

What future(s) for liberalized electricity markets?

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Cambridge Spring Research Seminar

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Outline

- Future utility challenges
 - Supporting non-commercial **renewables**
 - **Pricing** problematic with low variable cost plant
- Challenges in liberalized markets
 - **Investment** often problematic without contracts
 - **Tension between capacity adequacy and efficient pricing**
- Future challenges
 - **Decentralised generation**, new loads – EVs, heat pumps, ...

What models are on offer?

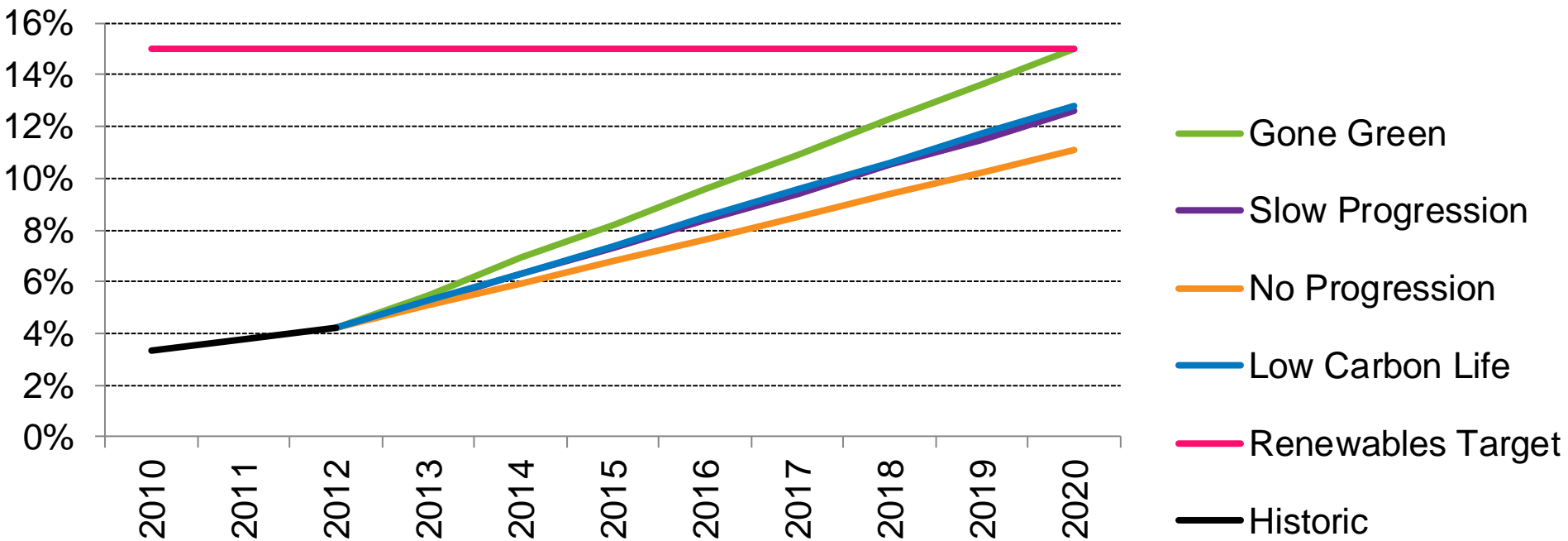


Future utility challenges

- Targets require massive growth of non-fossil plant
 - Low variable cost, high capital cost
 - Currently not commercial, needs **subsidy**
 - => **Requires political support**
- Growth of decentralised generation and peaky load:
 - PV, micro-CHP, EVs, heat pumps => **peakier net demand**
- Infrastructure & energy: **capital cost dominates**
 - network designed for peak not average flows
- Falling capacity margins => higher fixed costs
 - **How can generators recover fixed costs?**



