ISG187-SPAR

REPORTING ON NOVEMBER 2016

ISSUE 14 – PUBLISHED 13 DECEMBER 2016

SYSTEM PRICE ANALYSIS REPORT

The System Prices Analysis Report (SPAR) provides a monthly update on price calculations. It is published by the Market Analysis Team to the Imbalance Settlement Group (ISG) and on the ELEXON Website ahead of the monthly ISG meeting.

This report provides data and analysis specific to System Prices and the Balancing Mechanism[1]. It demonstrates out-turn prices and the data used to derive the prices. The data is a combination of II and SF Settlement Runs.

In addition to the SPAR, a post-implementation review will be published for changes under Modification P305 'Electricity Balancing Significant Code Review Developments'.

1 SYSTEM PRICES AND LENGTH

This report covers the month of November. Where available, data uses the latest Settlement Run (in most cases 'II' or 'SF').

In this report we distinguish between a 'long' and a 'short' market when analysing System Prices because the price calculation differs between two scenarios. When the market is long, System Prices will be based predominantly on the System Operator's 'sell' actions such as Accepted Bids. When the market is short, System Prices will instead be based predominantly on the System Operator's 'buy' actions. In November there was a high standard deviation in the System Price when the market was short. The short market average price was £117.26/MWh with prices ranging from £32.34/MWh to the highest price under P305 so far of £1,528.72/MWh. This high price is considered in more detail in Appendix 1.

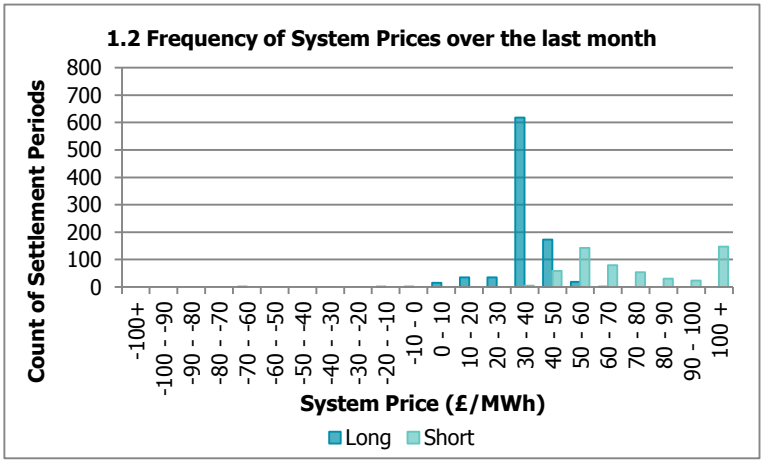
Graph 1.2 shows the distribution of System Prices across Settlement Periods in the last month when the market was long and short. System Prices were between £20/MWh and £50/MWh in 62% of Settlement Periods (in both directions). When the System was long 73% of prices were between £20/MWh and £40/MWh.

	System Price (Long)				
Month	**Min**	**Max**	**Median**	**Mean**	**Std Dev**
November 2016	-62.55	60.00	37.20	35.76	8.79

	System Price (Short)				
Month	**Min**	**Max**	**Median**	**Mean**	**Std Dev**
November 2016	32.34	1,528.72	68.00	117.26	181.85

1.1 System Price summary by month (£/MWh)

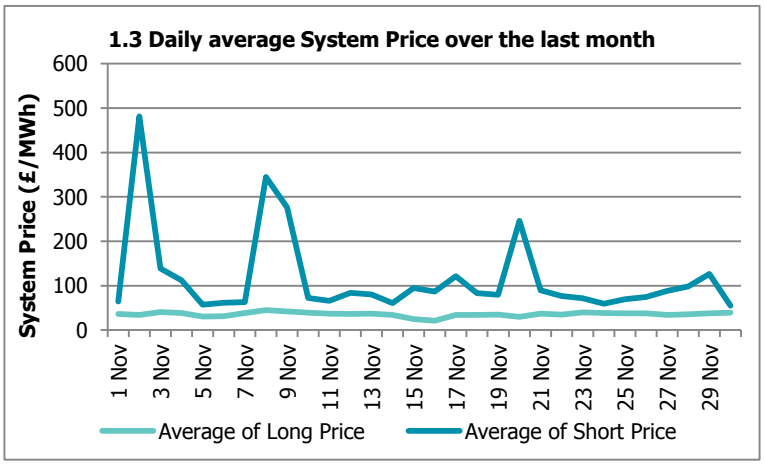
1.2 Frequency of System Prices over the last month



[1] For further detail of the imbalance price calculation, see our imbalance pricing guidance: https://www.elexon.co.uk/wp-content/uploads/2015/11/Imbalance_pricing_guidance_v9.0.pdfv

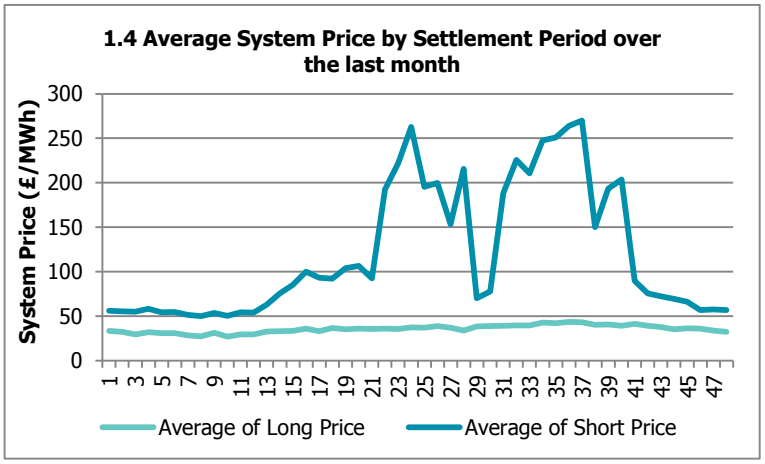
When the System was short 52% prices were between £40/MWh and £70/MWh and 27% of prices over £100/MWh. The lowest System Price when the system was short was £32.34/MWh, occuring at Settlement Period 5 on 17 November 2016.

There were three Settlement Periods with **negative System Prices** in November 2016 (compared to 11 the previous month and 120 in total in 2016). The lowest System Price was -£62.55/MWh, which occurred at Settlement Period 28 on 16 November 2016, and was set by negatively priced Bids from two wind generators. System Prices **exceeded £100/MWh** 147 times in November 2016 (compared to 101 times in October), these high prices were seen in 10.2% of Settlement Periods, regardless of length. The **highest System Price** was £1,528/MWh and occurred at Settlement Period 28 on 8 November 2016. The price was set by two Bids, from a Coal and a CCGT BMU.



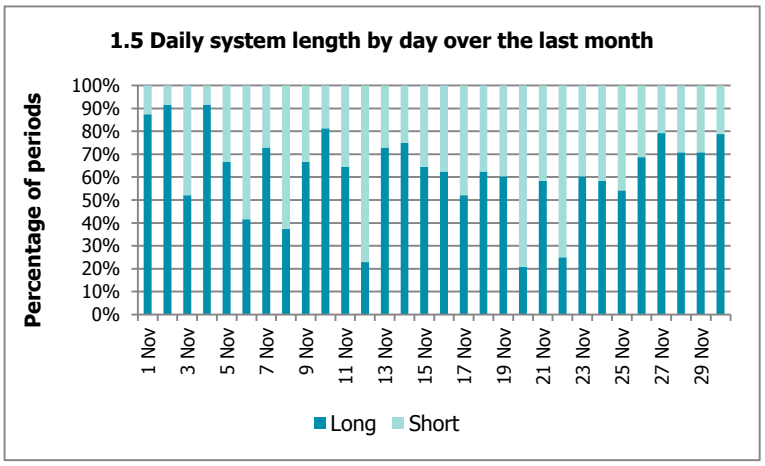
Graph 1.3 shows daily average System Prices over the last month. In November, the average System Price when the system was long was £37.76/MWh. The average System Price when the system was short was £117.26/MWh.

