ISG180-SPAR
REPORTING ON MARCH 2016

ISSUE 5 – PUBLISHED 15 APRIL 2016

SYSTEM PRICE ANALYSIS REPORT

The System Prices Analysis Report (SPAR) provides a monthly update on price calculations. It is published with the Imbalance Settlement Group (ISG) documentation a week ahead of the 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 March. Where available, data uses the latest Settlement Run (in most cases 'II' or 'SF').

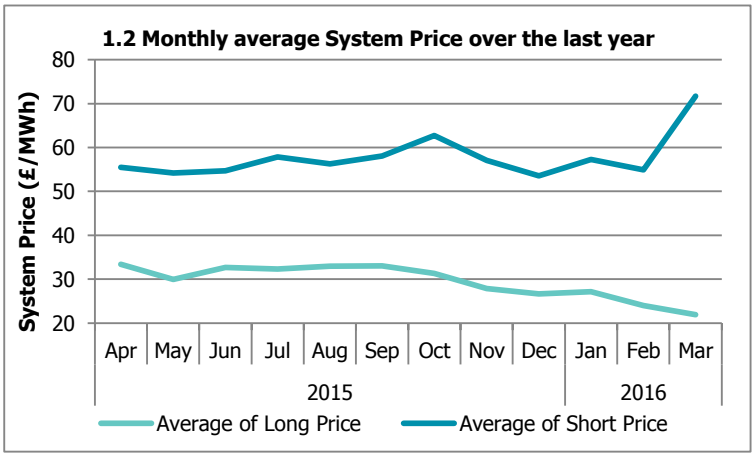
In this report we distinguish between a 'long' and a 'short' market when analysing System Prices because the price calculation differs between two scenarios. When the market is long, System Prices will be based predominantly on the System Operator's 'sell' actions such as Accepted Bids. When the market is short, System Prices will instead be based predominantly on the System Operator's 'buy' actions. In March this tended to result in prices 'flipping' between prices of around £50/MWh when the System is short, and prices of around of around £25/MWh when the System is long, reflecting the underlying value of Buy and Sell actions respectively.

Prices were more extreme in March 2016 than we have seen in recent months (see **graph 1.2**), which shows the monthly average difference between System Prices over the last year[2]. Monthly Short prices haven't been as high since September 2013, and Long Prices haven't been as low since June 2009.

	System Price (Long)				
Month	**Min**	**Max**	**Median**	**Mean**	**Std Dev**
March 2016	-63.02	39.70	24.78	21.92	10.03

	System Price (Short)				
Month	**Min**	**Max**	**Median**	**Mean**	**Std Dev**
March 2016	21.10	517.55	50.00	71.66	59.27

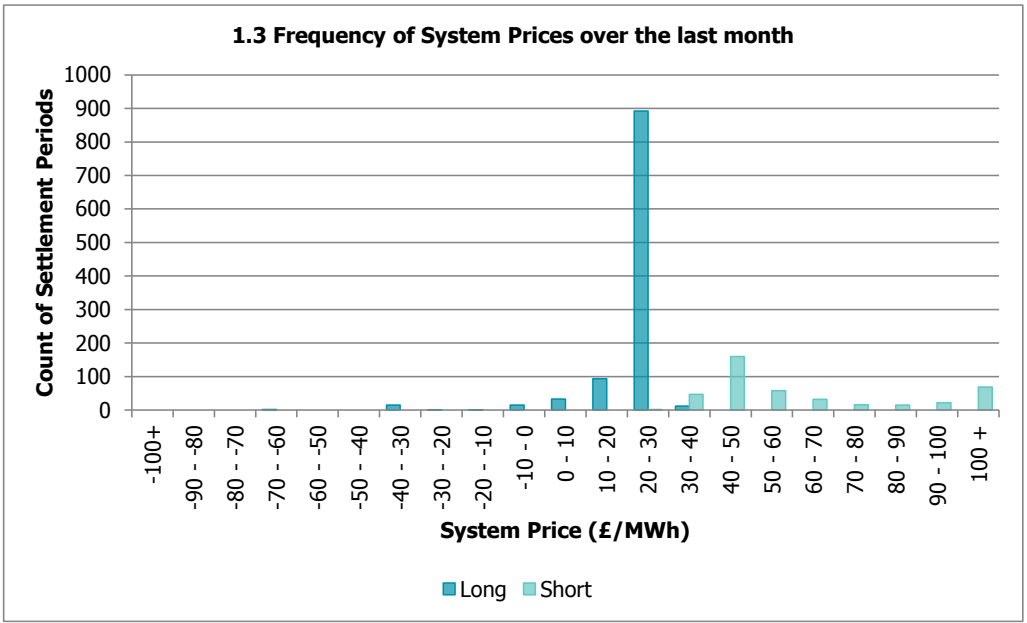
1.1 System Price summary by month (£/MWh)



