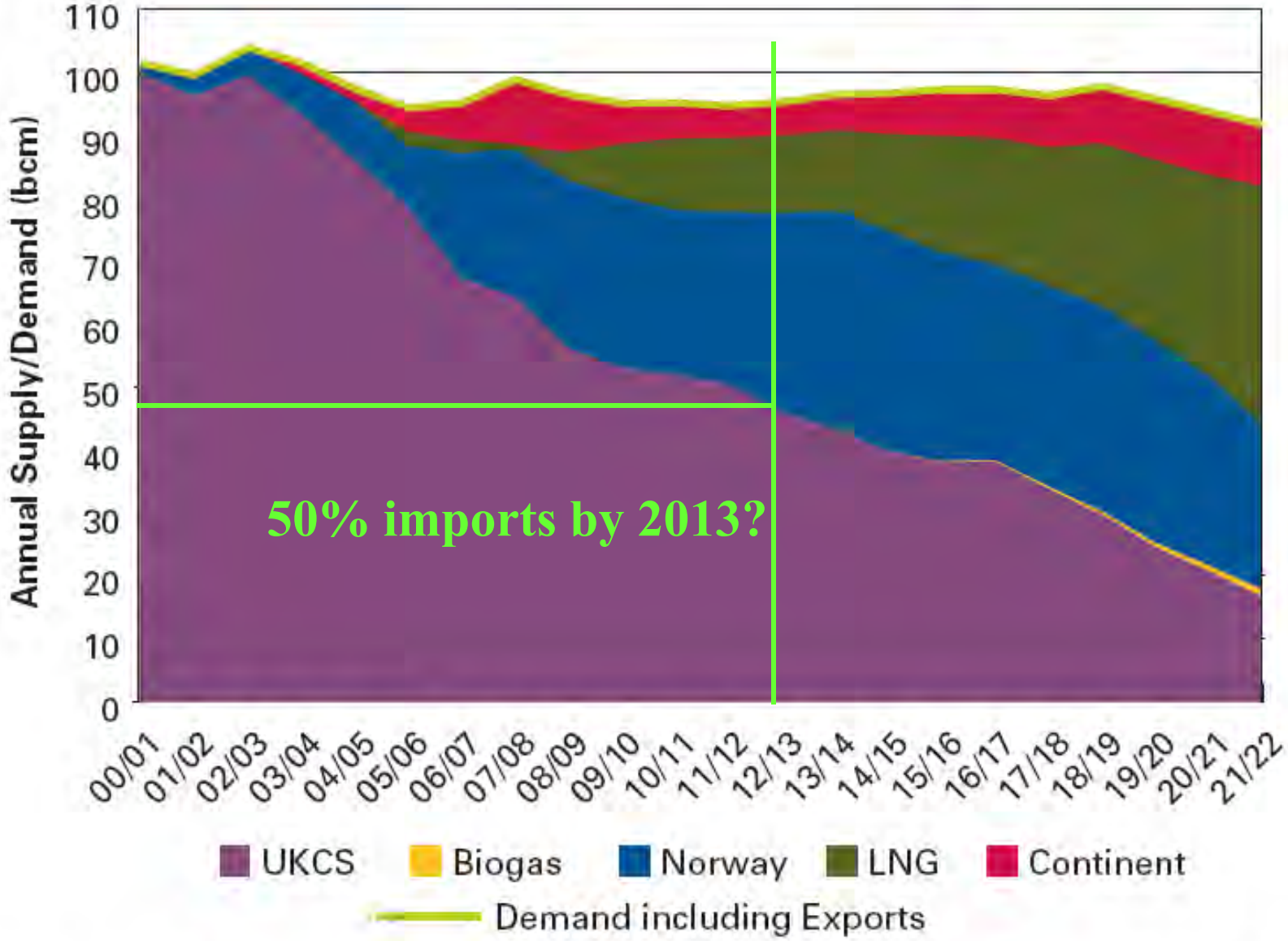
Chart 5.12: National Grid Base Case Annual Supply–Demand Match



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