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Reforming two-sided CfDs to be more market compatible

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Outline

- Case for long term contracts for VRE
  - UK abandons RO (green certificates) for 2-sided CfDs
- EC requires market responsive 2-sided CfDs
- Designing efficient VRE contracts
  - Curtailment: importance of location signals
  - Limiting excess rent
- Yardstick CfDs or limited payment
  - for MWh/MW not years

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Lessons learned for supporting Variable Renewable Electricity

- **VRE** is capital intensive => main cost is WACC
  - ⇒ Reduce risk to lower WACC: needs **good long-term hedge**
- Long-term contracts for VRE: risks to be reduced include
  - – greater price risk when fossil generation sets price
  - – Political risk of changing VRE targets/market design
  - – Future market risk of cannibalisation
- Original UK support was green (RO) certificate + market price
  - ⇒ Worst of both worlds, risky, and windfall profits if market price high
  - ⇒ Replace with CfD with FiT with government-set strike price
  - ⇒ High cost, replaced with ***auctions***
  - ⇒ Prices dramatically fall, WACC lowered by 3% (for 15 yrs!)
  - ⇒ System wide single price auction maximises competition
  - ⇒ Needs good location charges to **minimise system cost**

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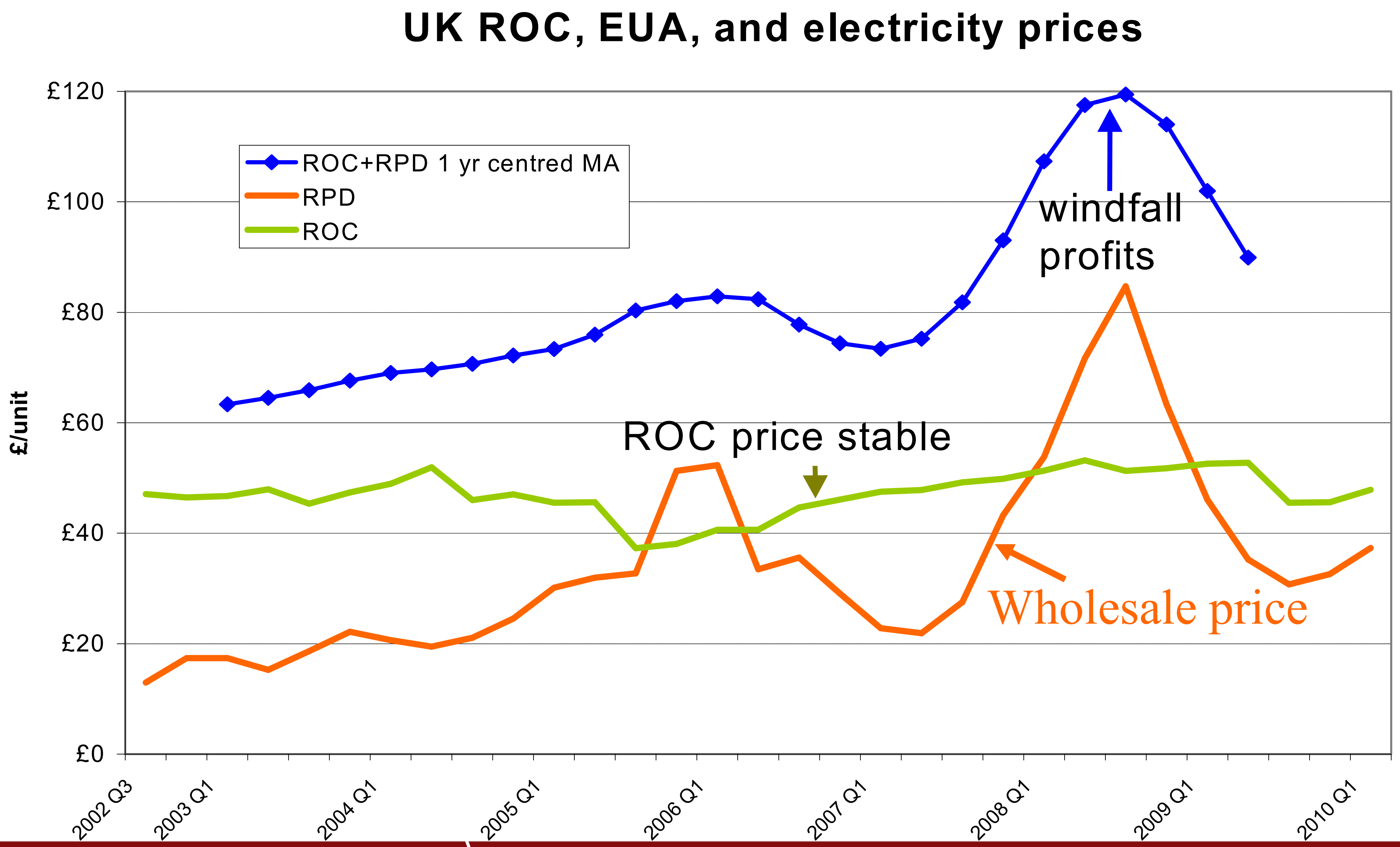
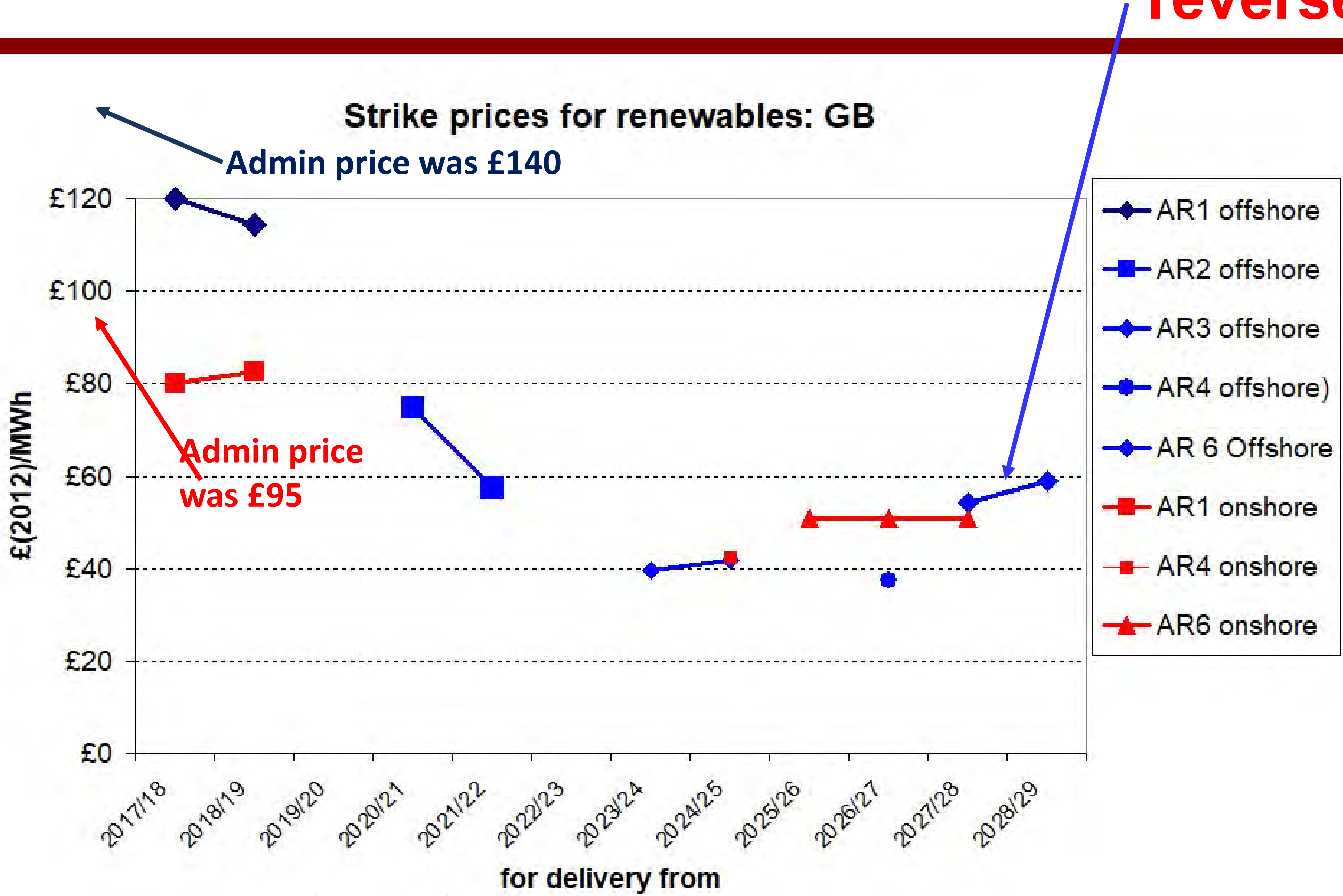
Current wholesale prices deliver massive windfall gains to RO contracts



