

Regulating the Electricity transition



1st International Capacity Building (ICB) "Learning from
Regulatory Experiences and Market Development in Europe"



Insights from the UK and its Electricity Market Reform

Michael Grubb

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Chair, UK Panel of Technical Experts on Electricity Market Reform

Former Senior Advisor, Sustainable Energy Policy / Improving Regulation, OfGEM (2011-2016)

- Evolution of UK electricity - overview
- A brief word on retail markets
- Electricity market reform
- The long term strategy
- Renewable energy and Intermittency
- Lessons and prospects

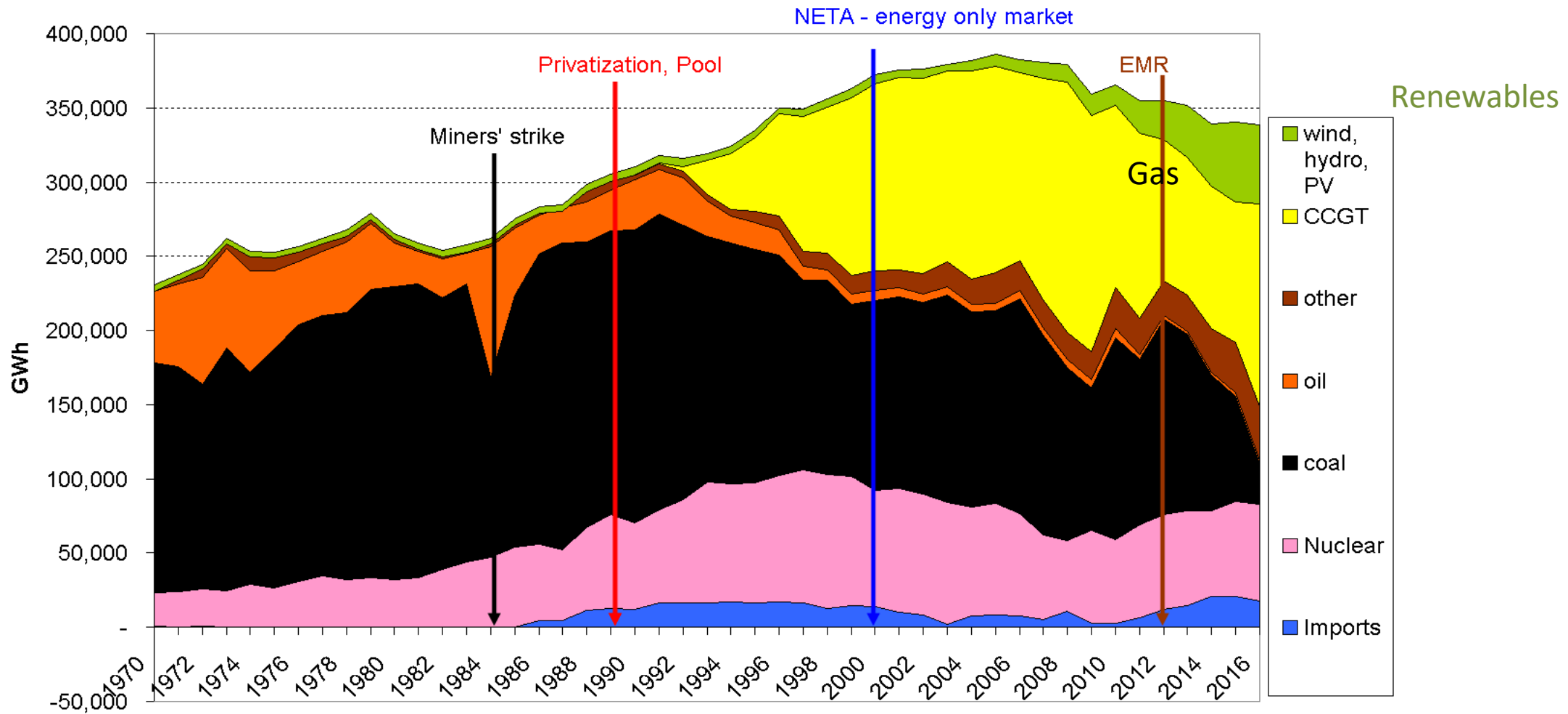
Presentation to Centre for Energy Regulation
Visiting delegation of Indian electricity regulators and experts
London, 19th Oct 2019



An “island of coal in a sea of oil and gas” no longer

.. moved through a ‘sea of gas’, coal now exiting with rapidly rising renewables

Generation supplied by fuel 1970-2016



M.Grubb and D.Newbery (2018), Reforming Electricity Markets for the Transition: Emerging Lessons from the UK's Bold Experiment, MIT Working Paper 113, <http://ceep.mit.edu/news/113>; Subsequent academic paper in *The Energy Journal*

	Policy environment	Regulatory remit
1990s	<p>First liberalisation</p> <ul style="list-style-type: none"> - Competition through electricity pool - System marginal price + cap^y payment <p>⇒ “Dash for gas”, based on Long term contracts (Purchasing Power Agreements) with distribution companies</p> <p>⇒ Collapse of R&D</p> <ul style="list-style-type: none"> - Some contract support for renewables 	<p><i>“Promote competition”</i></p> <p>Retail liberalisation</p> <p>Concerns about oligopolistic power in wholesale markets</p>
2000s	<p>Bilateral trading market (NETA/BETTA)</p> <ul style="list-style-type: none"> - replace pool, energy-only market <p>⇒ Vertical integration of generators with supply companies;</p> <p>⇒ Limited investment</p> <ul style="list-style-type: none"> - Market certificate trading (ROCs) support for renewables 	<p><i>“Protect interests of consumers”</i></p> <p>Growing concerns about lack of investment or new entry, transmission connection & bottlenecks, and short-termism ... and rising prices and fuel poverty</p>
2010s	<p>Electricity Market Reform (EMR)</p> <p>+ Climate Change Act</p>	<p><i>“Protect interests of present and future consumers”</i></p>



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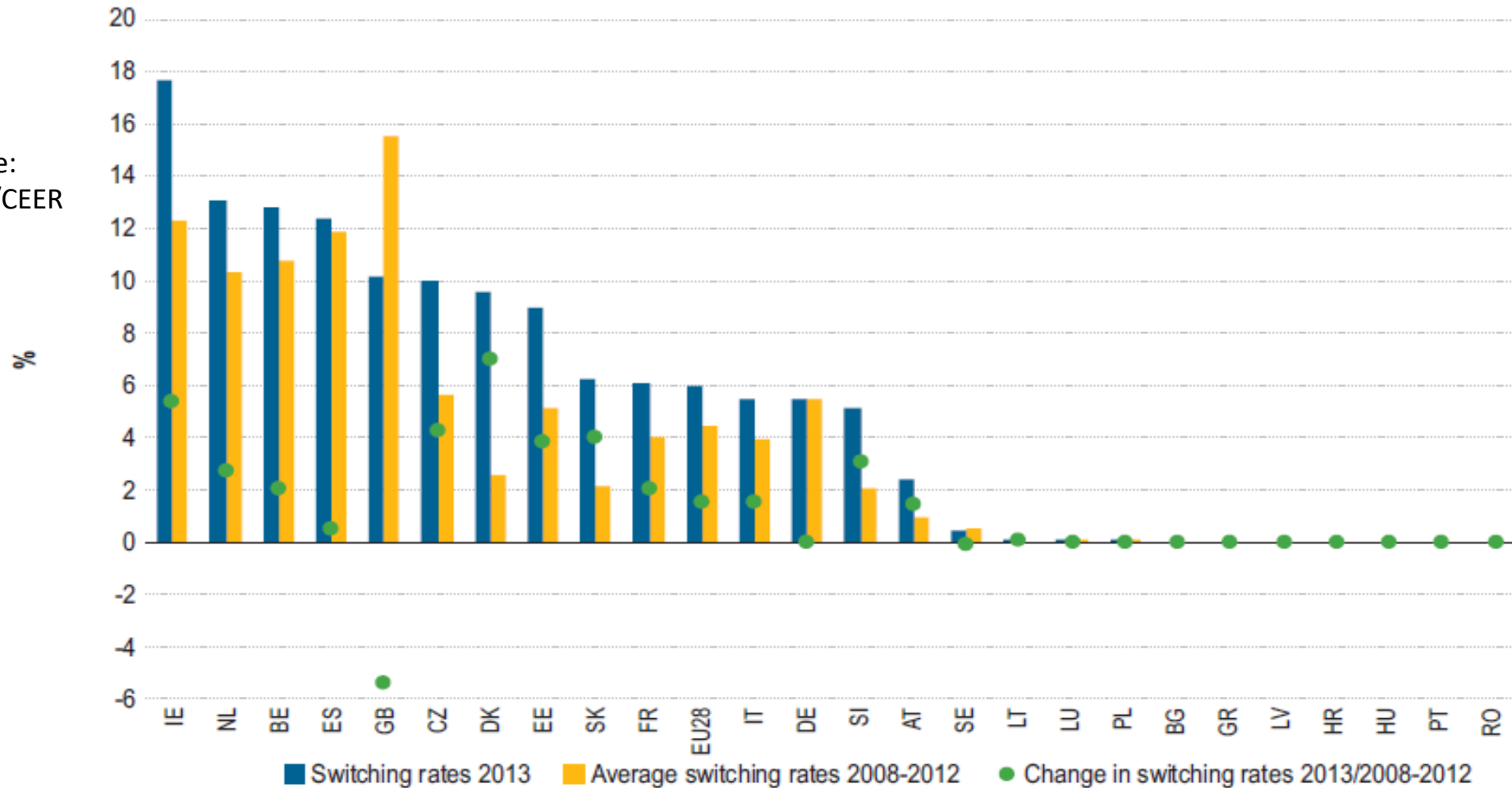
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Retail markets – ‘Sticky customers’