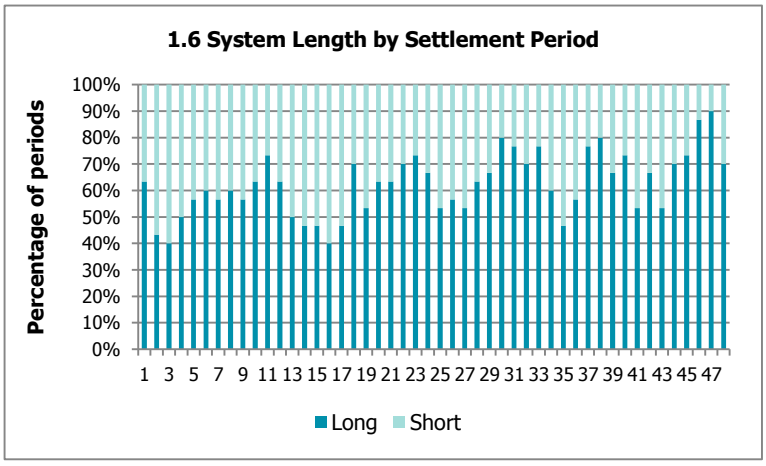
The highest daily average price when the system was short was £481/MWh and occurred on the 2 November. On this day the System Price was short for four Settlement Periods. The Maximum System on the day was £862/MWh, this lead to the high short daily average price.



Graph 1.4 shows the variation of System Prices across the day. Short prices were highest in Settlement Period 37 and long prices lowest in Settlement Period 10. Long prices show little variance over settlement periods, with the price typically around £30/MWh. In contrast, short prices have a distinctive morning and evening peak.

Graph 1.5 shows system length by day, and **graph 1.6** shows system length by Settlement Period in November. The system was long for 62% of Settlement Periods in November (compared with 74% in October). On the 20 November 2016 the System was Short for 38 Settlement Periods.





2 PARAMETERS

In this section we consider a number of different parameters on the price. We consider:

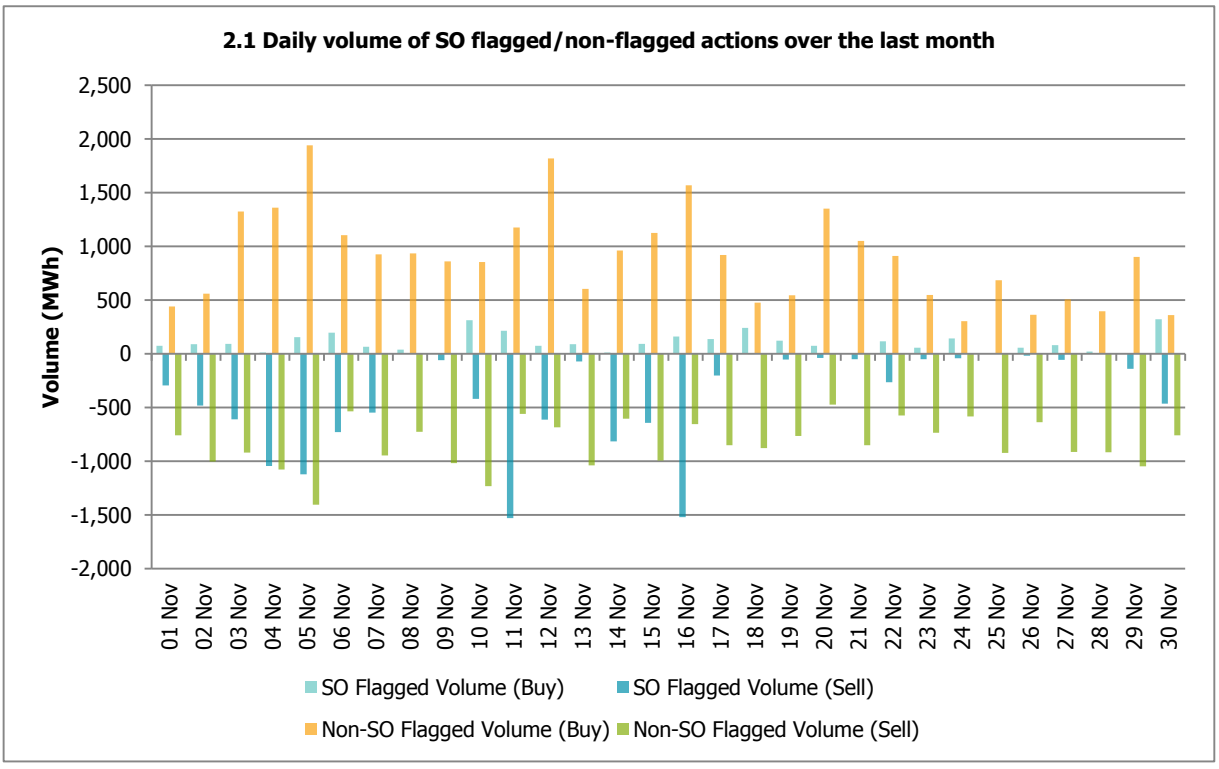
- The impact of flagging balancing actions;
- The impact of NIV tagging;
- The impact of PAR tagging;
- The impact of the Replacement Price; and
- How these mechanisms affect which balancing actions feed into the price.

Flagging

The Imbalance Price calculation aims to distinguish between 'energy' and 'system' balancing actions. Energy balancing actions are those which are related to the overall energy imbalance on the system (the 'Net Imbalance Volume'). It is these 'energy' balancing actions which the imbalance price should reflect. System balancing actions are actions which relate to non-energy, system management actions (e.g. locational constraints).

Some actions are 'flagged'. This means that they have been identified as potentially being 'system related', but rather than removing them completely from the price calculation (i.e. tagging them) they may be re-priced, depending on their position in relation to the rest of the stack (this process is called Classification). Actions are flagged by the System Operator when they were taken to resolve a locational constraint on the transmission network (SO-flagging), or when they were taken to correct short-term increases or decreases in generation/demand (CADL Flagging).

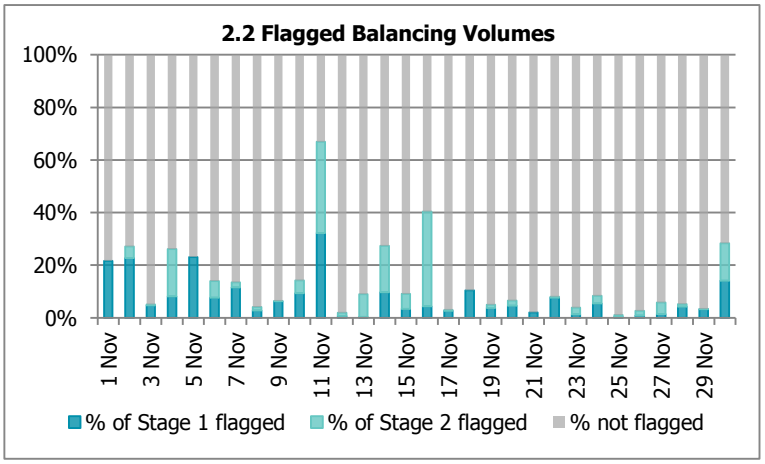
Graph 2.1 shows the volumes of buy and sell actions that have been flagged by the SO as being constraint related across the month.