Earlier auction price falls reversed



Source: https://www.gov.uk/government/publications/contracts-for-difference-cfd-allocation-round-6-results

Case for CfDs

- CfDs address future market price risk
  - Generators lose when prices low, while retailers gain & vice versa

$\Rightarrow$ case for trade in offsetting risk over 1-2 years

$\Rightarrow$ conventional CfD is a mutually attractive price hedge

- $\Rightarrow$ Leave to market, standardise for liquidity
- $\Rightarrow$ Purely **financial**, does not distort production/trading

- Long-term price hedges can reduce cost of capital
  - PPAs work with credible asset-heavy counterparty
  - But limited potential, **insufficient for massive renewables**
  - For which only credible counterparty is state or regulator

Long-term contracts replace missing futures market

EC Regulation 2024/1747

- “the energy crisis.. has revealed a number of shortcomings and unexpected consequences” (9)
  - One-sided CfDs and Feed-in Premium => ***windfall profits***
- MS’s should “create the right market conditions for long-term market-based instruments, such as PPAs” (28)
- Public support schemes “should be two-way CfDs” (35)
- should be voluntary (37)
- CfDs holders “should participate efficiently in the electricity markets” (41)

UK CfDs with FiTs meet some but not all of these

UK CfD with FiT design

- Standard 2-sided CfD specifies volume M MW, strike price s
- Generator receives (or pays) $(s - p)M$ regardless of output
  - May be paid or pay depending on expected **reference price *p***
- If $p > c$ (avoidable cost) generator produces $y > M$ MW
  - Profit is $(s - p)M + (p - c)y = (s - c)M + (p - c)(y - M)$
  - **both positive**
- If $p < c$ generator produces zero
  - Profit is $(s - p)M$ as $y = 0$
  - Financial arbitrage pushes s towards expected future price, p
- CfD incentivises efficient market response
- CfD with FiT pays $(s - p)y$ on metered output y for 15 yrs
- Profit is $(s - p)y + (p - c)y = (s - c)y$

No incentive to change output in response to p

Reforming VRE support

- Aim: minimise cost of finance while ensuring market responsiveness
- VRE and grid contracts should
  - Hedge long-term risks
  - Signal **least system-cost** location for each technology
  - Provide short-term operating signals (congestion, curtailment, flexibility)
  - Minimise infra-marginal rent to favoured locations
  - Maximise competition => **auction** sets single country-wide strike price
- Pay for **capacity** not output for efficient technology choice