UK target for renewables: *Future Energy Scenarios*

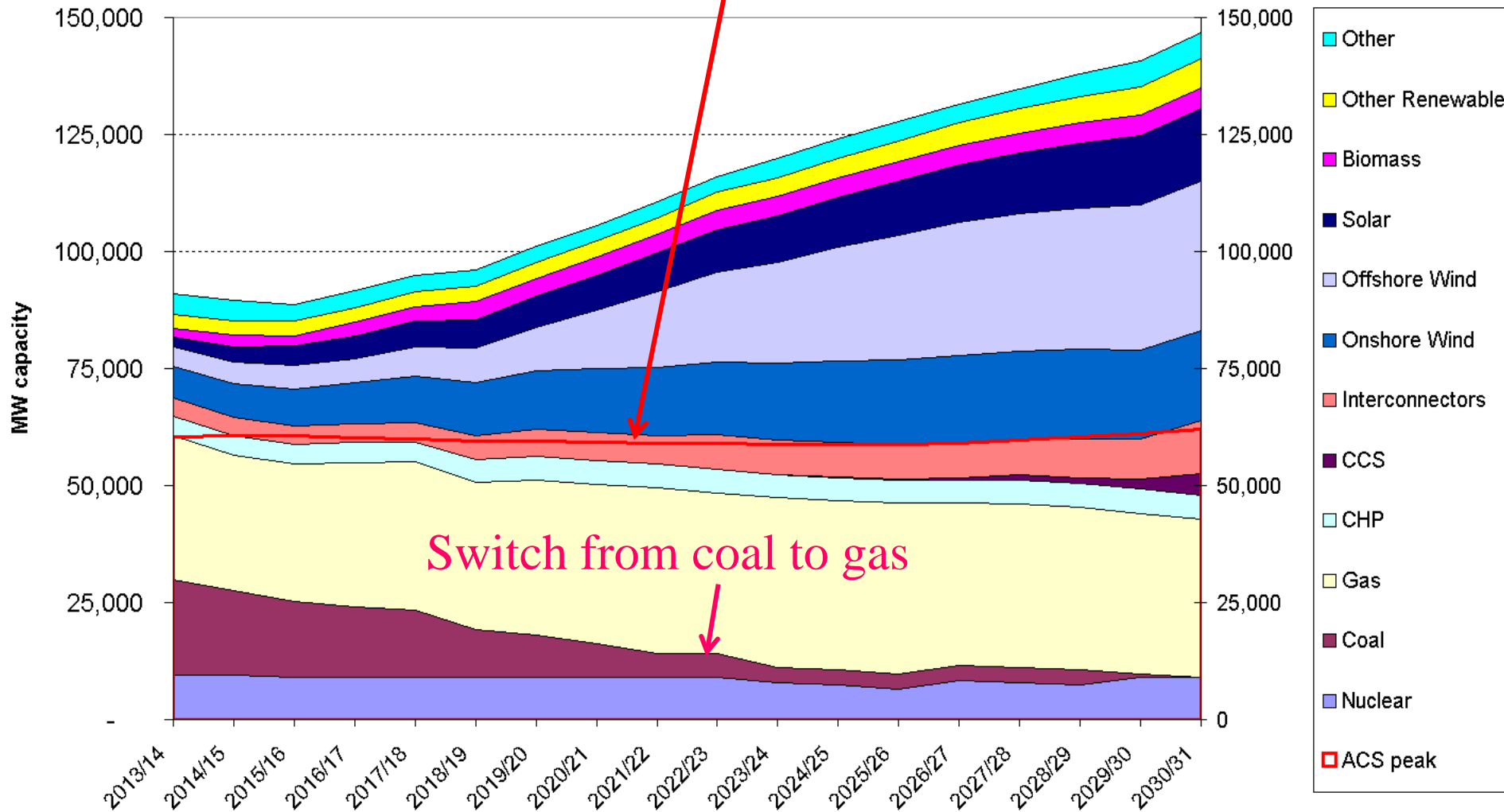


Future energy scenarios 2015



Low peak, huge capacity growth

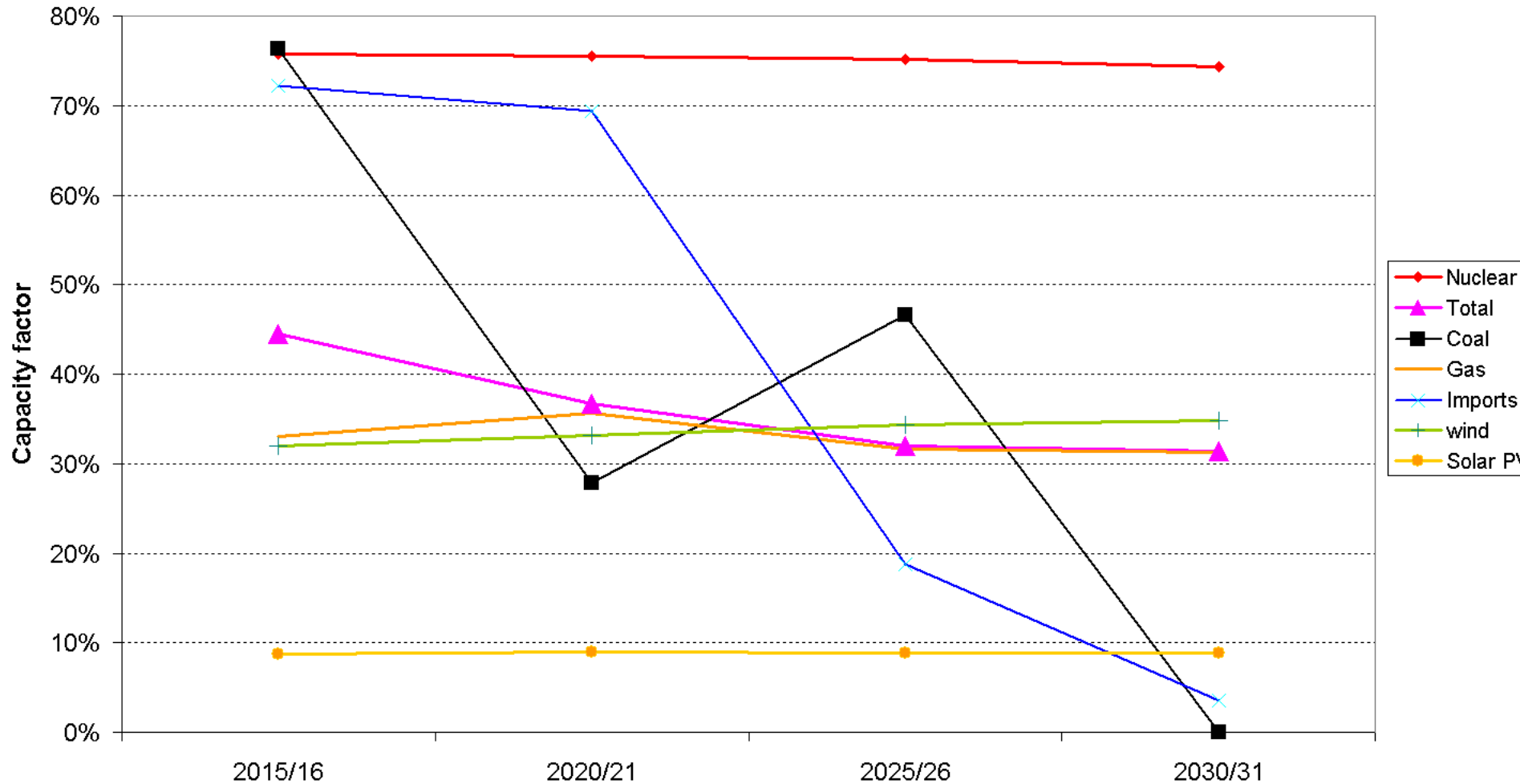
UK Generation capacity under *Gone Green*





