



Electricity Market Reform

The GB Capacity Market Auction Results

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April 2015

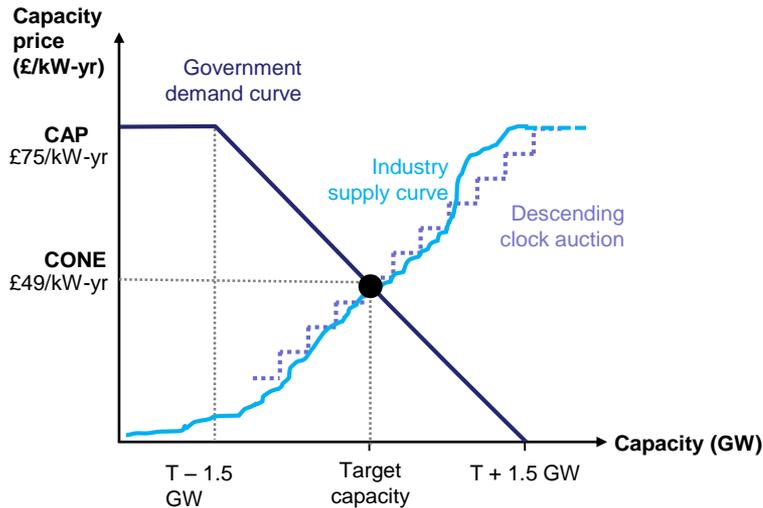
CRA Charles River
Associates

The Capacity Market will fundamentally change the GB power market. The results of the first auction will drive the GB capacity mix and will inform future policy and rule changes

This presentation is focussed on seven questions:

- What are the key design features of the GB Capacity Market?
- Who are the key players?
- What are the key drivers?
- What were the results of the first Capacity Market auction?
- What does this tell us about market expectations?
- What does this tell us about participant's bidding behaviours?
- How can the results of the auction affect future power market trends?
- How might the Capacity Market evolve?

The Capacity Market is a forward-looking, market-based mechanism with administratively set parameters



Forward “reliability” market

- Four year-ahead and one year-ahead auction
- Open to assets in early stages of development
- The target capacity is intended to provide a **LOLE of 3 hours** p.a.
 - The target capacity for the first T-4 auction was set at **48.6 GW**. This excludes a 2.5 GW provision for DSR which is set aside for the T-1 auction, as well as the capacity that opted out of the auction but plans to remain operational.
- Ability to arbitrage between long-term and short-term auctions

Participants

- Technology neutral (mostly excluding low carbon)
- Economics of both new and existing plant to drive auction
- Price to be set by what the marginal plant (existing or new build) expects to need to make whole
- DSR can reduce need for thermal capacity

Auction

- Pay as Clear: value of all new and existing capacity set by marginal clearing unit
- Sloped demand curve expected to help reduce strategic bidding
- Descending clock auction to support transparency

Penalties

- Load following arrangements for delivery (obligation linked to load at time of system stress) – allows generation to manage risks of non-delivery
- Financial penalties set at 100% of annual capacity market revenues to incentivise performance

Set thresholds

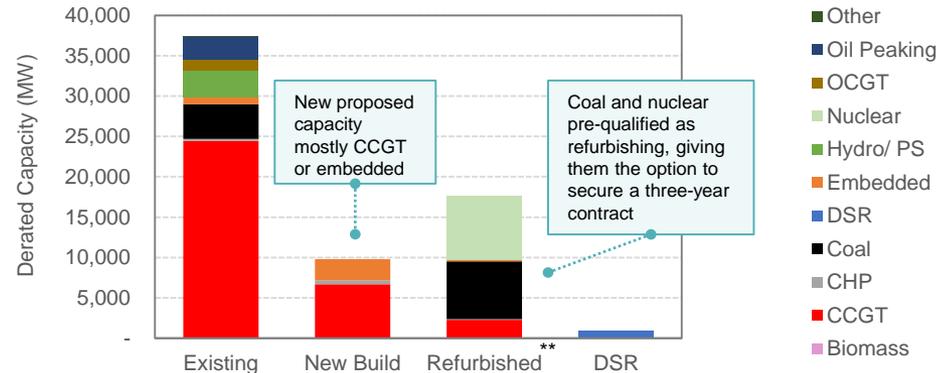
- Net CONE set at **£49/kW-year**
- Maximum price for first auction set at **£75/kW-year**
- Price taker threshold set at **£25/kW-year** – limits to existing plant exiting above this price
- Refurbishment threshold set at **£125/kW-year**.

Contract length

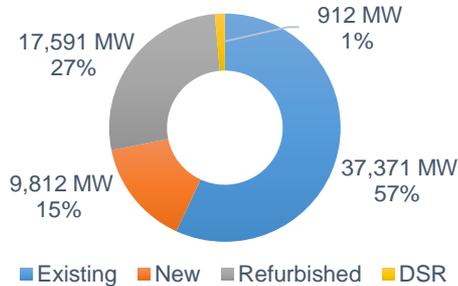
- One-year contracts for existing plant, 15-year contracts for new plant
- Difference in contract length may bias market towards new additions
- Capital expenditure thresholds set the eligibility for different contract terms
- Long-term contracts improve financeability for new plant

The pre-qualification results revealed a wide range of market participants, each with unique value and cost drivers

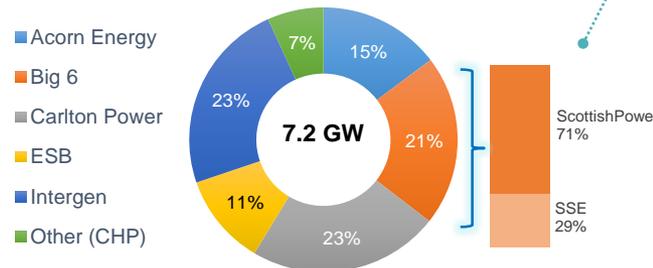
- **A total of 65.4 GW prequalified** for the first capacity auction in December of 2014, made up of:
 - Around 58 GW of transmission-connected, 6.8 GW of distribution-connected, and 0.9 GW of (unproven) DSR.
- **There were 9.8 GW of new proposed capacity**, of which “embedded” or distribution-connected generation accounted for around 2.6 GW.
- **17.4 GW of capacity pre-qualified as “refurbishment”**, with the majority being able to bid in also as “existing.”
 - This included 7.9 GW of nuclear capacity and 7.1 GW of coal.
 - The majority of the refurbishments were proposed by E.On, EDF, and RWE. Eggborough also pre-qualified as refurbishment.
- Longannet opted out of the auction citing high transmission costs and uncertainty around energy margins.



