

UK Electricity Market Reform and the Energy Transition: Emerging Lessons

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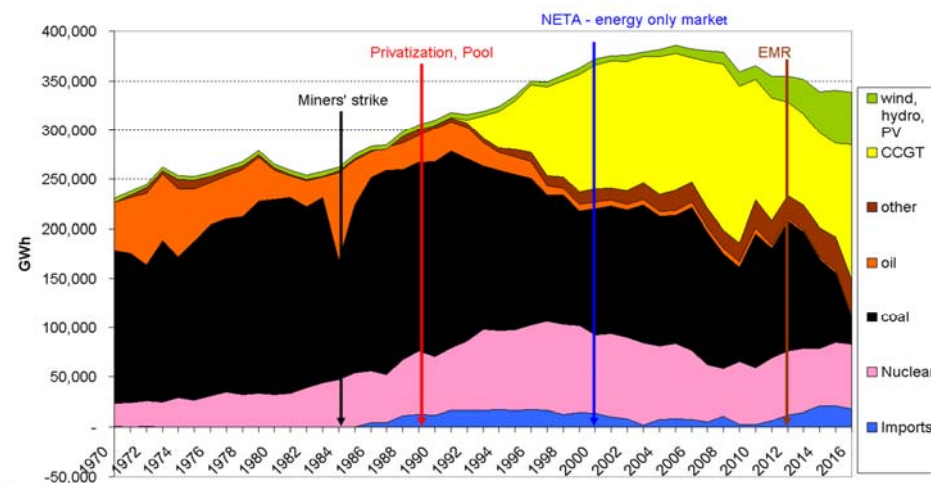
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- Evolution of UK policy & regulation
- **EMR reforms**: aims and instruments
 - Need better support for **RES**
 - Need better signals than ETS for **decarbonization**
 - Need timely **flexible capacity**
- **EMR results**
 - **carbon price support**, **Emissions performance standard**
 - **CfDs** for zero-carbon generation and auctions
 - **capacity auctions**
- **Lessons** for market design and regulation
 - Capacity needs reward
 - auctions better than bureaucrats
 - **RES support needs improving**
 - **network tariffs need major rethink**

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Evolution of electricity market and policy

Generation supplied by fuel 1970-2016



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UK electricity journey – overview

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

- ETS offers **inadequate low-C investment signal**
- **RES lagging** countries with feed-in tariffs
- Ambitious RES targets increase **intermittency**
 - Need **flexible peaking reserves**
 - Normally comes from old high cost plant = coal
 - Large Combustion Plant Directive 2016 **limits coal**
 - Integrated Emissions Directive further **threat to coal**
 - Carbon price floor => **close old coal**
 - high EU gas prices and low load factors
 - **gas unprofitable, new coal threatened by future C price**
- Future prices now depend on uncertain policies
 - on carbon price, renewables volumes, other supports
 - on policy choices in UK and EU

Hard to justify investing in reliable power
Consensus that market not delivering objectives

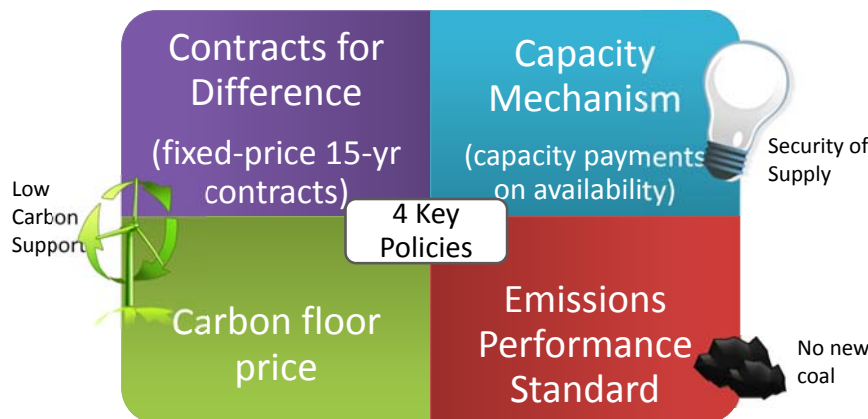
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- Controversial step for a pioneer of electricity liberalisation
- Ofgem's *Project Discovery* (2009) – Regulator's detailed study of the future challenges of the electricity market
- Addressing **key risks** identified became the **three aims of EMR**:



What is EMR?