Low capacity factors for plant with high MC

UK Capacity factor for various fuels under *Gone Green*

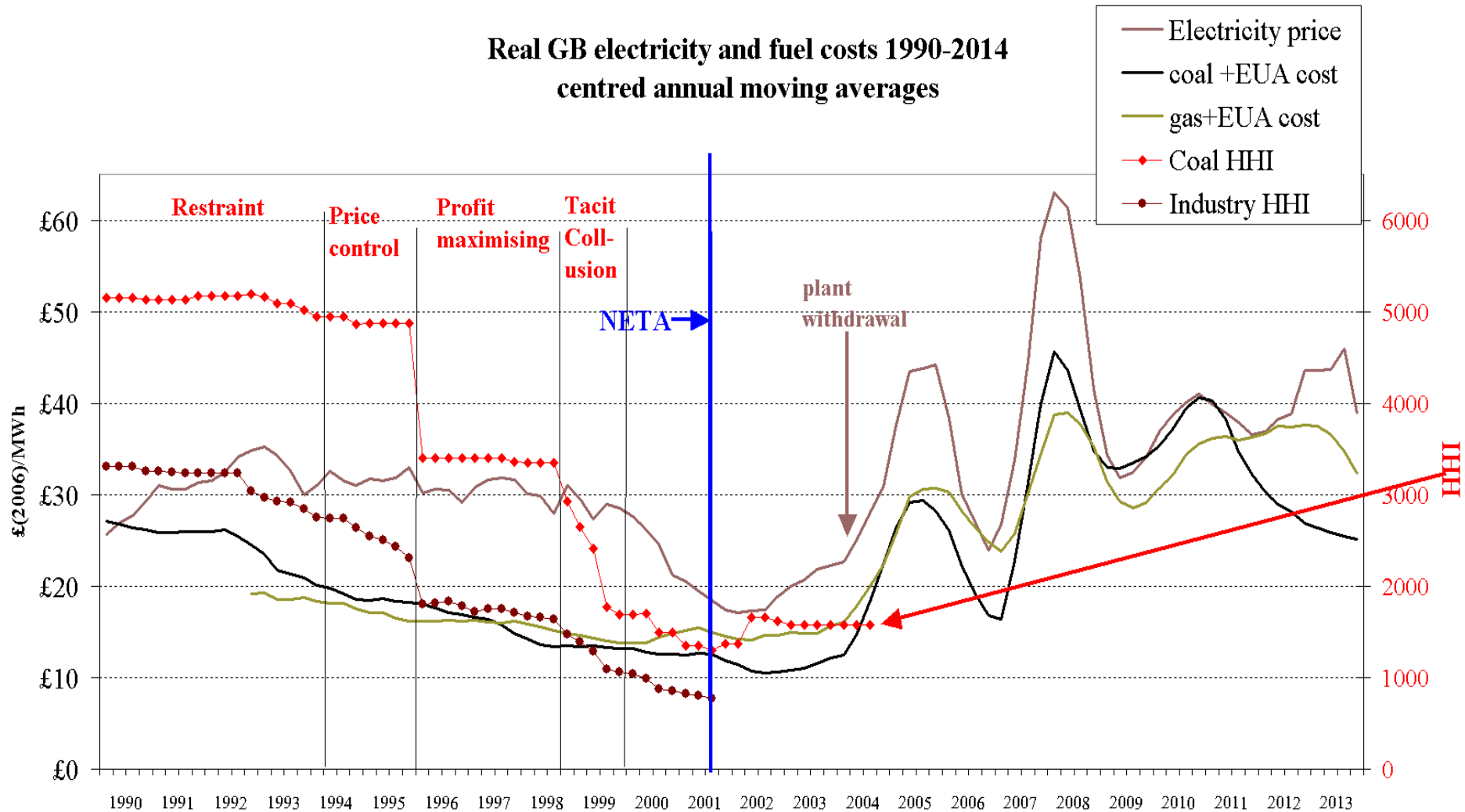


Pricing and investment

- SMC: **system** marginal cost, highest MC generating
- Efficient price = **SMC + CP**
 - CP = $LoLP * (VoLL - SMC)$, VoLL = Value of Lost Load
- ***How confident are gencos that the price will cover their average total cost (AC) and justify investment?***
 - High cost fossil mostly at margin => SMC/AC high
 - Or price set abroad over interconnectors
 - => plant expected to cover cost, **private investment OK**
 - Low cost low-C often at margin => SMC/AC low
 - => **Requires scarcity/capacity price and longer-term contracts**



