ISG205-SPAR

REPORTING ON APRIL 2018

ISSUE 30 – PUBLISHED 22 MAY 2018

SYSTEM PRICE ANALYSIS REPORT

The System Prices Analysis Report (SPAR) provides a monthly update on price calculations. It is published by the ELEXON 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.

The new System Price Analysis Dashboard is now available on the ELEXON website, and allows customers to model System Prices under post 1 November 2018 scenarios.

This month's SPAR contains an appendix on Arbitrage in energy balancing volumes.

1 SYSTEM PRICES AND LENGTH

This report covers the month of April. 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 are based predominantly on the System Operator's 'sell' actions such as accepted Bids. When the market is short, System Prices are based predominantly on the System Operator's 'buy' actions. **Table 1.1** gives a summary of System Prices for April 2018, with values shown in £/MWh.

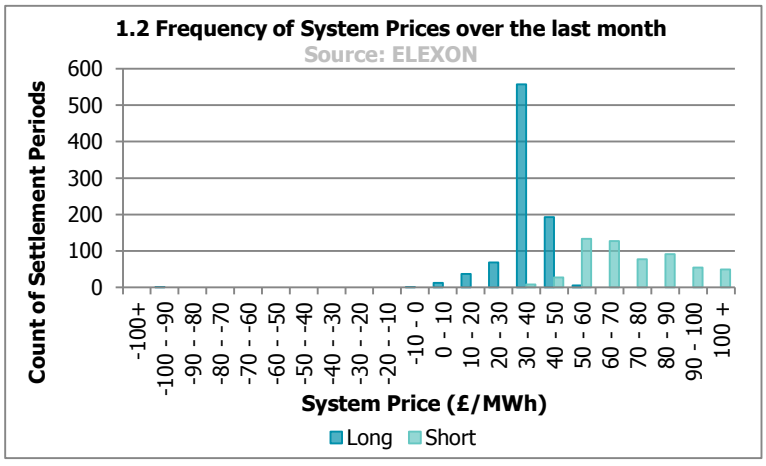
Graph 1.2 shows the distribution of System Prices across Settlement Periods in April 2018 when the market was long and short.

64% of System Prices were between £30/MWh and £60/MWh, regardless of system length. When the system was long, 86% of prices were between £30/MWh and £50/MWh. When the system was short, 46% of prices were between £50/MWh and £70/MWh and 9% of prices were over £100/MWh.

	System Price (Long)				
Month	**Min**	**Max**	**Median**	**Mean**	**Std Dev**
April 2018	-92.38	59.45	37.55	35.53	8.82

	System Price (Short)				
Month	**Min**	**Max**	**Median**	**Mean**	**Std Dev**
April 2018	37.35	158.00	68.50	73.39	19.22

1.1 System Price summary by month (£/MWh)



[1] For further detail of the Imbalance Price calculation, see our imbalance pricing guidance: https://www.elexon.co.uk/reference/credit-pricing/imbalance-pricing/

SYSTEM PRICE ANALYSIS REPORT

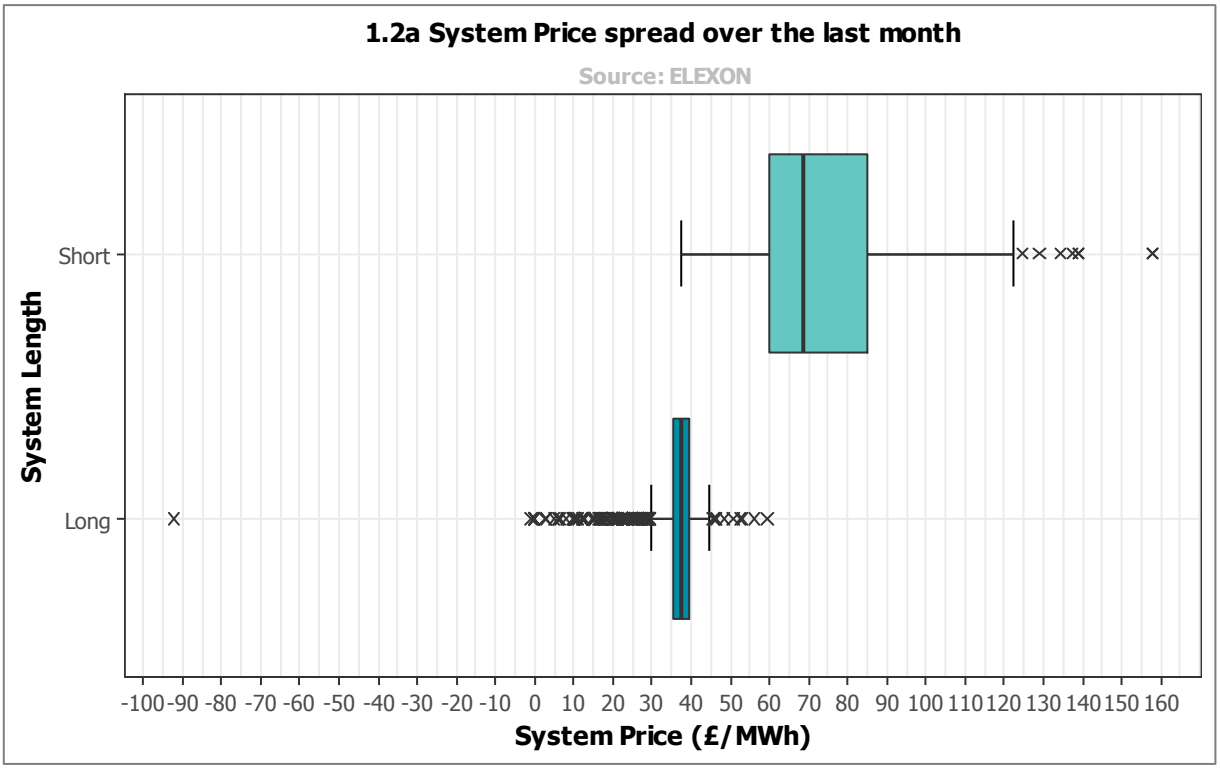
System Prices exceeded £100/MWh 49 times in April 2018 (compared to 128 times in March). The highest System Price, £158/MWh, occurred in Settlement Periods 25 and 26 on 13 April 2018. These prices were set by an Offer from a Gas BMU priced at £158/MWh.

The lowest System Price of the month was -£92.38/MWh. This occurred in Settlement Period 31 on 26 April 2018, and was set by negatively priced Bids from Biomass and Gas BMUs.

Graph 1.2a shows the spread of System Prices in April 2018 displayed as a box plot diagram, and split between a short and long system. The middle line in each box represents the median System Price of the month, which is £68.50/MWh for short Settlement Periods and £37.55/MWh for long Settlement Periods. Each box edge represents the lower and upper quartiles (25th and 75th percentile respectively), with the Interquartile Range (difference between the Upper and Lower quartiles) being £25.09/MWh for short System Prices and £4.00/MWh for long System Prices.

Outliers are shown on the graph as crosses, and have been defined as being greater than 1.5 x the Interquartile Range away from the Upper and Lower quartiles. Under this definition, 8 of the 673 (1.4%) short System Prices for April were outliers - with a System Price greater than £122/MWh. The graph also shows how these high short System Prices are distributed up to the maximum short System Price for the month of £158/MWh.

For long System Prices, the majority of prices fall within a narrow band; 86% of prices are between £30/MWh and £50/MWh. The lowest long System Price of the month, -£92.38/MWh, is much lower than other long System Prices in April.