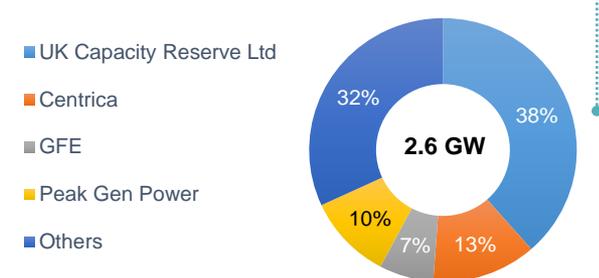
Pre-qualified Capacity by Type



New Transmission-connected Capacity by Owner



New Embedded Capacity by Owner



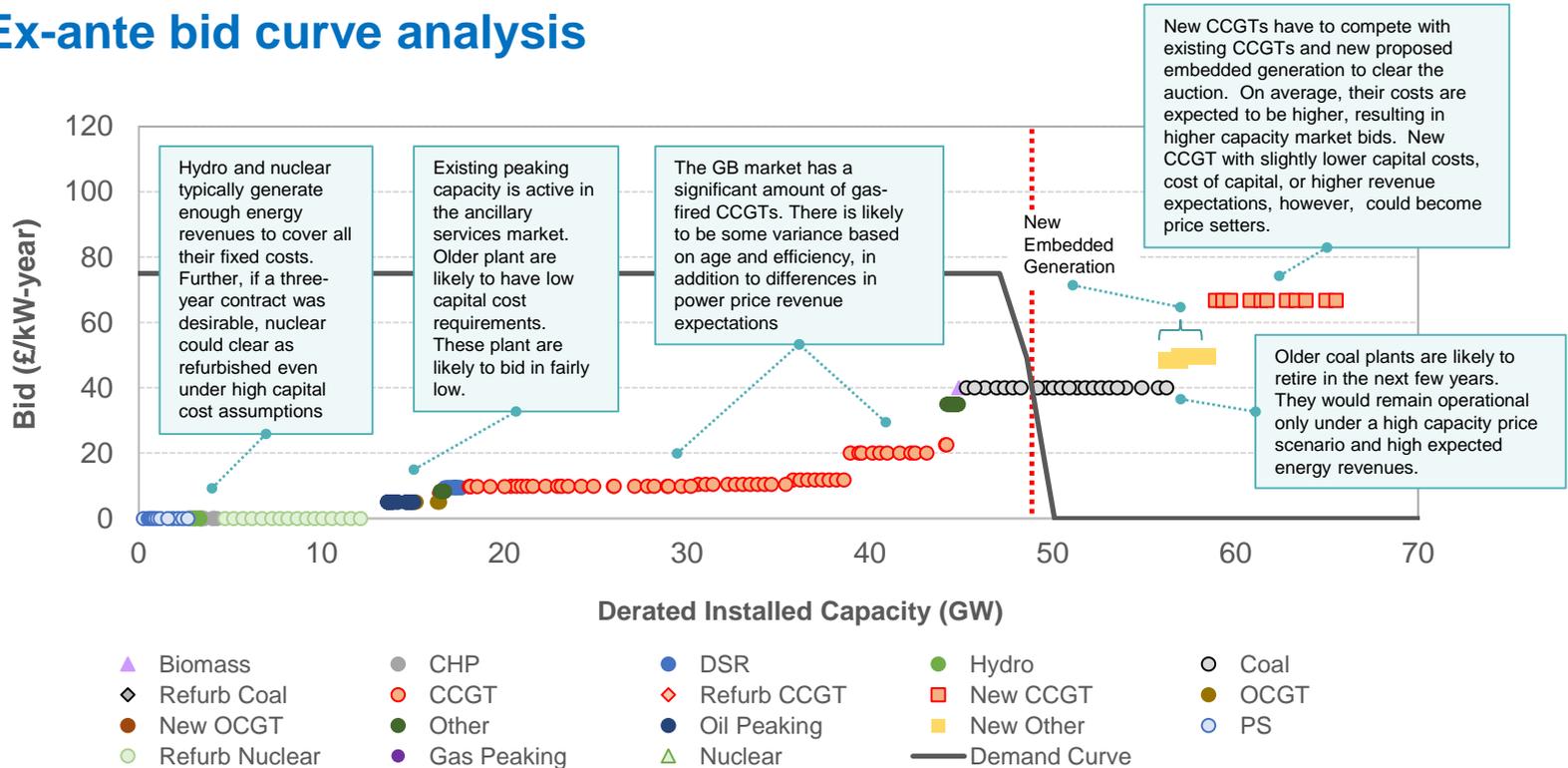
Source: National Grid. Pre-qualification results. 31 October 2014.

** Note that the “refurbishing CCGT” category consists of Pembroke, which was built in 2012 and likely crossed the £125/kW threshold without an actual intent to refurbish.

Market expectations for the results of the first auction ranged from around £30/kW-year to around £50/kW-year

$$\text{Revenues required from Capacity Market (bid)} = \text{Levelised Capital Costs} + \text{FOM} - \text{Energy Revenues}$$

Ex-ante bid curve analysis

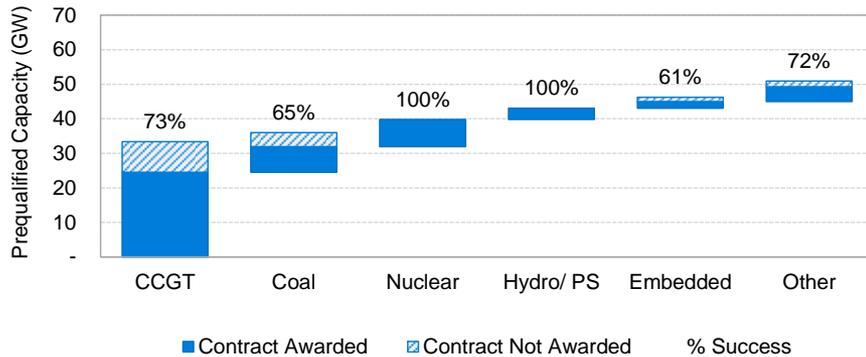


Source: CRA analysis based on National Grid's published pre-qualification results.