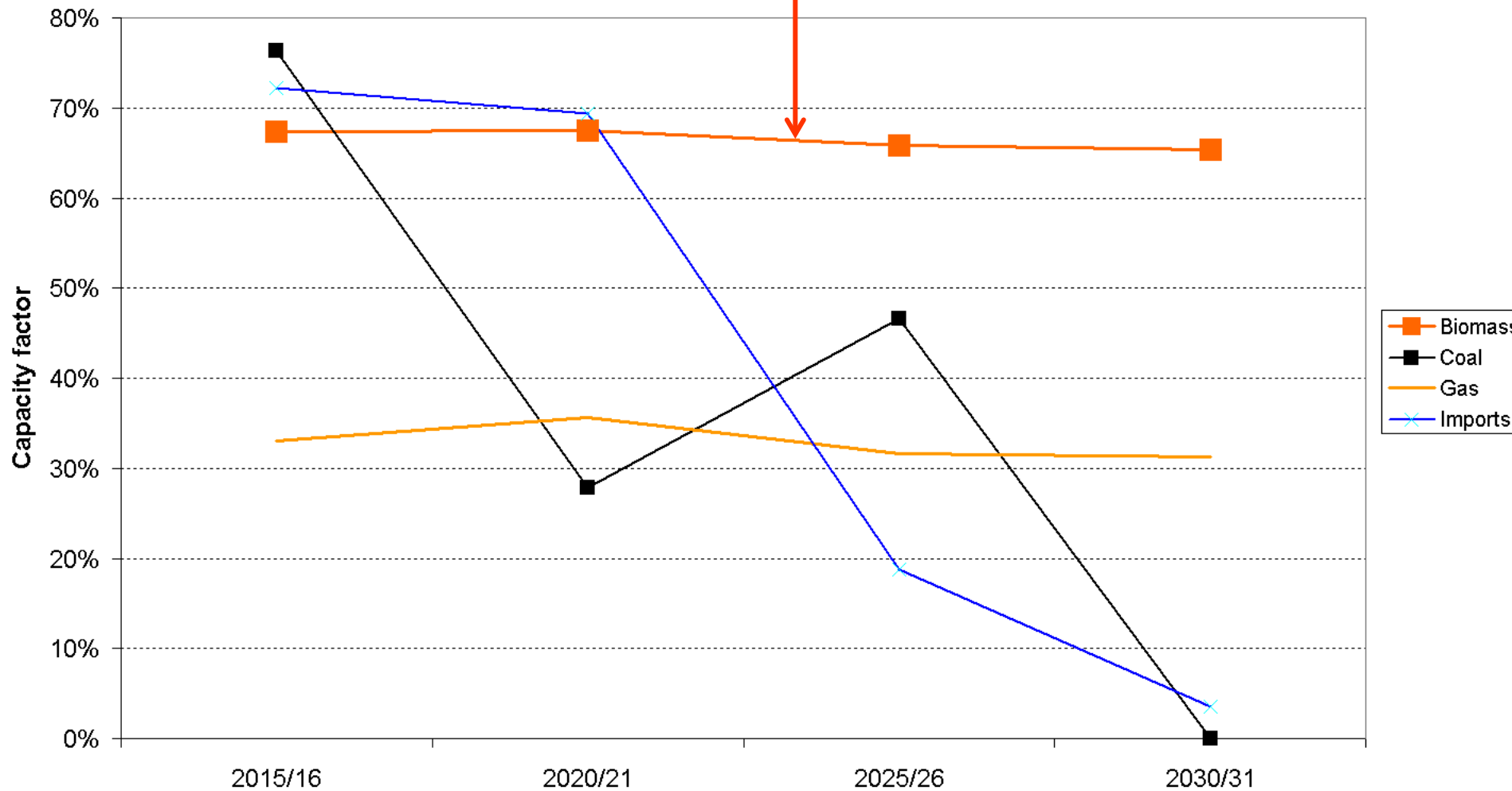
Wholesale prices driven by fuel costs and market power





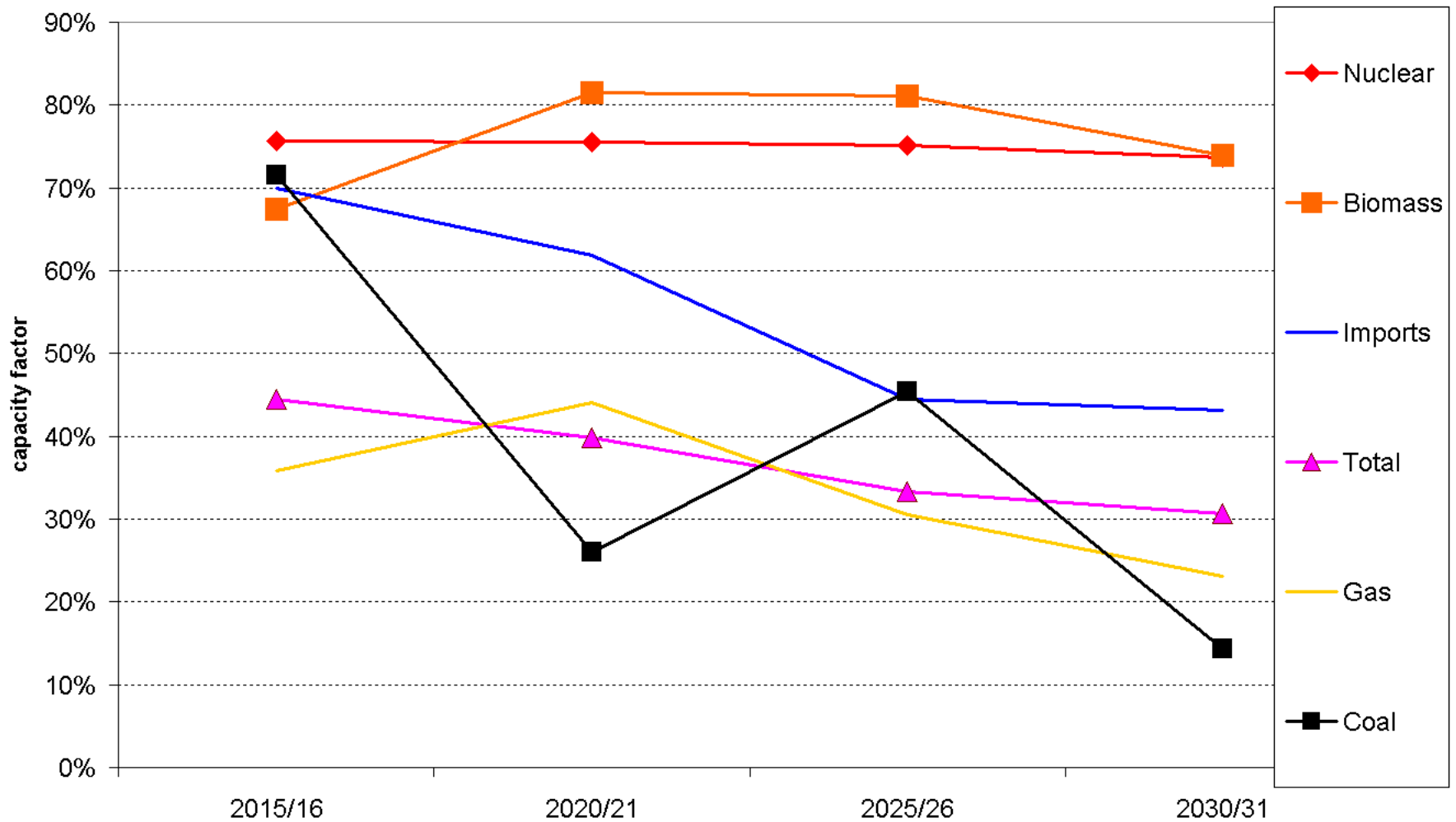
Can biomass set the price?