SYSTEM PRICE ANALYSIS REPORT

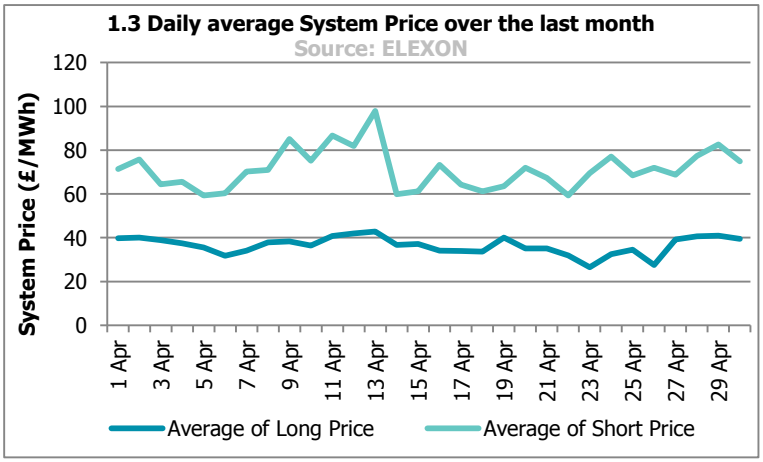
Graph 1.3 shows daily average System Prices over the last month. In April, the average System Price was £35.53/MWh when the system was long and £73.39MWh when the system was short.

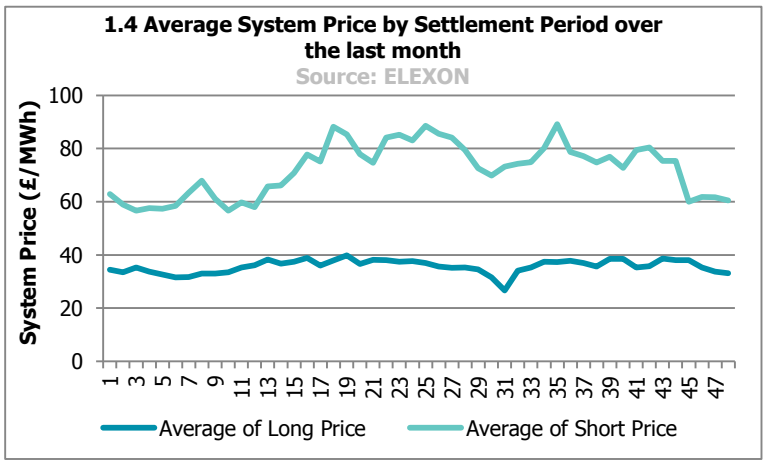
The highest daily average price when the system was short was £97.92/MWh, and occurred on 13 April. The system was short for 27 Settlement Periods on this day.

The lowest daily average price when the system was long was £26.54/MWh on 23 April 2018. The system was long in 45 Settlement Periods on this day, with the average reduced by three Settlement Periods with a System Price of £0/MWh.

Graph 1.4 shows the variation of System Prices across the day. Short prices were highest in Settlement Period 35, with long prices lowest in Settlement Period 31. The lowest average System Prices regardless of market length was seen during Settlement Period 2, when the System Price was, on average, £36.01/MWh.

Average long Settlement Period System Prices ranged between £26.61/MWh and £39.79/MWh. Average short Settlement Period prices varied more, from £56.33/MWh to £89.20/MWh.

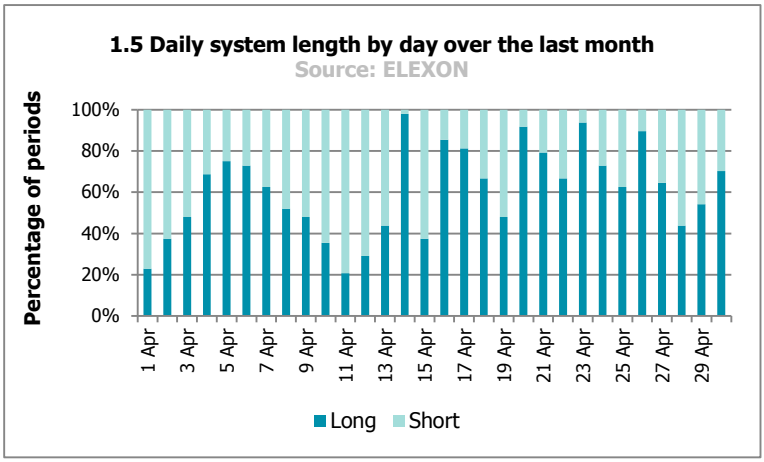


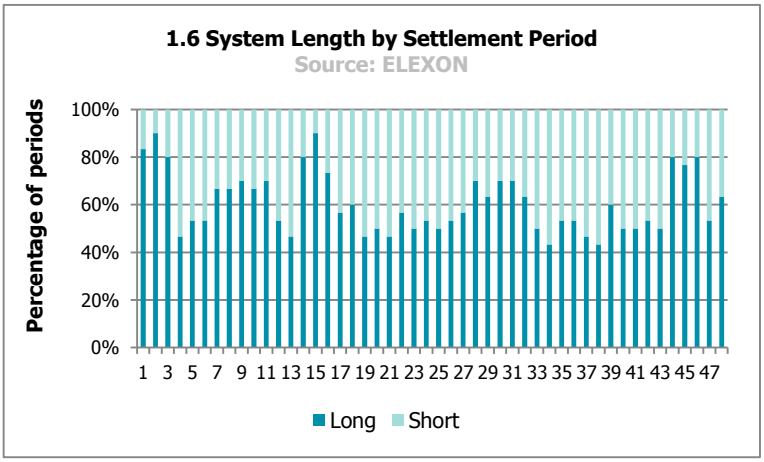


Graph 1.5 shows system length by day, and **Graph 1.6** shows system length by Settlement Period for April. The system was long for 61% of Settlement Periods in March, compared to 55% in March.

On 11 April, the system was short for 79% of Settlement Periods. The average NIV when the system was short on this day was 414MWh, while the average System Price in a short Settlement Period was £86.68/MWh. In contrast, on 14 April the system was long in 98% of Settlement Periods.

Settlement Periods 34 and 38 were short for 57% of the month, whilst Settlement Period 2 was short for 10% of the month.





2 PARAMETERS

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

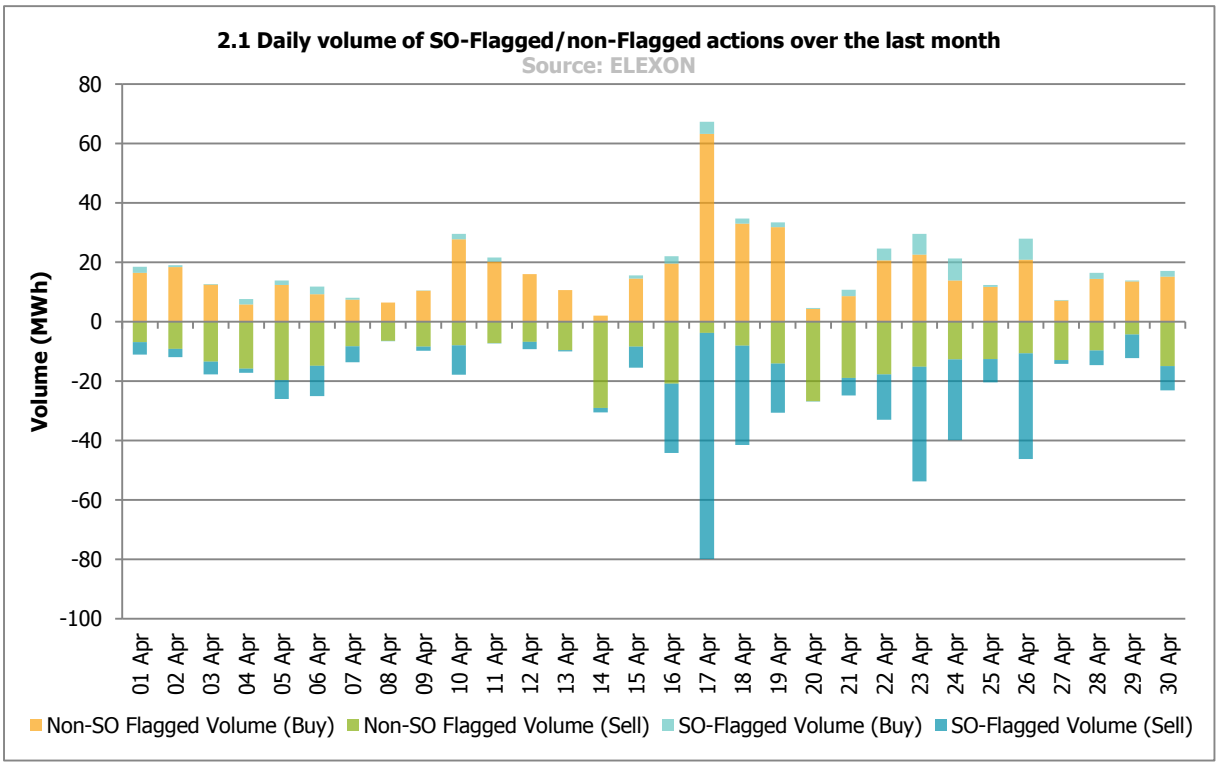
- The impact of Flagging balancing actions;
- The impact of NIV Tagging;
- The impact of PAR Tagging;
- The impact of the Replacement Price; and
- How these mechanisms affect which balancing actions feed into the price.