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

[2] For comparison, this represents the 'Main Price' rather than the 'Reverse Price' for Settlement Periods before the implementation of P305.

Graph 1.3 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 75% of Settlement Periods. When the System was long 85% of prices were between £20/MWh and £40/MWh, whereas when the System was short 52% prices were between £40/MWh and £60/MWh. Prices did not rise above £40/MWh when the System was long, or fell below £30/MWh when the System was short.



There were 34 Settlement Periods with **negative System Prices** within March 2016 (compared to 66 in 2015). The average negative System Price was -£22/MWh and the lowest -£63.02/MWh, which occurred at Settlement Periods 16 and 17 on 27 March 2016. These prices were set by Bids from seven wind BMUs and a Balancing Service Adjustment Action (BSAA), all priced at -£63.02/MWh. **Table 1.4** shows what fuel types contributed to negative System Prices in March.

The **System Price was £0/MWh** in four Settlement Periods when the price was set by Bids from CCGT, Hydro and Pumped Storage BMUs.

	Prices < £0/MWh
Coal	3.66%
Combined Cycle Gas Turbine	21.42%
Non-Pumped Storage Hydro	0.40%
Open Cycle Gas Turbine	13.69%
Pumped Storage	0.91%
Wind	31.22%
BSAA	28.69%

1.4 Proportion of priced volume from different fuel types

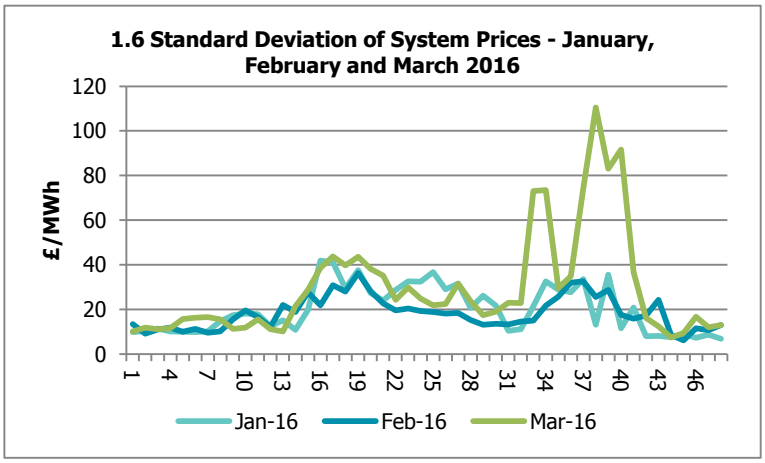
System Prices **exceeded £100/MWh** 69 times in March 2016 (compared to 27 times in February). **Table 1.5** shows what fuel types were contributing to the short System Price in March. When prices were above £100/MWh, priced volumes comprised mostly of Offers from Pumped Storage BMUs, but when prices were above £150/MWh the majority of priced volumes came from Coal BMUs.

	Prices > £100/MWh	Prices > £150/MWh
Coal	14.75%	30.27%
Combined Cycle Gas Turbine	22.83%	28.18%
Non-Pumped Storage Hydro	10.03%	0.00%
Open Cycle Gas Turbine	2.49%	8.12%
Pumped Storage	44.08%	30.19%
BSAA	5.83%	3.24%