32% of sell balancing actions taken in November had an SO-flag. 31% of SO-flagged sell actions came from Wind BMUs, 48% from CCGT BMUs and 11% of actions came from actions taken outside the balancing mechanism (Balancing Service Adjustment Actions, BSAAs). The average initial price (i.e. before any re-pricing) of a SO-flagged sell action was -£24.47/MWh.

10% of buy balancing actions taken in November had an SO-flag. 19% of SO-flagged buy actions came from CCGT BMUs, 9% from Coal BMUs and 67% from BSAAs. The average initial price of a SO-flagged buy action was £104.42/MWh.

Any actions which are less than 15 minutes total duration are CADL flagged. 2% of Buy actions and less than 1% of Sell actions were CADL flagged in November. The majority of CADL flagged buy actions (89%) came from Pumped Storage BMUs. 44% of CADL flagged sell actions came from CCGT.



SO-flagged and CADL-flagged actions are known as 'first stage flagged'. First stage flagged actions may become 'second stage flagged' depending on their price in relation to other un-flagged actions. If a first stage flagged balancing action has a more expensive price than the most expensive first stage un-flagged balancing action it becomes second stage flagged. This means that it is considered a system balancing action and becomes unpriced. **Graph 2.2** shows first and second stage flagged action volumes as a proportion of all actions taken on the system. Note these are all balancing actions that were accepted – only a proportion of these will feed through to the final price calculation. On 11 November 52% of actions were SO Flagged, 41% of the SO Flagged actions came from CCGT BMU's.

The Replacement Price

If there are 'second stage' flagged action volumes left in the NIV, these will be unpriced, as was the case for less than 1% of Buy actions and 2% of Sell volume in November. Unpriced actions are assigned a Replacement Price, currently based on the most expensive 1MWh of un-flagged actions.

Sell actions will typically have their prices revised upwards by the Replacement Price for the purposes of calculating the System Price. In November, the average original price of a second stage flagged sell action was £-11.53/MWh, and the average Replacement Price for sell actions (when the System was long) was £30.31/MWh.

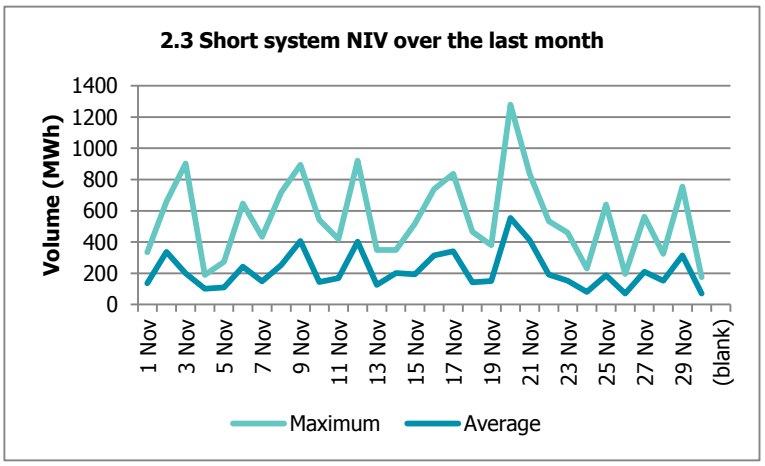
Buy actions will typically have their prices revised downwards by the Replacement Price for the purposes of calculating the System Price. In November, the average original price of a second stage flagged buy action was £118.13/MWh, the average Replacement Price for buy actions (when the System was short) was £67.88/MWh.

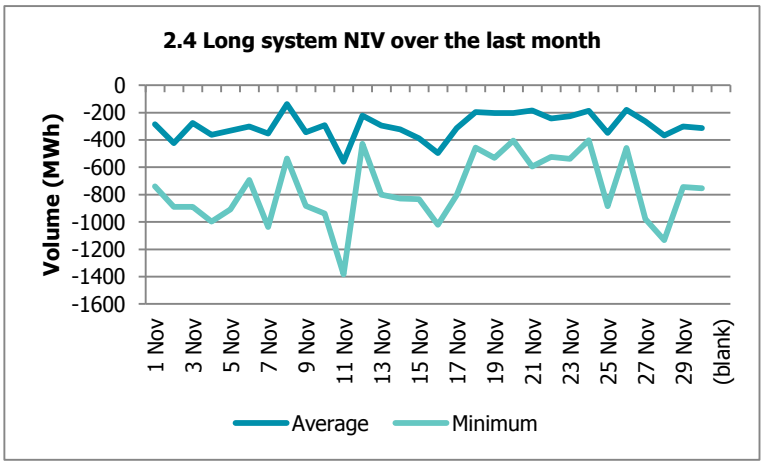
NIV and NIV tagging

The Net Imbalance Volume (NIV) represents the direction of imbalance of the System – i.e. whether the system is long or short overall. **Graph 2.3** shows the greatest and average NIV when the system was short and **graph 2.4** shows greatest and average NIVs when the system was long in November (short NIVs are depicted as positive volumes and long NIVs are depicted as negative volumes).

In almost all Settlement Periods the System Operator will need to take balancing actions in both directions (buys and sells) to balance the system. However, for the purposes of calculating an imbalance price there can only be one imbalance in one direction (the Net Imbalance). 'NIV tagging' is the process which subtracts the smaller stack of balancing actions from the larger one to determine the Net Imbalance. It is from these remaining actions that the price is derived.

NIV tagging has a significant impact in determining which actions feed through to prices. 70% of volume was removed due to NIV tagging in November. Because the most expensive actions are NIV tagged first, NIV tagging has a dampening effect on prices when there are actions in both directions.



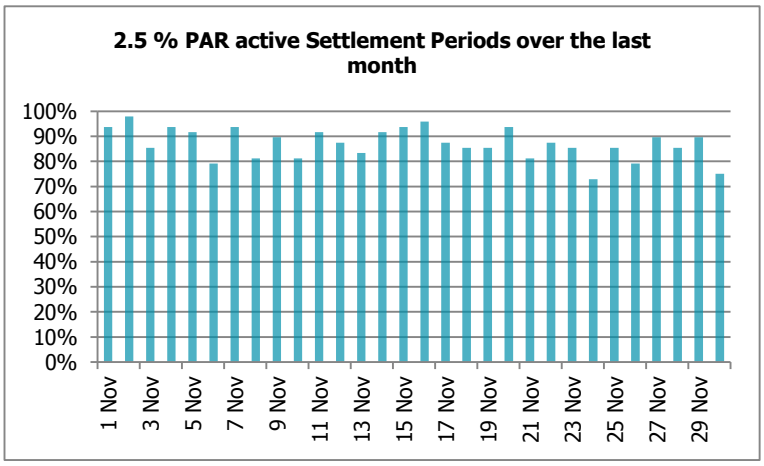


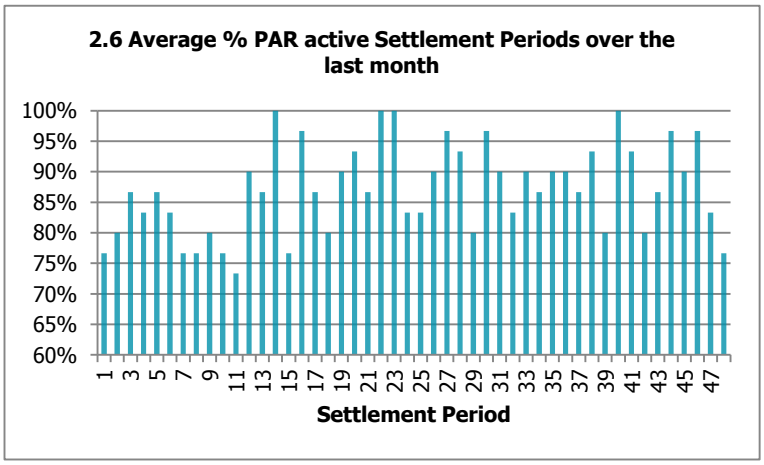
PAR tagging

PAR is the final step of the Imbalance Price calculation. It takes a volume weighted average of the most expensive 50MWh of actions left in the stack. PAR is currently set to 50MWh. The PAR volume is due to decrease to 1MWh on 1 November 2018.

