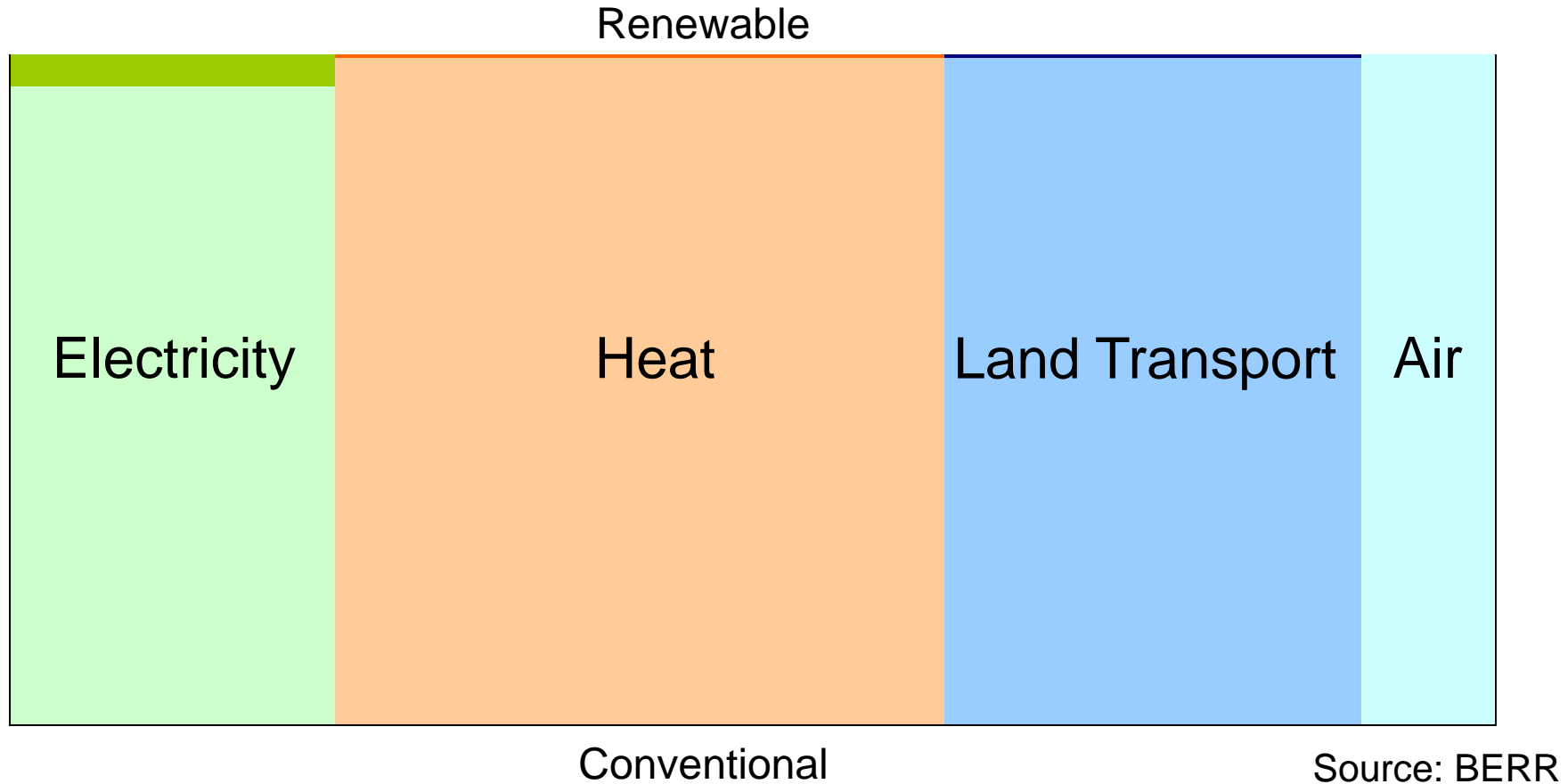


The Economics of Offshore Wind Energy

Richard Green

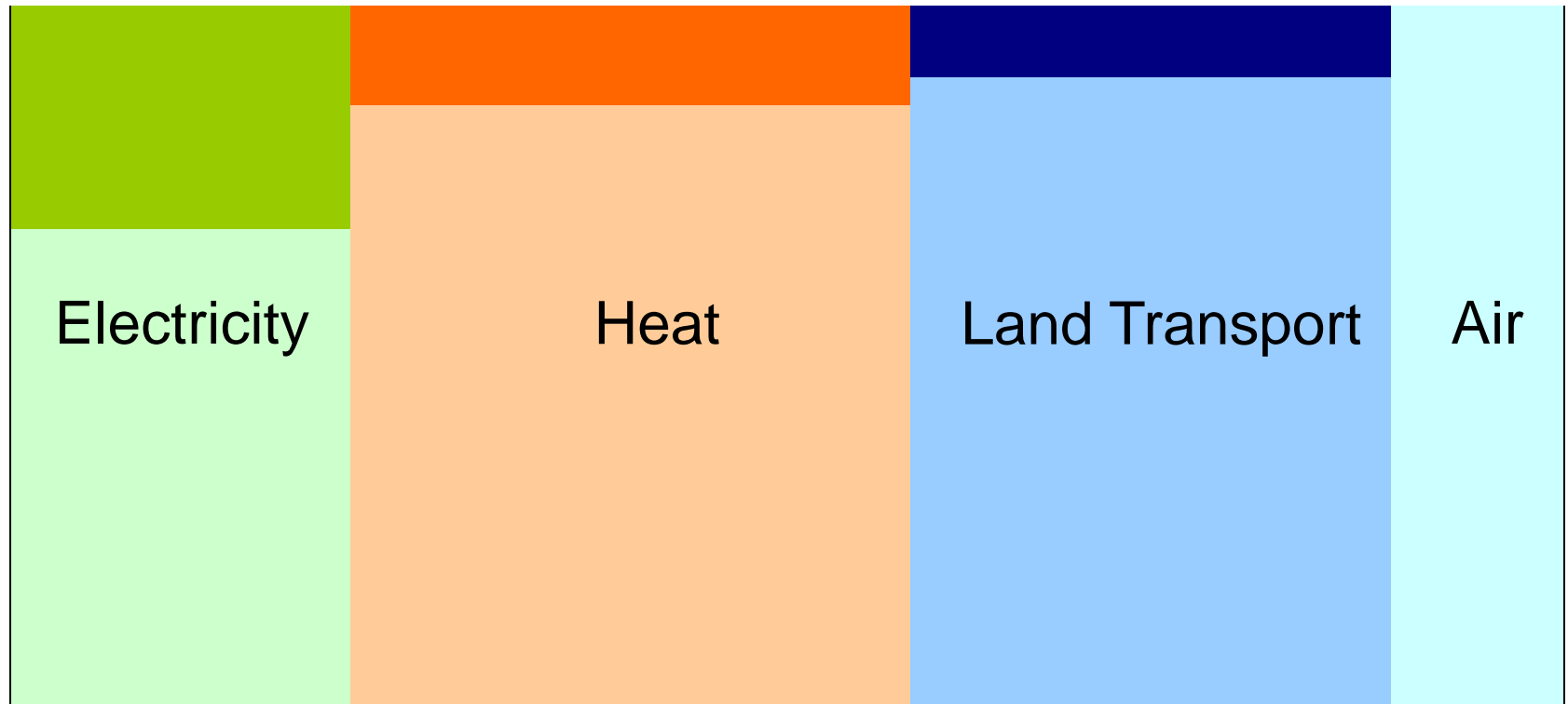
University of Birmingham

UK Energy in 2006



UK Energy in 2020 (?)

Renewable – 15% target