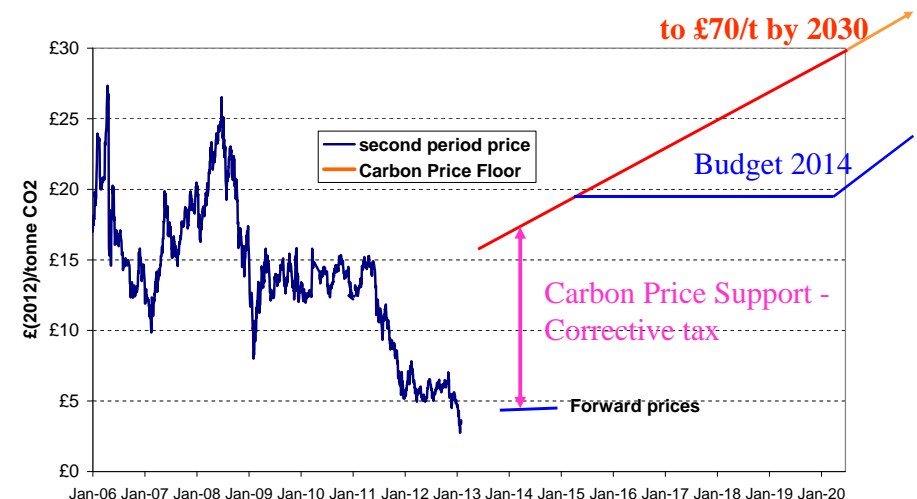


EMR brought major changes to the market.
 Main regulatory input on design of Capacity Mechanism and overall institutional

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UK's Carbon Price Floor - Budget March 2011

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

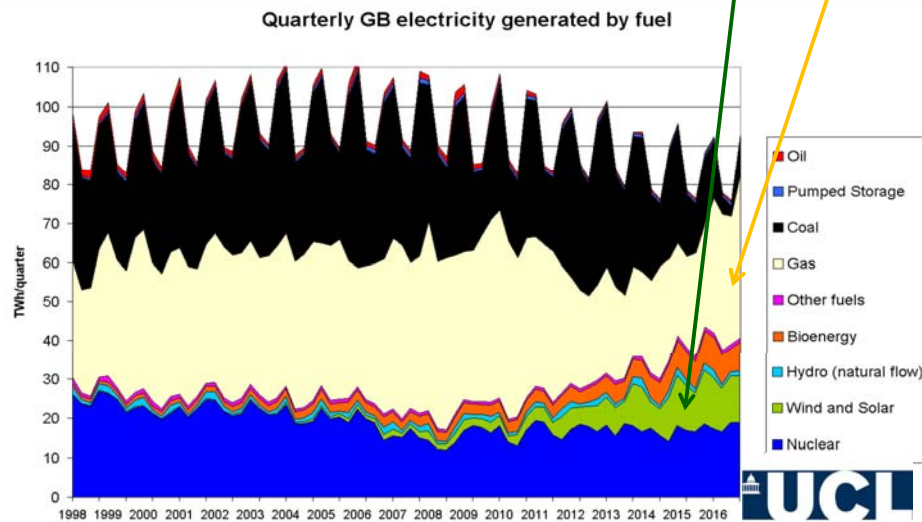


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Source: EEX and DECC Consultation