Flagging

The Imbalance Price calculation aims to distinguish between 'energy' and 'system' balancing actions. Energy balancing actions are those 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 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 (a process called Classification). The System Operator flags actions when they are taken to resolve a locational constraint on the transmission network (SO-Flagging), or 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 in April 2018 as being constraint related. On 17 April, 95% of sell volume was SO-Flagged.



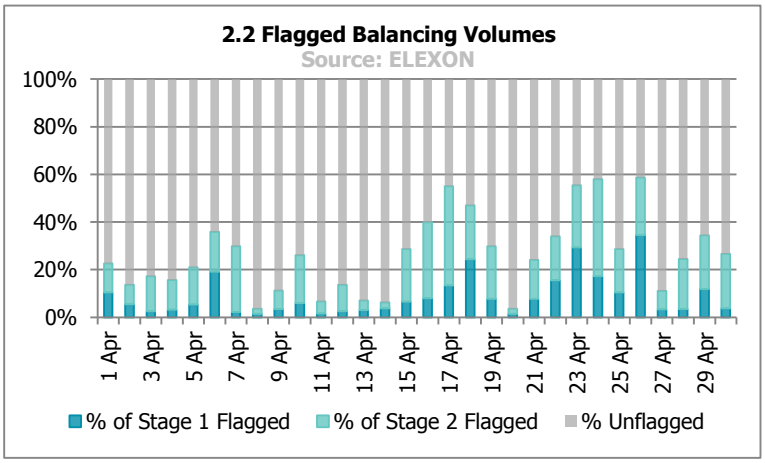
49% of sell balancing actions taken in April had an SO-Flag compared with 31% in March. 33% of SO-Flagged sell actions came from CCGT BMUs, 29% from Balancing Services Adjustment Actions (BSAAs) and 28% from Wind BMUs. The average initial price (i.e. before any re-pricing) of a SO-flagged sell action was -£20.15/MWh.

10% of buy balancing actions taken in April had an SO-Flag, compared to 6% in March. 53% of SO-Flagged buy actions came from CCGT BMUs and 38% was from BSAAs. The average initial price of a SO-Flagged buy action was £65.39/MWh.

Any actions which are less than 15 minutes total duration are CADL Flagged. 3% of buy actions and 1% of sell actions were CADL Flagged in April. The majority of CADL Flagged buy actions (94%) came from Pumped Storage BMUs. 58% of CADL Flagged sell actions came from CCGT BMUs, with Pumped Storage BMUs accounting for a further 39%.

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 Unflagged actions. If a First-Stage Flagged balancing action has a more expensive price than the most expensive First-Stage Unflagged balancing action it becomes Second-Stage Flagged. This means 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 the accepted balancing actions – only a proportion of these will feed through to the final price calculation.



The Replacement Price

If there are Second-Stage Flagged action volumes left in the NIV, these will be repriced by the Replacement Price. In total 50% of sell actions in April were flagged. Of these 18% were assigned a Replacement Price, currently based on the most expensive 1MWh of Unflagged actions.

Sell actions will typically have their prices revised upwards by the Replacement Price for the purposes of calculating the System Price. In April, the average original price of a Second-Stage Flagged repriced sell action was £8.37/MWh and the average Replacement Price for sell actions (when the System was long) was £34.30/MWh.

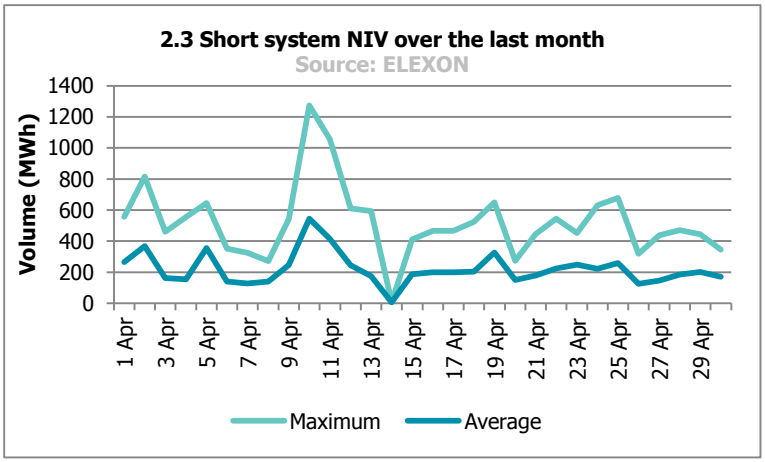
12% of buy actions were Flagged; of these 2% had the Replacement Price applied. The average original price of a buy action with the Replacement Price applied was £100.73/MWh, and the average Replacement Price was £84.26/MWh.

If there are no Unflagged actions remaining in the NIV, the Replacement Price will default to the Market Index Price. This occurred in 31 long Settlement Periods in April, compared to seven long Settlement Periods last month.

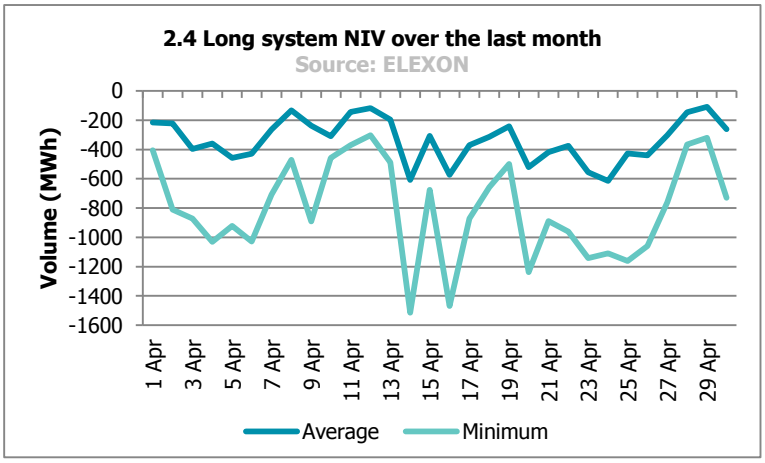
NIV and NIV Tagging

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 the greatest and average NIVs when the system was long. Note 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. 61% of volume was removed due to NIV tagging in April. The most expensive actions are NIV Tagged first; hence NIV Tagging has a dampening effect on prices when there are balancing actions in both directions.



The minimum long system NIV of the month was -1,515MWh, on 14 April 2018 during Settlement Period 31.

The maximum short system NIV of the month (1,273MWh) was seen on 10 April in Settlement Period 23. There were -285MWh of sell actions in this Settlement Period, and 1,571MWh of buy actions from Offers and system buy actions in this Settlement Period. The System Price was £89.86/MWh in this Settlement Period.