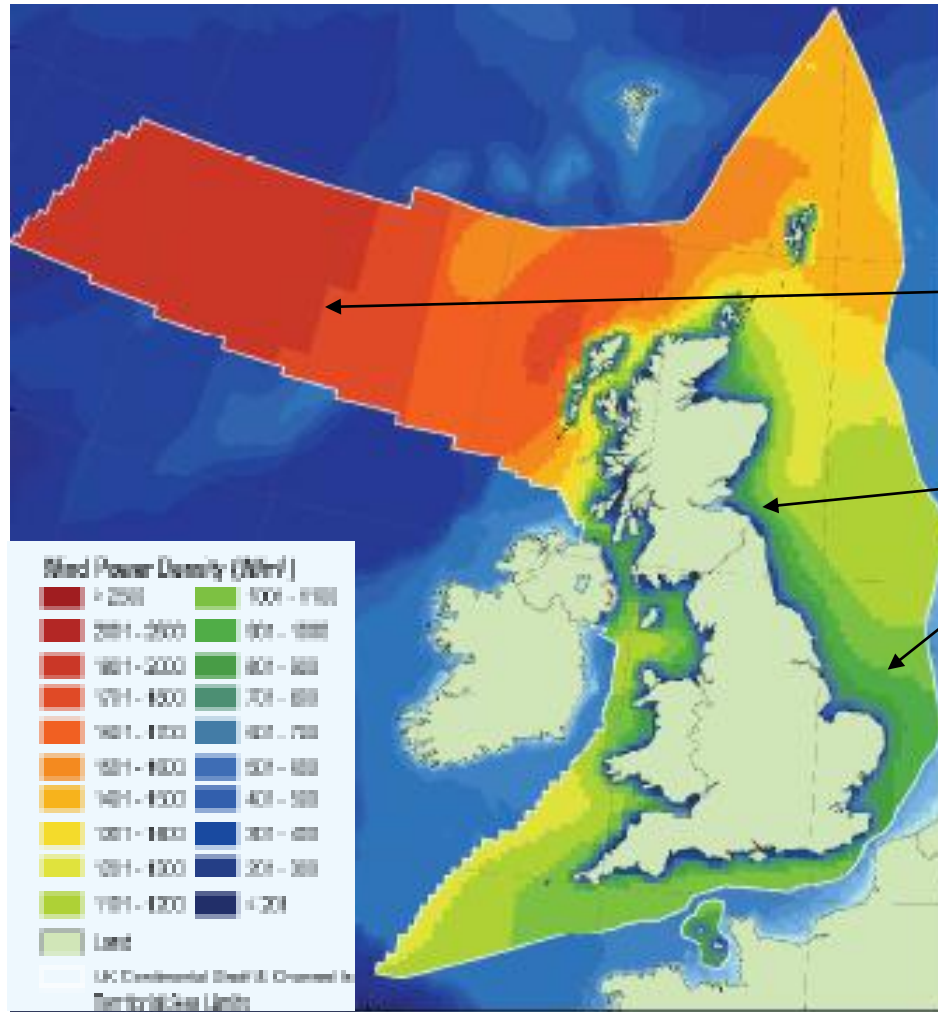
Conventional

Source: BERR

The UK Context

- 2020 target for 15% renewable energy implies over 30% of electricity
- Few remaining sites for hydro
- Marine is immature
- Biomass needs land to grow it
- Onshore wind is controversial