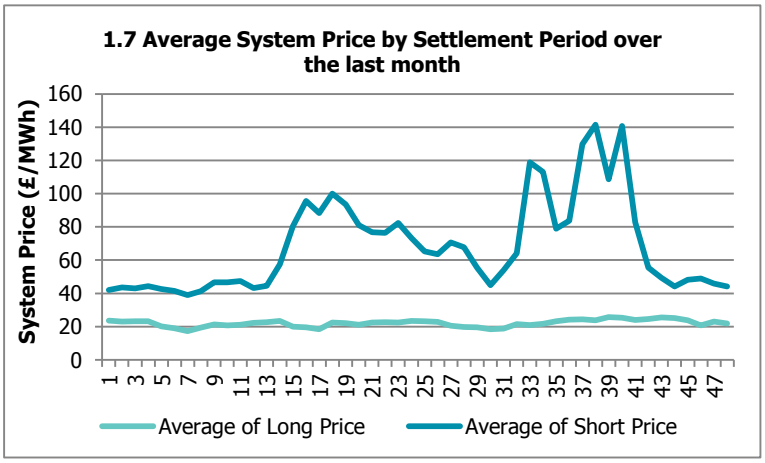
1.5 Proportion of priced volume from different fuel types

The **maximum System Price** was £517.55/MWh and occurred at Settlement Periods 38 and 40 on 10 March 2016. The price was set by Offers from coal BMUs priced at £500/MWh, and a Buy Price Price Adjuster (BPA) of £17.55/MWh. The BPA is calculated by National Grid to reflect the cost of any option fees for a given Settlement Period.

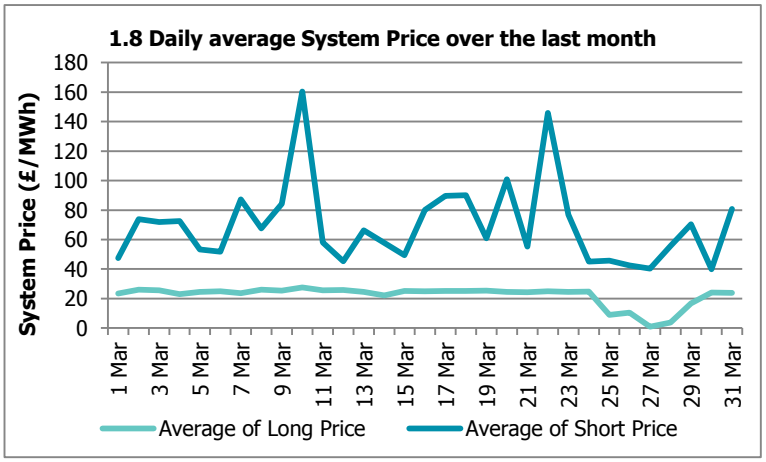
The price volatility can be shown in **graph 1.6**, which depicts at standard deviation of prices (long and short) for January, February and March 2016.



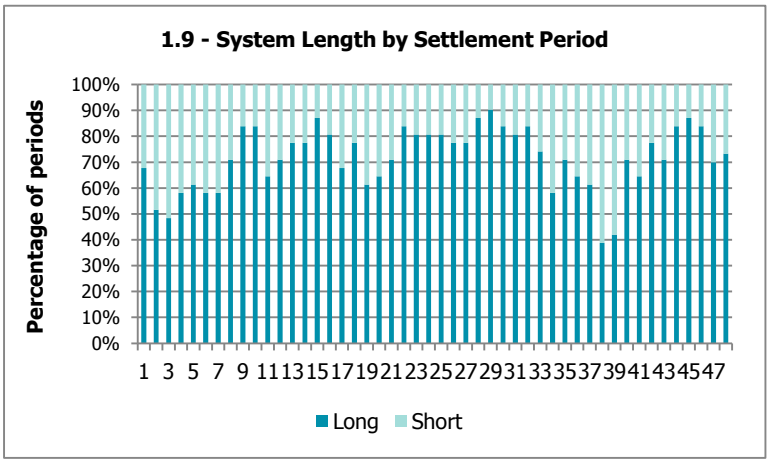
Graph 1.7 shows the variation of System Prices across the day. Short prices were highest in Settlement Period 38, and long prices lowest in Settlement Period 7.