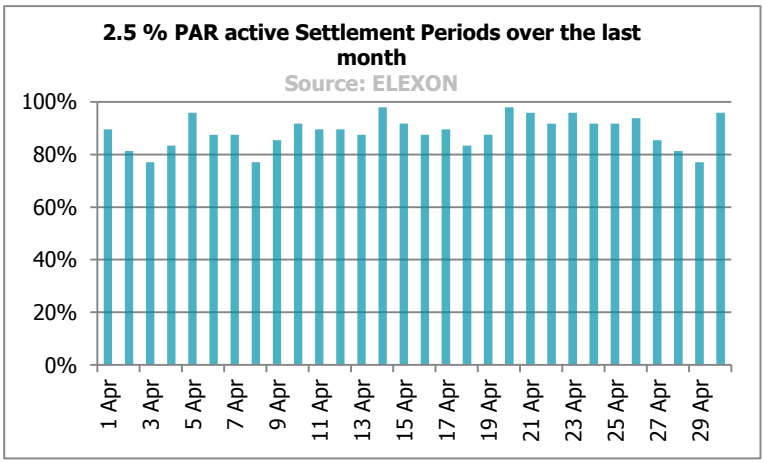
PAR Tagging

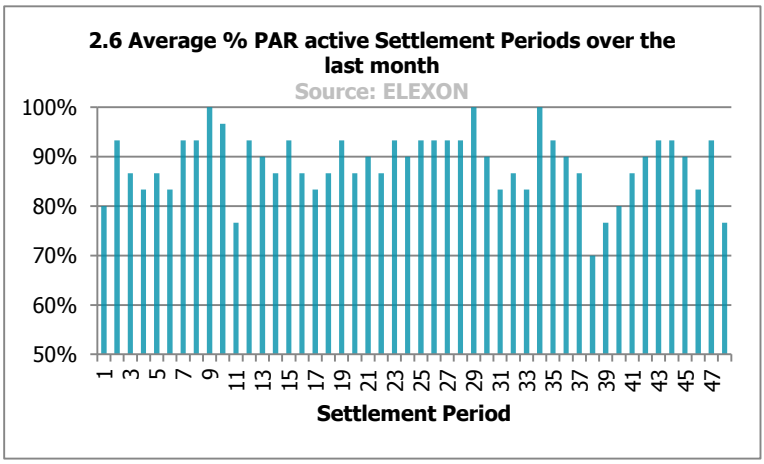
PAR is the final step of the Imbalance Price calculation. It takes a volume weighted average of the most expensive 50MWh of actions left in the stack. PAR is currently set to 50MWh, but is due to decrease to 1MWh on 1 November 2018.

The impact of PAR Tagging across the month can be seen in **Graph 2.5**. PAR Tagging is active when there are 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 Imbalance Price calculation stack. PAR was active for 89% of Settlement Periods in April.

Graph 2.6 shows the proportion of Settlement Periods over the last month when PAR Tagging was active. Settlement Period 38 had the lowest active PAR Tagging in April 2018 with 70%, representing the NIV being smaller in this period or the system being more balanced as a whole prior to System Operator balancing activity.

Settlement Periods 9, 29 and 34 had PAR Tagging active every day across April.





DMAT and Arbitrage Tagged Volumes

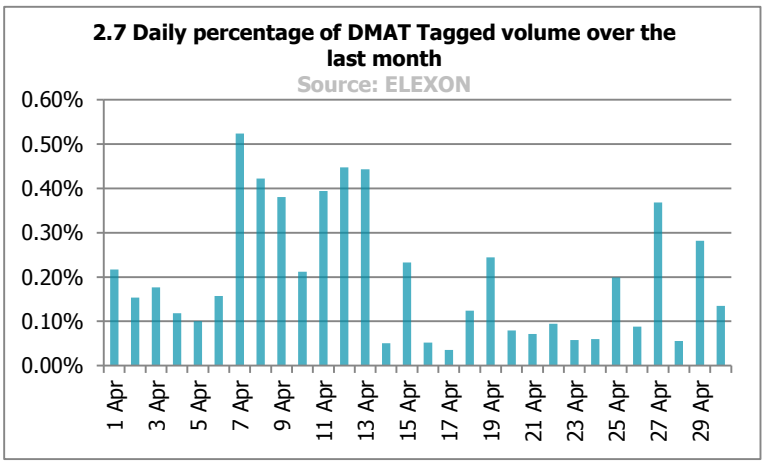
Some actions are always removed from the price calculation (before NIV Tagging). These are actions which are less than 1MWh (De Minimis Acceptance Threshold (DMAT) Tagging) or buy actions which are either the same price or lower than the price of sell actions (Arbitrage Tagging). More information on Arbitrage Tagging is given in this month's appendix.

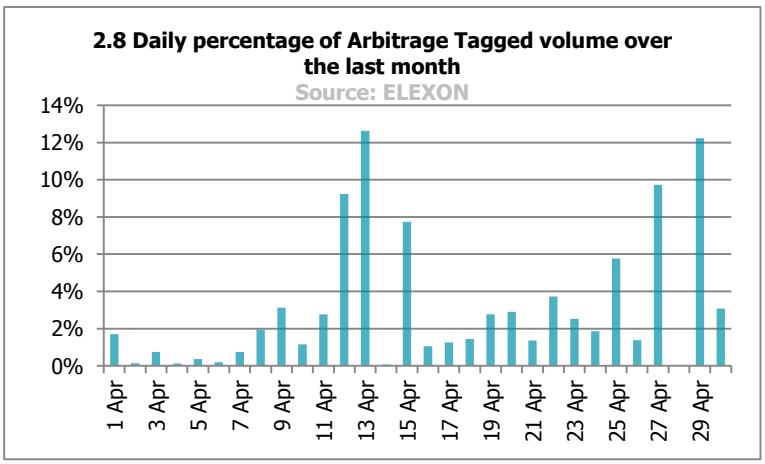
Graph 2.7 shows the volumes of actions which were removed due to DMAT Tagging. 0.15% of total buy and sell volume was removed by DMAT Tagging in April. 58% of DMAT Tagged volume came from Balancing Services Adjustment Actions (BSAAs), whilst 30% came from CCGT BMUs.

Graph 2.8 shows the volumes of actions that were removed due to Arbitrage Tagging. 46% of Arbitrage Tagged volume was from BSAAs, 40% from CCGT BMUs and 8% from Coal BMUs.

In April the average initial price of an Arbitrage Tagged buy action was £38.28/MWh, and for a sell action was £43.08/MWh. The maximum price of an Arbitrage Tagged sell action was £115/MWh, and the lowest priced Arbitrage Tagged buy action was £0/MWh.

On 13 April 2018, 2,608MWh of actions were Arbitrage Tagged, representing 12.63% of daily volume. The average price of an Arbitrage Tagged buy action was £41.76/MWh and for a sell action was £50.22/MWh. 0.44% of daily volume was DMAT Tagged on this day.





3 BALANCING SERVICES

Short Term Operating Reserve (STOR) costs and volumes

This section covers the balancing services that the System Operator (SO) takes outside the Balancing Mechanism that can affect the price.

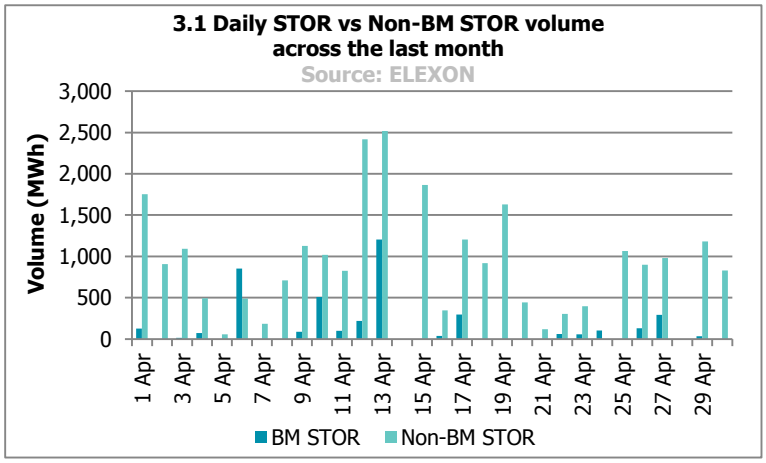
In addition to Bids and Offers available in the Balancing Mechanism, the SO can enter into contracts with providers of balancing capacity to deliver when called upon. These additional sources of power are referred to as reserve, and most of the reserve that the SO procures is called Short Term Operating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