Our windy seas

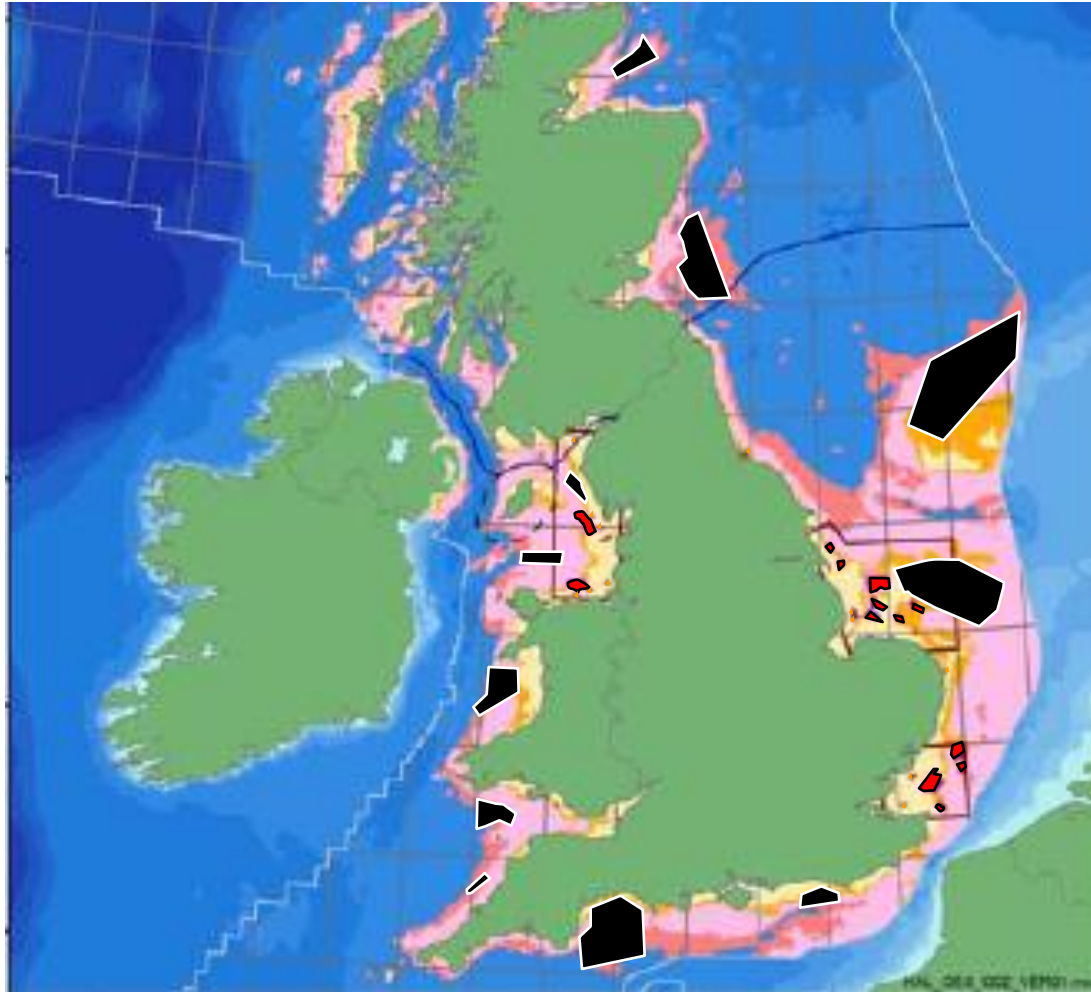


2 kW/m²

1 kW/m²

Source: DECC
Renewable
Energy Strategy

Areas to develop



Colours show
depth of sea

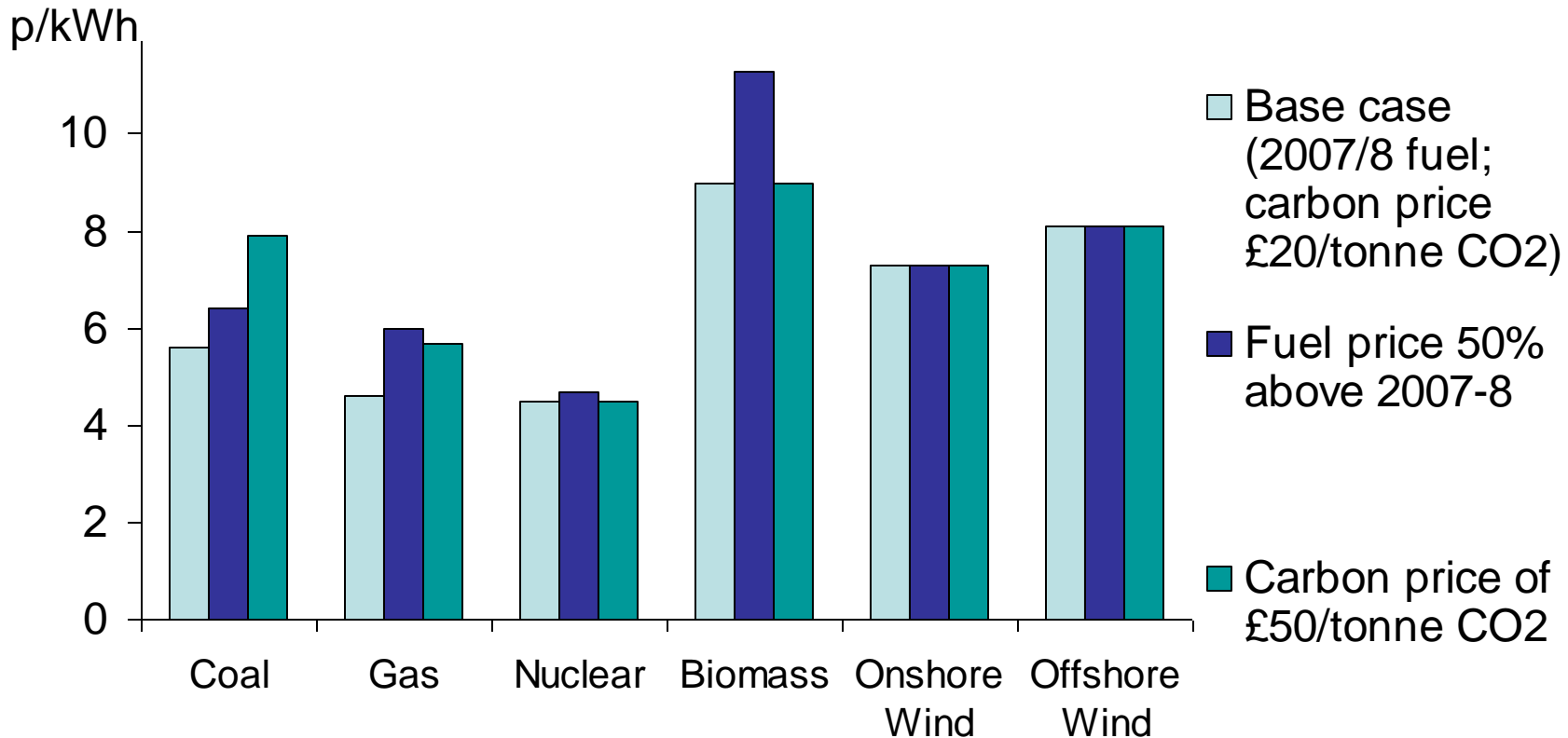
The basic economics

- You borrow a lot of money
- You build some turbines
- You arrange a link to shore (and pay for it)
- You hope the wind blows
- You get money for selling electricity
- You get extra help through policy
- You hope to pay back your borrowings

Costs

- For a wind generator, the up-front cost of building dominates the total
- Larger turbines are more cost-effective (so far)
- Learning-by-doing is reducing costs
- Capacity bottlenecks have raised them
- Deeper water will raise them