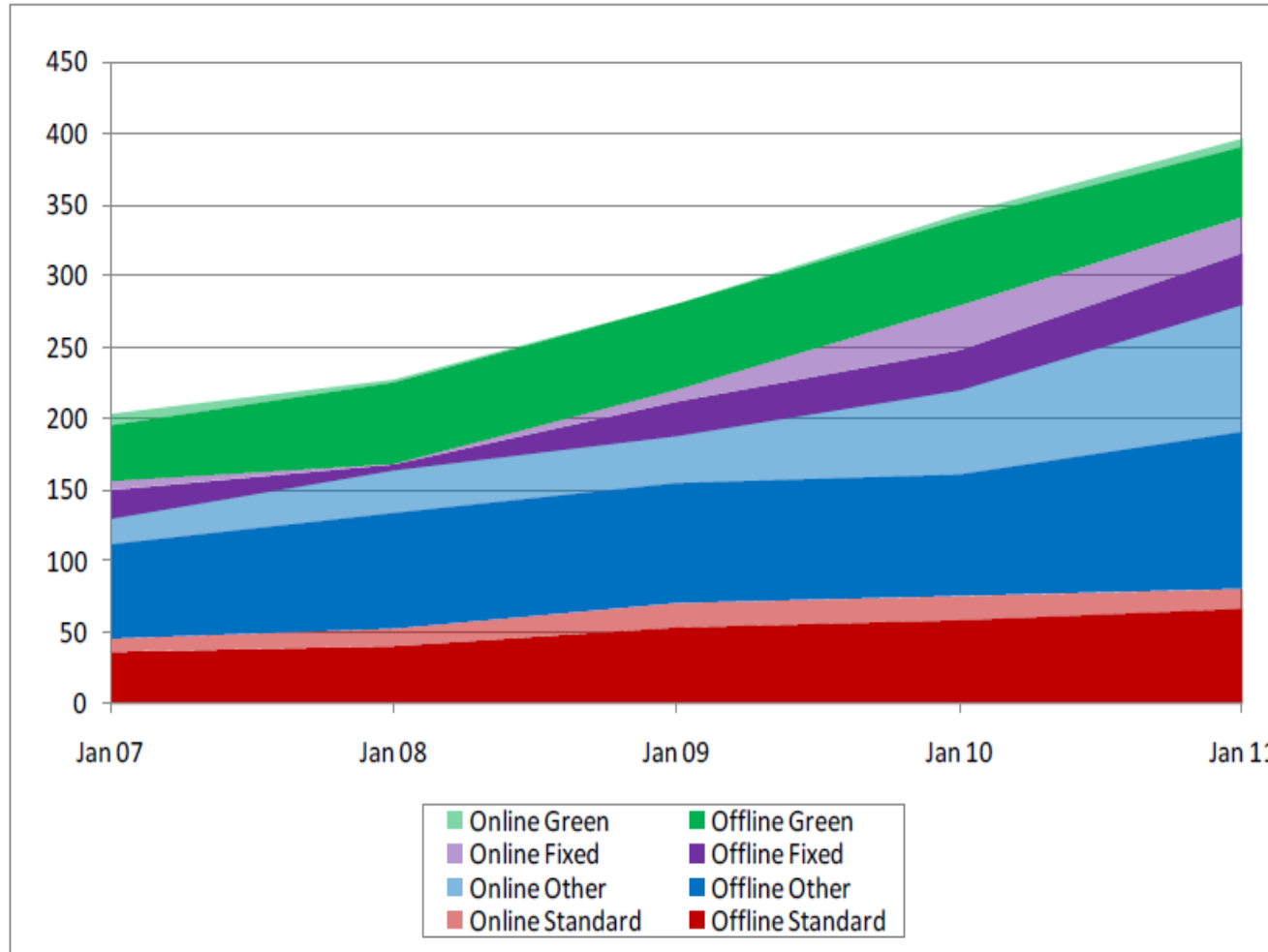
- concern that many customers don't take advantage of competition

Switching rates (number of households switching supplier per year) for gas household consumers in Europe, 2008-2012 and 2013



– concerns over prices and competition

Figure 2.1 Number of tariffs available to domestic consumers on 1 January 2007 to 2011



- Homogeneous commodity/quasi-commodity
- Main innovation in contract packages, not product
- ‘Confusopoly’
- No evolution to energy services market

Source: Ofgem 2011





Characteristics of electricity and gas as products make them strongly prone to “First Domain” decision-making behaviour (dominated by non-economic factors / non-optimising behaviour) with low rates of innovation

No product differentiation

- All electrons (or all methane): no physically distinct products to drive consumer engagement

Incidental not deliberative consumption

- Not a conscious choice: implicit in other decisions with cost usually invisible (or trivial) at point of use

No substitutes

- For the vast majority of uses there are no reasonable substitutes to electrons or methane: cannot buy something different instead

Continuous

- No discrete point at which consumers “need to go and buy a new one” and hence focus on decision

Essential

- impractical to force a decision (eg. “choose or be disconnected”) unlike many financial or insurance products with natural expiry terms.



=> Disengaged consumers may be natural state of electricity or gas system

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- Neo-liberal consensus
 - Competition
 - From duopoly to breakup
 - From pool to bilateral trading
 - Environment
 - Carbon pricing (Climate Change Levy, EU ETS)
 - .. Move towards more diversified technology incentives
 - Implementation supports
 - Carbon Trust, Energy Savings Trust, supplier obligations
- Rise of investment worries, regulatory tensions and popular concern over rising prices and vulnerable customers
- Landmark 2008 legislations
 - Energy Act inc Ofgem “present and future consumers”
 - Climate Change Act
- Electricity questions take centre stage