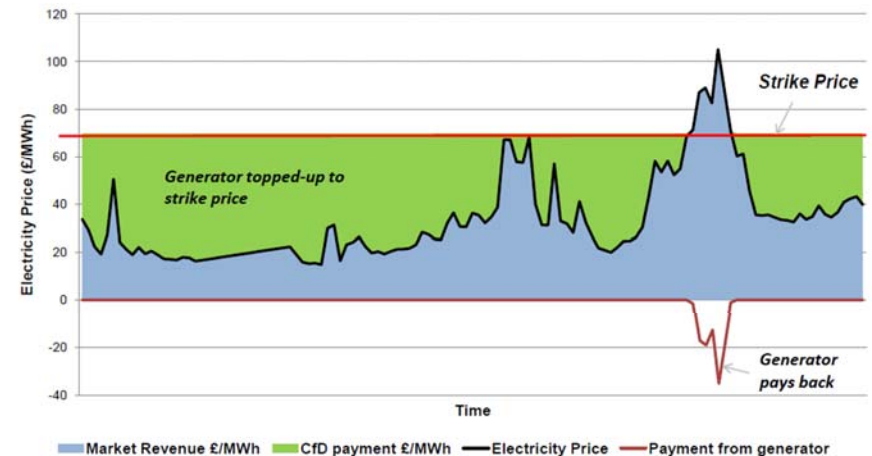
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Coal displaced by RES & gas: carbon price floor working



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Contracts for Difference (CfDs) (structure for renewable energy & nuclear)



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RES CfD 2015 auction results

Auctions better than bureaucrats!

Technology			lowest admin price	clearing price	2015/16	2016/17	2017/18	2018/19	Total Capacity (MW)
Advanced Conversion Technologies	£/MWh		£140	£114.39			£119.89	£114.39	62
	MW						36	26	
Energy from Waste with Combined Heat and Power	£/MWh		£80	£80				£80.00	94.75
	MW							94.75	
Offshore wind	£/MWh		£140	£114.39			£119.89	£114.39	1162
	MW						714	448	
Onshore wind	£/MWh		£95	£79.23			£79.99	£82.50	748.55
	MW						45	77.5	
Solar PV	£/MWh		£120	£50.00	£50.00	£79.23		626.05	69.55
	MW				2.88	36.67			

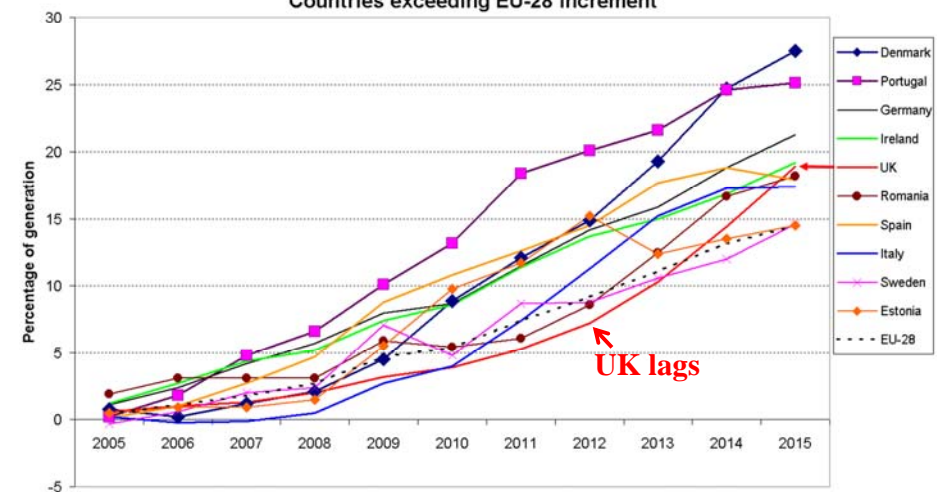
Source: DECC (2015)

withdrawn

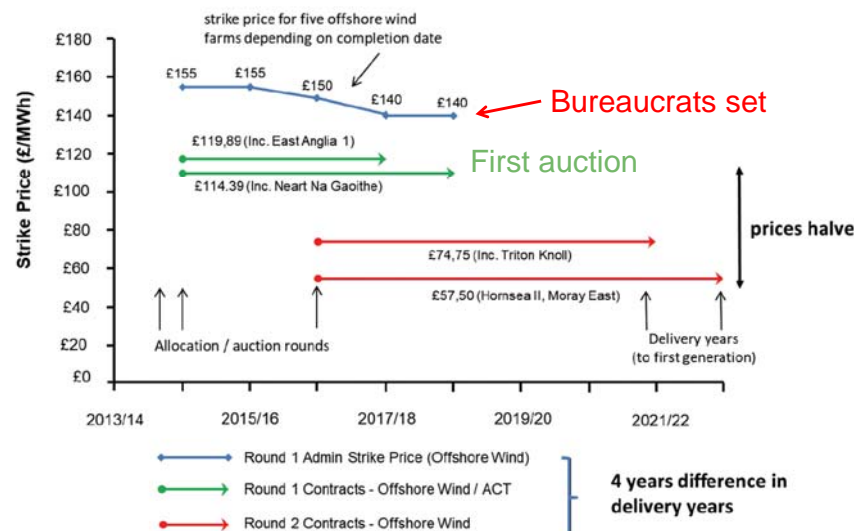
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UK RES catching up