The impact of PAR tagging across the month can be seen in **graph 2.5**. When PAR tagging is active, this means that there were more than 50MWh of actions left in the NIV following the previous steps of imbalance price calculation. Only the most expensive 50MWh are used in the calculation, so any volumes greater than 50MWh are 'PAR tagged' and removed from the price calculation stack.

Graph 2.6 shows the proportion of Settlement Periods over the last month when PAR tagging was active.



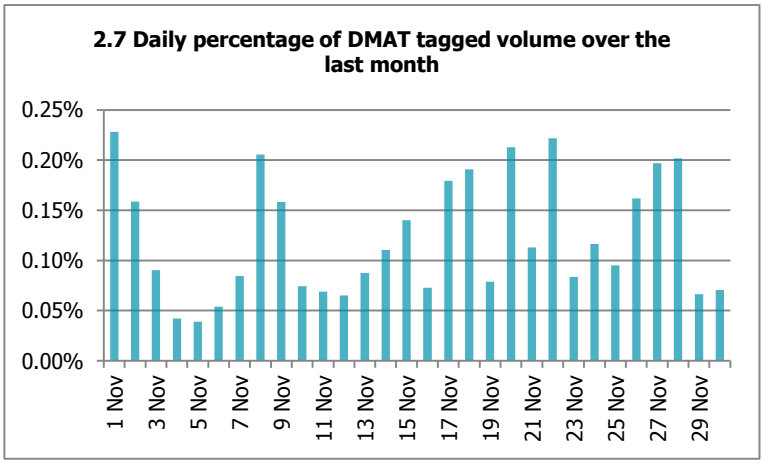


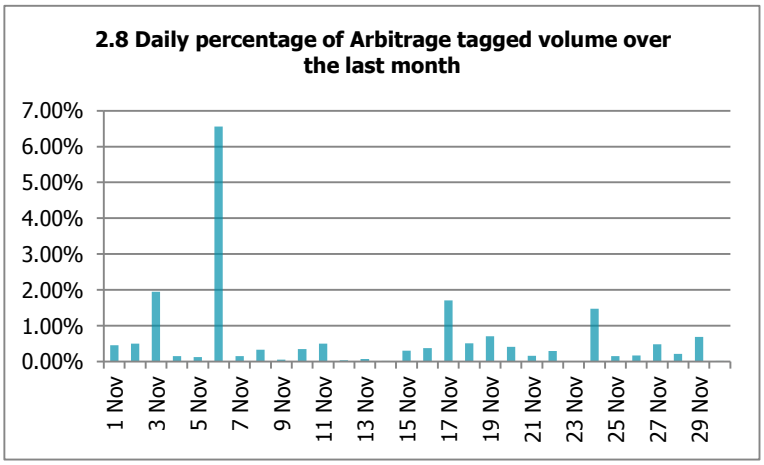
DMAT and Arbitrage Tagged Volumes

Some actions are always removed from the price calculation (before NIV tagging). These are actions which are less than 1MWh (De Minimis Acceptance Threshold (DMAT) tagging) and buy actions which are either the same price or lower than the price of sell actions (Arbitrage tagging).

Graph 2.7 shows the volumes of actions which were removed due to DMAT tagging. The majority of these volumes came from CCGT BMUs (54%) and Balancing Services Adjustment Actions (20%).

Graph 2.8 shows the volumes of actions that were removed to Arbitrage tagging. The total volume of tagged actions on 6 November was 3,503MWh. 97% of Buy Stack Arbitrage Volume on this day came from Balancing Services Adjustment Actions. In the Sell Stack 50% of Arbitrage Volume was from CCGT BMUs and 48% from BSAAs.





3 BALANCING SERVICES

Short Term Operating Reserve (STOR) costs and volumes

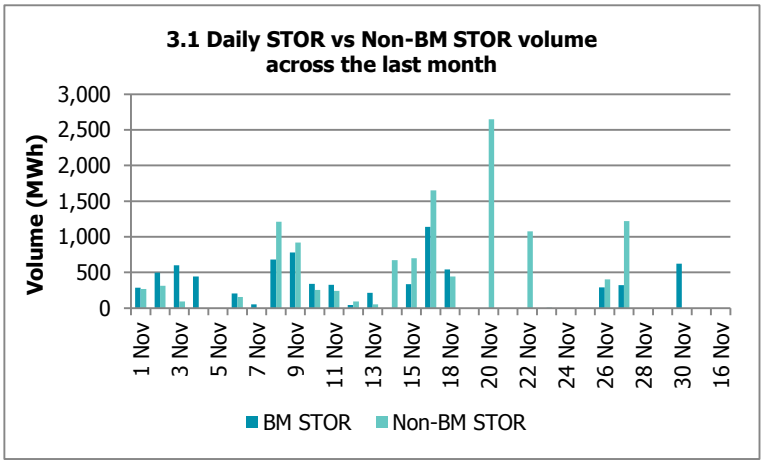
This section covers the balancing services that the System Operator takes outside the Balancing Mechanism that can have an impact on the price.

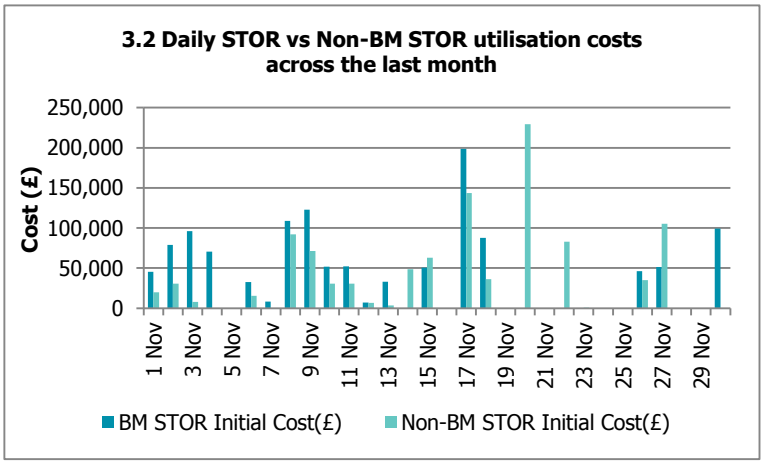
In addition to Bids and Offers available in the Balancing Mechanism, the SO can enter into contracts with providers of balancing capacity to deliver when called upon. These additional sources of power are referred to as reserve and most of the reserve that the SO procures is called Short Term Operating Reserve (STOR).

Under STOR contracts, availability payments are made to the balancing service provider in return for capacity being made available to the SO during specific times (STOR Availability Windows). When STOR is called upon, the SO pays for it at a pre-agreed price (its Utilisation Price). Some STOR is dispatched in the Balancing Mechanism (BM STOR) while some is dispatched separately (Non-BM STOR).

Graph 3.1 sets out STOR that were called upon during the month – split into volumes as BM STOR and non-BM STOR. **Graph 3.2** shows the utilisation costs of this capacity.