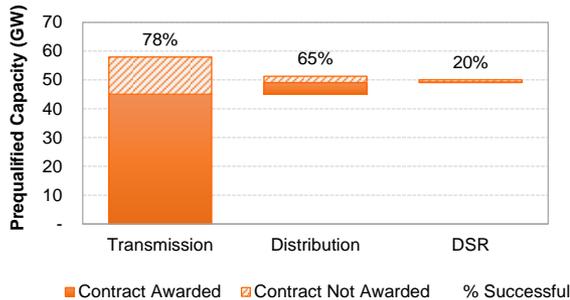
The GB capacity market auction cleared below market expectations at £19.40/kW-year

Contracts Awarded to Pre-qualified Capacity

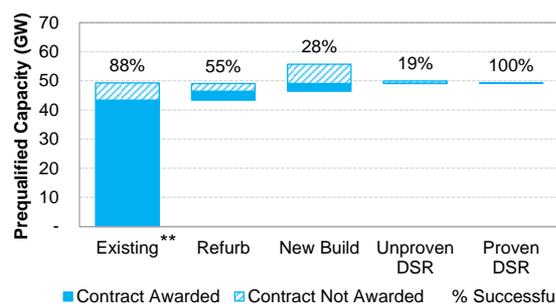
By Technology



By Connection Type

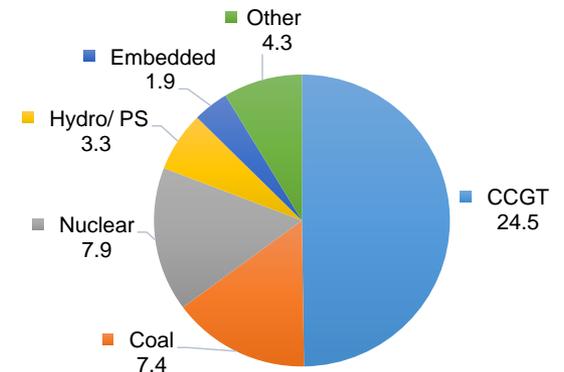


By Type of CMU



- The GB Capacity Market auction started on 16 December, 2014 and ended after 11 rounds on 18 December, 2014 with a clearing price of **19.40/kW-year**.
- **49.3 GW of capacity were awarded contracts** with durations ranging from one year to 15 years.
- **2.6 GW of new capacity** secured capacity contracts, representing about 28% of new capacity that pre-qualified for the auction.
- Around **5.9 GW of existing capacity exited** the auction above the clearing price.
- None of the nuclear plant cleared as refurbishment, while only 3 GW out of 7.1 GW of coal refurbishments secured a three year contract.
- Almost **1 GW of new embedded generation cleared** the auction, which represents about 50% of new embedded generation that pre-qualified for the auction.

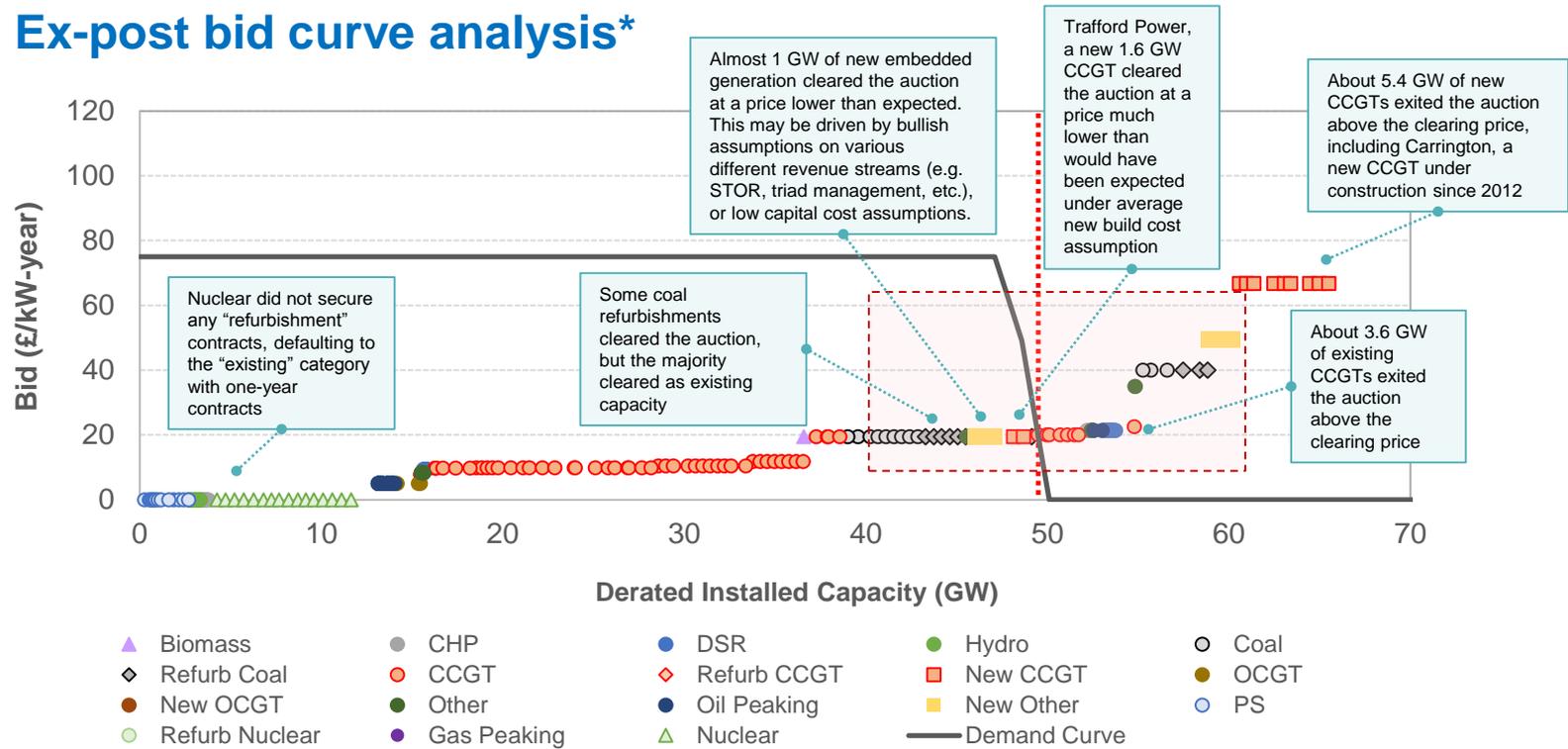
Cleared Capacity by Fuel Type (GW)