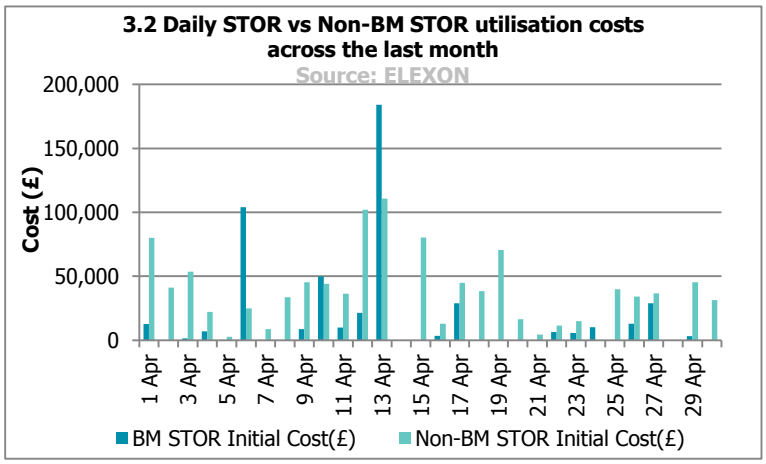
Under STOR contracts, availability payments are made to the balancing service provider in return for capacity being made available to the SO during specific times (STOR Availability Windows). When STOR is called upon, the SO pays for it at a pre-agreed price (its Utilisation Price). Some STOR is dispatched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

Graph 3.1 gives STOR volumes that were called upon during the month – split into BM STOR and non-BM STOR. **Graph 3.2** shows the utilisation costs of this capacity. 86% of the total STOR utilised in April came from outside of the Balancing Mechanism.

The average Utilisation Price for STOR capacity in April was £52.85/MWh (£118.80/MWh for BM STOR and £42.13/MWh for non-BM STOR).

On 13 April, the utilisation cost for BM STOR totalled £184,000. 1,203MWh of BM STOR volume was called upon across this day, which represented 29% of the total BM STOR volume in April.





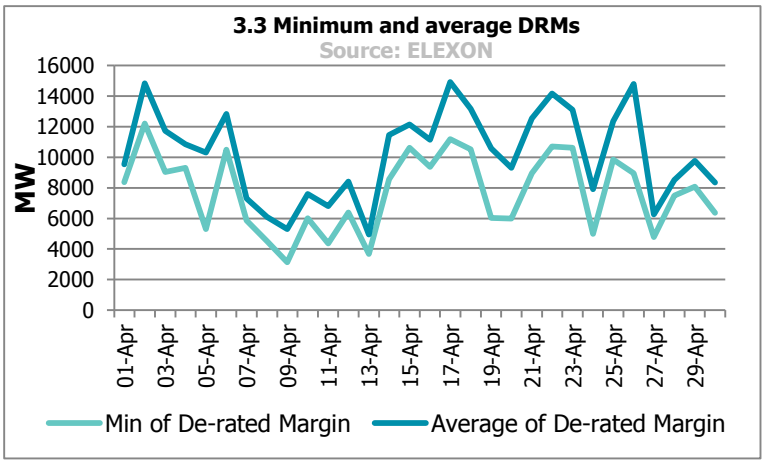
De-Rated Margin, Loss of Load Probability and the Reserve Scarcity Price

There are times when the Utilisation Prices of STOR plants are uplifted using the **Reserve Scarcity Price (RSVP)** in order to calculate System Prices. The RSVP is designed to respond to capacity margins, so 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 April 2018.

The System Operator has determined a relationship between each DRM and the LoLP[2], which will determine the RSVP. The minimum DRM in April was 3,142MW on 9 March in Settlement Period 20 (compared to 4,307MW in March).

The RSVP re-prices STOR actions in the Imbalance Price calculation if it is higher than the original Utilisation Price. No STOR actions were re-priced using the RSVP in April (see **Table 3.4**).



3.4 Top 5 LoLPs and RSVPs

Date	SP	DRM	LoLP	RSVP	RSVP Used	System Length	System Price
09/04/2018	20	3,142.34	0.0000	**0.01**	No	Long	36.27
09/04/2018	19	3,284.92	0.0000	**0.00**	No	Short	90.00
09/04/2018	18	3,406.65	0.0000	**0.00**	No	Short	107.95
13/04/2018	22	3,683.77	0.0000	**0.00**	No	Short	110.02
13/04/2018	20	3,766.01	0.0000	**0.00**	No	Short	112.00

[2] The System Operators methodology for LoLP is set out in the LoLP Methodology statement: https://www.elexon.co.uk/wp-content/uploads/2015/10/Loss_of_Load_Probability_Calculation_Statement_v1.0.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 RSVP, 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:

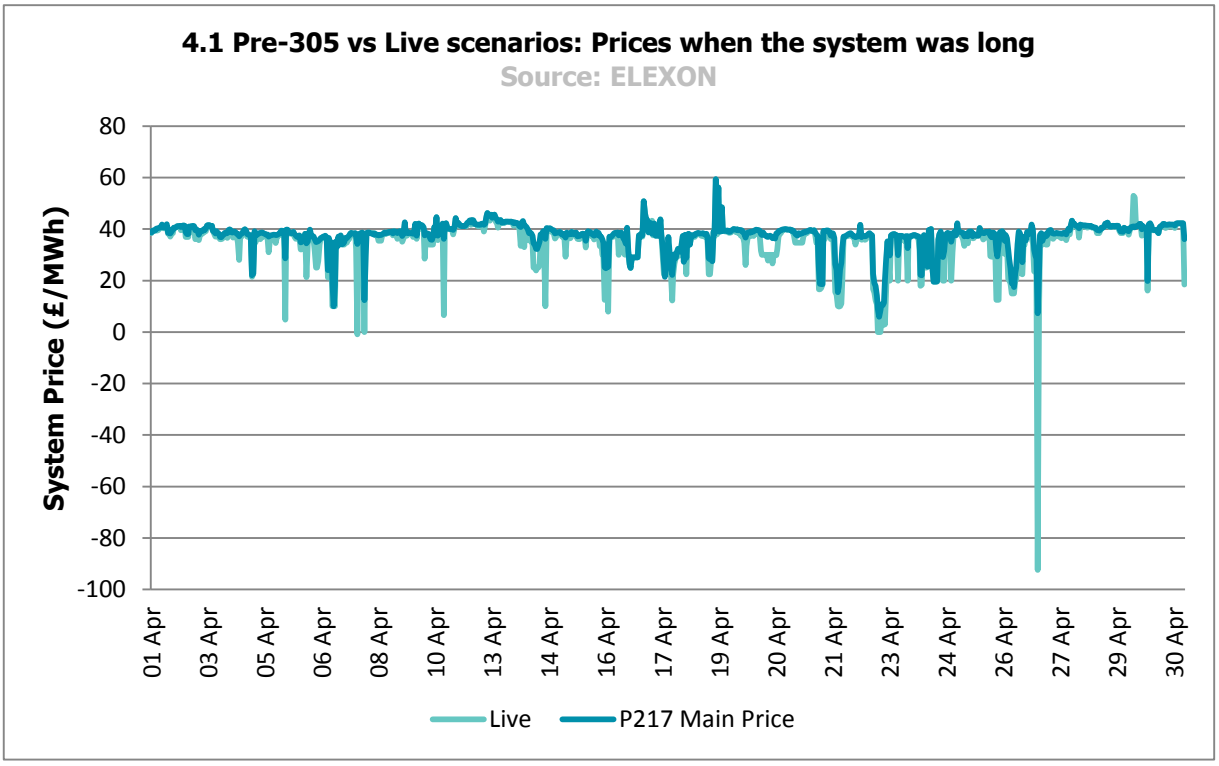
- A reduction in the PAR value to 1MWh (RPAR will remain at 1MWh);
- The introduction of a 'dynamic' LoLP function[3]; and
- An increase in the VoLL to £6,000MWh, which will apply to all instances of VoLL in arrangements, including the RSVP function.

[3] From 1 May 2018 the Transmission Company will calculate Indicative LoLP values using the Dynamic Method, whilst it continues to calculate Final LoLP values using the Static Method. Indicative LoLP values using the Dynamic Method will be published on the ELEXON Portal.