The average Utilisation Price for STOR capacity in November was £89.12/MWh (for BM STOR it was £153.44/MWh, and for non-BM STOR it was £81.86/MWh). The lowest STOR Utilisation Price was £61.99/MWh and the highest STOR Utilisation Price was £561/MWh.

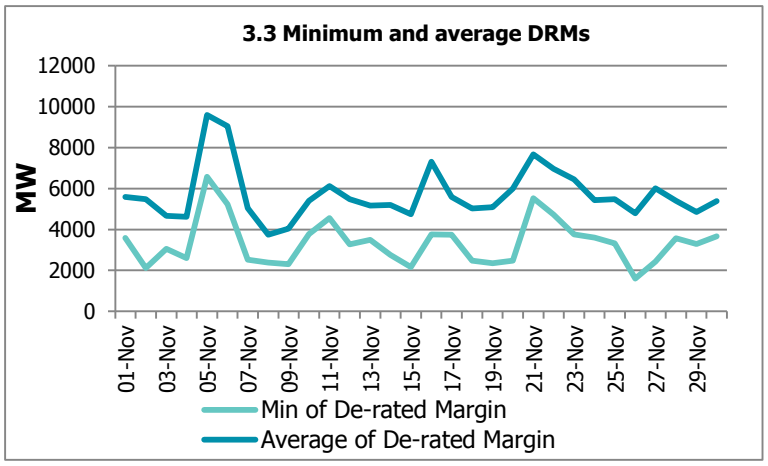




De-rated margin, loss of load probability and the Reserve Scarcity Price

There are times when the Utilisation prices of STOR plant are uplifted using the **Reserve Scarcity Price (RSP)** in order to calculate imbalance prices. The RSP is designed to respond to capacity margins so that it rises as the system gets tighter (the gap between available and required generation narrows). It is a function of **De-Rated Margin (DRM)** at Gate Closure, the likelihood that this will be insufficient to meet demand (the **Loss of Load Probability**, LoLP) and the **Value of Lost Load** (VoLL, currently set at £3,000/MWh).

Graph 3.3 shows the daily minimum and average Gate Closure DRMs for November 2016.



The System Operator has determined a relationship between each DRM and the LoLP which will determine the RSP[2]. The minimum DRM in November was 1,605MW (October minimum 387MW) on 26 November settlement Period 35.

The RSP is used to re-price STOR actions in the Imbalance Price calculation if it is higher than the original Utilisation Price of the STOR capacity. No STOR actions were re-priced using the RSP in November.

3.4 Top 5 LoLPs and RSPs

Date	SP	DRM	LoLP	RSP	RSP Used	System Length	System Price
26/11/2016	35	1,605.13	0.0109	**32.78**	No	Short	90.00
26/11/2016	36	1,768.22	0.0058	**17.32**	No	Short	100.00
02/11/2016	35	2,121.27	0.0012	**3.67**	No	Short	862.12
15/11/2016	39	2,159.11	0.0010	**3.06**	No	Short	74.80
26/11/2016	37	2,248.64	0.0007	**1.97**	No	Long	42.89

[2] The System Operators methodology for LOLP is set out in the LoLP Methodology statement: https://www.elexon.co.uk/wp-content/uploads/2014/10/37_244_11A_LOLP_Calculation_Statement_PUBLIC.pdf

4 P305 - SPECIFIC ANALYSIS

This section compares live prices with two different pricing scenarios. First we consider what prices would look like with the **pre-P305 price calculation** to highlight the impact of P305. Before the implementation of P305, the price calculation had:

- A PAR of 500MWh, and an RPAR of 100MWh;
- No non-BM STOR volumes or prices included in the price stack;
- No RSP, and instead a Buy Price Adjuster (BPA) that recovers STOR availability fees; and
- No Demand Control, Demand Side Balancing Reserve (DSBR), or Supplementary Balancing Reserve (SBR) actions priced at VoLL.

We also consider the **November 2018 Scenario**, which captures the effect of changes to the imbalance price parameters that are due to come in on 1 November 2018. These are:

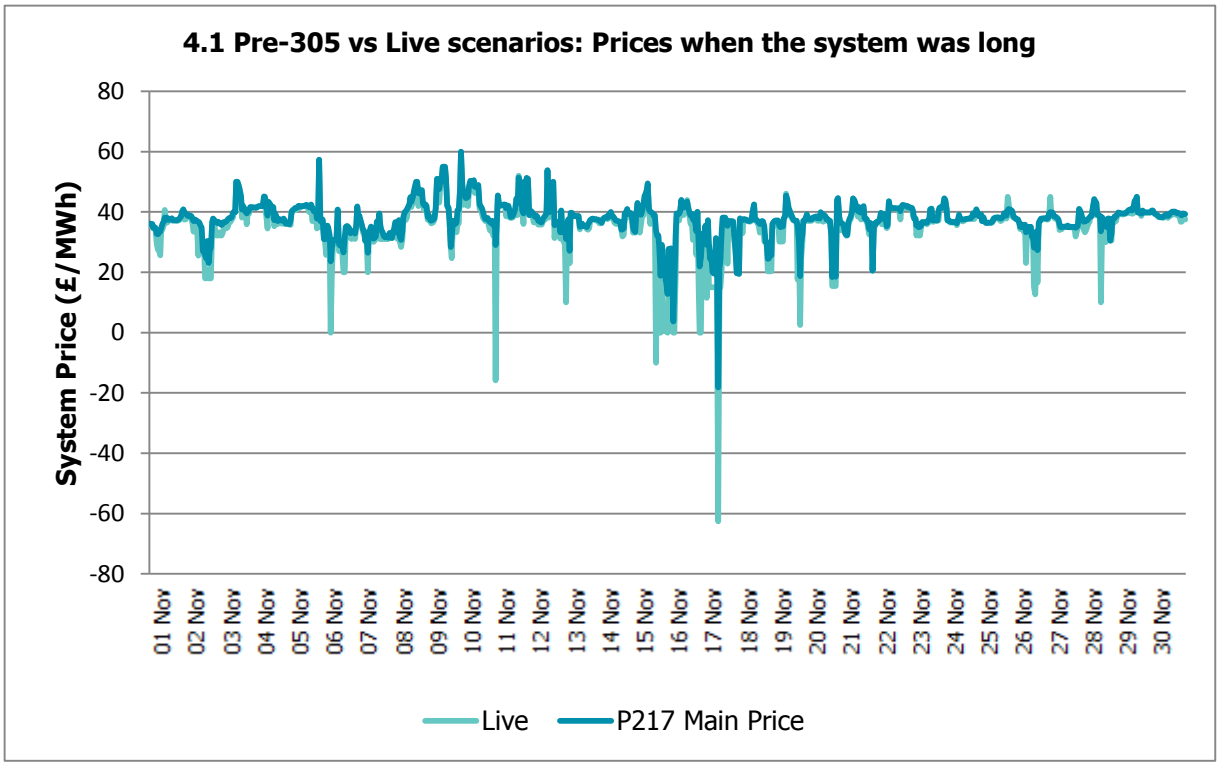
- A reduction in the PAR value to 1MWh (RPAR will remain at 1MWh);
- The introduction of a 'dynamic' LOLP function; and
- An increase in the VoLL to £6,000MWh, which will apply to all instances of VoLL in arrangements, including the RSP function.

Pre-P305 Price Calculation

The inclusion of non-BM STOR volumes in the pricing stack changed the system length from long to short in 30 Settlement Periods.