** Includes plant that qualified as refurbished but cleared as existing

Differences from CRA's ex-ante expectations were most notable in relation to existing coal plant

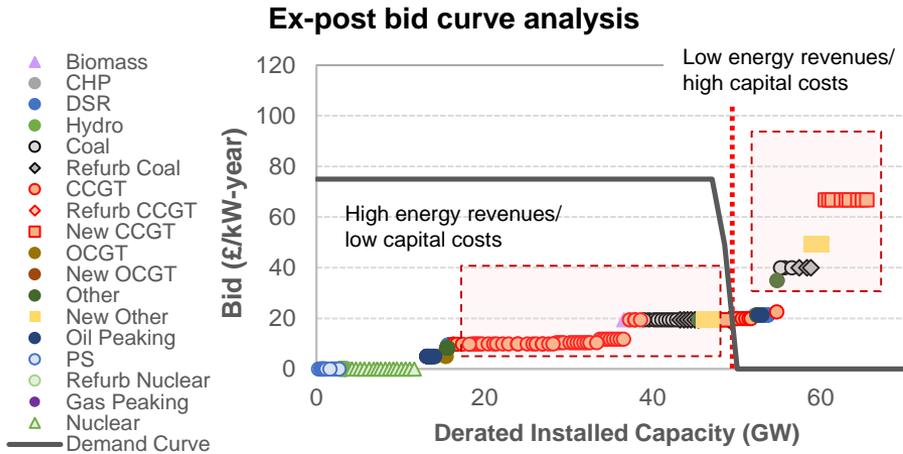
Ex-post bid curve analysis*



* Note that there is no information available to re-construct the actual bid curve of the clearing round. The curve above has been constructed based on our ex-ante analysis of costs and revenues, modified where necessary with information on the generators that cleared and did not clear the auction.

Source: CRA analysis based on National Grid's published pre-qualification results.

The results highlight a wide range of expectations for energy market revenues



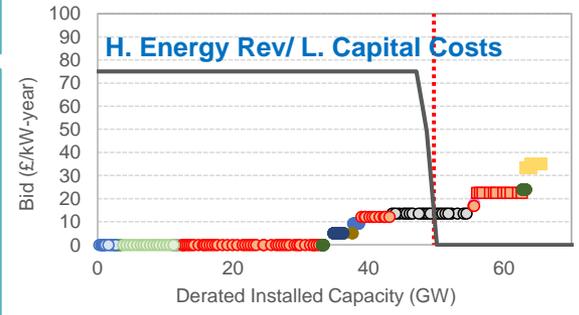
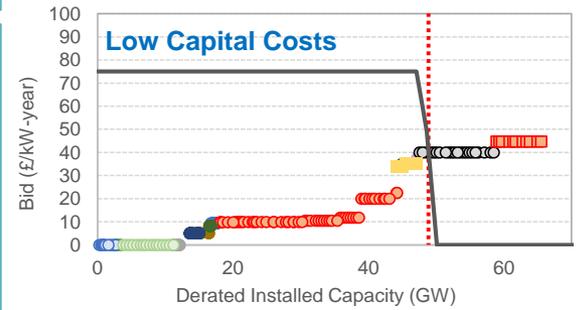
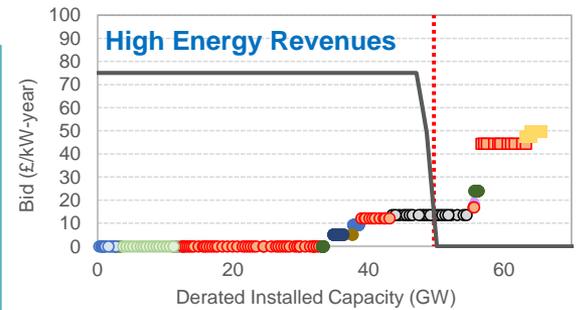
With the exception of a few marginal CCGT and coal-fired plant, high energy margin expectations may help explain the low clearing price of the auction. This may be the result of expected retirements following the results of the auction or lower coal contracts.

Low capital costs alone may not explain the number of cleared coal refurbishments. For some marginal participants, expectations of higher energy or ancillary services revenues (like SBR) were likely factored into their bids. However, low capital costs assumptions may have influenced the number of embedded generation that cleared the auction.

Based on CRA's analysis, a new CCGT would need to benefit from both low construction costs and expect high energy revenues to bid below £20/kW-year. Assumptions on additional revenue sources may also be required.

- The results of the auction indicate a wide range of expectations around market outcomes and capital costs (see appendix for underlying assumptions)
 - Based on CRA's own fundamental analysis, the low clearing price in the auction indicates that a large number of participants may expect higher revenues than currently observed in market forwards. This may be a result of expected retirements putting upward pressure on energy prices or additional forms of revenues, like SBR payments.
 - On the other hand, the close to 6 GW of capacity that exited the auction may signal a reluctance to continue operations under current market conditions.
 - For a new CCGT plant to clear the auction at such a low clearing price, a combination of high energy revenues, low capital costs, and the ability to obtain additional revenues was likely assumed