Cumulative increment in share of RES in generation from 2004
Countries exceeding EU-28 increment



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- Learning spill-overs need remuneration
 - Almost entirely from making and installing equipment
- ⇒ Contract €X/MWh for (e.g.) 30,000 MWh/MW, auction determines premium €X

Reasons:

- Subsidy targeted on source of learning = **investment aid**
 - Reduces cost of capital and risk via debt finance
 - Ideally associated with CO_2 credit per MWh
- Could expose RES to current locational spot price
 - ⇒ incentivizes efficient location, connection
- Does not amplify benefits of high wind/sun
 - Not over-reward favoured locations with same learning
- Auction better than bureaucrats at minimizing cost

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Capacity Mechanism / Market (to reward 'firm' generating capacity)

Why

- Ensure market can deliver **security of supply**
- Payment for availability to **encourage investment**

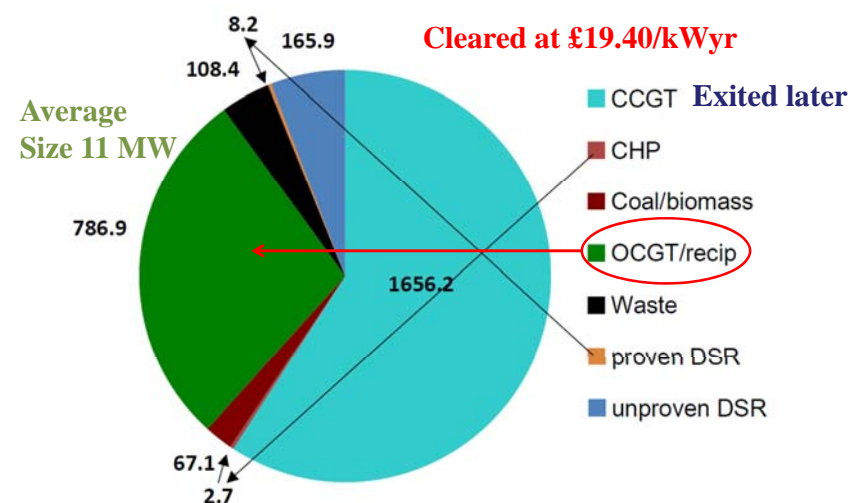
How

- **Market wide** auction of capacity obligations, run by National Grid
- Successful bidders get fixed **revenue** additional to wholesale market
- **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 (DSR)

Effect

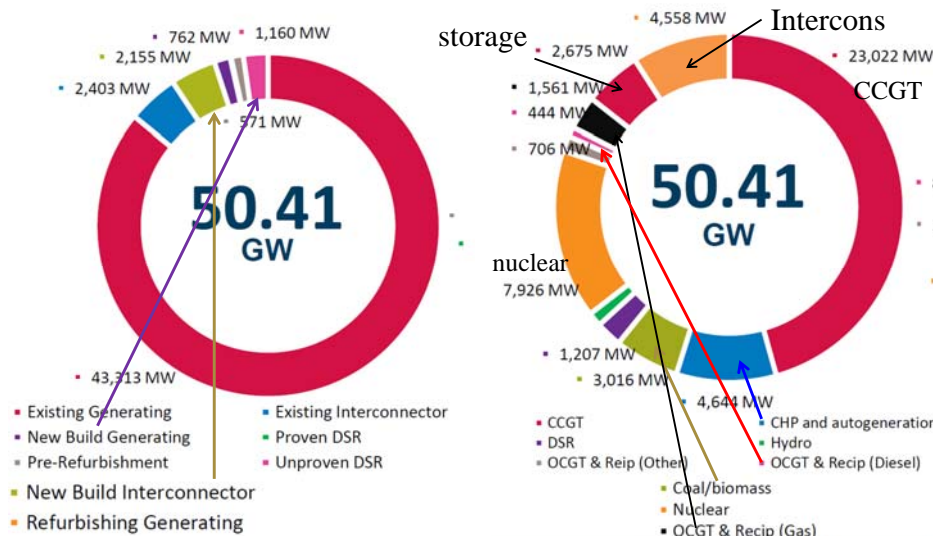
- ✓ Reduces price volatility
- ✓ Insurance against blackouts
- ✓ Encourages demand side - somewhat
- ? Expected cost – estimate required for new CCGTs, around £50/kw/yr
- ⇒ **Would appear to cost consumers £2.5bn/yr for 50 GW capacity**
- ⇒ Lower prices – impact on interconnector / other investment
- x Design makes it very difficult for DSR to participate equally