Background

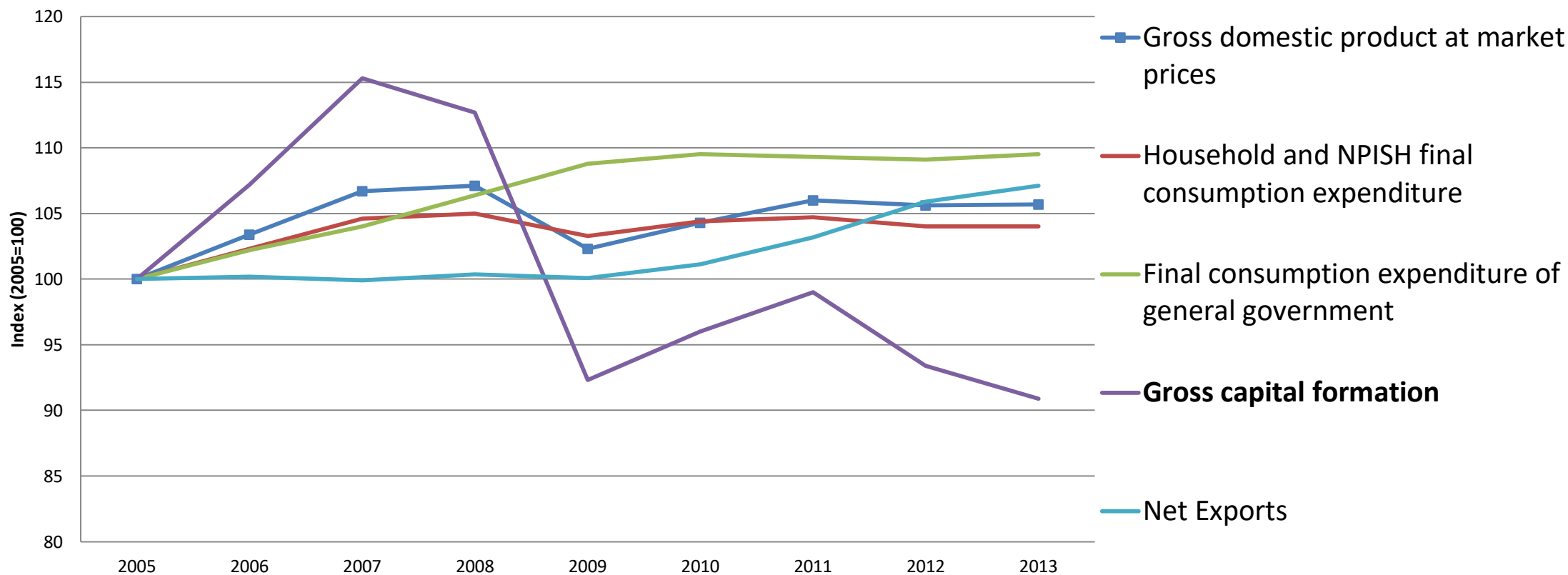
“Its complicated ...”

- ‘Pioneer of liberalisation’ concluded it could not deliver the capital investment needed for security or decarbonisation
- Nuclear & renewables seen as key
- Intellectual evolution:
 - Academic struggles between idealised theory and emerging evidence
 - CCC (2008) concern around inadequate capital intensive investment
 - Ofgem (Project Discovery, 2009) concern around security adequacy



Growing emphasis on need for stable investment environment in aftermath of financial crisis

Relative decline of gross capital formation in the EU



Source: Spencer T, O. Sartor et al, "What is Needed in the EU's 2030 Climate and Energy Framework?" *Climate Strategies* working paper, forthcoming 30 Sept 14



See also House of Lords, EU Subcommittee D report, 2013: 'No country is an energy island: securing investment for the EU's future'

Including power sector analysis of costs of delay

Eurelectric's *Power Choices Reloaded* – high cost of a Lost Decade

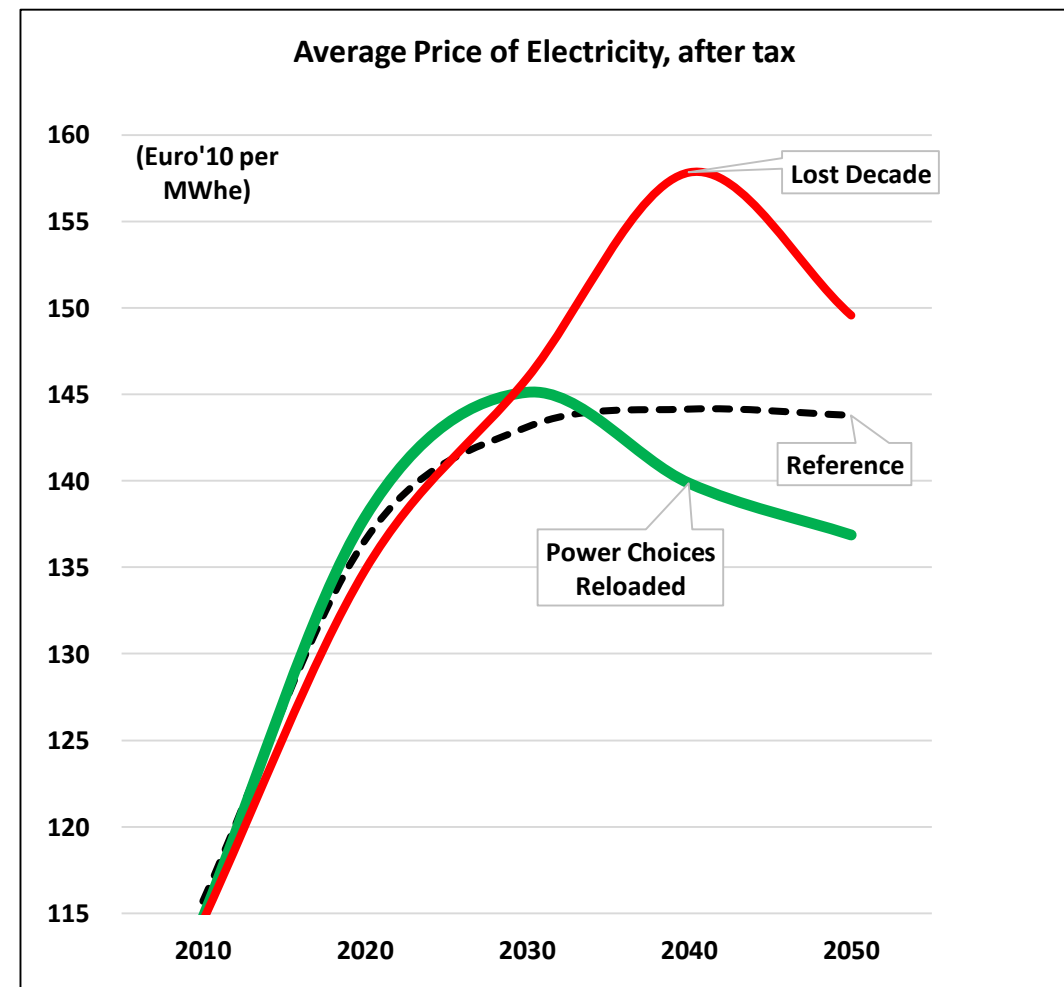
Power Choices Reloaded's *Lost Decade* modelling scenario assumes a complete lack of action in the decade 2020-2030, therefore the entire decarbonisation action has to occur in the last two decades to 2050

Infrastructure, power sector decarbonisation, mobility electrification and technology R&D, as well as energy efficiency in the demand side sectors will have to develop in a very short period of time post-2030

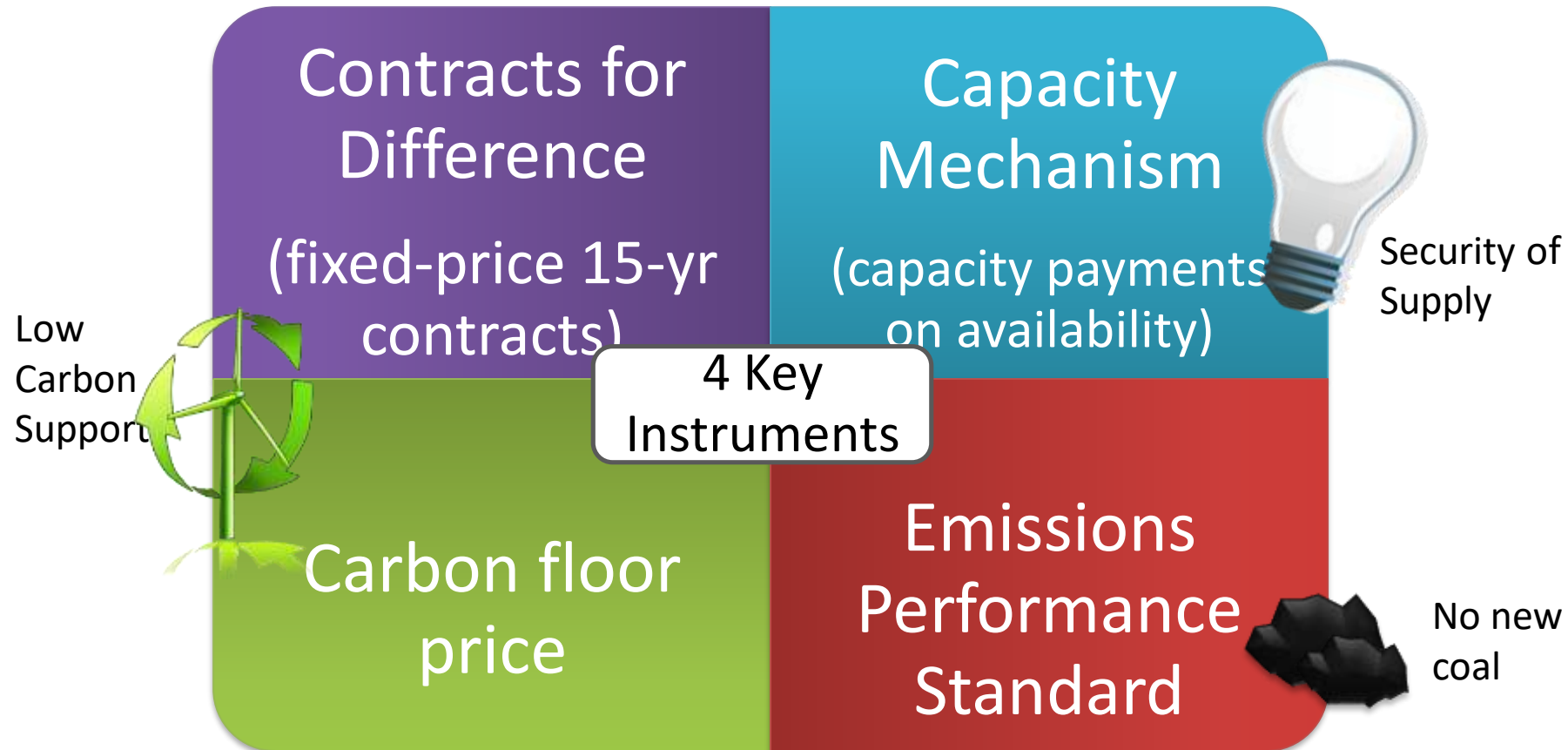
The changes required in the system from 2030 to obtain the necessary cumulative emissions reductions by 2050 result in this scenario being barely feasible in true life