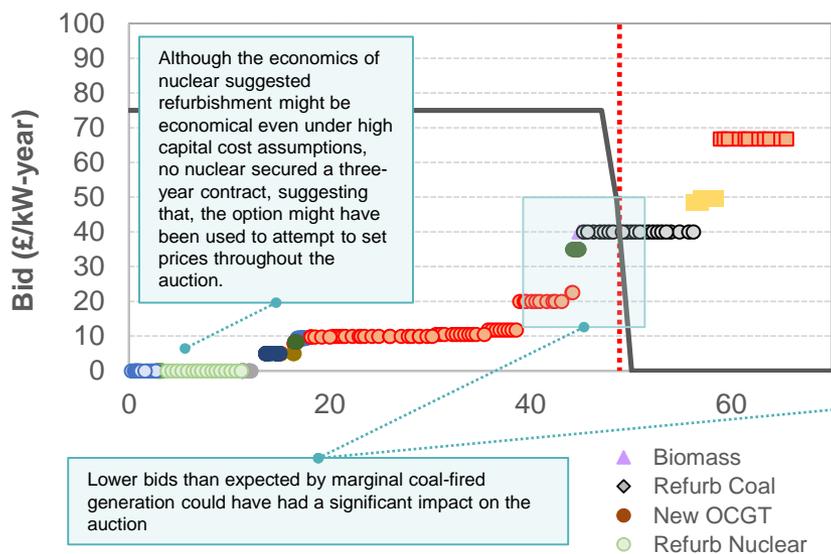
Ex-ante scenario analysis



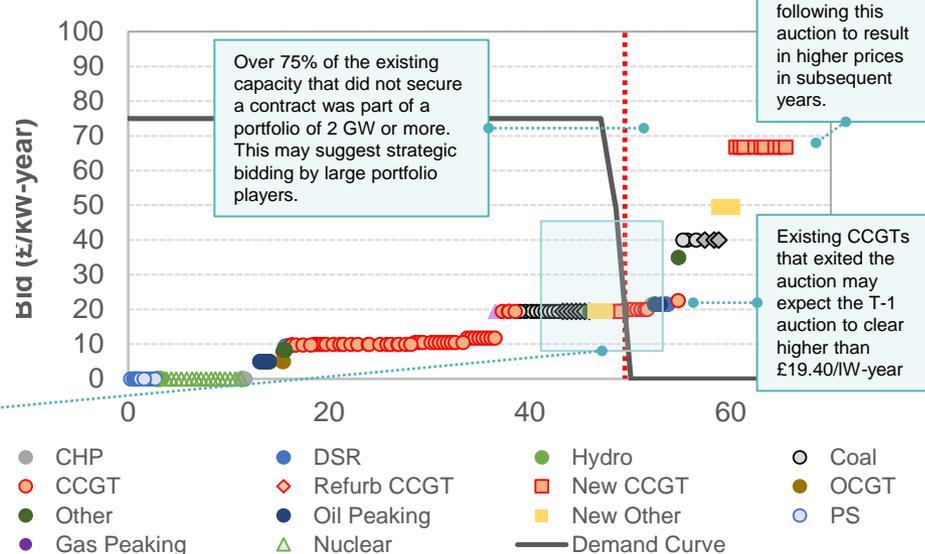
Strategic bidding behaviour and arbitrage opportunities between the T-1 and T-4 auction may help explain some of the auction results

- Expectations of market fundamentals and construction costs may not fully explain the results of the capacity auction.
- The potential to participate in subsequent auctions, including the T-1 auction for the same 2018/2019 delivery year, may provide additional opportunities for generators to secure capacity contracts
 - Existing plant that did not secure a contract may expect the T-1 auction to clear higher, or may be unwilling to commit to remain operational under the auction results
 - Further, Carrington, for example, may be able to participate in this year's T-4 auction (for delivery in 2019/2020) and still secure a 15-year contract

Ex-ante bid curve analysis



Ex-post bid curve analysis



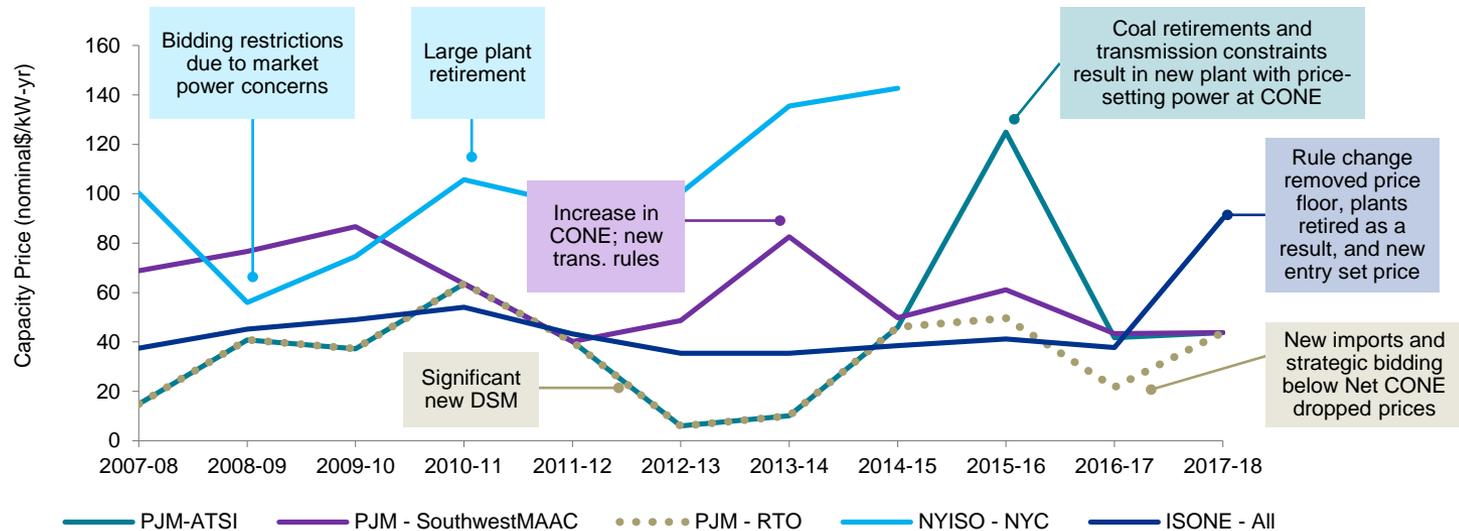
Strategic bidding and gaming behaviour can lead to some surprising auction results