Graph 4.1 compares live System Prices when the system was long with prices re-calculated using the pre-P305 pricing scenario (for comparison we use the Main Price calculation). On average, live prices were £1.89/MWh lower when the system was long compared to the pre-P305 calculation. This is expected, in particular because of the reduction of PAR from 500MWh to 50MWh to make prices 'more marginal'. This change reduces the dampening effect of a large PAR.

When the system was long, prices were different in 87% of Settlement Periods. 68% of long Settlement Periods changed by less than £1/MWh.

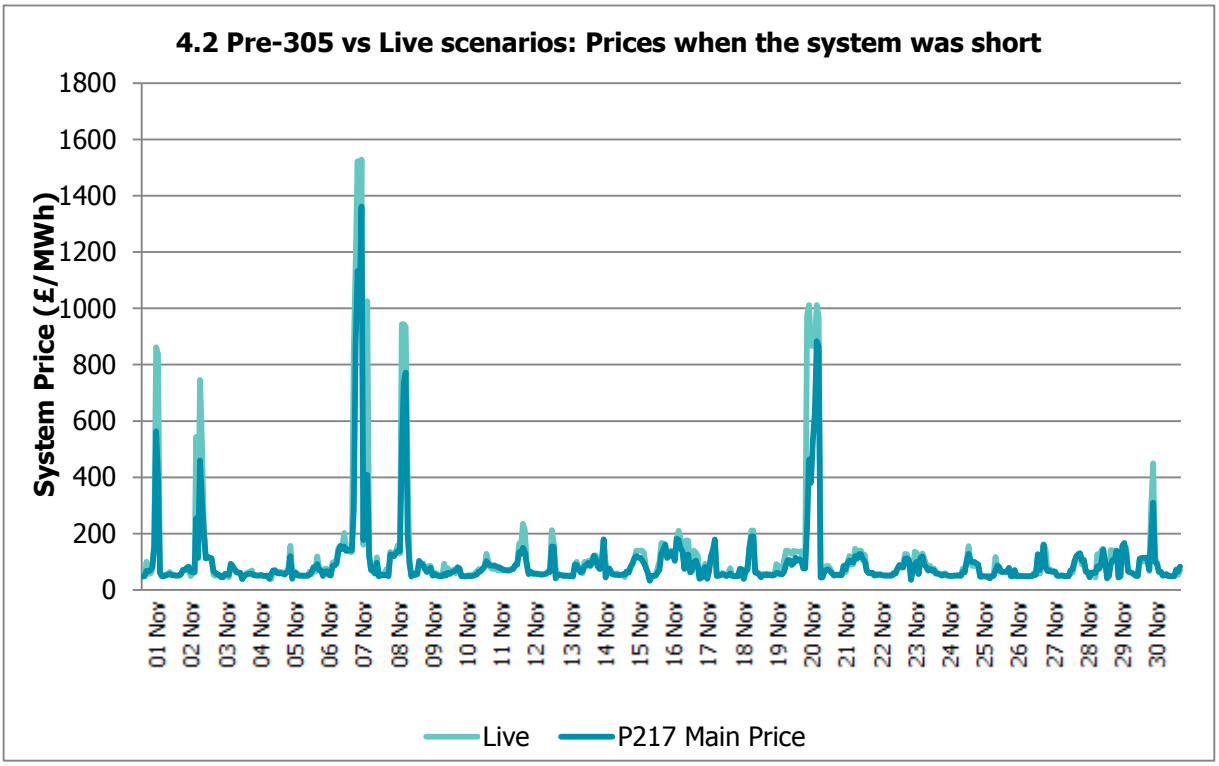


Graph 4.2 compares live System Prices when the system was short with prices re-calculated using the pre-P305 pricing scenario (using the Main Price calculation).

Live prices were on average £19.24/MWh higher when the system was short, and 32% of short Settlement Periods had price changes greater than £10/MWh.

The biggest difference in prices when the system was short was £747.86/MWh, which happened on 10 November at Settlement Period 31. The change in prices was a result of the dampening effect of a larger PAR in the P217 scenario.

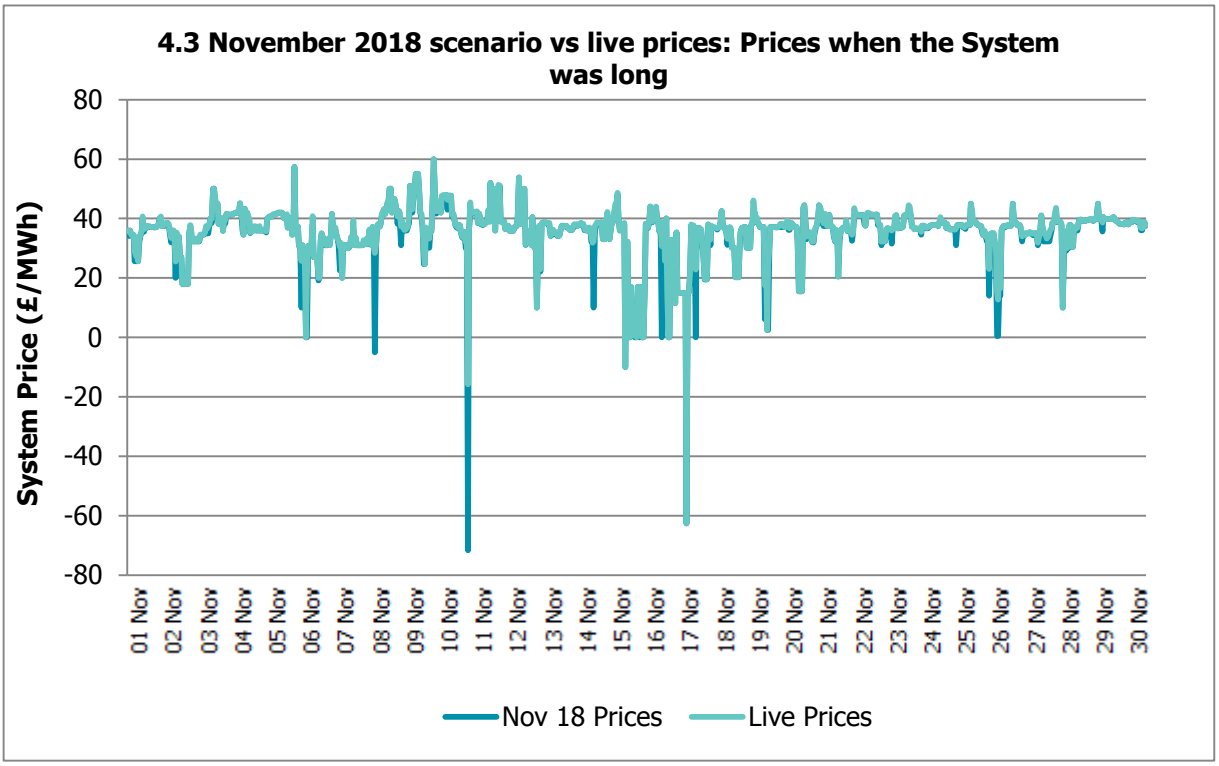
The System changed direction from long to short as a result of the P305 changes in 8 Settlement Periods. This is due to the inclusion of Non-BM STOR volumes in the calculation.