Key failures involved in the Lost Decade case

- Weak carbon market until 2030
- Limited financing under uncertainty hampering investment
- Market coordination failures delaying infrastructure
- Non-completion of IEM leading to low cross-border energy trade
- Slower pace of technology progress: learning curves and build up of supply chains
- Delays to energy efficiency persisting up to 2030, especially on the demand-side and in electrification



Four instruments



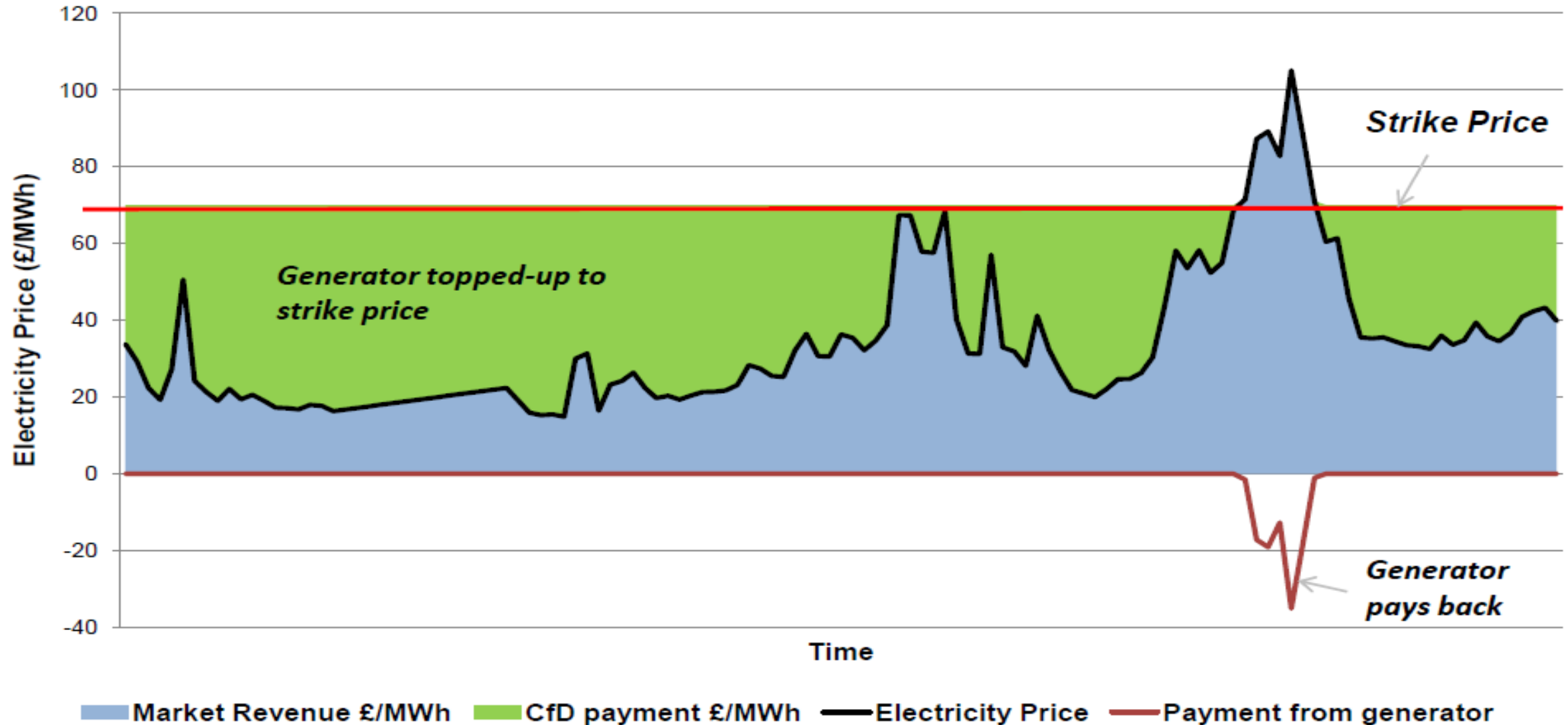
... with significant challenges in overall institutional design.

Some Key debates

- Can shifting risk to government reduce costs? Yes if
 - *the risks arise from private perception of policy risk;*
 - *markets (particularly capital markets) are myopic*
 - *the benefits are partly public (eg. Due to inadequate environmental pricing, or innovation / learning spillovers, etc)*
- Do we need a Capacity Mechanism in addition to low carbon supports?
 - *Yes in UK context – but design is crucial to minimise risk of perverse incentives*
- Institutional complexities
 - *contracting bodies and their governance*
- Terms and constraints for long term contracts
 - *Hinkley Point (35yr) vs renewables (15 yrs)*
 - *State Aid struggles*
- Risks to market?
 - *More State involvement*
 - *Some risks of perverse incentives remain (eg. Metered output)*