Pre-P305 Price Calculation

Graph 4.1 compares live System Prices when the system was long with prices re-calculated using the pre-P305 pricing scenario 'P217' (for comparison we use the Main Price calculation). On average, live prices were £1.93/MWh lower when the system was long compared to the pre-P305 calculation. This is expected as the reduction of PAR from 500MWh to 50MWh aims to make prices 'more marginal', by reducing the dampening effect of a large PAR.

When the system was long, prices were different in 88% of Settlement Periods; in 69% of these periods the change was less than £1/MWh. The biggest price change occurred on the 26 April 2018 in Settlement Period 31, where the live price was £99.64/MWh lower than the System Price would have been under the P217 Scenario. This difference was due to the reduction in PAR.

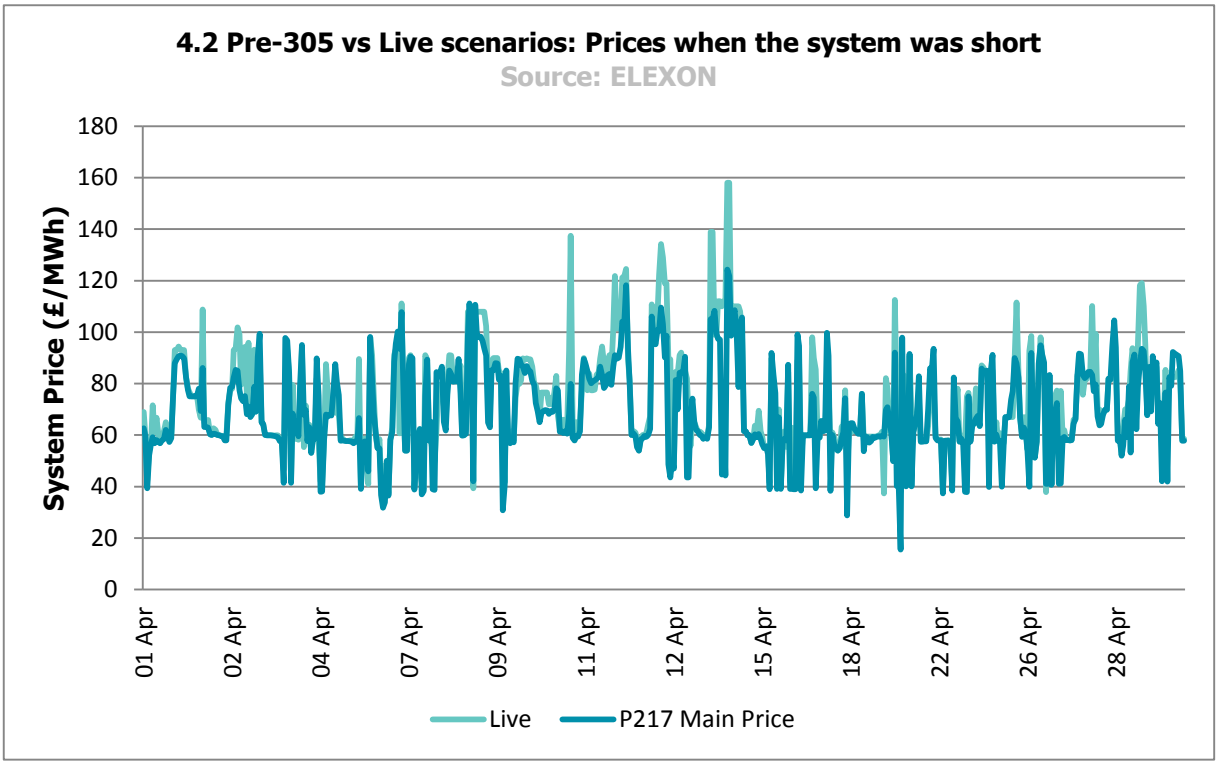


Graph 4.2 compares live System Prices when the system was short with prices re-calculated using the pre-P305 pricing scenario 'P217' (using the Main Price calculation).

Live prices were on average £3.84/MWh higher when the system was short, with 78% of Settlement Periods having live System Prices the same or higher than the Pre-305 scenario.

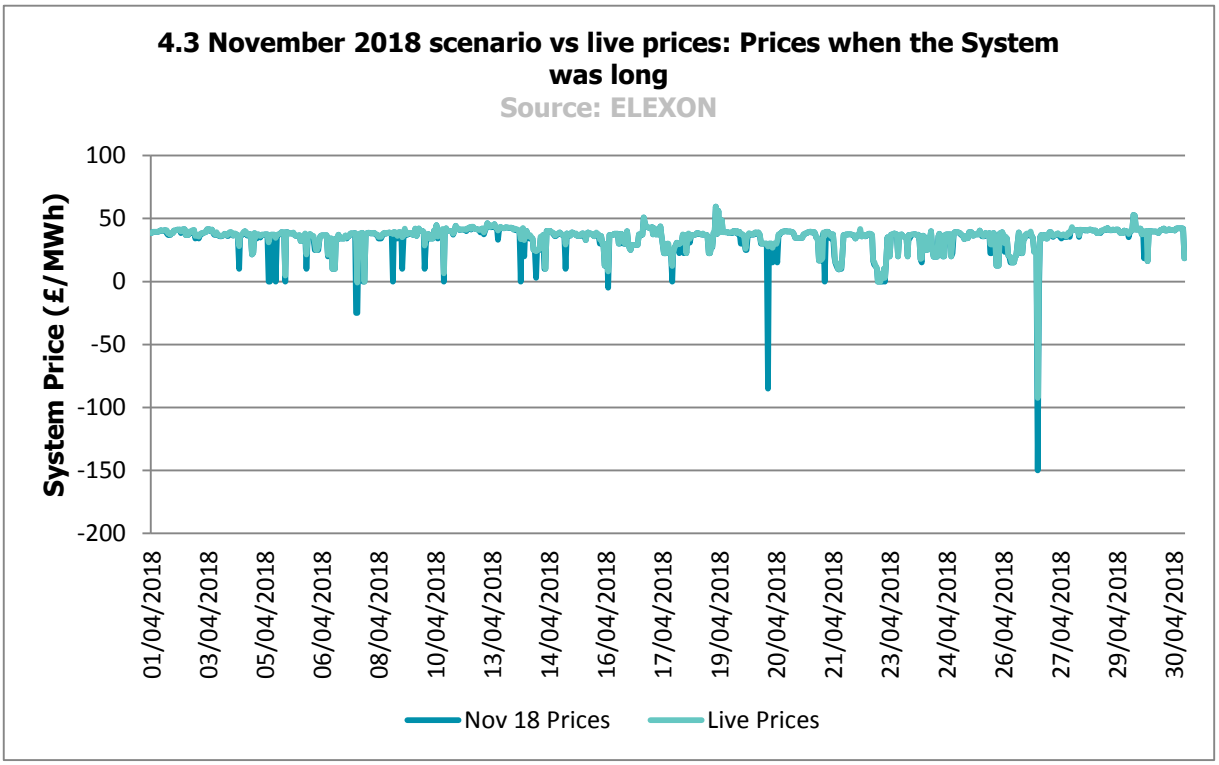
The biggest difference in prices when the system was short was £67.75/MWh (13 April 2018 during Settlement Period 24), as a result of the inclusion of non-BM STOR in the pricing calculation. In the P217 scenario, the Main Price would have been £44.25/MWh compared to the live scenario System Price of £112/MWh.

The inclusion of non-BM STOR volumes in the pricing stack changed the system length from long to short in 56 Settlement Periods.