Estimated costs to the generator

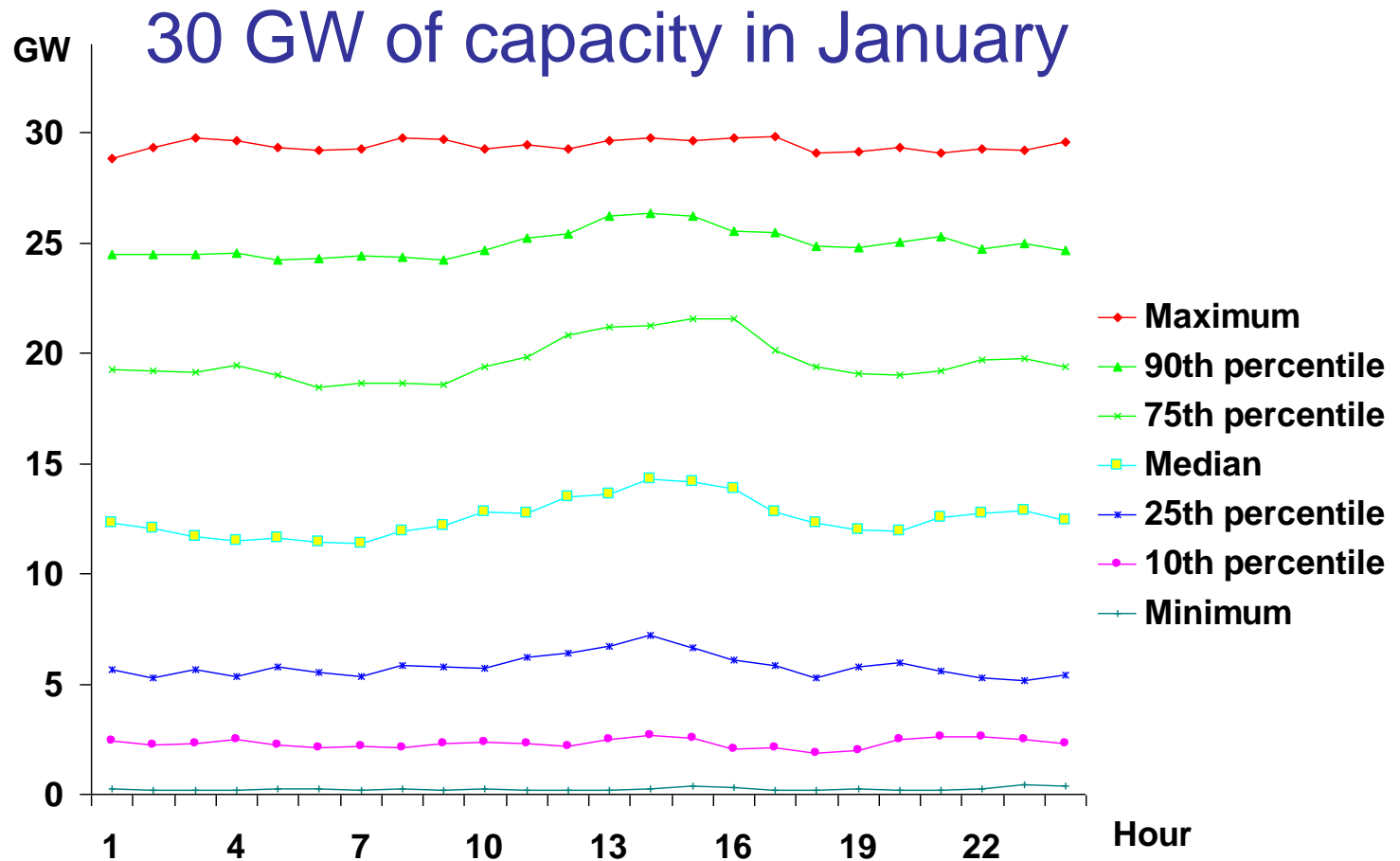


Source: House of Lords, 2008

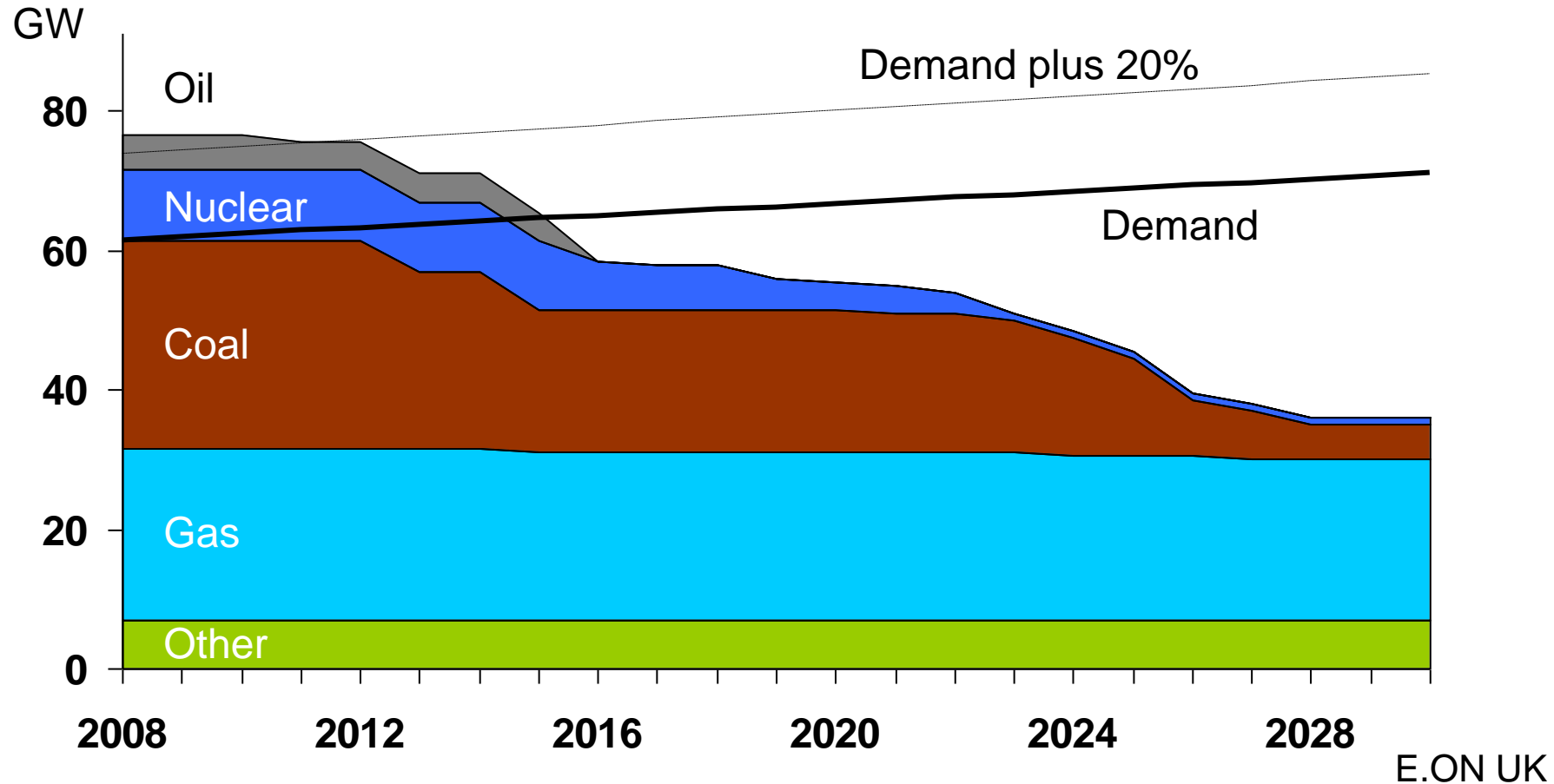
Wind

- Most turbines give full output for wind speeds between 15 m/s and 25 m/s
- Most give no output below about 5 m/s
- Average cost = cost ÷ load factor
- Onshore load factors are around 30%
- Offshore hope to reach 40%
- Winds across the UK tend to be correlated