  ⇒ Costs are up-front, running costs independent of market prices

⇒ **Efficient** grid charges guide **location**

⇒ Long-term efficient nodal TNUoS (transmission) charges

  ⇒ 20 yr fixed charge updated for new contracts with new system information

  ⇒ Provides **future cost certainty** before VRE bids in **auction**

Variable Renewable Electricity
VRE: wind, PV

- Peak:average output for wind 2-4:1, PV 8-11:1

⇒ increasing volumes curtailed as VRE rises

⇒ exacerbated by transmission constraints

- **Marginal** curtailment is **3+ times average**

⇒ critical to locate new VRE at uncongested nodes

⇒ need strong locational connection signals

⇒ + integrated network and generation location planning

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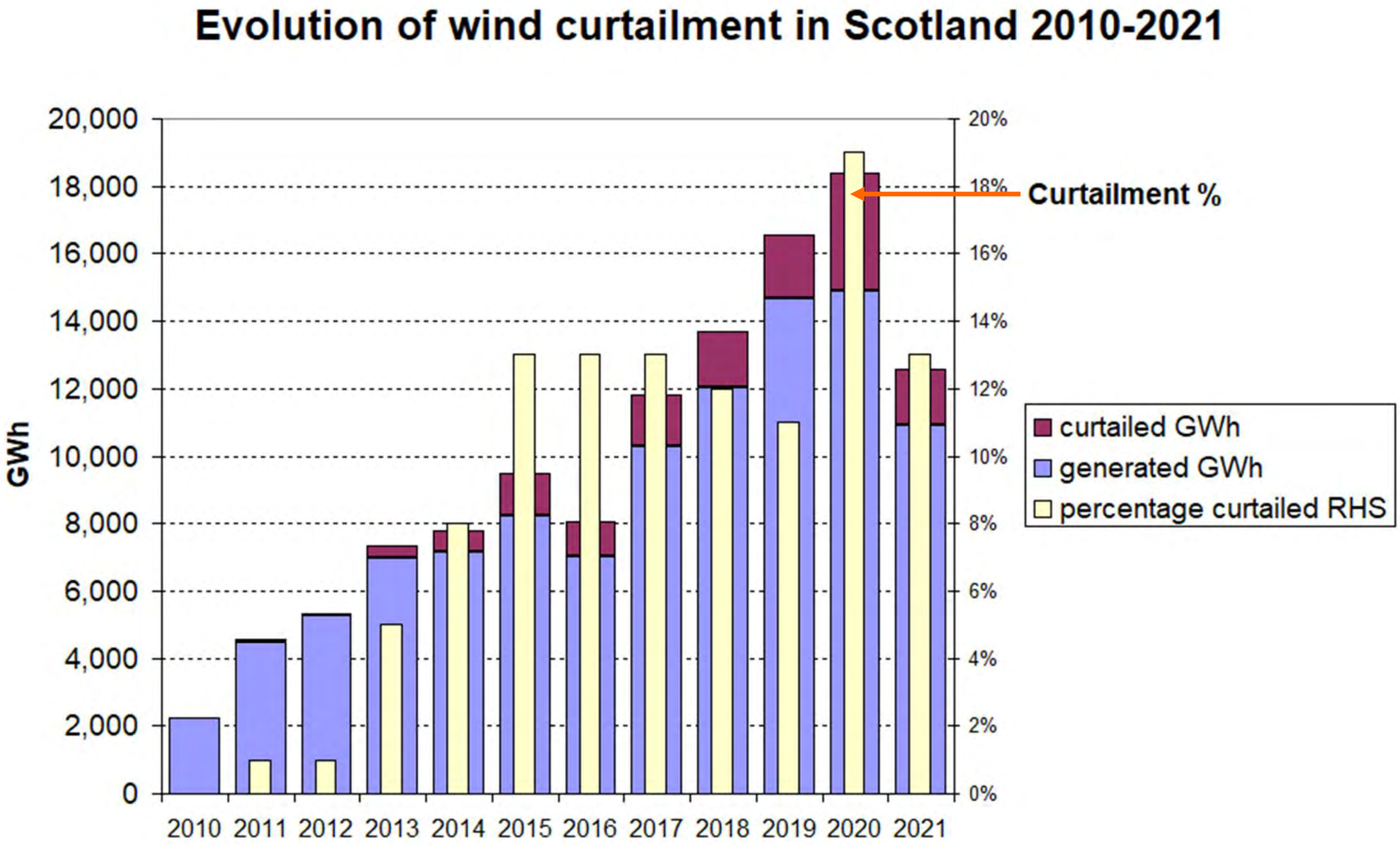
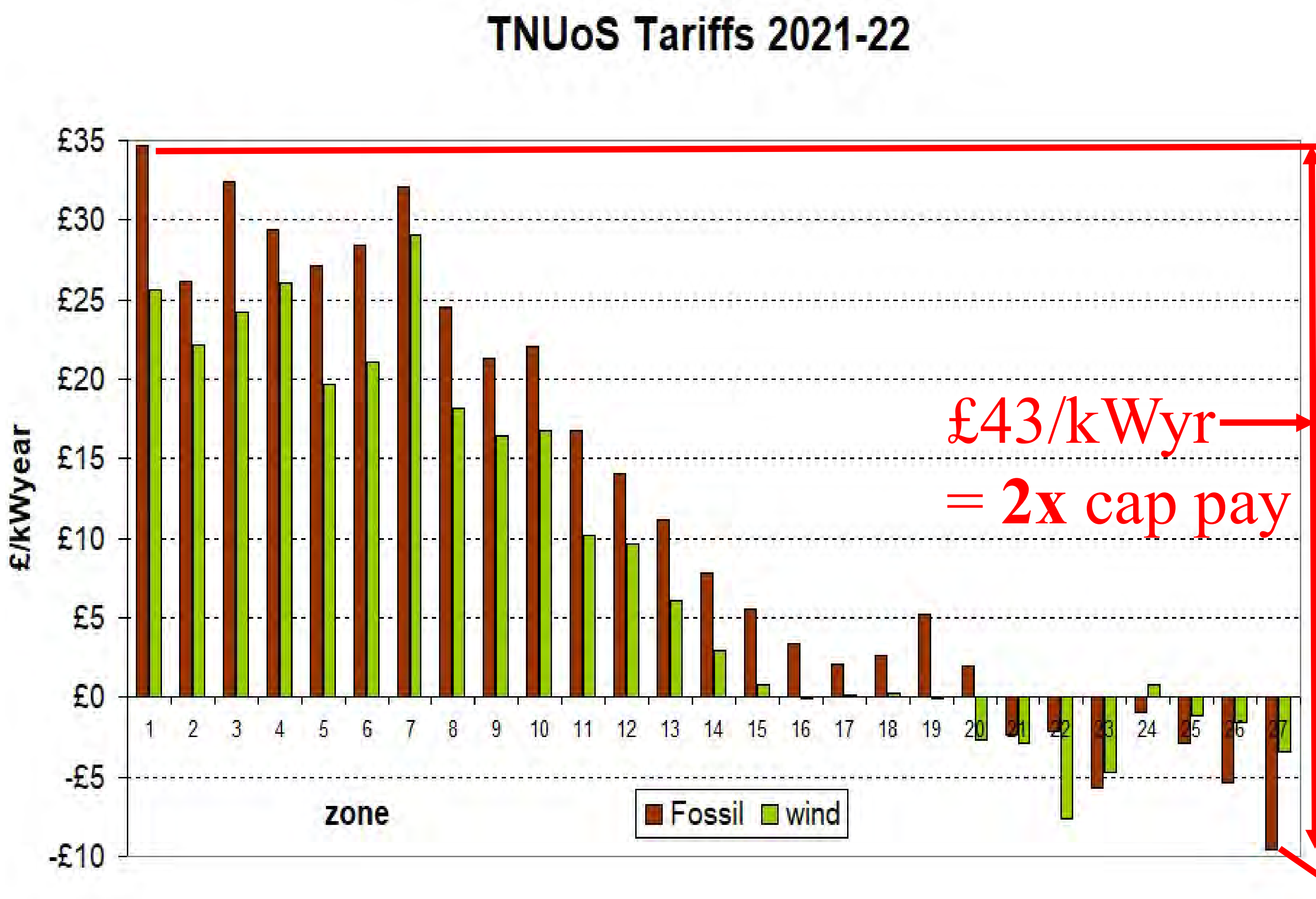
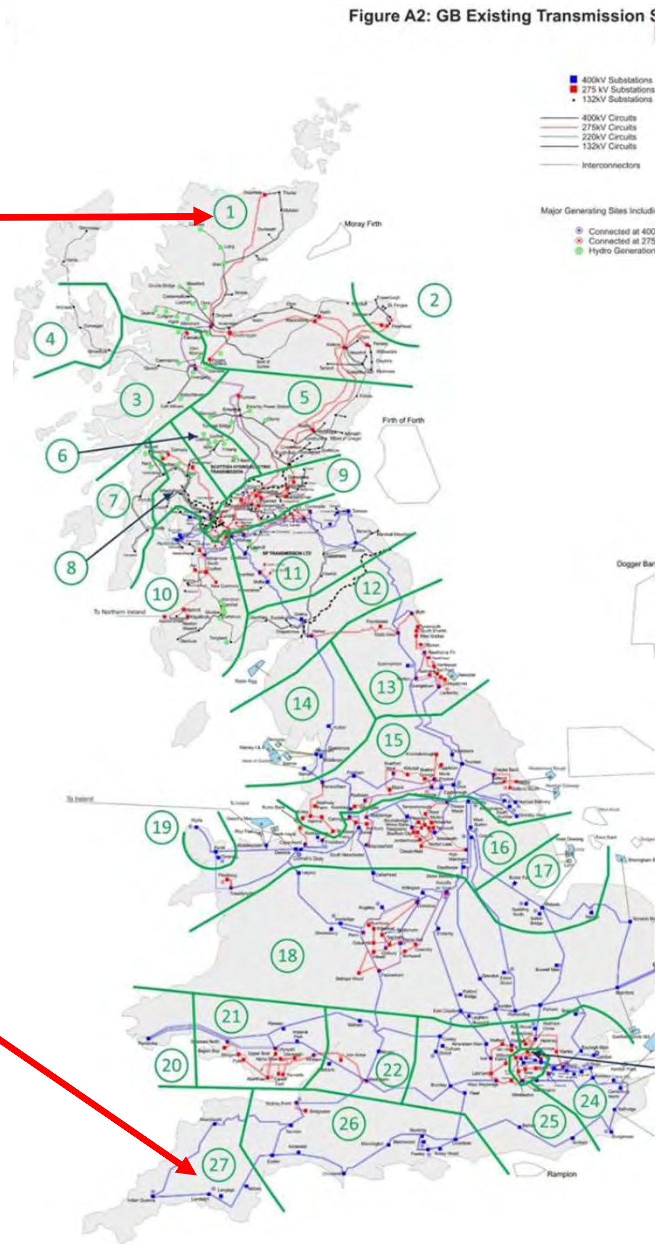
Transmission congestion curtails Scottish wind