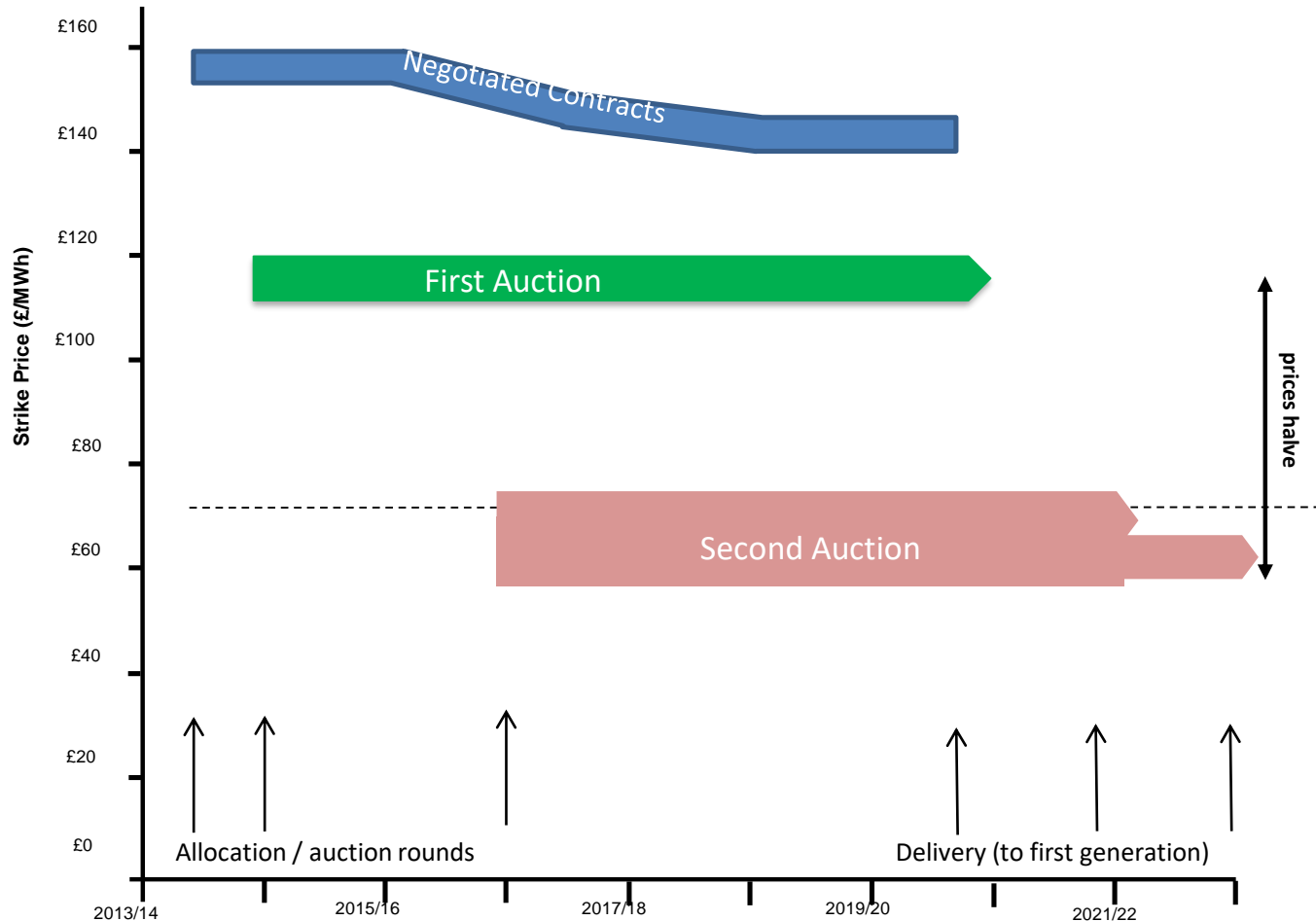
Contracts for Difference



Benefits and lessons for UK Offshore wind



Drawing also on the *EnergieWende*, the UK has been able to engineer our own dramatic transformation of a huge renewable resource



Initial gain from auctions followed by dramatic progress in offshore wind, > halving costs

Enormous resource, growing UK stake in the value chain

Capacity Market

Why

- Ensure market can deliver **security of supply**
- Stable revenues to **encourage investment**

How

- **Market wide** auction of capacity obligations, run by National Grid
- Successful bidders get **stable revenue** at clearing price
- **Obligated to deliver capacity** when needed or face penalties
- Technology neutral – but those receiving CfDs are not eligible
- Pilot scheme to help Demand-side response transition into the CM

Effect

- ✓ Insurance against blackouts
- ✓ Reduces price volatility
- ? Less peaky prices – impacts on other investments (eg. DSR)
- ? Need independent procedures for establishing 'derating factors' - complex

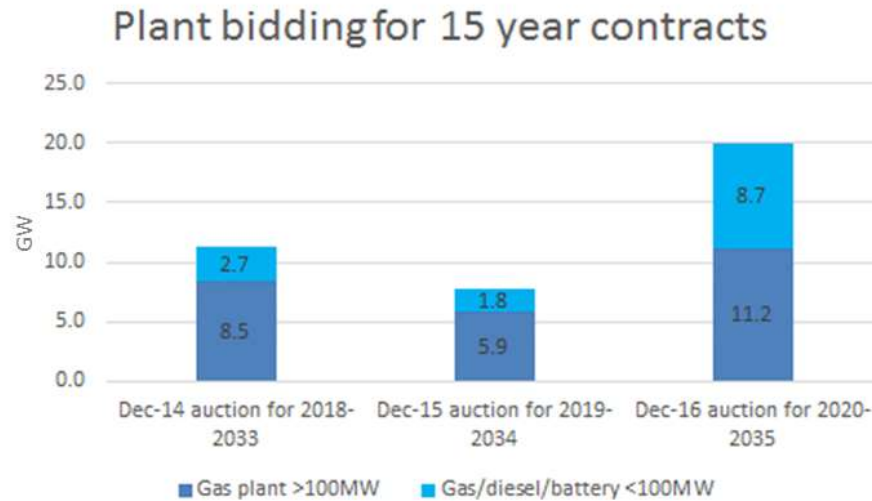


Capacity: be careful what you ask for ...



Fixed, system-wide auctioned payments for firm capacity

Lots of bids, low prices, new options, lots of angst ...

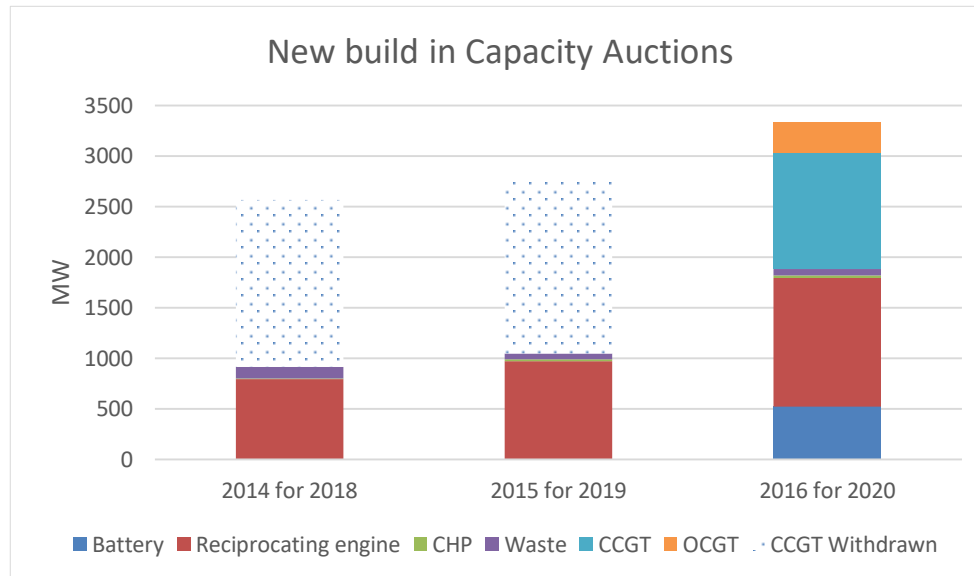


First main capacity auction (Dec 2014)

Almost 50GW awarded, clearing price **19.40/kW/year***
 Mix of 1-year, 3-year (refurbishment) and 15 year (2.5GW of new build out of 10GW bid) contracts
 Mainly existing nuclear, gas and coal generators
 One new big gas plant wins agreement – but cancelled
 V. Little demand side response

Second main capacity auction (Dec 2015)

Clearing price **£18.00/kW/year**
 46.35GW awarded – new options replace retiring coal
 Interconnectors, 1GW of small reciprocating engine
 Concern about diesel



Third main capacity auction (Dec 2016)

Clearing price **£22.50/kW/year**
 52.43GW awarded, inc 3.4 GW new capacity – over 500MW batteries
 New diesel largely excluded, but wider concern about 'embedded benefit' exemptions from transmission

Jan 2018: Reformed system yields *even lower price - £8/kW/yr*



Increasing role of government

- Does not necessarily imply reduced role of competition
- May give competition *direction*, create 'new markets'

Giving competition direction / 'new markets'

- May increase pace and/or scale of competition
- Challenges incumbency and likely to reveal new options

Be careful what you ask for

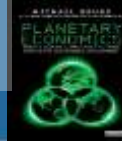
- Not all new options will be welcomed
- May crowd out what you thought you wanted (but might change your mind..)

Our language and metrics are inadequate

- Are these 'interventions' or 'markets' or what?
- What is a subsidy (and how do we measure it)?
- What is 'baseload', what is 'backup', what is 'reserve margin'?
- Are EMR instruments the long term solution? Indeed, is that a chimera?
- What is the evolution ... ?