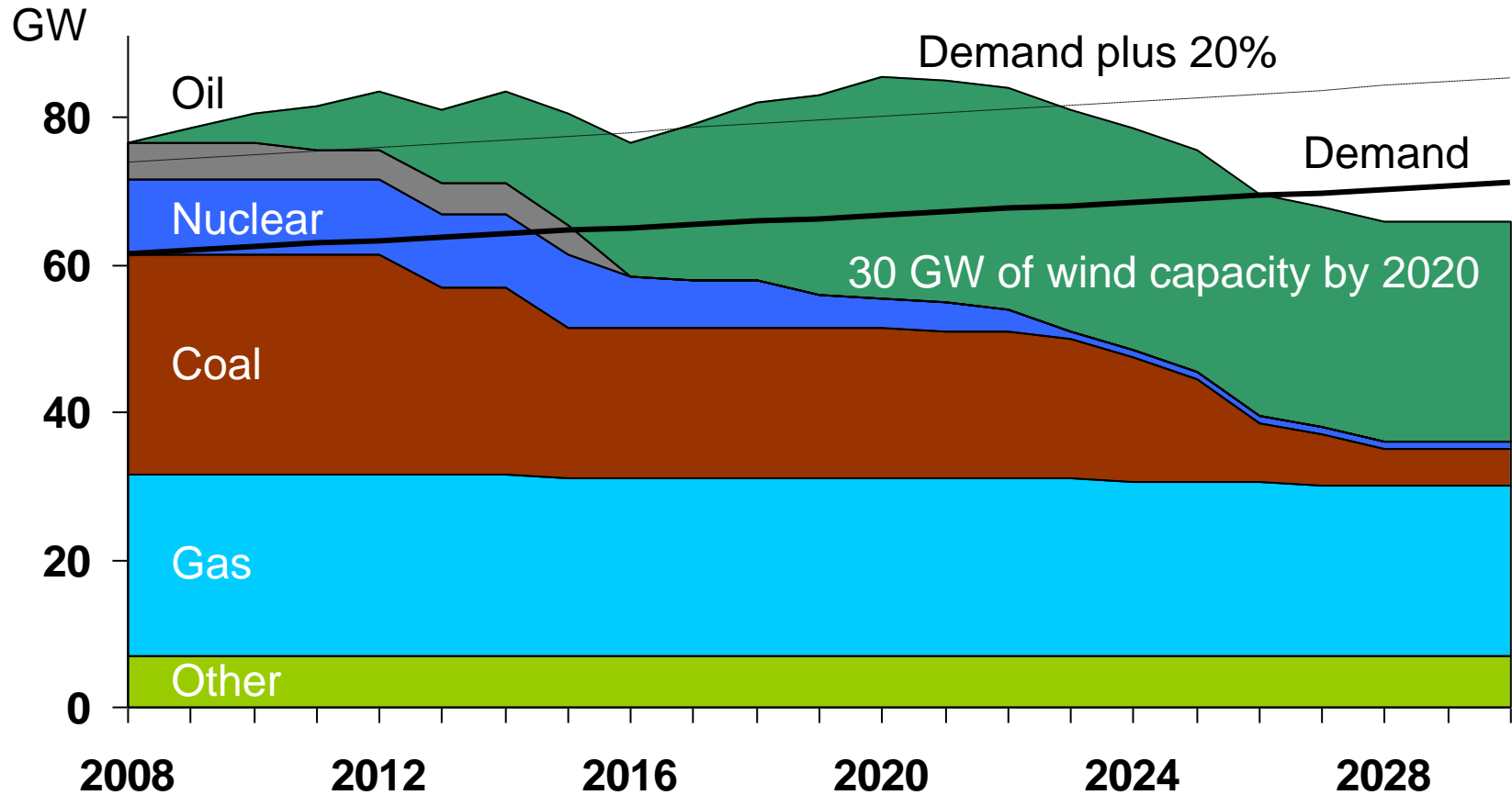
Wind Output - Probability distribution



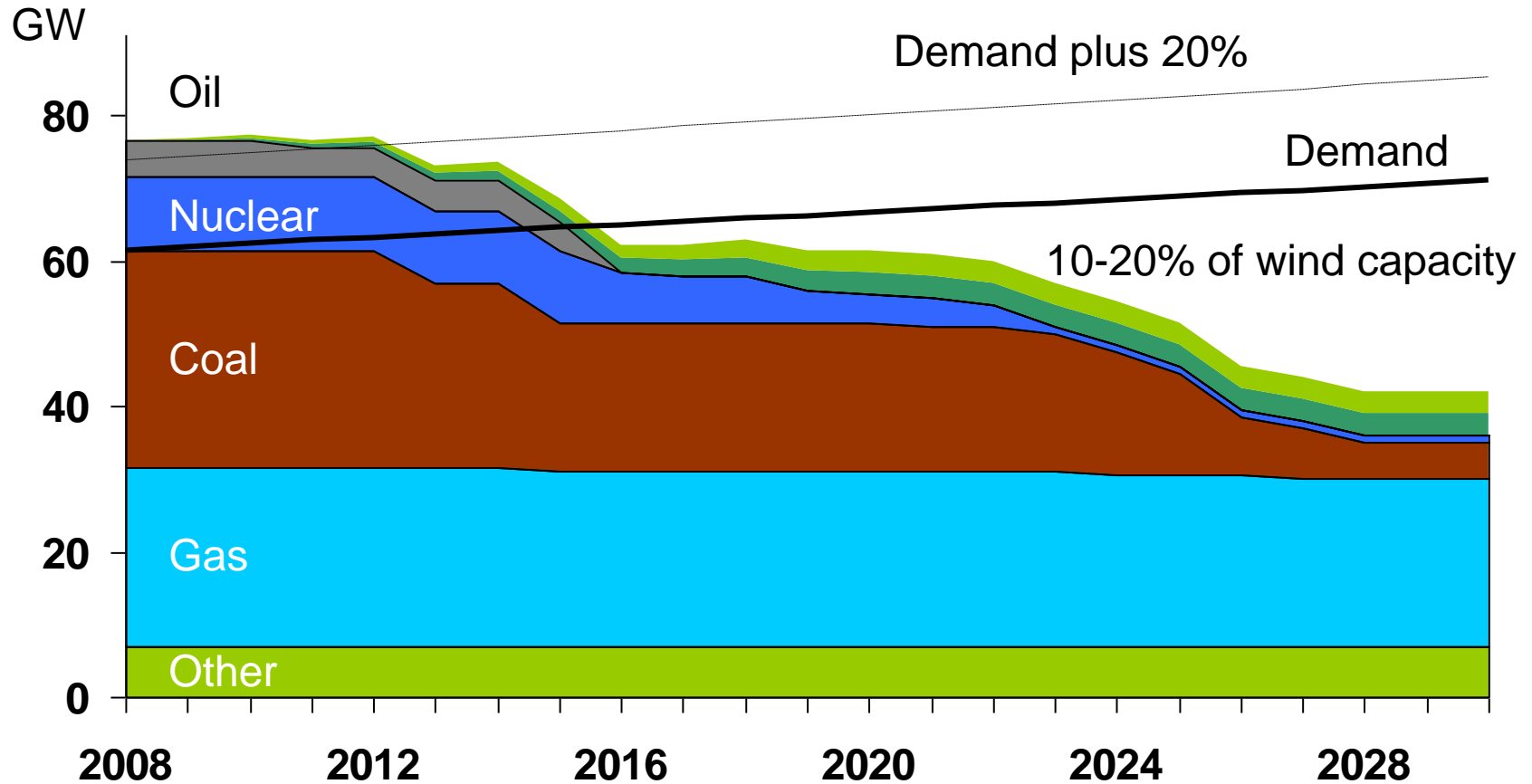
We need generating capacity



The growth of wind capacity



The wind capacity credit



Impact of wind on prices

- The average price of power has to cover the costs of conventional generators (over the long run)
- When it's (not) windy, the price will be relatively low (high)
- This means wind generators get an average price (a few percent) below that received by base-load stations

Possible support policies

- Grants
 - Offset capital costs
- Feed-in tariffs
 - Fixed income per unit generated
- Tradable Green Certificates
 - Obligation on retailers creates demand
 - Supplementary income to market price