Bidding strategy	Potential Benefits	Risks	Deterrents
Premature retirements	<ul style="list-style-type: none"> Generators that opt out of the capacity market with the intent to remain operational can create a capacity shortfall if they retire ahead of stated plans. This could increase the price in the secondary auction. 	<ul style="list-style-type: none"> Opportunity costs of obtaining a contract in the secondary auction. 	<ul style="list-style-type: none"> Risk of regulatory investigation by Ofgem.
False retirement statements	<ul style="list-style-type: none"> False retirement statements can create an artificial capacity shortfall and lead to a higher demand for the auction. This can in turn increase the clearing price. 	<ul style="list-style-type: none"> Strategy only cost-effective if supply curve is not flat. 	<ul style="list-style-type: none"> Risk of regulatory investigation by Ofgem. Inability to participate in T-1 auction.
Capacity withholding during the auction	<ul style="list-style-type: none"> Participants with large portfolios have an economic incentive to withhold capacity if they think they can influence the results of the auction and cause a higher clearing price. This may result in an overall portfolio benefit even at the expense of one individual unit. 	<ul style="list-style-type: none"> Requires a sloped supply curve to ensure that the benefit exceed the cost. 	<ul style="list-style-type: none"> Risk of regulatory investigation by Ofgem. Price-taker threshold
Portfolios with a range of refurbishing costs	<ul style="list-style-type: none"> Refurbishing plant can easily influence the clearing price if they believe they are in a marginal position. By structuring a range of bids across all refurbishing plant, they can further increase their chance of being marginal and securing a higher price for the whole portfolio. The risk is limited by the fact that if the price drops below their refurbishment bid, they can still get a clearing price as an existing generator. 	<ul style="list-style-type: none"> Requires a sloped supply curve to ensure the cost of losing a three year contract for one unit is less than the benefit for the overall portfolio. 	<ul style="list-style-type: none"> Risk of regulatory investigation by Ofgem.
Collusive auction strategies	<ul style="list-style-type: none"> There remains a risk that companies may explicitly or implicitly collude to explicitly avoid bidding down prices in the auction. This is complicated by the potential for joint ventures or tolling arrangements in the electricity generation market, where discussion of bids between individual players with additional units in the markets is difficult to monitor and control. 	<ul style="list-style-type: none"> In a highly competitive auction, there is a significant risk of exiting the auction through a high-price bidding strategy. This risk is somewhat mitigated by the option refurbished units have (see above). 	<ul style="list-style-type: none"> Risk of regulatory investigation by Ofgem and/or the CMA.

The results of the capacity market auction provide some indication of participant's expectations, but they do not provide any more insights into how the energy market will actually outturn

- The clearing price of the auction was below most analysts' expectations and lower than our fundamental analysis would suggest is needed to make the marginal plant profitable.
- This suggests that unless the T-1 auction clears significantly higher than the T-4 auction, the existing plant that did not clear the auction may be expected to retire over the next few years.
 - A high clearing price for the T-1 auction may be the result of new, cleared plant not commissioning on time, higher load growth than expected, less-than-expected DSR, or plant that opted out of the auction (but expected to remain operational) retiring early.
- Widespread retirements may lead to increasing energy revenues for those plant that remain operational, but that will partly be influenced by the rate of load growth and the amount of new renewable capacity (not influenced by the results of the capacity auction).
- Although fundamental power market analysis may suggest that, *ceteris paribus*, high energy spreads would be accompanied by low capacity prices, and vice versa, this fundamental link may not always hold under the design of EMR.
 - Capacity prices are set four years in advance under expected market conditions, however, unexpected mild weather and higher than expected renewable generation may result in very depressed power prices, even though capacity prices for delivery in that year were set low in expectation of "normal" conditions.
 - This may be further exacerbated by the fact that EMR includes one mechanism to support renewables (CfD) and a separate one to support capacity may lead to both low capacity prices and low energy prices.

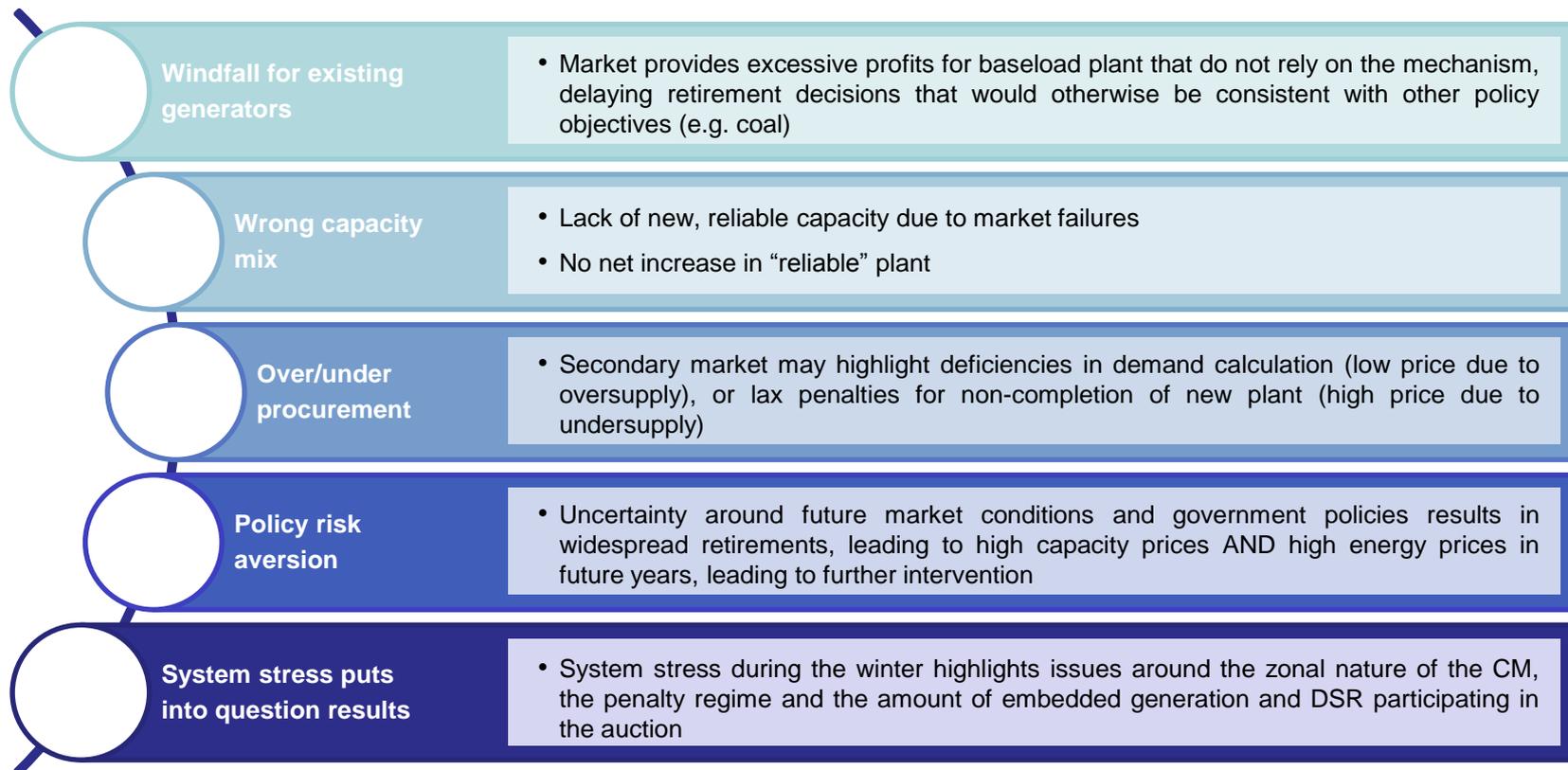
Even established Capacity Markets continue to surprise, as participants learn from previous outcomes, and react to market fundamentals and new rules