UK Capacity factor for various fuels under *Gone Green*





Capacity factors for various fuels under Slow Progression



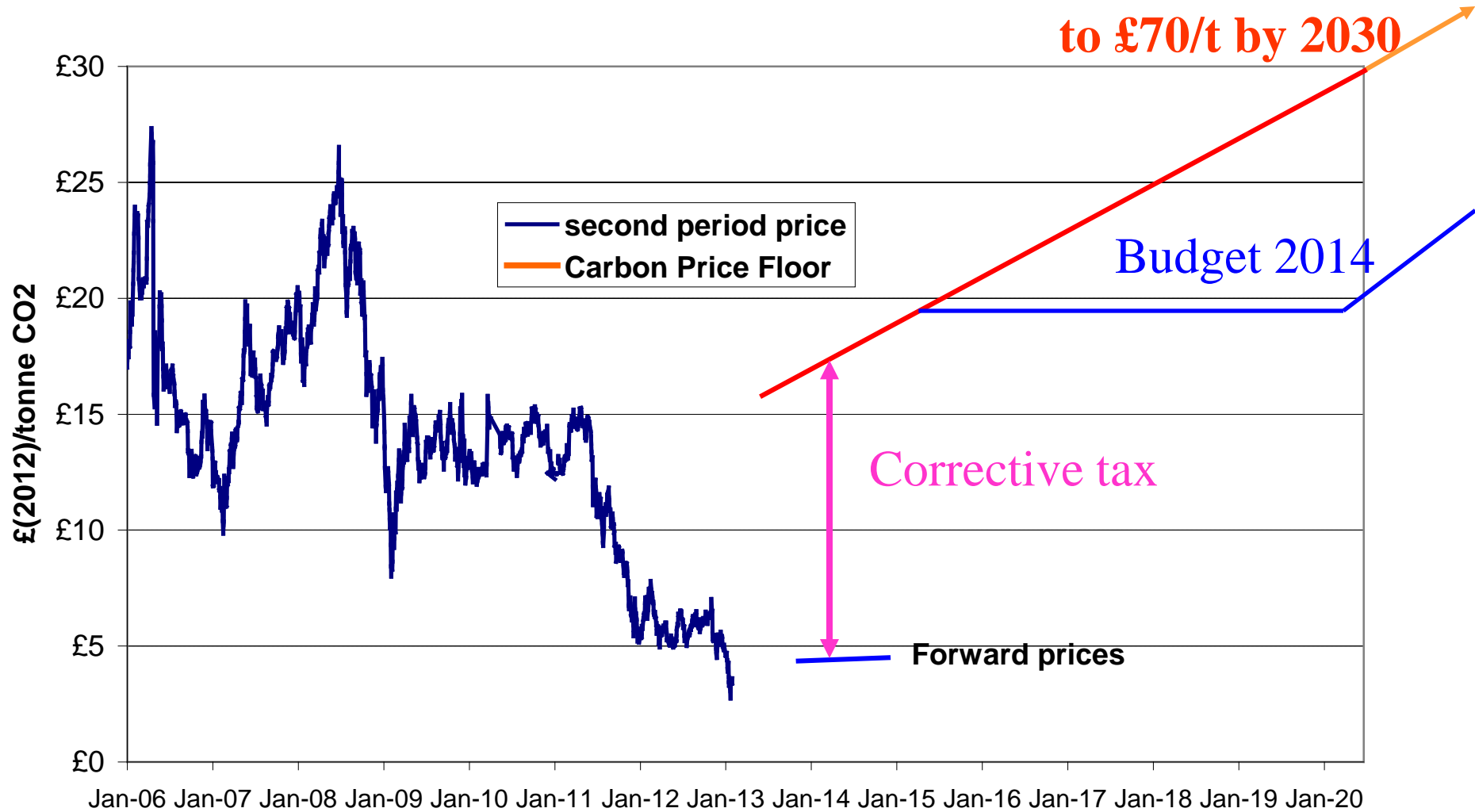
Electricity Market Reform: does it solve the problems?

- **Energy Act** 18 December 2013 to address:
 - Security of supply and carbon/RES targets
 - problems with EU ETS
 - Market/policy failures
- To deliver **secure low-C in UK affordably**
 - => **capacity payments auctioned**
 - **HMT sets Carbon Price Floor in 2011 for 2014**
 - but reneged on it in 2014
 - **de-risk investment => Contracts** to lower WACC
 - Originally bureaucratically set, **now auctioned**