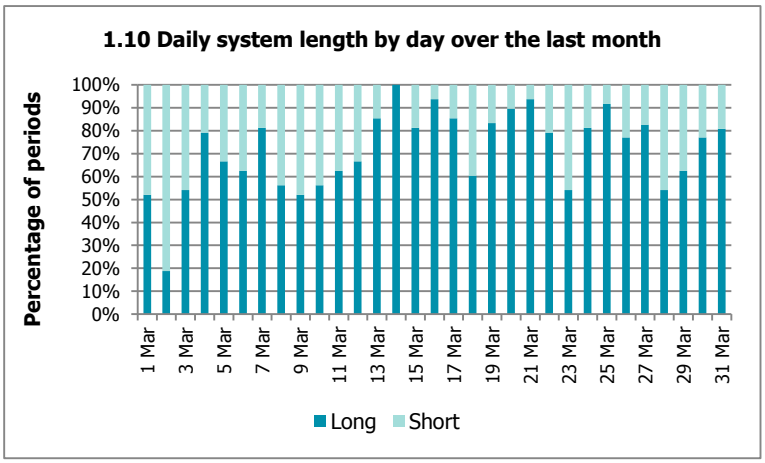


Graph 1.8 shows daily average System Prices over the last month. In March, the average System Price when the system was long was £21.92/MWh. The average System price when the system was short was £71.66/MWh.



Graph 1.9 shows system length by Settlement Period, and **graph 1.10** shows system length by day in March. The system was long for 72% of Settlement Periods in March.





2 PARAMETERS

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

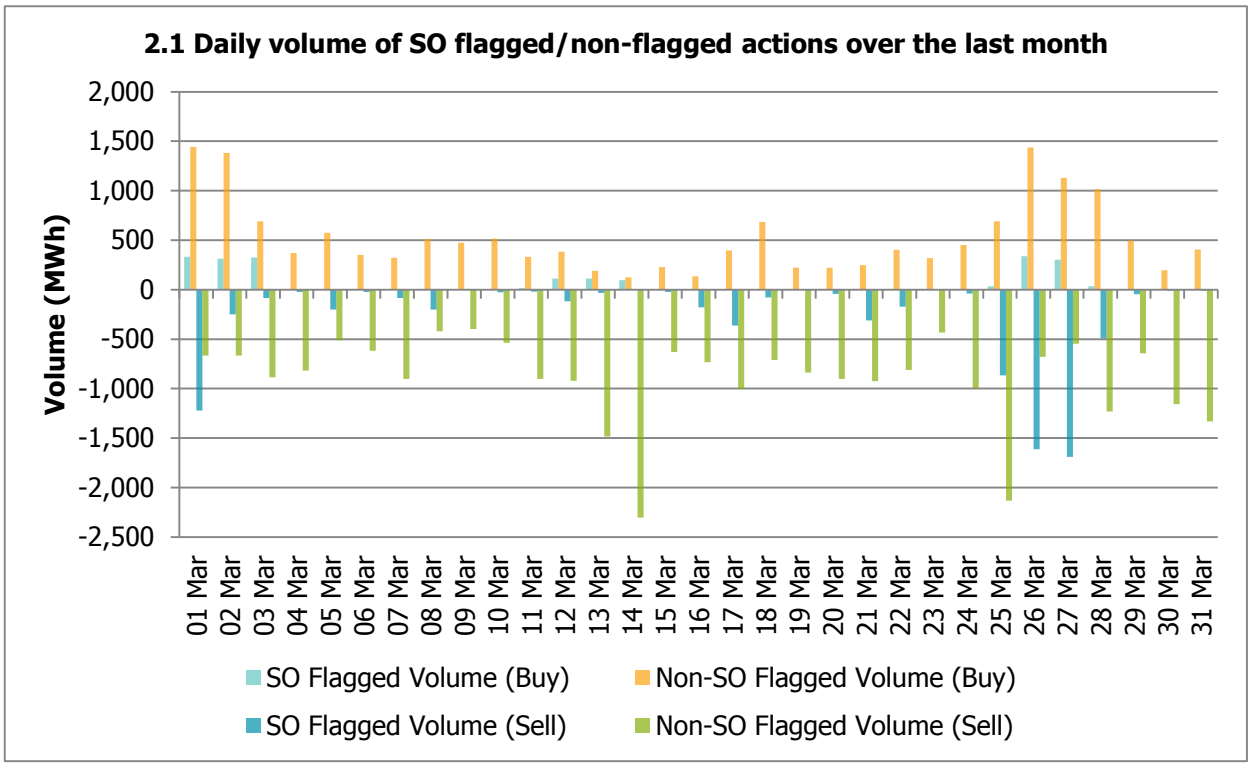
- The impact of flagging balancing actions;
- The impact of NIV tagging;
- The impact of PAR tagging;
- The impact of the Replacement Price; and
- How these mechanisms affect which balancing actions feed into the price.