New build 2014 T-4 auction



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T-4 for 2021/22 cleared at £8.40/kWyr



Flaws in GB Capacity Procurement

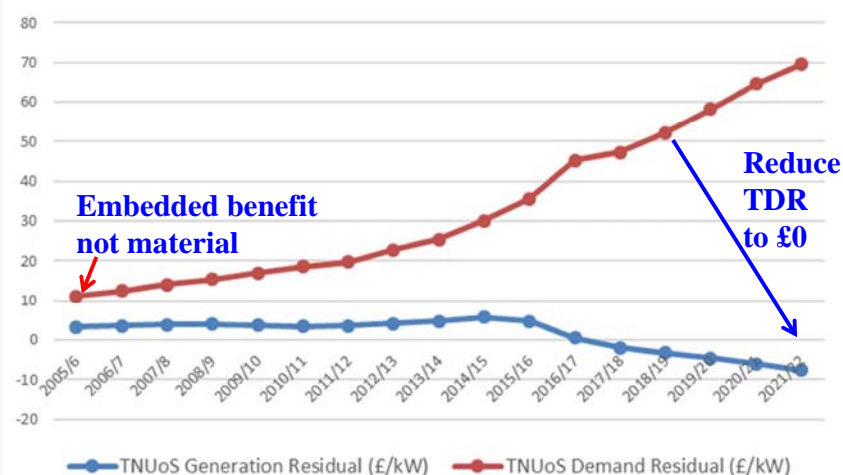
- Transmission-connected generation TG **pays** full G TNUoS
 - Distribution-connected generation DG **receives** L TNUoS
 - But avoided cost at most the transmission demand residual
 - = extra money to pay **full cost less efficient charge** of transmission
- ⇒ represents **extra** £50/kWyr embedded benefit in 2018/19
- ⇒ Auction cleared at £20/kWyr
- ⇒ DG gets £70/kWyr and TG gets £20/kWyr
- ⇒ Large number of small (10 MW) diesel and reciprocating engines win capacity contracts on distribution network

Over-encourages entry of costly subscale plant

GB Transmission demand residual – extra to DN connex

Source: Ofgem (2017)

Residual History (£/kW) 2005-2021



Reliability Options (RO) preferable to Capacity agreements

- RO sets **strike price, s** (e.g. at €500/MWh)
- Market price **p** reflects scarcity (Voll x LoLP)
 - SO sets **floor price** to reflect spot conditions
 - Wholesale price signals efficient international trade
- RO auctioned for annual payment **P**
 - 7-10 yrs for new, 1 yr for existing capacity
- Gen pays back wholesale price **p**
 - less strike price if available (**p - s**)
 - G chooses whether to be paid **p** or **s + P**
- Suppliers hedged at strike price **s** for premium **P**

Trade over interconnectors efficient

No need to pay foreign generators

- “Contracts mark return to **Single Buyer Model**”
 - but all IPPs in 1990s had long-term PPAs
- “**Bureaucrats, not markets choose investment**”
 - but current RES support Govt designed after intense lobbying by incumbents
 - => tenders, auctions to create competition
 - => contracts should incentivise efficient operation
- “Wholesale price will be **distorted by contracts**”
 - fossil mostly at margin until 2020+, problem is excess PV on sunny summer weekends
 - Problem from RES, not contracts