Guiding investment location
Transmission Network Use of System





GB has strong locational signals for investment

More transmission needed where VRE located

Guiding location decisions: two approaches

- Current: set locational TNUoS charges to guide location
  - TNUoS based on Investment Cost Related Prices (ICRP ≈ LRMC)
    - £/MWkm; zones defined by LMPs; assumes **instantly adjustable**
- Problems of TNUoS:
  - Changed annually even for plant that cannot move
  - changes muted to avoid excessive investor uncertainty
  - Adjusts slowly at best, poor short-run decisions
  - ***Remedy***: long-term TNUoS contracts to guide ***efficient*** location
- Alternative: locational or zonal pricing
  - to guide location (needs contract hedge)
  - delivers better spot interconnector use

⇒ Lower prices in wind surplus zones, higher in import zones

⇒ Export surplus Northern wind, import cheap EU electricity in south

Europe still needs to address efficient VRE location

Incentive compatible VRE CfD

- Contract is for day-ahead forecast of hourly CF θ_{hr}

  Pays $\theta_{hr}K$ where K MW is capacity, h is hour, r is location
- **Yardstick CfD** duration is ***N*** MWh/MW capacity
  - E.g. 40,000 full operating hours based on forecast output
- Auction sets strike price s and grid sets charges t_r/MW.yr
- Annual profit is $\sum_h(s - p_{hr})\theta_{hr}K + \sum_h \text{Max}(p_{hr} - c)y_h, 0) - t_r K$

  $= \sum_h\{(s - c)y_h + \underbrace{(y_{hr} - \theta_{hr}K)(p_h - c)\}} - t_r K,$