November 2018 Price Calculation

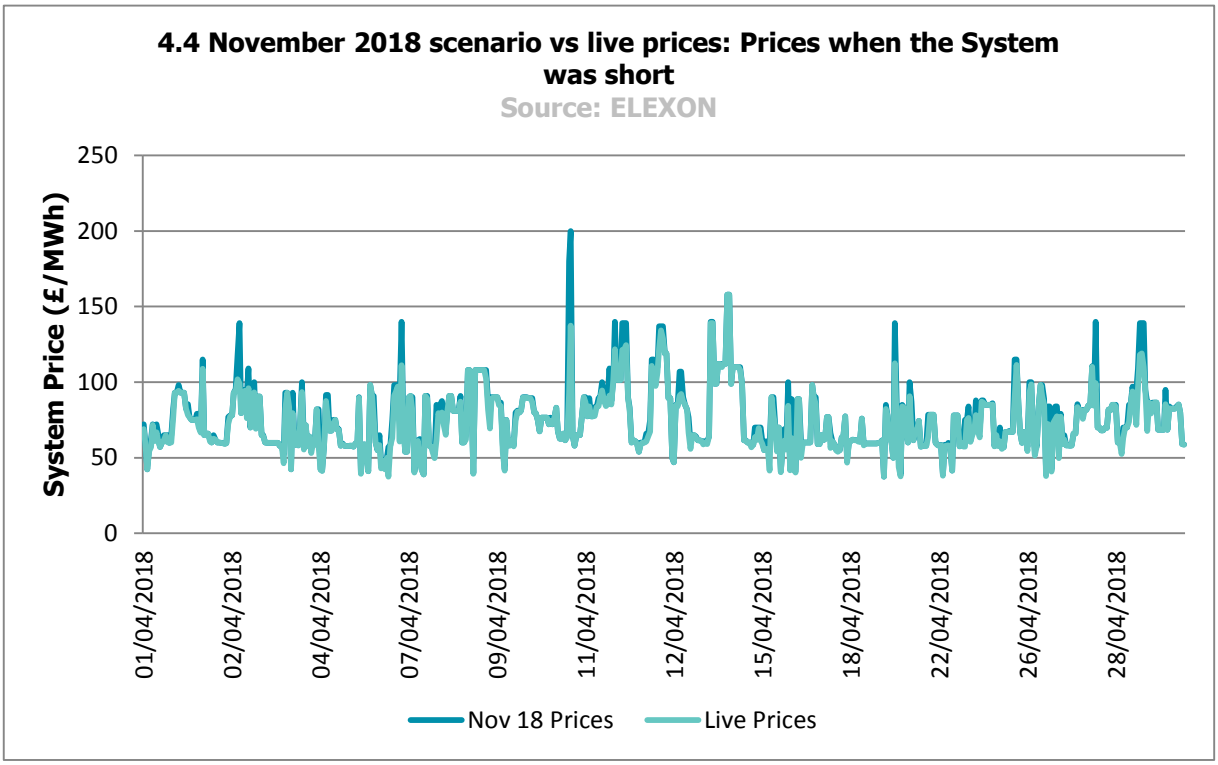
Under the November 2018 scenario, when the system is long prices would be the same or lower, and when the system is short prices would be the same or higher. **Graph 4.3** compares live System Prices with prices recalculated using the November 2018 scenario when the system was long.



The average price differences across the month are relatively small under the November 2018 scenario. Prices were different in 54% of Settlement Periods, with 12% of these changes greater than £1/MWh. System Prices would be £1.24/MWh lower when the system was long, and £3.04/MWh higher when the system was short. When the system was long and System Prices changed, price changes were less than £1/MWh in 75% of Settlement Periods and greater than £5/MWh in 10% of Settlement Periods. The biggest shift in price was -£112.74/MWh (Settlement Period 27 on 20 April 2018), when the price would have been -£85/MWh under the November 2018 scenario compared to the current live System Price of £27.74/MWh.

Graph 4.4 compares live System Prices with prices re-calculated using the November 2018 scenario when the system was short. Prices would be higher in 50% of short Settlement Periods under the November 2018 scenario; 37% changed by more than £5/MWh and 19% by more than £10/MWh. The biggest difference in price was £87.38/MWh (Settlement Period 7 on 11 April), when the price would have been £180/MWh under the November 2018 scenario compared to the current live System Price of £92.62/MWh.

Under the November 2018 scenario, there would be 59 Settlement Periods in April 2018 with prices greater than £100/MWh, compared to 49 periods under the current live scenario.



There were no Demand Control actions taken during April 2018. Under the November 2018 scenario, these action types would be priced at a VoLL of £6,000/MWh rather than the current £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 RSVPs can be seen in **Table 4.5.** The RSVP would have re-priced no STOR actions in April.

4.5 Reserve Scarcity Prices with VoLL of £6,000

Date	SP	DRM	LoLP	RSVP	RSVP Used	System Length	System Price
09/04/2018	20	3,142.34	0.0000	**0.02**	No	Long	36.27
09/04/2018	19	3,284.92	0.0000	**0.01**	No	Short	90.00
09/04/2018	18	3,406.65	0.0000	**0.00**	No	Short	107.95
13/04/2018	22	3,683.77	0.0000	**0.00**	No	Short	110.02
13/04/2018	20	3,766.01	0.0000	**0.00**	No	Short	112.00

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 Index Price	**MIP**	The Market Index 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	**RSVP**	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 RSVP. The RSVP function is based on the prevailing system scarcity, and is calculated as the product of two following values: · the Loss of Load Probability (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 between Standard Settlement Runs.

SYSTEM PRICE ANALYSIS REPORT

APPENDIX 1 – ARBITRAGE IN ENERGY BALANCING

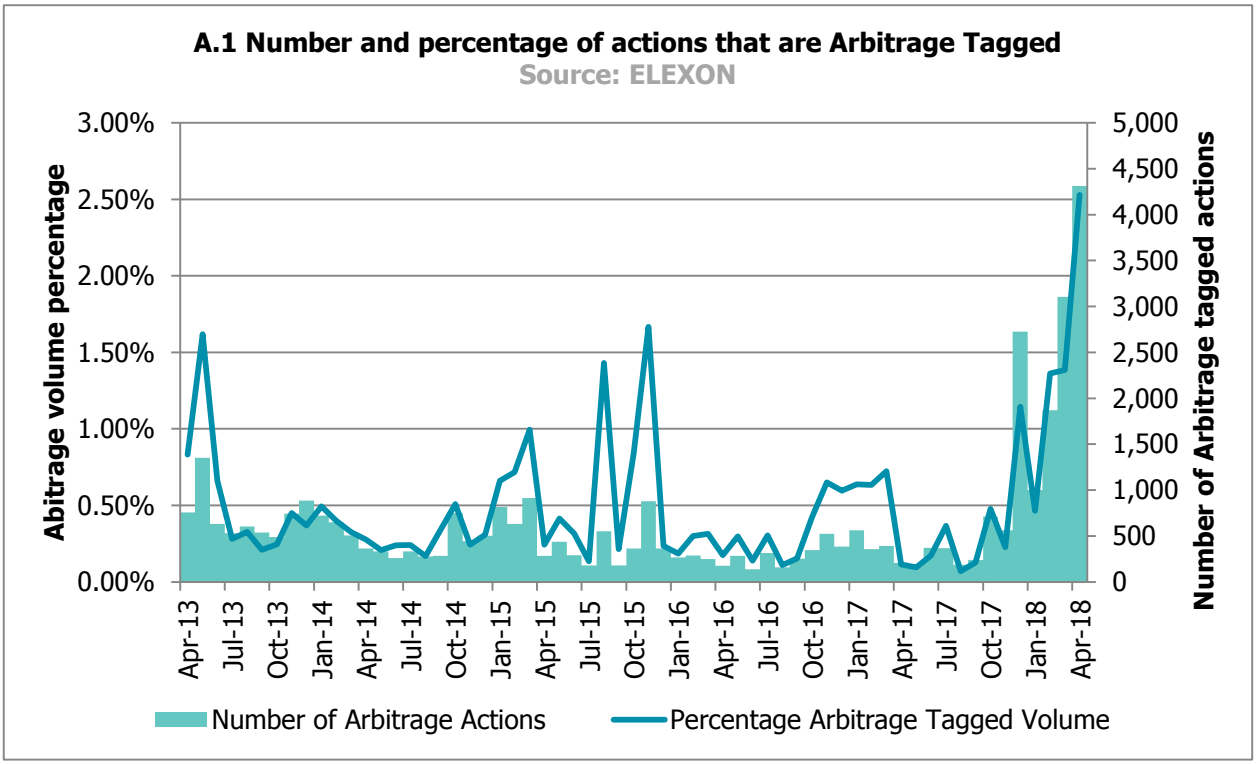
In this section one of our Market Analysts, Emma Tribe, takes a detailed look at Arbitrage as used in the System Price calculation. During April, Arbitrage Tagging removed 2.53% of energy balancing volume from the System Price calculation. This was the highest percentage of Arbitrage Tagging over the last five years.

emma.tribe@elexon.co.uk

Arbitrage can occur in any market when it is possible to simultaneously buy and sell a product, and make a profit by taking advantage of a price differential. The term Arbitrage is used in the calculation of the Energy Imbalance Price when the price for buy energy balancing volume is the same or less than the price for sell energy balancing volume. The difference in price for these volumes creates a profit for National Grid.