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 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.

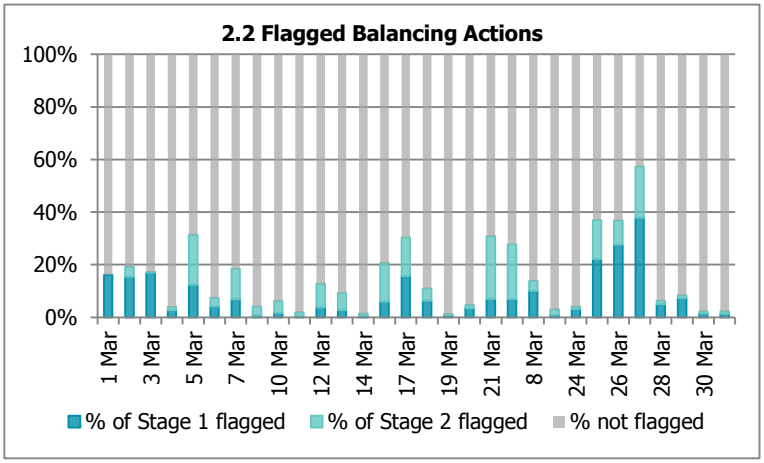


31% of SO flagged Bids came from Gas BMUs, 40% from wind BMUs, and 14% from coal BMUs. The average initial price (ie before any re-pricing) of a flagged Bid was -£32.49/MWh.

66% of SO-flagged Offers came from gas BMUs and 18% came from coal BMUs. The average initial price of a flagged offer was £52/MWh.

Any actions which are less than 15 minutes total duration (regardless of whether these span across different Settlement Periods) are CADL flagged. 4% of Buy actions and 0.08% of Sell actions were CADL flagged in March.

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 actions 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.



The Replacement Price

If there are 'second stage' flagged action volumes left in the NIV, these will be unpriced, as was the case for 0.56% of Buy volumes and 3% of Sell volumes in March. These actions therefore require 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 March, the average second stage flagged sell action was -£21.65/MWh, and the average Replacement Price when the System was long was £8.90/MWh.

Buy actions will typically have their prices revised downwards by the Replacement Price for the purposes of calculating the System Price. In March, the average second stage flagged buy action was £78.64/MWh, and the average Replacement Price when the System was long was £59.05/MWh.