UK's Carbon Price Floor - in Budget of 3/11

EUA price second period and CPF £(2012)/tonne

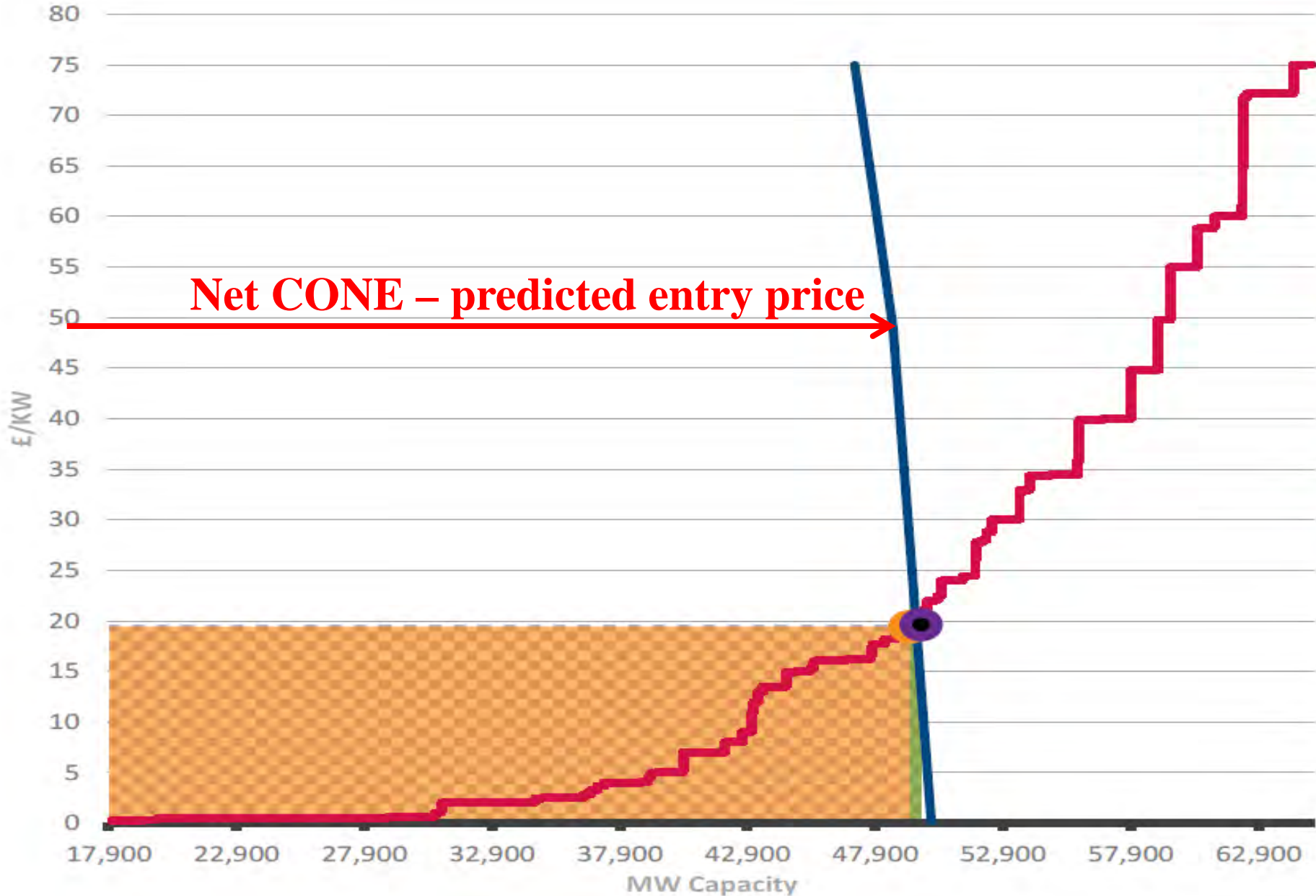


EMR – results so far

- Capacity auction December 2014:
 - PTE criticized **over-cautious excessive procurement**
 - ignoring interconnector contribution
 - New entry price predicted at **£49/kWyr** for CCGT
 - Could have cost **£2.5 billion**
- Market clearing price **£19.40/kWyr**, CCGT entered
 - => auctions much better than bureaucrats**
 - PTE + DG COMP forces interconnectors to be included
- CfDs – those with fixed prices did well
 - DG COMP requires market testing
- => Auction run, set lower prices**



GB Dec 2014 Capacity auction result



Source: National Grid (2014b)

CfD 2015 auction results

Technology		admin price	lowest clearing price	2015/16	2016/17	2017/18	2018/19	Total Capacity (MW)
Advanced Conversion Technologies	£/MWh MW	£140	£114.39			£119.89 36	£114.39 26	62
Energy from Waste with Combined Heat and Power	£/MWh MW	£80	£80				£80.00 94.75	94.75
Offshore wind	£/MWh MW	£140	£114.39			£119.89 714	£114.39 448	1162
Onshore wind	£/MWh MW	£95	£79.23		£79.23 45	£79.99 77.5	£82.50 626.05	748.55
Solar PV	£/MWh MW	£120	£50.00	£50.00 32.88	£79.23 36.67			69.55

Source: DECC (2015)

Foolish bid - withdrew

Energy Union 2015: Action point 5

- Creating a seamless internal energy market that benefits citizens, ensuring security of supply, **integrating renewables** in the market and **remedying** the currently uncoordinated development of **capacity mechanisms** in Member States call for **a review of the current market design**.
 - The Commission will propose **a new European electricity market design in 2015**, which will be followed by legislative proposals in 2016.



Several possible investment solutions

- Real public sector interest rates now near **zero**
 - **Govt finance attractive** when backed by productive assets
 - Aggregate risks low, markets amplify company risks
 - => finance low-C generation from **state development banks**
- **But** need **contestability** to deliver efficiency
 - => **auctions** for PPA contracts
 - Or regulated revenues if flexibility needed? (but generating is simple!)
 - => single buyer (ISO) for efficient dispatch? Or **Pool**?

Design market to fit technology



A new European market design

- Present Target Electricity Model is energy-only market
 - *Successfully coupled interconnectors day-ahead*
- But has not addressed reliability and balancing
 - => Patchwork of capacity remuneration mechanisms (CRMs)
- US FERC – suggest Standard Market Design
 - Based on best pricing principles and hedges
 - *Voluntary*, but nodal pricing seems to be winning

What guiding principles?

Is there an EU SMD that should be an option?