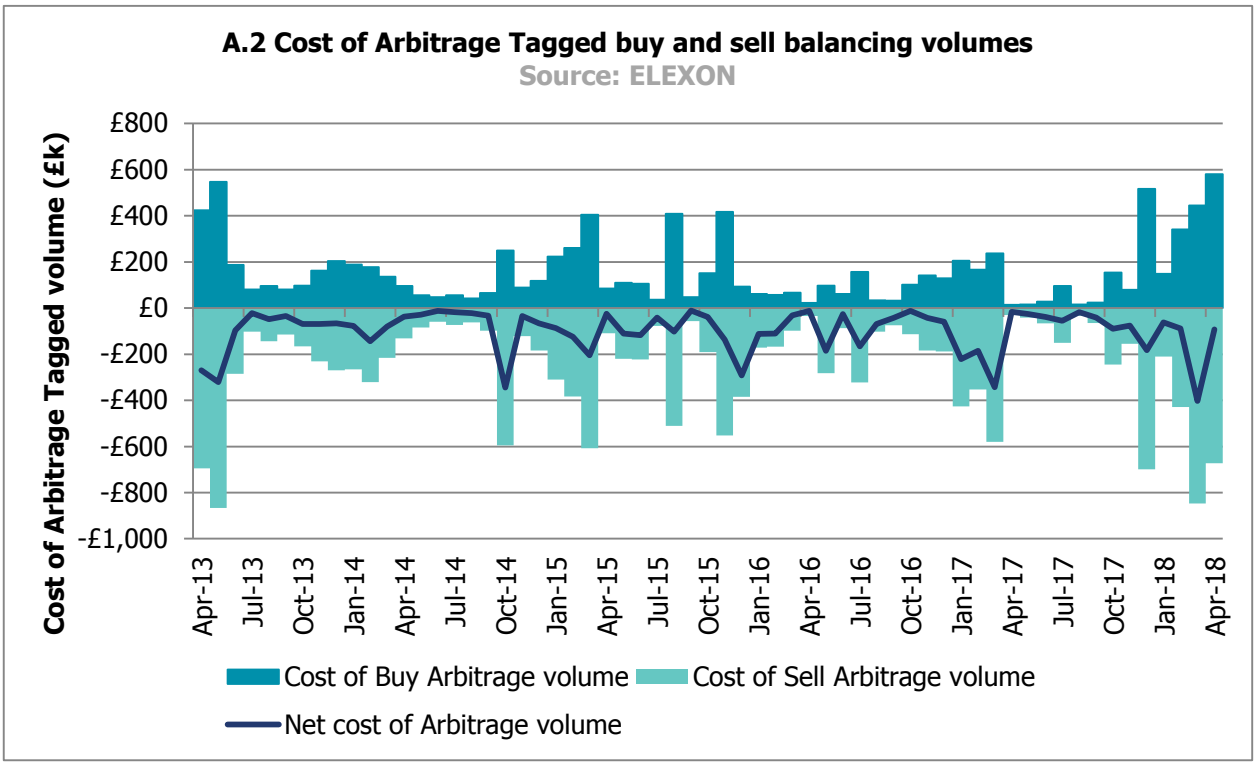
Arbitrage balancing volumes are removed from the System Price calculation by Arbitrage Tagging. Arbitrage Tagging has been included in the BSC since New Electricity Trading Arrangements (NETA) was introduced in March 2001.

Graph A.1 shows that Arbitrage Tagging removed 2.53% of energy balancing volume in April 2018. A volume of 32GWh was tagged; this tagged volume came from 4,311 balancing actions. This was the highest percentage and number of Arbitrage Tagged actions in the last five years.

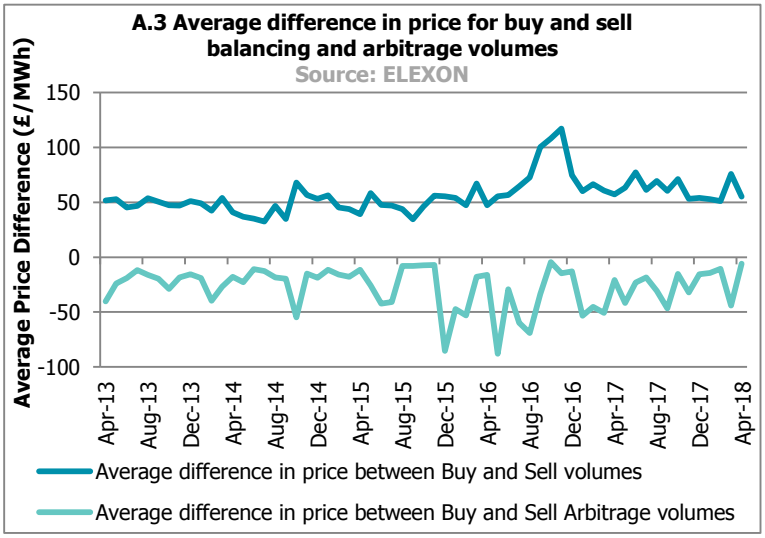


November 2015 had a higher Arbitrage Tagged volume (39GMh), but there was a higher volume of balancing actions taken during the month. The percentage of balancing volume removed due to Arbitrage Tagging in November 2015 was 1.67%, which is less than the percentage in April 2018.

Graph A.2 shows the cost of Arbitrage Tagged volume for the same time period as above. The net cost of Arbitrage Tagged balancing volume in April 2018 was -£93,059, where a negative shows net money to National Grid. The greatest negative net cost of Arbitrage Tagged balancing volume occurred in March 2018, when the net cost was -£403,341. Over the five year period the net cost of Arbitrage volume was -£6million.



Buying and selling energy volumes for Arbitrage can only generate a profit when the buy price is less than the sell price. **Graph A.3** looks at the average difference in price for buy and sell volumes, and compares these to the difference in price for Arbitrage volumes.



The average difference in price for Arbitrage volumes in April 2018 is -£6.06/MWh, while the average price difference for all buy and sell volumes is £55.24/MWh. Over the five year period, the average price difference for all volumes is £56.12 and for Arbitrage volumes is -£27.34/MWh.

The largest average price difference for Arbitrage volumes occurred in May 2016 when the difference was -£88.15/MWh. The smallest average difference was -£4.40/MWh in October 2016.

The lowest price for buy balancing action was -£115.44/MWh for 14.96MWh. This price was for a Balancing Services Adjustment Action (BSAA) on 29 January 2016. The highest price for a sell balancing action was £580/MWh for -83.46MWh from BSAA on 23 January 2017.

Graph A.4 shows the percentage of Arbitrage volume by fuel type for the five year period. BSAA volumes represent 41% of all Arbitrage volumes; volumes from Gas BMUs represent 35%, Coal BMUs 17%, Wind BMUs 4% and 3% from Hydro and Pumped Storage BMUs.

In April 2018, 46% of Arbitrage Tagged volume was from BSAA, representing 21% of all BSAA balancing volume during the month. In the same month, 40% of Arbitrage Tagged volume came from Gas BMU's, which represents 0.2% of all Gas BMU balancing volume.

A.4 Percentage of arbitrage volume by fuel type between April 2013 and April 2018

Source: ELEXON