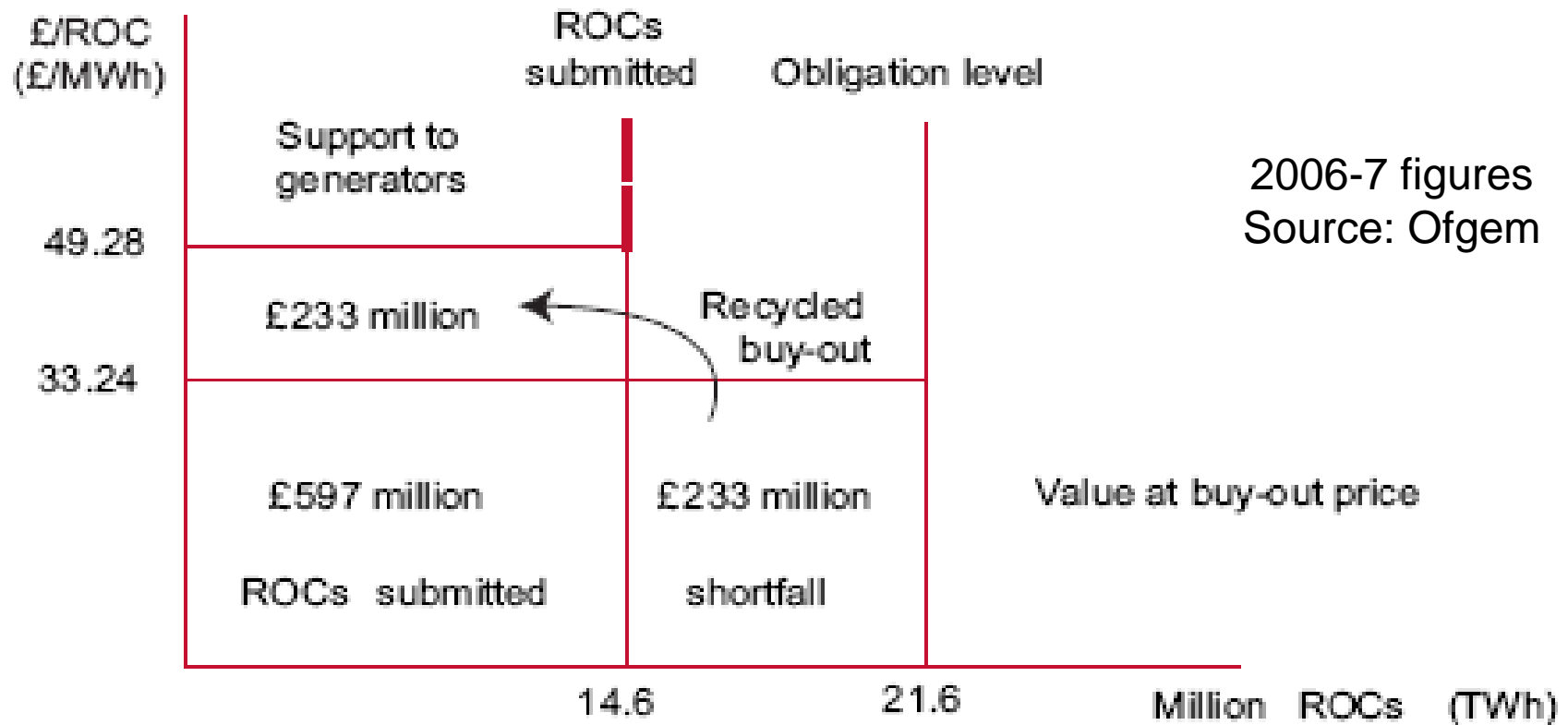
Feed-in Tariffs

- Fixed price per unit of output
 - May depend on site as well as technology
- Avoids risk over market price
- Generator won't respond to price signals
- Have been very effective in promoting investment on the Continent
- Will be used for small schemes in UK

Tradable Green Certificates

- Obligation on retailers to surrender certificates or pay fine, creating demand
- Generators paid for certificate(s) & power
- Incentives related to market price
- Generators face price risks
- UK's Renewables Obligation is of this type