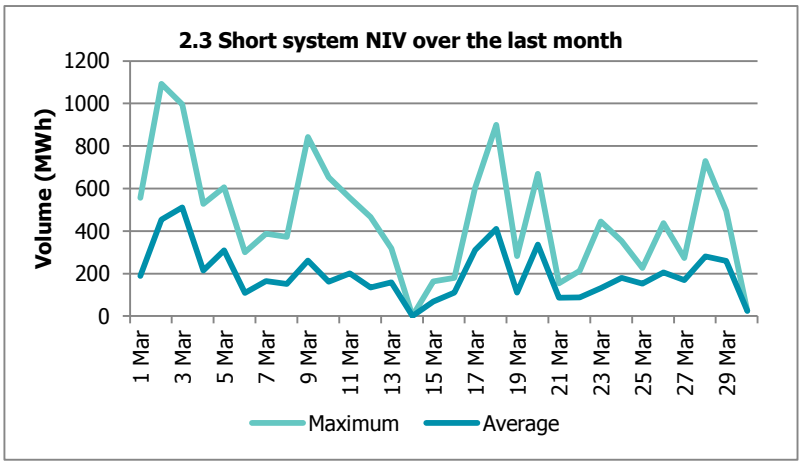
NIV and NIV tagging

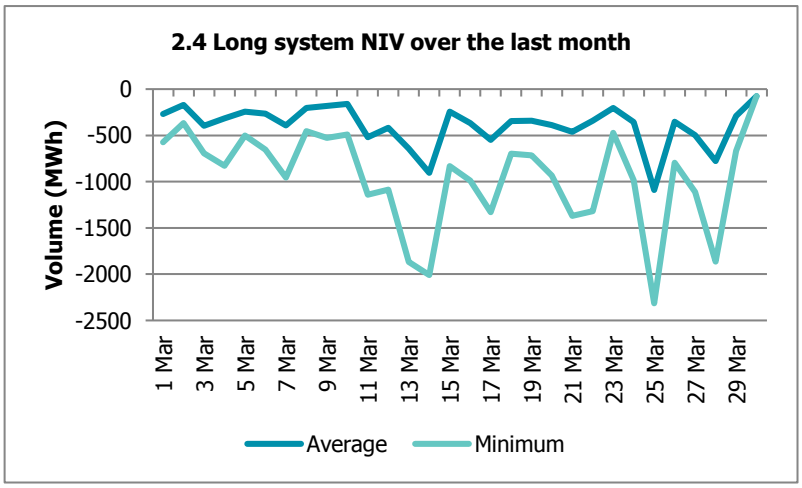
The Net Imbalance Volume (NIV) represents the direction of imbalance of the System – ie whether the system is long or short overall. **Graph 2.3** shows the greatest and average NIV when the system was short and **graph 2.4** shows greatest and average NIVs when the system was short in March (short NIVs are depicted as positive volumes and long NIVs are depicted as negative volumes). There were no short Settlement Periods on 14 March.

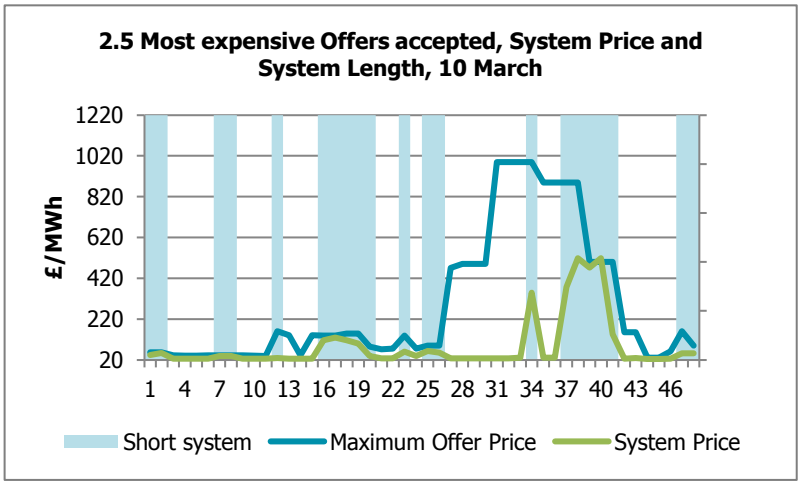
In almost all Settlement Periods the System Operator will need to take balancing actions in both directions (buys and sells) to balance the system. However, for the purposes of calculating an imbalance price there can only be one imbalance in one direction (the Net Imbalance). 'NIV tagging' is the process 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. 73% of actions were NIV tagged in March. Because the most expensive actions are NIV tagged first, NIV tagging has a dampening effect on prices when there are actions in both directions.

For example, **graph 2.5** shows that Offers of up to £990/MWh were accepted to balance the System when the System was short on 10 March 2016, but were not reflected in the price calculation because Bids in the opposite direction resulted in the most expensive Offers from being 'NIV-tagged' from the remaining stack of balancing actions. When Offers of £990/MWh were accepted (and when the System was short) in Settlement Period 34, the System Price was £350/MWh.