November 2018 Price Calculation

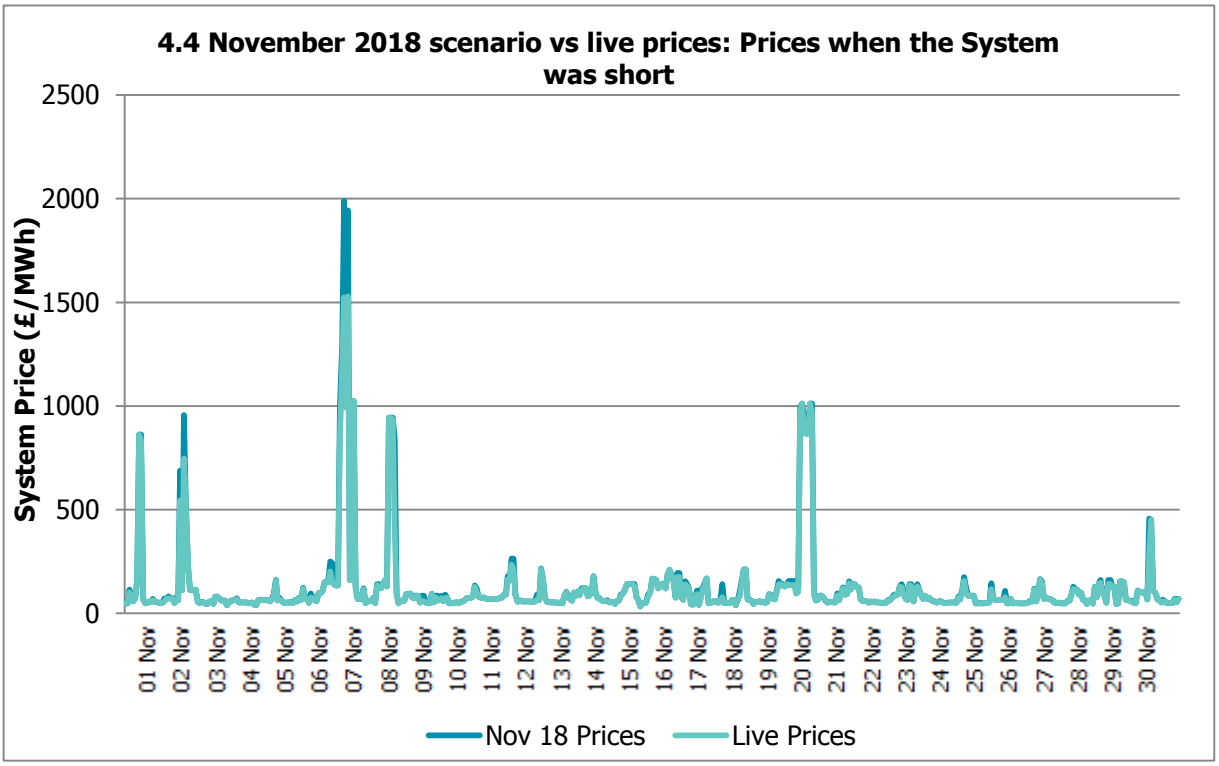
The average price differences across the month are relatively small under the November 2018 scenario – prices were £0.68/MWh lower when the system was long and £7.88/MWh higher when the system was short. There was no change in prices in 52% of Settlement Periods. When the system was long, prices were the same or lower, and when the system was short prices were the same or higher under the November 2018 scenario.

Graph 4.3 compares live System Prices with prices re-calculated using the November 2018 scenario when the system was long. The magnitude of the changes seen when the system was long was less than those when the system was short – price changes were less than £1/MWh in 75% of Settlement Periods when the system was long (and 29% when the system was short). 4% of price changes were greater than £5/MWh when the system was long. The biggest shift in price was -£55.80/MWh. This happened at Settlement Period 10 on 11 November 2016 when the price would have been -£71.60/MWh under the November 2018 scenario, whereas the live System Price was -£15.80/MWh.



Graph 4.4 compares live System Prices with prices re-calculated using the November 2018 scenario when the system was short. Prices would have been higher in 49% of short Settlement Periods under the November 2018 scenario. Of those prices that did change, 40% of these changed by more than £5/MWh under the November 2018 scenario, and 27% by more than £10/MWh. The biggest difference in price was £466.54/MWh at Settlement Period 26 on 8 November 2016. The price would have been £1,990/MWh under the November 2018 scenario, whereas the live price was £1,523/MWh. This change is a result of the reduction in PAR.

Under the November 2018 scenario there would have been 160 Settlement Periods in November with prices greater than or equal to £100/MWh, compared to 147 periods under the live scenario.



There were no Demand Control actions taken during the month. Under the November 2018 scenario these action types would be priced at a VoLL of £6,000/MWh (rather than £3,000/MWh). Although this scenario does not capture the impact that a move to a dynamic LoLP methodology will have, the impact of the change in VoLL on the RSPs can be seen in **table 4.5.** The RSP would have re-priced a total of 4 STOR actions in November.

4.5 Reserve Scarcity Prices wilth VoLL of £6,000

Date	SP	DRM	LoLP	RSP	RSP Used	System Length	System Price
26/11/2016	35	1,605.13	0.0109	**65.57**	Yes	Short	90.00
26/11/2016	36	1,768.22	0.0058	**34.64**	No	Short	100.00
02/11/2016	35	2,121.27	0.0012	**7.34**	No	Short	862.12
15/11/2016	39	2,159.11	0.0010	**6.12**	No	Short	74.80
26/11/2016	37	2,248.64	0.0007	**3.94**	No	Long	42.89

5 GLOSSARY

Term	Abbrev.	Definition
Bid		A proposed volume band and price within which the registrant of a BM Unit is willing to reduce generation or increase consumption (i.e. a rate below their FPN).
Bid/Offer Acceptance	**BOA**	A Bid or Offer within a given Settlement Period that was Accepted by the SO. BOAs are used in the imbalance price calculation process e.g. to calculate NIV or the System Price.
Offer		A proposed volume band and price within which the registrant of a BM Unit is willing to increase generation or reduce consumption (i.e. a rate above their FPN).
System Price		A price (in £/MWh) calculated by BSC Central Systems that is applied to imbalance volumes of BSC Parties. It is a core component of the balancing and settlement of electricity in GB and is calculated for every Settlement Period. It is subject to change via Standard Settlement Runs.
Replacement Price		A price (in £/MWh) calculated by BSC Central Systems that is applied to volumes that are not priced during the imbalance pricing process (detailed in BSC Section T) It is calculated for every Settlement Period, and is subject to change via Standard Settlement Runs.
Utilisation Price		The price (in £/MWh) sent by the SO in respect of the utilisation of a STOR Action which: (i) in relation to a BM STOR Action shall be the Offer Price; and (ii) in relation to a Non-BM STOR Action shall be the Balancing Services Adjustment Cost.
Market Price		The Market Price reflects the price of wholesale electricity in the short-term market (in £/MWh). You can find an explanation of how it is calculated and used in the Market Index Definition Statement (MIDS).
Reserve Scarcity Price	**RSP**	Both accepted BM and non-BM STOR Actions are included in the calculation of System Prices as individual actions, with a price which is the greater of the Utilisation Price for that action or the RSP. The RSP function is based on the prevailing system scarcity, and is calculated as the product of two following values: · the Loss of Lost Load (LoLP), which will be calculated by the SO at Gate Closure for each Settlement Period; and · the Value of Lost Load (VoLL), a defined parameter currently set to £3,000/MWh.
Replacement Price Average Reference	**RPAR**	The RPAR volume is a set volume of the most expensive priced actions remaining at the end of the System Price calculation, and is currently 1MWh. The volume-weighted average of these actions, known as the Replacement Price, is used to provide a price for any remaining unpriced actions prior to PAR Tagging.
Long		In reference to market length, this means that the volume of Accepted Bids exceeds that of Accepted Offers
Short		In reference to market length, this means that the volume of Accepted Offers exceeds that of Accepted Bid
Net Imbalance Volume	**NIV**	The imbalance volume (in MWh) of the total system for a given Settlement Period. It is derived by netting Buy and Sell Actions in the Balancing Mechanism. Where NIV is positive, this means that the system is short and would normally result in the SO accepting Offers to increase generation/decrease consumption. Where NIV is negative, the system is long and the SO would normally accept Bids to reduce generation/increase consumption. It is subject to change via Standard Settlement Runs.