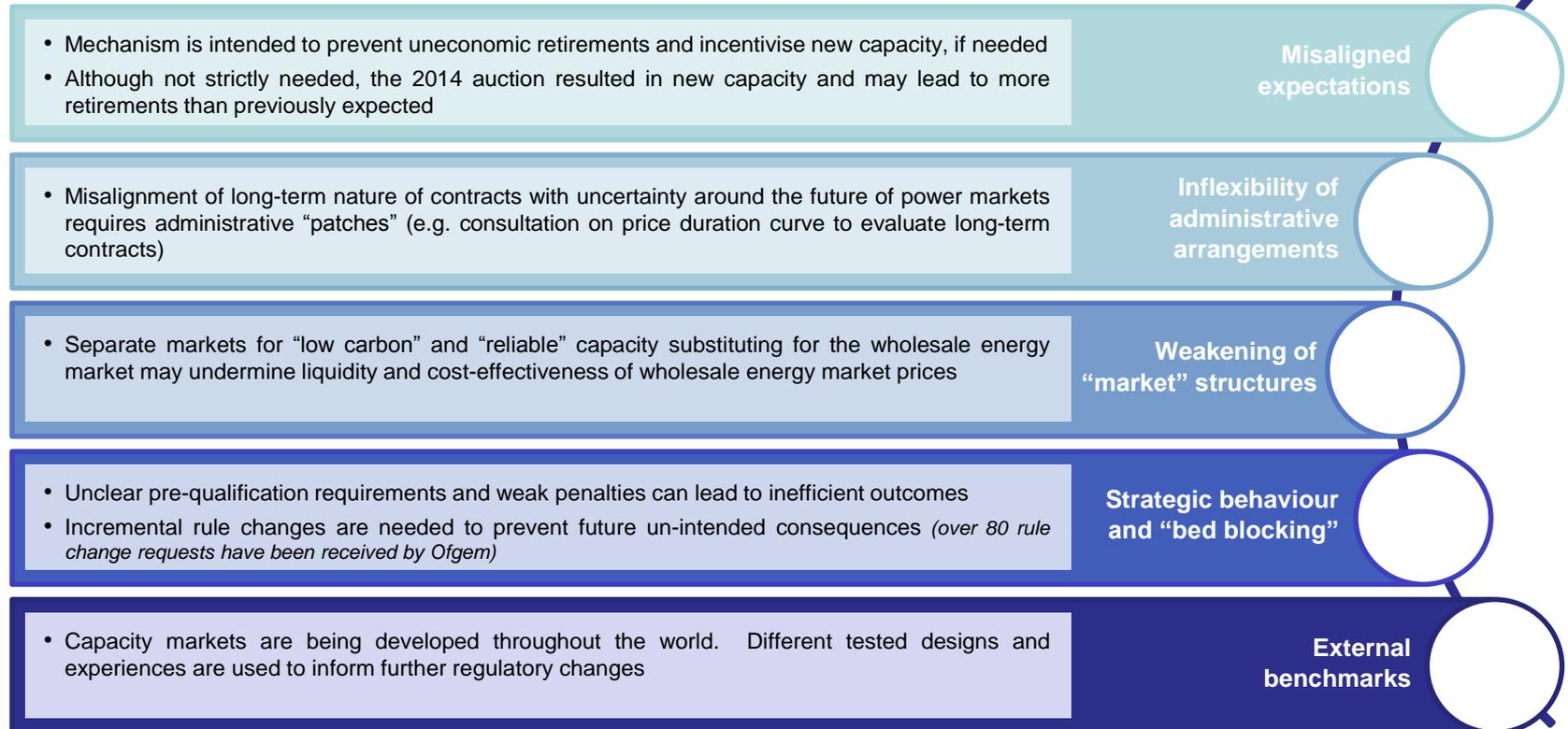
Experience in other capacity markets suggests that capacity prices are volatile and unpredictable. The causes of price uncertainty in US markets have been varied:

- **Market fundamentals** – Fundamental link between energy market, ancillary services market, and capacity market.
- **Design changes and ongoing administrative uncertainties** – Issues around DSR, CONE, and minimum and maximum prices have contributed to volatility.
- **Interconnector eligibility** – changes in eligibility criteria for interconnected capacity. In GB, DECC has still to finalise how interconnector capacity participates into the auction.