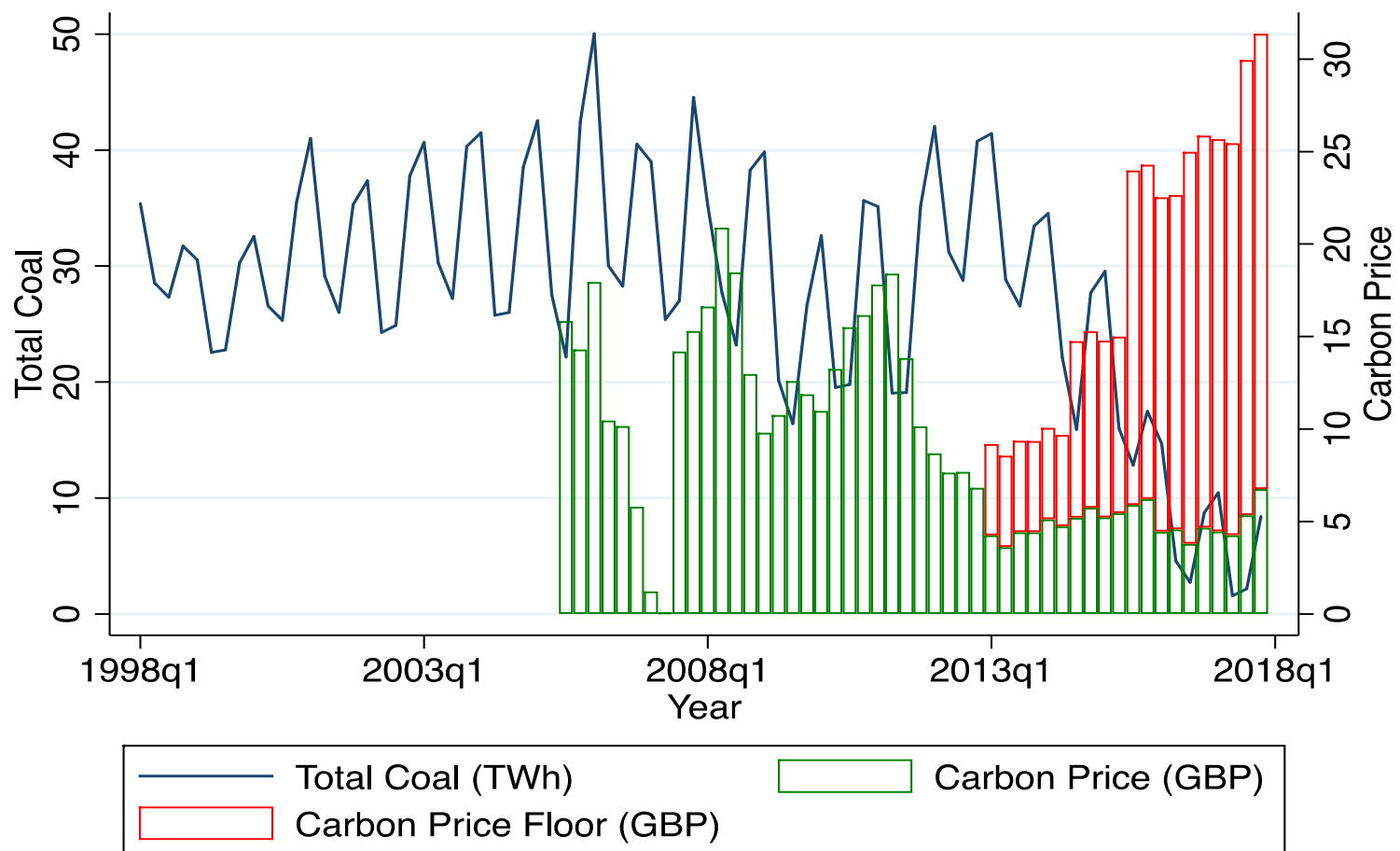
+ Carbon floor price impacts coal



Dramatic (80%) fall since 2012: first days without coal power for over a Century
Driven as declining gas price meets rising carbon price, and renewables
Falls 2012-15 offset by rising renewables; increased gas in 2016

UK power sector CO₂ **halved** since 1990, coal now below 10% of generation.

UK Coal Generation and Carbon Prices



C price drives *operation and closure*, less new investment or efficiency. Impact since 2014 much bigger than before due to price+ **and** :

- Lower gas – coal price differential
- energy efficiency policies, demand declining since c. 2010
- Rapidly rising share of renewables

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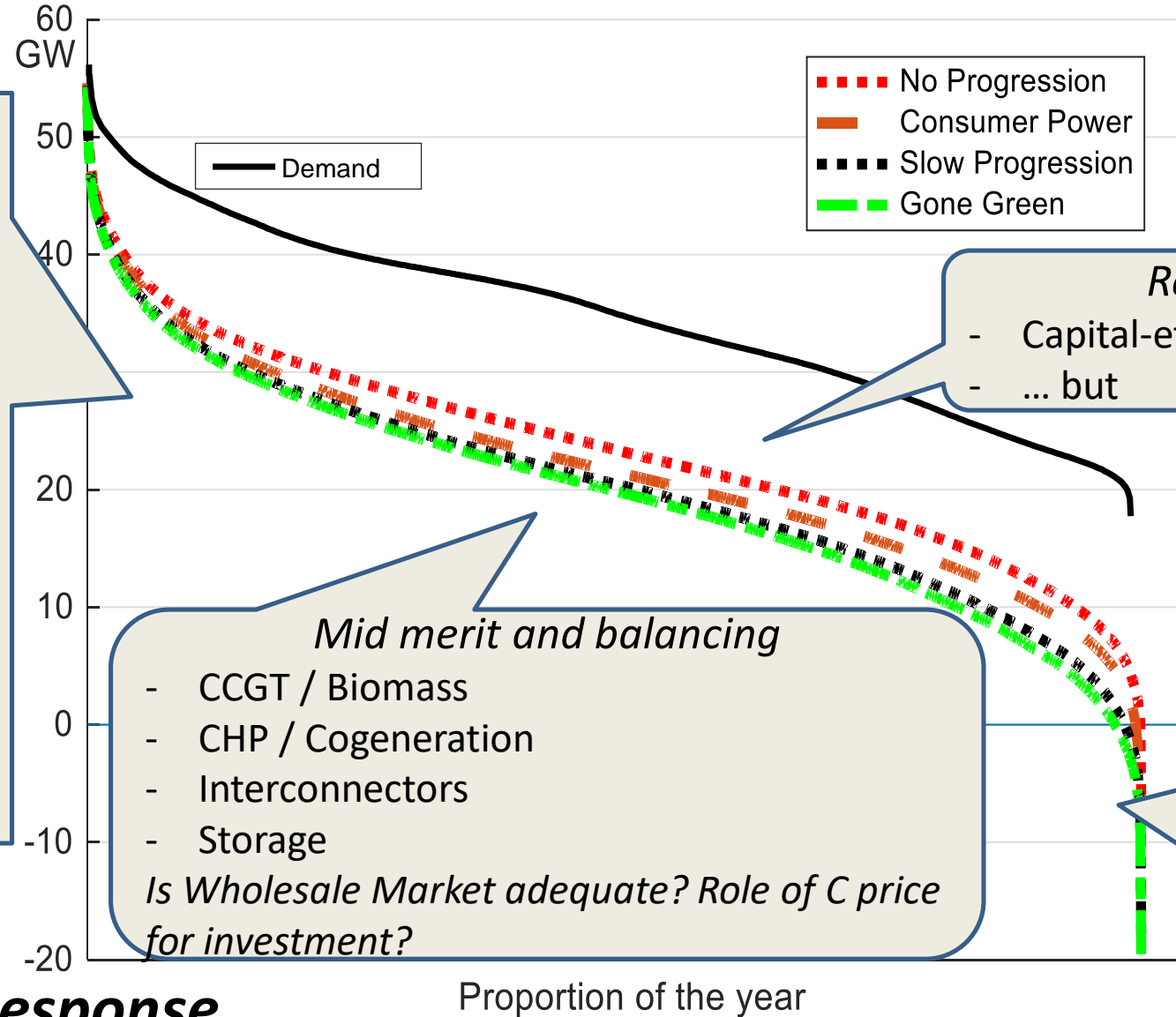


Future Challenges

- Impact of sporadically unstable gas prices
- Politicisation of the energy debate
- Nationalism vs Europeanisation of UK energy system and the accounting of Interconnectors
- Popular opposition to onshore wind driving up energy costs
- Interactions between capacity mechanism and CfDs
- The impracticality of a rising UK-only carbon price floor fuels doubt over the 'post-EMR' landing
- Politicisation of the European debate and doubts about political will for meaningful 2030 consensus
- *What is an efficient system with renewables and Intermittency ...?*



A strategy for changing 'load duration' & 'system costs'



"Peaking and peak-shaving:"

- Reciprocating engines (gas or other)
- Industrial backup
- DSR
- Interconnectors
- Storage
- Varied 'latent capacity'

Is Capacity Mech really fit for all this?

Renewable energy

- Capital-efficient contracts
- ... but

Mid merit and balancing

- CCGT / Biomass
- CHP / Cogeneration
- Interconnectors
- Storage

Is Wholesale Market adequate? Role of C price for investment?