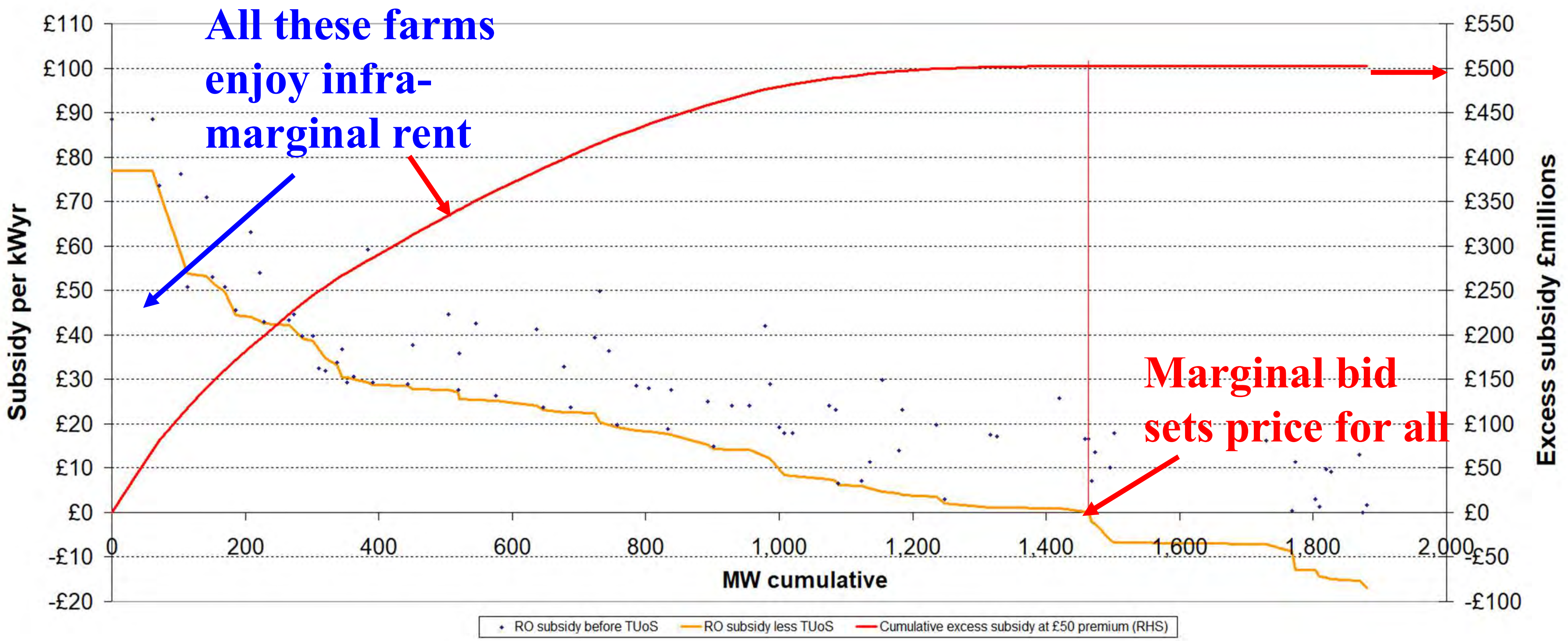
  If $p_{hr} > c$, $Ey_{hr} = \theta_{hr}K$ on average for a good forecast, so positive profit

  If $p_{hr} < c$, set $y_h = 0$ to make **second term positive**
- $s\ {}_h\sum^L \theta_{hr} = s\boldsymbol{N}$ sets strike price in **auction**, given cost/MW

Yardstick CfD is an excellent market responsive hedge

Cumulative excess subsidy from a time-based contract

Subsidy calculated from rolling capacity factors
Auction clears at 25% CF and £50/MWh subsidy for 15yr contract



Market responsiveness - 2

- **Alternative** to a financial or yardstick CfD:
- No CfD payment if hourly spot price is **≤ €0**
  - ≈ avoidable cost of VRE

=> avoids inefficient dispatch order – main inefficiency

- Simpler to design/introduce
  - Already adopted by some countries
  - Works better with contract in MWh/MW not years
- Does it encourage efficient spot/balancing trading?
  - only with nodal pricing?

Merchant exposure?

- Developer may prefer more market exposure
  - possible upside compensates for low prices

  $\Rightarrow$ Partial cover: 2-sided CfD via auction for 80% capacity
  - remaining 20% capacity exposed to market
- Popular in Australia, lower public exposure
  - Similar risk to 100% cover, allows more VRE for given auction size
- Consistent with Regulation's voluntary contracting

Conclusions

- 2-sided CfDs need to be made market responsive
  - yardstick CfD or no payment at/below zero price
- VRE needs good locational investment signals
  - to minimise congested curtailment
- Minimise excess rent from high resource locations
  - limit cover to MWh/MW – e.g. 40,000 MWh/MW contracted
  - auctions: encourage numerous competitors
- Hybrid CfD + merchant to maximise entry?

EC's 2-sided CfDs principles good starting point

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Acronyms

CF	capacity factor
CfD:	Contract for Difference
FiT	Feed-in Tariff (paid on metered injection)
MS	Member State
PPA	Power Purchase Agreement
RO(C):	Renewable obligation (certificate)
TNUoS	Transmission Network Use of System
VRE:	variable renewable electricity
WACC:	weighted average cost of capital