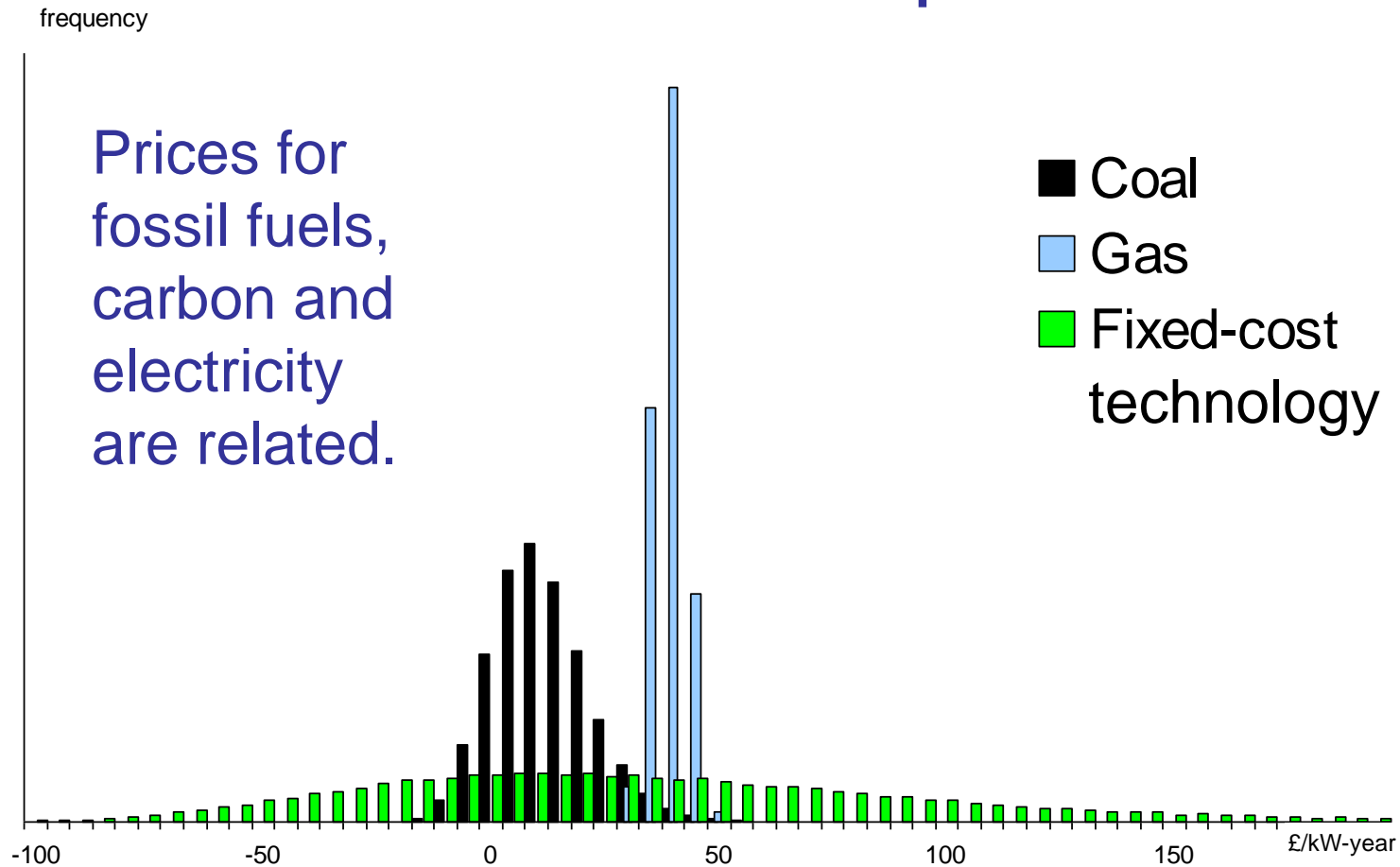
The Renewables Obligation



Cost of the RO

- UK renewables output has been below target, so the RO has a high cost per MWh
- Planning system the main culprit
- Uncertainty over income may also hinder generation investment
- But changing the system could delay investment for several years...

Relative risk of profits



Consequences

- Linking support to market price makes income stream risky
- This raises the cost of capital
- This raises the cost of offshore wind
- Have we got the balance right?



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