6 APPENDIX 1 - A DETAILED LOOK AT 8 NOVEMBER AND 20 NOVEMBER HIGH PRICES

In this section one of our Market Analysts, Emma Tribe takes a detailed look at the Imbalance Prices over £1,000/MWh in November. November is the first month since the introduction of BSC Modification P305 to have prices over £1,000/MWh.

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8 November Prices

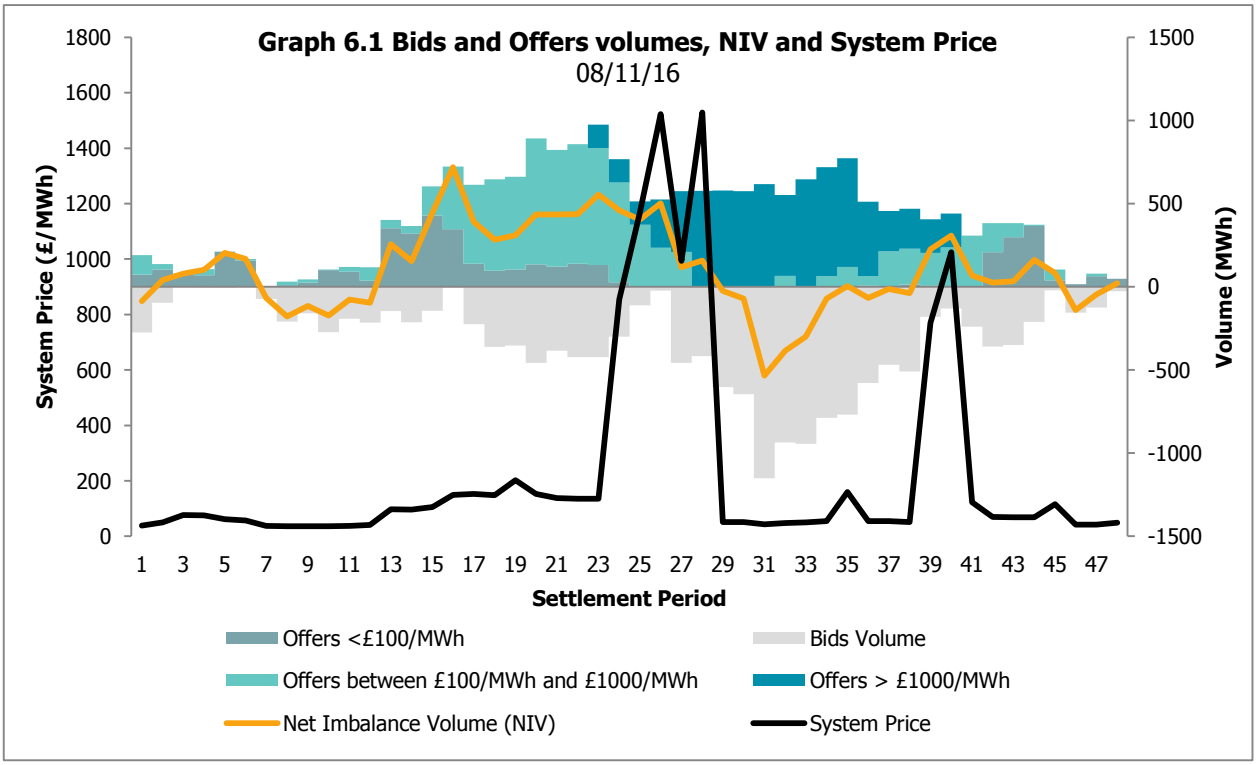
There were four prices over £1,000/MWh on 8 November:

- **£1,167/MWh** during Settlement Period 25,
- **£1,523/MWh** during Settlement Period 26,
- **£1,529/MWh** during Settlement Period 28 and
- **£1,025/MWh** during Settlement Period 40.

The highest price of the day, of £1,529/MWh in Settlement Period 28 was also the highest System Price since the introduction of BSC Modification P305. This was set by a £1,285/MWh priced Bid from a Coal BMU and a £1,944/MWh priced Bid from a Combined Cycle Gas Turbine (CCGT). In November 2018 when the PAR becomes 1MWh the £1,944/MWh Bid would have set the System Price.

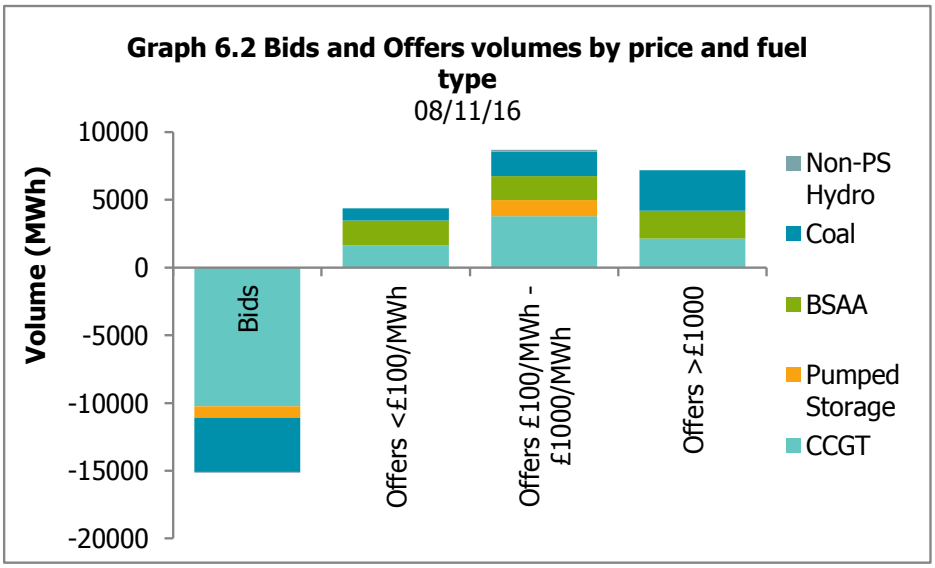
Graph 6.1 shows the volume of higher priced Offers increasing during the day. Between Settlement Period 25 and 40 75% of Offers were priced over £1,000. While the system was short (positive NIV), these high priced Offers set the System Price. When the system is long the high priced Offers are removed from the calculation due to NIV tagging.

NIV tagging removes the volume of any negative priced action and any action volume above the orange NIV line from the price calculation when the System is Short. During the day the System was short for 30 Settlement Periods, the average short System Price was £345/MWh.



Graph 6.2 shows the bids and offers split by fuel type and price. The maximum prices offers during the day were £1,990/MWh from a CCGT BMU. Accepted Offers priced over £1,000/MWh came from Balancing Services Adjustment Actions (BSAA) as well as CCGT and Coal BMU's.

Of the 5,668MWh of BSAA actions in the buy stack, 21% of the volume came from Short Term Operating Reserve STOR providers. These actions would not have been included in the price calculation pre-BSC modification P305.



20 November Prices

Graph 6.3 Shows the high System Prices between Settlement Period 31 and 37. In Settlement Period 32 and Settlement Period 36 the System Price was £1,011/MWh. During the day no Offers priced over £1,000/MWh were accepted. The highest priced Offers of the day was £995/MWh from a Coal BMU, these Offers set the System Price in Settlement 32 and 36 combined with a Buy Price Adjuster of £16.32/MWh.