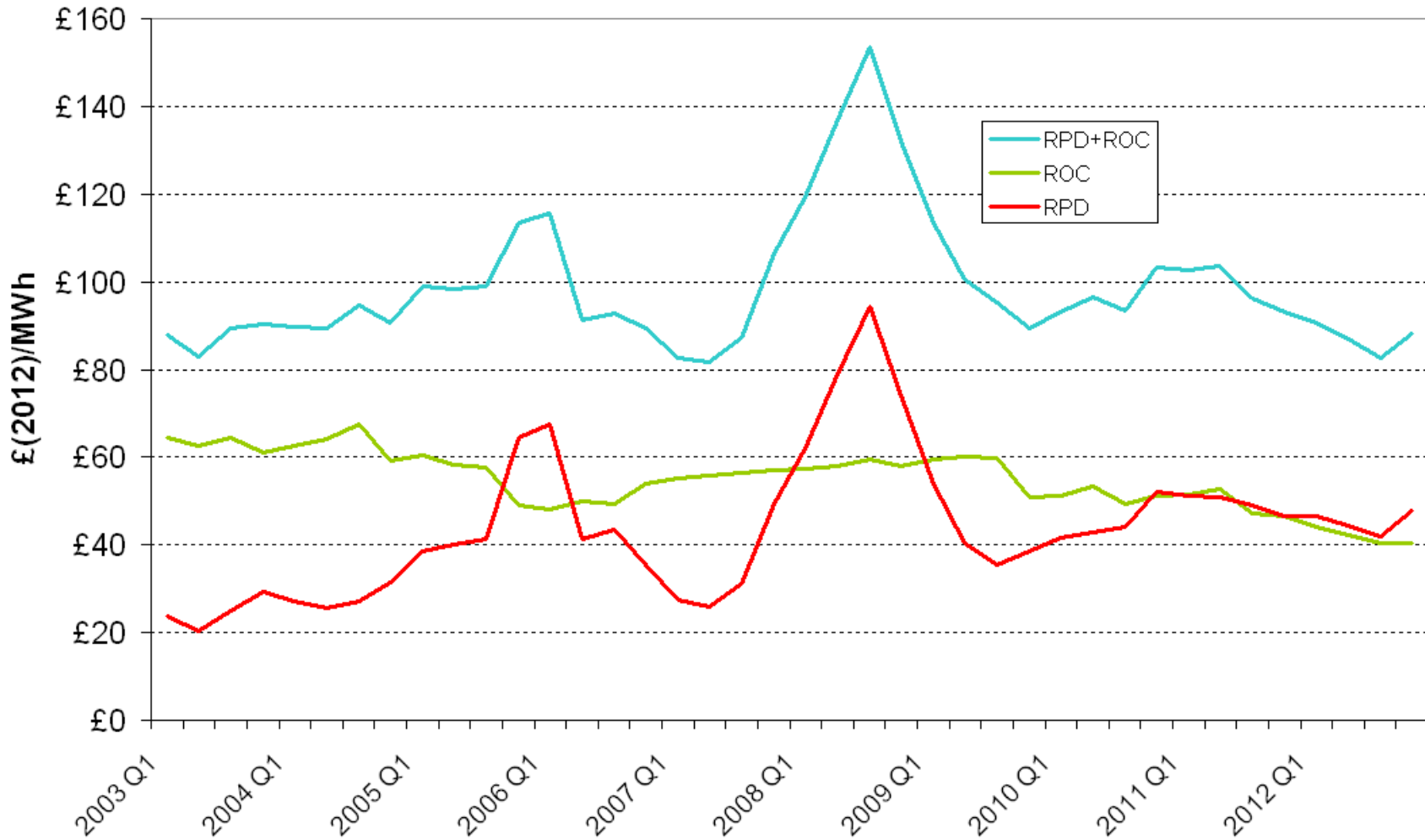
Guiding principles

- **Efficient pricing** solves many problems
 - Trade benefits country with efficient pricing
 - Pricing all **flexibility** reduces need for CRM
 - Each MS chooses its own market design subject to **no distorted prices in coupled markets**
=> **Need to rethink renewables support schemes**
- One market design unlikely to fit all Member States
 - Contrast isolated centrally dispatched SEM with Nord Pool
- Capacity and energy are two different products
=> pay for peak capacity used
 - For wires for peak demand (**no net metering for DG**)
Reduce risk by contracts, not price distortions



Premium FiT risky

Support to Wind under the ROC Scheme (real prices)



Renewable support models

- DG Comp wants **renewables integrated in the market**
 - Wind & PV depress prices in some hours
 - ⇒ **Premium FiT discourages excess supply automatically**
 - But raises **market and balancing risk**
- Hedge with CfD on predicted output/revenue
 - Ideally offered by traders, perhaps with trader of last resort
 - ISO could offer insurance against balancing risk
- Any subsidies needed via capacity payment
 - Based on de-rated capacity, paid on availability
 - CP set through periodic **auctions in nominal terms for n yrs**



Optional EU Standard Market Design?

- **Central dispatch** in voluntary pool
 - ISO manages balancing, dispatch, wind forecasting
 - **LMP + capacity payment** = $LoLP * (VoLL - LMP)$
 - Hedged with **reliability option (RO)**
 - => reference prices for CfDs, FTRs, balancing, trading
- **Auction/tender LT contracts for low-C generation**
 - Financed from state investment bank
 - Credible counterparty to LT contract, low interest rate
 - CfDs when controllable, Premium FiTs when not, **or**
 - **Capacity availability payment plus energy payment**
 - Counterparty receives LMP, pays contract
- Free entry of fossil generation, can bid for **LT RO**
 - To address **policy/market failures**



Future utility solutions

- PV, CHP, EVs, heat pumps => **peakier net demand**
- Smart solutions => manage distribution networks
 - to handle constraints without excess underutilised investment
 - => **time-of-use pricing** or automatic appliance control
 - => **demand side services** needed to handle intermittency
 - => needs **efficient aggregators** for small DSR and DG
 - => Virtual Power Plant concept offers DSR to grid and networks
- network designed for peak not average flows
 - => pay for T&D capacity = **insurance**, including energy
 - => Two-part tariff feasible with smartish meters



Assessment

- Low-C investment is durable and capital intensive
 - needs *stable credible future prices* to invest
 - and guaranteed contracts for cheap finance
 - Two-part tariffs for energy and access?
 - EU policy is a messy 28-state compromise
 - neither stable nor credible: => *subsidiarity!*
 - Each country searches for best solution
 - => *some mix of contracts and capacity markets*
 - Gains from cross-border trading higher with RES
 - share reserves & renewables to reduce investment
 - *Enable efficient solutions to drive out bad*
- rapidly evolving environment for utilities*