"Surplus utilisation ..."

- Interconnectors
- Storage
- ? H generation?

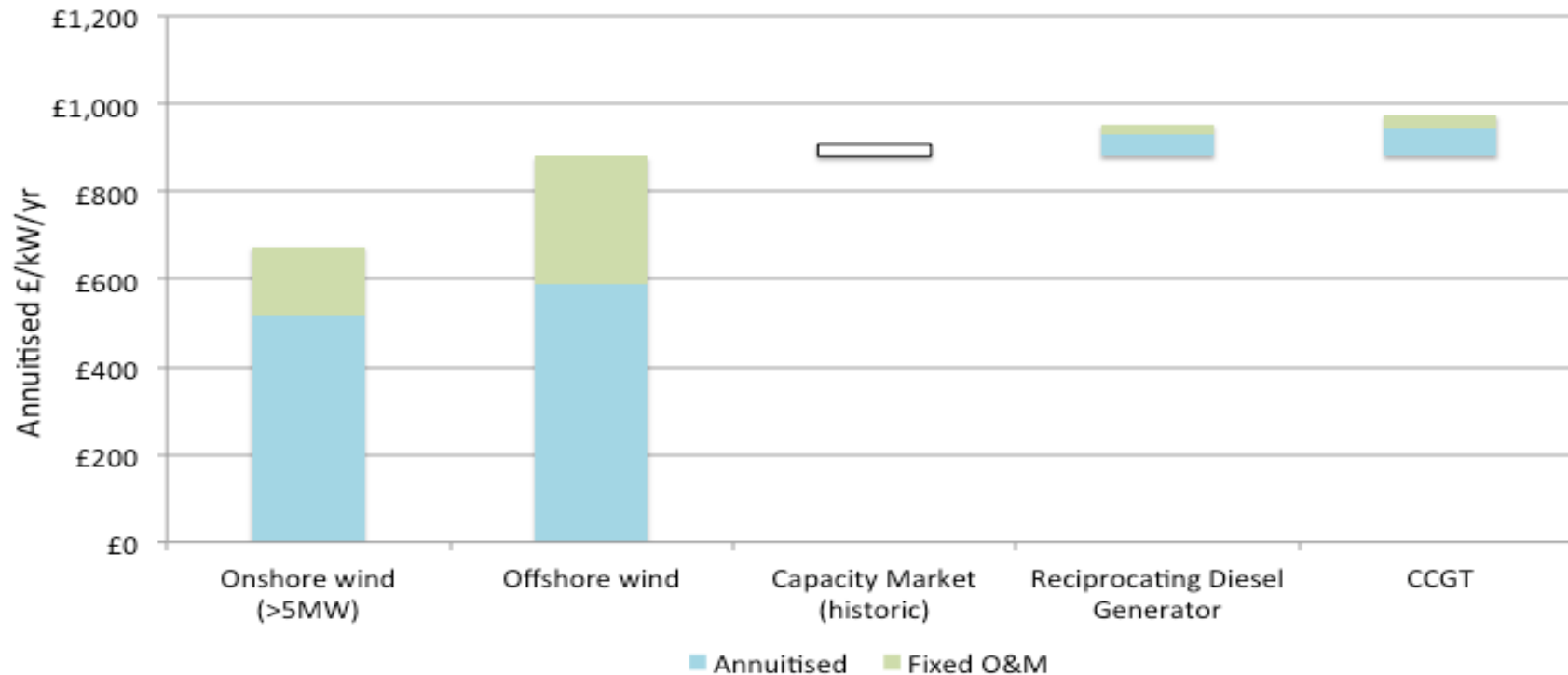
Or conflict and cannibalisation?

... and Dynamic response...

Proportion of the year

The cost of 'backup' *in itself* is modest

The capital cost even of new backup capacity adds maybe 10% (annuitized capital cost)



Notes:

- Fixed O&M includes insurance, connection and use of system charges.
- The figure assumes new backup capacity is required equal to the annual average output of the wind energy, which is a plausible indication of the optimal level.
- Costs are annuitized at 5% ARR; USD to GBP exchange rate = 0.75
- Offshore wind, onshore wind and CCGT values from DECC 2013 cost of generation publication, 2016 projected values. For reciprocating diesel engine, data from Lazard Version 9



Source: Grubb, Smith and Drummond (2016), UCL submission to House of Lords Enquiry into the Economics of UK Energy Policy: UCL EI/ISR, October 2016

EMR - renewables: trim the sails before rocking the boat

- CfD auctions for renewables – reinstate the cheapest
- ... whilst articulating system costs and time-dependent options

EMR – capacity market 5-year review: reform, or reboot?

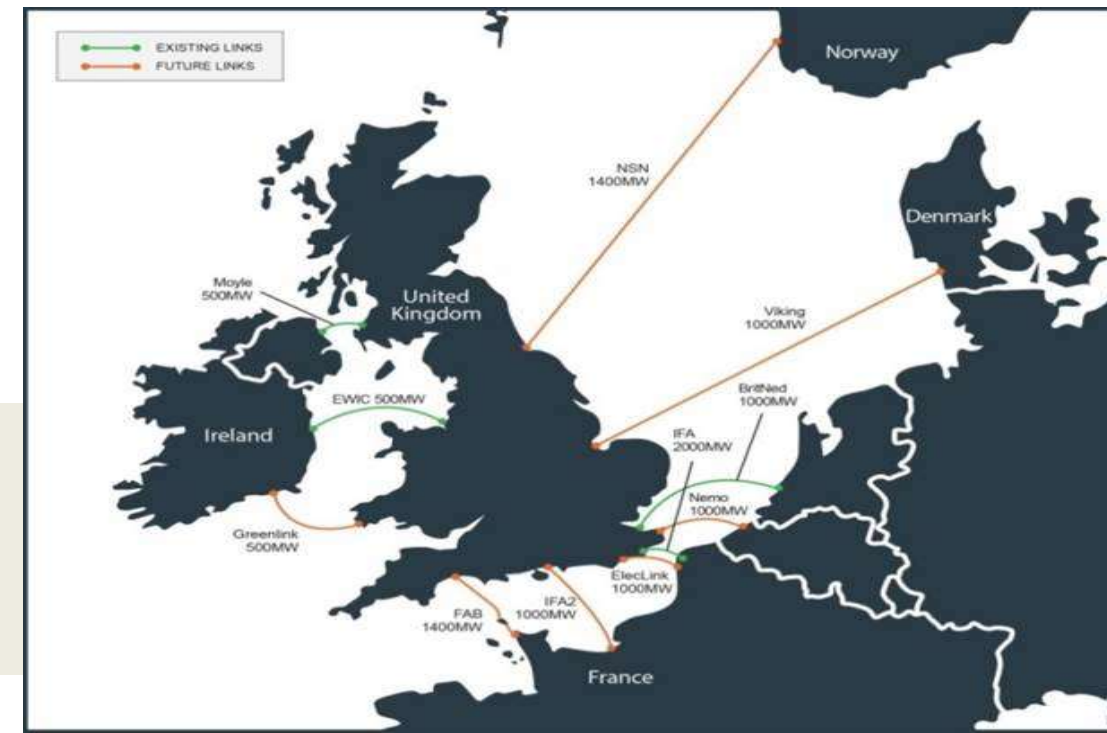
Need to focus **on the D's not the C's**:

- Decentralised generation
- Demand-side resources & differentiation
- Dynamics
- ... and **DATA**

Distributed service providers (DSP/Os?)

Post-Brexit ...

- Too early: could UK stay in a pan-European Energy Union ?
- ? Including Single Electricity Market ?
- Direct cross-border contracting?