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UK Electricity Market Reform - Key lessons

- For Strategic investments – e.g. security and sustainability, especially emerging renewables - **a role for government is inescapable**
- Can shifting some risk to government (e.g. long term contract) be good? Yes if
 - *the risks arise from private perception of policy risk;*
 - *markets (particularly capital markets) are myopic; or*
 - *the benefits are partly public (e.g. due to inadequate environmental pricing, or innovation / learning, etc.)*
- Do we need a Capacity Mechanism in addition to low carbon supports?
 - *Yes in UK conditions – but scope is crucial, so too is design*
- Auctions are very valuable – **competitive pressures remain important**
 - Better than government decision at cutting costs / finding options
- Institutional complexities
 - *contracting bodies and their governance*
- Transmission and distribution – *new frontiers?*



This presentation is based on the working paper
Grubb, M. and D. Newbery (2018). UK Electricity Market Reform and the Energy Transition: Emerging Lessons, CEEPR WP 2018-4 at
<http://ceepr.mit.edu/files/papers/2018-004.pdf>

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CfD	Contract for Difference
CP	Capacity payment
CPF	Carbon Price Floor
DG	Distribution-connected Generation
DN	Distribution Network
EMR	Electricity Market Reform
G, L	Generation, Load
LoLP	Loss of Load probability
PPA	Power Purchase Agreement (long term contract)
RES	Renewable energy/electricity supply
RO	Reliability option
ROC	Renewable Obligation (i.e. green) Certificate
SMC/P	System Marginal Cost/Price
T-4	Auction 4 yrs before delivery at date T
T&D	Transmission and Distribution
TDR	Transmission demand residual
TG	Transmission-connected generation
TNUoS	Transmission Network Use of System, G =Generation, L=Load
VOLL	Value of Lost Load

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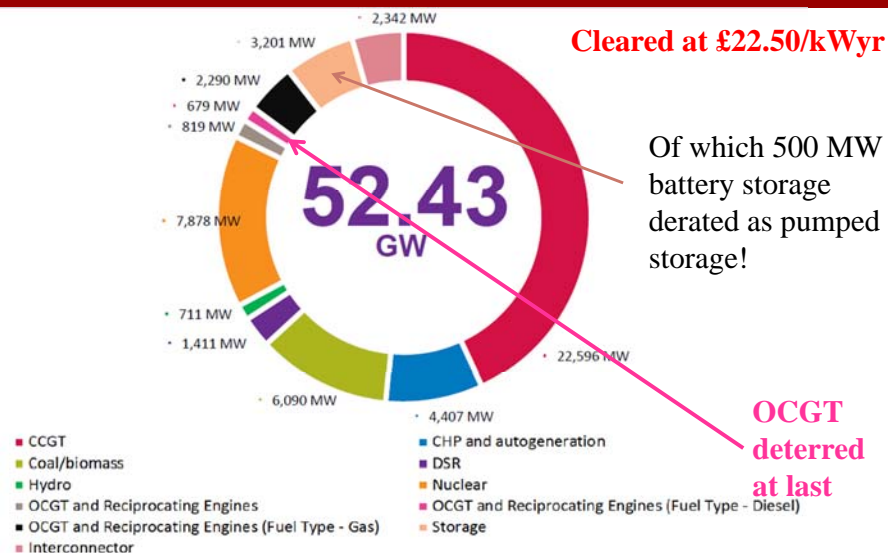
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T-4 auction Dec 2016 for 2020/21



Efficient tariffs

- Distinguish **efficient price** and short-fall in **required revenue**
 - Efficient peak T price is **marginal** expansion cost
 - At best 30% average cost, less if demand falling
- Ramsey-Boiteux pricing** => "tax" inelastic demand
 - => equi-proportional reductions in all types of demand
 - incl. option to take up to N Kw
- Diamond-Mirrlees**: **tax only final consumers**
 - => T&D revenue shortfall on final consumption **not** net demand (at network connection)
 - => reduces embedded G benefit from £60 to < £10/kWyr
 - => **Regulators** need to compute **efficient T&D tariffs**
 - => and move faster. Auction in 1 day grants 15-yr contract

Generation and Load TNUoS 2016/17