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Acronyms

AC	Average cost	
CCGT	Combined cycle gas turbine	
CfD	Contract for difference	
DG, DSR	Distributed Generation, Demand Side Response	
EMR	(UK) Electricity Market Reform	
EV	Electric vehicle	
FiT	Feed-in tariff	
HMT	HM Treasury (Min of Finance)	
ISO	Independent System Operator	
LMP	Locational marginal price or nodal price	
LoLE	Loss of Load Expectation = sum of LoLP = Loss of Load probability	
LT	Long-term	
PPA	Power purchase agreement	
PV	Photo voltaic	
RES	Renewable energy supply	
RO	Reliability Option	
SEM	Single Electricity Market of island of Ireland	
SMC	System marginal cost	
SMD	Standard Market Design (the US model) T&D	Transmission and distribution
VOLL	Value of Lost Load	
WACC	Weighted average cost of capital	



Spare Slides

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Energy Union Feb 2015

- In line with the Environmental and Energy Aid Guidelines, renewable production needs to be supported through **market-based schemes** that address market failures, ensure cost effectiveness and **avoid overcompensation or distortion**.
- The Commission will propose a **new Renewable Energy Package in 2016-2017**.
- ...the new European energy **Research & Innovation** approach should comprise an updated Strategic Energy Technology Plan



Local conditions influence price setting

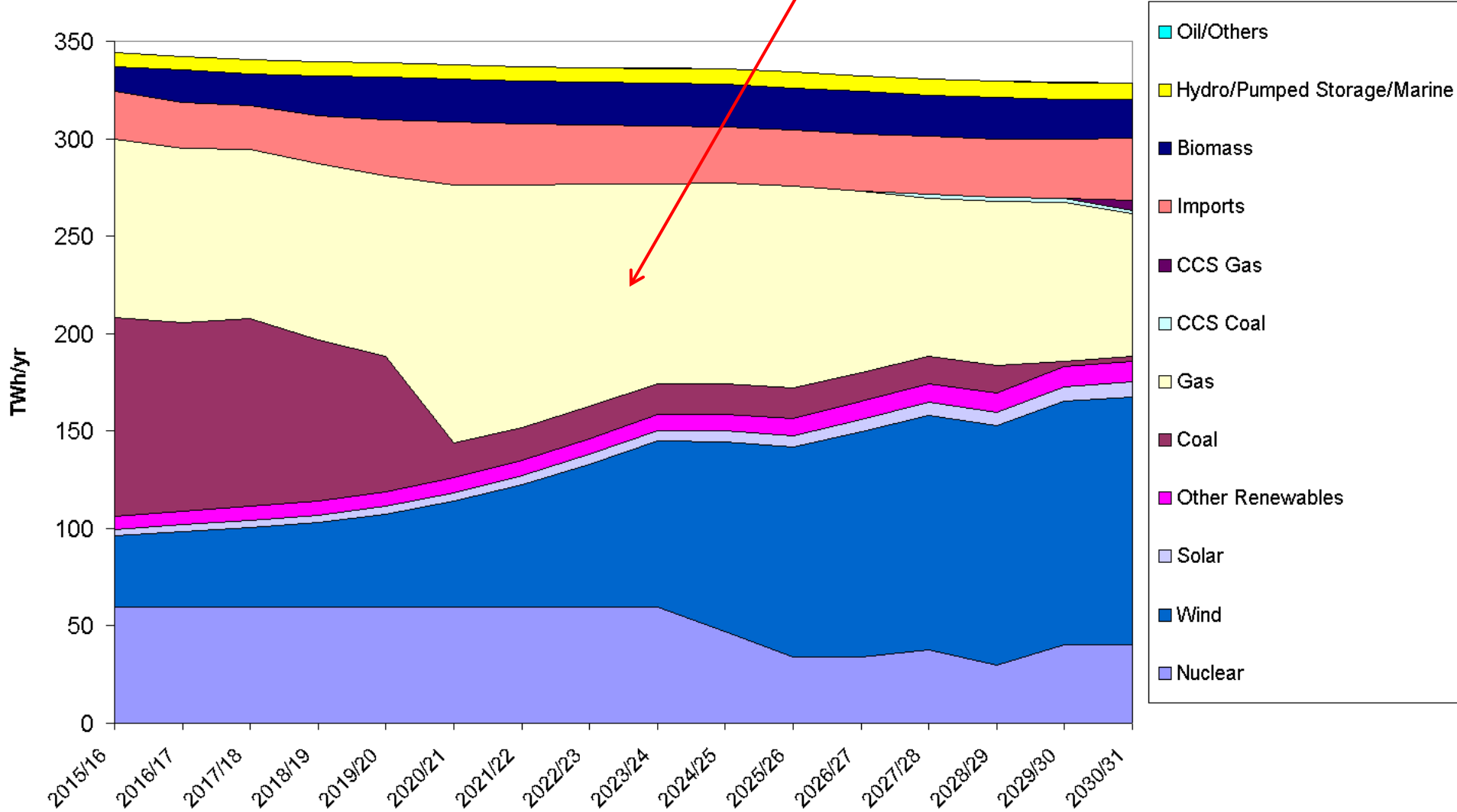
- Nordic model – huge low-MC storage hydro
 - Well interconnected to markets with different fuel mix
- French model: 88% zero-carbon zero MC
 - But well interconnected, high exports/imports, EdF dominant
- GB model: coal, gas, nuclear almost equal
 - Competitive market, interconnection 5% but rising
- DK: wind 80% of peak demand, coal 45%
 - Very strong interconnection
- DE: high wind + PV erodes peak prices
 - reasonable interconnection, weak N-S grid
- SEM (NI+IE) small, 15% interconnected, diversified
 - Wind growing to 75% non-synchronous penetration





Does gas usually set price?

Generation Output Slow Progression



Criticisms of EMR

- “Contracts mark return to **Single Buyer Model**”
 - but all IPPs in 1990s were long-term PPAs
- “**Bureaucrats**, not markets choose investment”
 - but current RES support designed after intense lobbying by incumbents
 - => **auctions** to create competition
 - => contracts should incentivise efficient operation
- “Wholesale **price will be distorted by contracts**”
 - **CfDs are financial**, problem is **low variable cost plant** => consumer capacity payments / reliability options?
- Without govt. underwriting contracts no cheaper
 - need guarantees that are defensible under State Aid rules