The GB Capacity Market will continue to evolve - future policy decisions will depend on the perceived reasons for any undesirable outcomes in this and subsequent auctions



Further, as a regulated mechanism, the Capacity Market is prone to further adjustments and amendments, irrespective of whether the specific objectives of the mechanism were met



CRA credentials

Design and implementation of capacity markets and mechanisms

- CRA analysed and reviewed the DECC strawman CM design with respect to potential market power and gaming last year.
- Represented generators in creating the current PJM capacity market (reliability pricing mechanism). Participated in creating the rules implementing it and provided testimony defending it to regulators. CRA is currently working with stakeholders on proposed further PJM developments.
- CRA is active in the German electricity market on behalf of the German government and is following the various CM proposals being circulated and discussed in Germany.
- CRA is currently advising NextEra, a major US thermal and renewables generator, on further development of the ISO New England capacity market (FCM).
- First identified monopsony behaviour by large buyers and state governments in capacity markets as a source of market power abuse that was proving fatal to revenue adequacy. This led to market rules in PJM, NYISO and ISONE to curtail the abuse
- Served as advisors to the New England Power Pool and committee of market participants in the design of the ISO-New England energy and capacity markets and associated rules. Separately, represented generators and later the ISO in reforming the ISO-New England capacity market and creating associated market rules.
- Designed and testified with respect to the capacity market rules, including mitigation rules, for the New York City portion of New York ISO.
- Involved in a recent series of engagements for generators in Texas in proposing mechanisms to achieve revenue adequacy including both capacity markets and alternative scarcity-related revenue mechanisms.
- CRA has analysed the *Reserva de Potencia* mechanism in the Spanish electricity market (MIBEL) for a large Iberian utility client.
- Advised the Electricity Reform Implementation Unit of Western Australia on energy and capacity auctions.

CRA credentials

Auctions

- Designed and conducted auctions over the past several years in which a large US electric supplier that retained the obligation to supply historic load purchased the energy and capacity needed to meet annual load requirements.
- Advised a state regulatory commission on the design of rolling three year capacity and energy procurement auctions for the state's utilities and monitored the auction conduct and results.
- We advised RWE on the appropriate design for a series of electricity auctions (VPPs) for end-user customers in the German market (mandated by the German Cartel Office). We proposed and agreed an auction design with the Cartel Office. We have implemented online auctions using CRA's proprietary auction software since February 2007.
- CRA recently provided advice to a Nordic utility on the development of auctions for long term electricity contracts to provide longer term pricing signals in the market.
- Advised utilities in the Netherlands and Spain on product and auction design and implementation for a virtual power plant auction.
- On behalf of an association of independent power producers in Brazil, analysed an "old energy" electricity auction conducted by the government, evaluating the auction design and rules and proposing improvements for future auction.
- Advised the Power Pool of Alberta on the creation of tradable packages of power purchase agreements and creation of an auction for their sale

CRA credentials

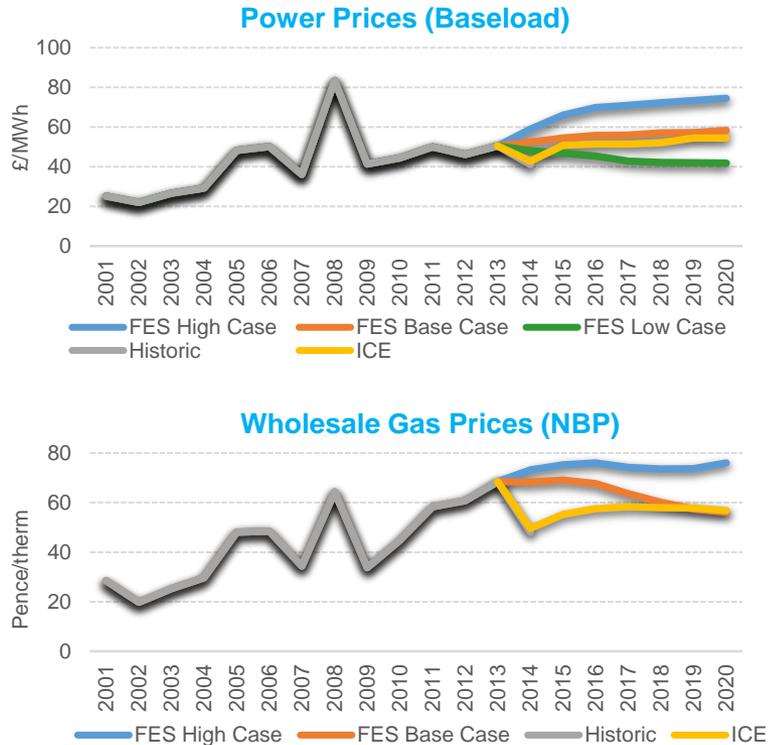
European power markets

- Advisor to the German government on power sector issues.
- Advice to a major UK energy supplier with respect to an Ofgem/CMA investigation into the retail energy supply market.
- Analysis of competitive effects of acquisitions in the UK natural gas and power markets for a major UK energy company.
- We advised the Netherlands Competition Authority on the competitive effects of a proposed transaction in the Dutch generation market.
- Analysis of market coupling issues for a European client.
- Analysis of market coupling and exchange/transmission issues in the Iberian market.
- Advice to various UK clients on power market issues.

Analysis Market Assumptions

APPENDIX 1

There is significant uncertainty around energy prices in the next few years – expectations of energy margins for each type of participant can vary significantly as a result



We have developed three energy margin scenarios based on forecasts of power and fuel prices from National Grid's 2014 Future Energy Scenarios (FES).

The three scenarios are:

- **FES High** - based on FES high power price forecasts and FES high fuel and carbon price forecasts;
- **FES Base** - based on FES base power price forecasts and FES base fuel and carbon price forecasts;
- **FES Low** - based on FES low power price forecasts and FES base fuel price forecasts, using the CPF as the carbon price.

We have also developed a scenario based on market-quoted prices on future gas and power contracts traded on the Intercontinental Exchange (ICE). All assumptions are summarised below.

2018 Assumptions (£ 2014)		Unit	Base Case	ICE Forwards	High Case	Low Case
Power Prices	Baseload	£/MWh	57.10	48.47	72.20	42.20
	Peak	£/MWh	68.52	59.21	86.64	50.64
Fuel Prices	Gas	pence/therm	60.10	52.95	73.50	60.10
	Coal	\$/tonne	100.60	73.92	100.60	100.60
	Oil	\$/barrel	92.40	83.78	92.40	92.40
Emissions	CO2	£/tonne	24.40	18.00	28.20	18.00

Source: CRA analysis and 2014 Future Energy Scenarios from National Grid.

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