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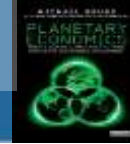
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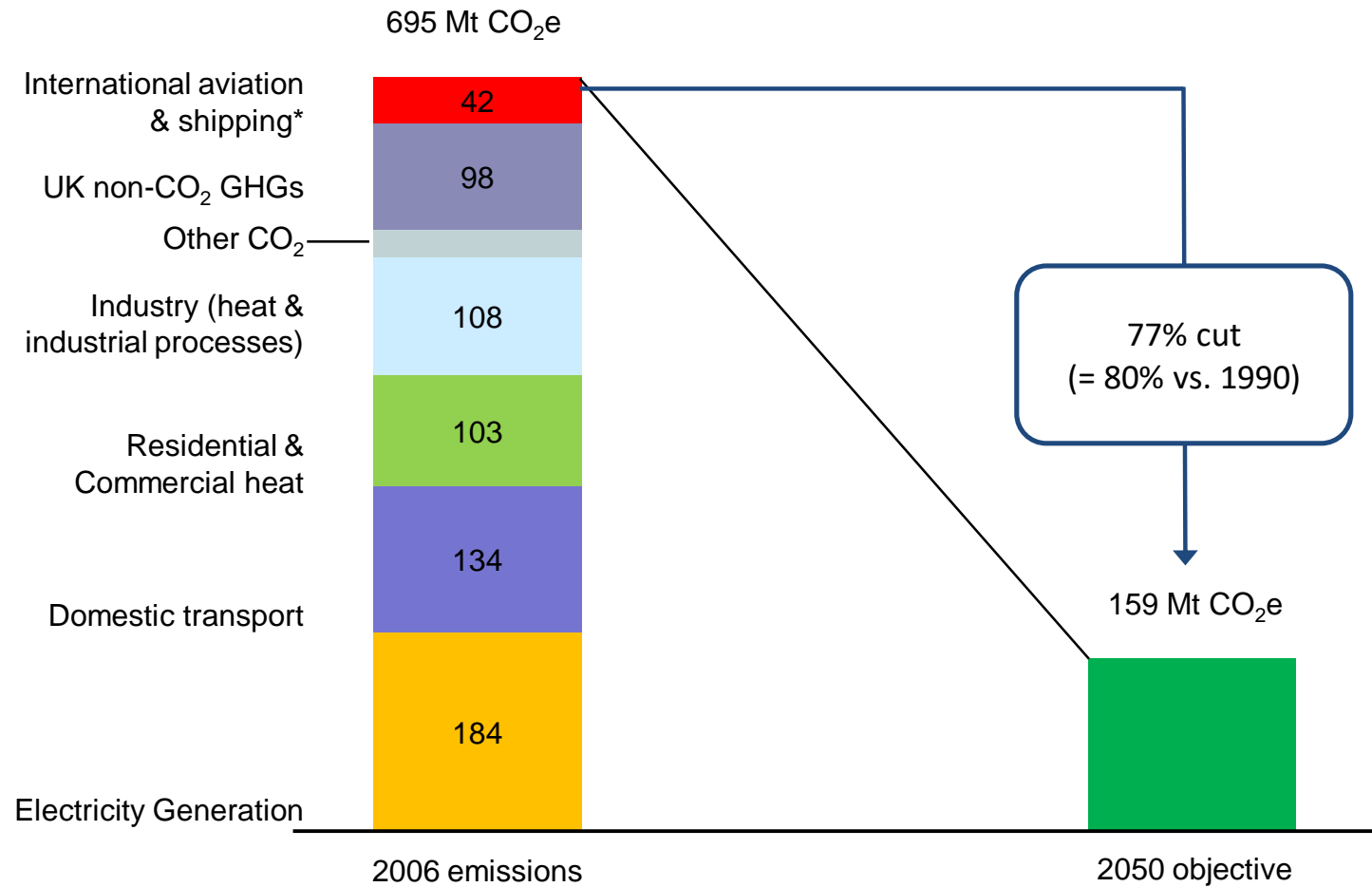
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2008 UK Climate Change Act

- UK commitment to 80% reductions GHG emissions by 2050 (from 1990)



* bunker fuels basis





CCC Report (Dec 2008) placed decarbonisation of electricity at the centre of the intermediate and long-term strategy

Reducing power sector emissions:

Renewables (Wind, solar, tidal and marine, biomass), nuclear, CCS

Application of
power to transport
and heat

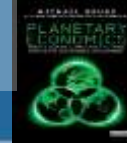
Reducing transport emissions:

- Fuel efficiency
- **Electric**/plug-in hybrids
- Bio fuels

Reducing heat emissions:

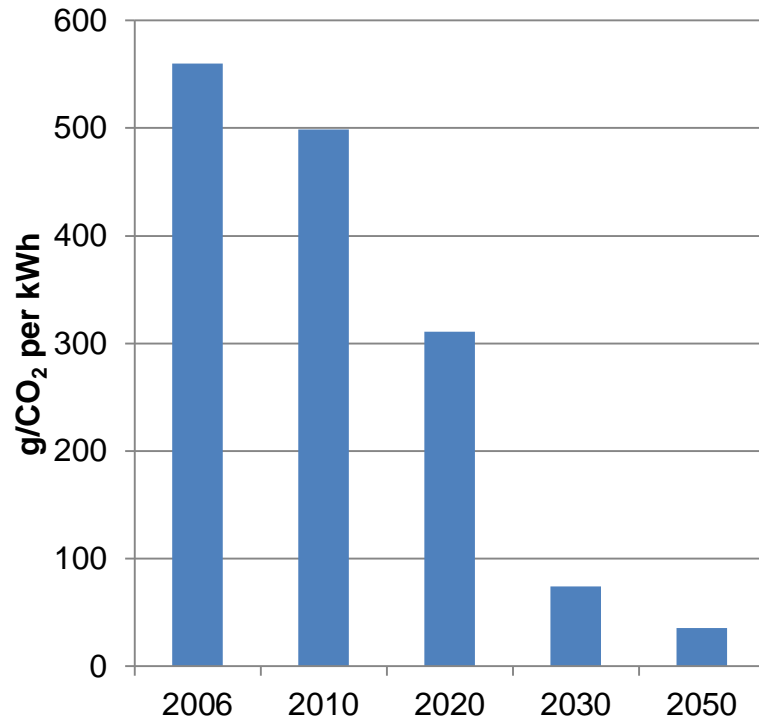
- Energy efficiency
- Lifestyle change
- **Electric heat** (e.g. heat pumps, storage heating)
- Biomass boilers
- CCS in industry



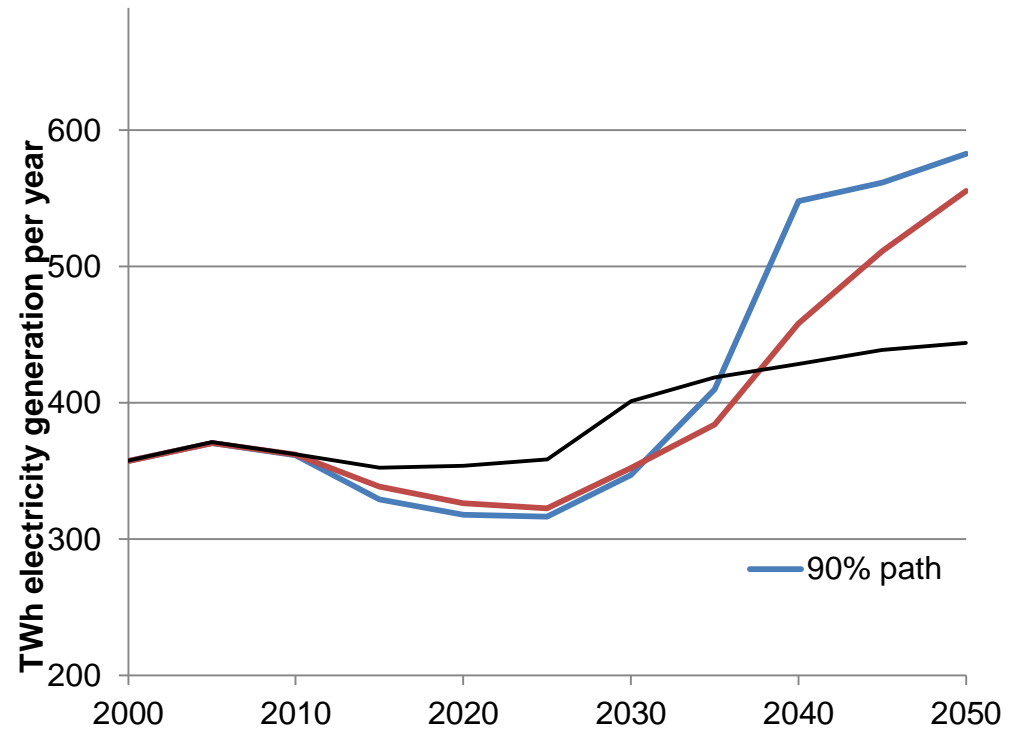


The strategy requires radical decarbonisation of power sector *followed by expansion of electricity to transport and maybe heating sectors*

Electricity CO₂ emissions intensity to 2050



Electricity generation to 2050



... which would also bring short-term storage with the added demand



EMR is a step forward but far from the whole journey

- May evolve multiple markets with managed competition between them?