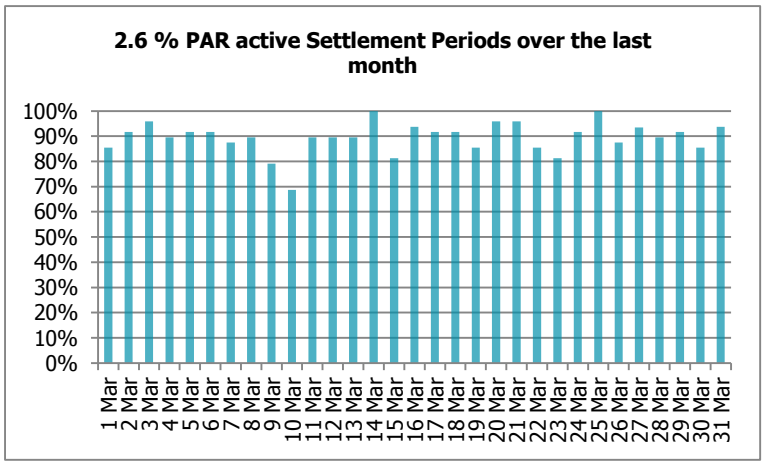


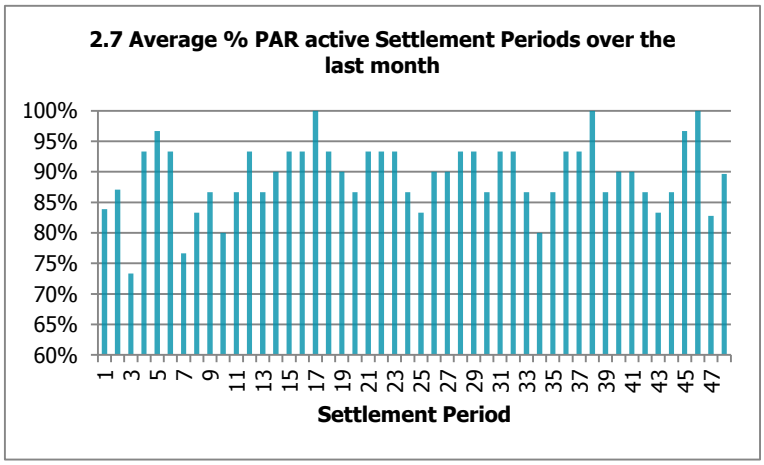
PAR tagging

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. While 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 2.6**. 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 50MWh are 'PAR tagged' and removed from the price calculation
stack.

Graph 2.7 shows the proportion of Settlement Periods over the last month when PAR tagging was active.



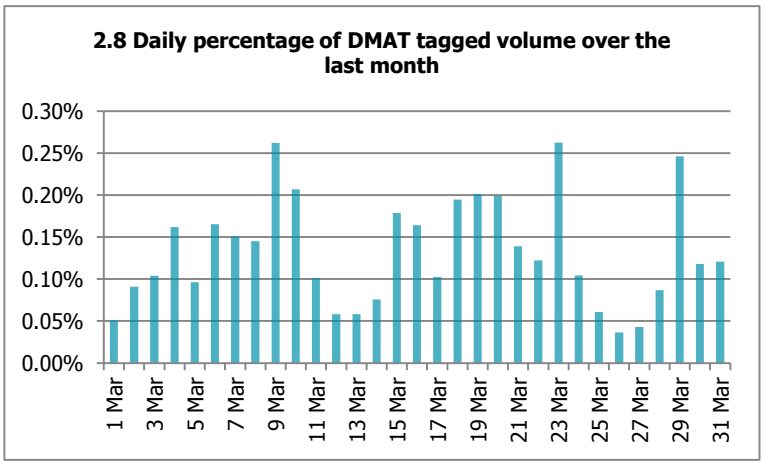


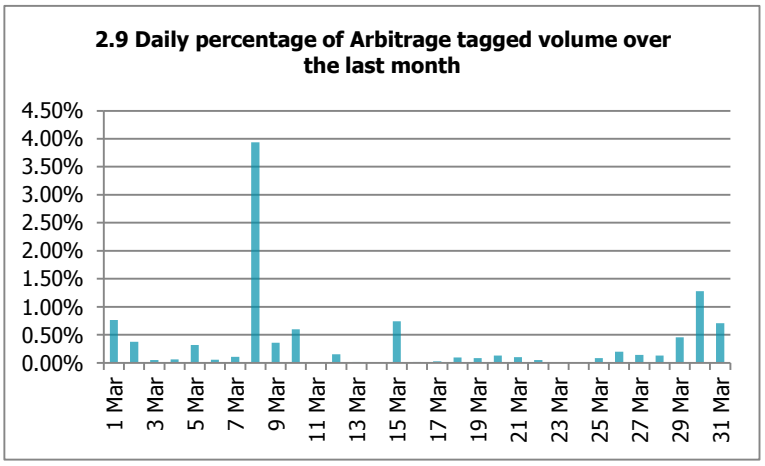
DMAT and Arbitrage Tagged Volumes

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 2.8 shows the volumes of actions which were removed due to DMAT tagging.

Graph 2.9 shows the volumes of actions that were removed to Arbitrage tagging.



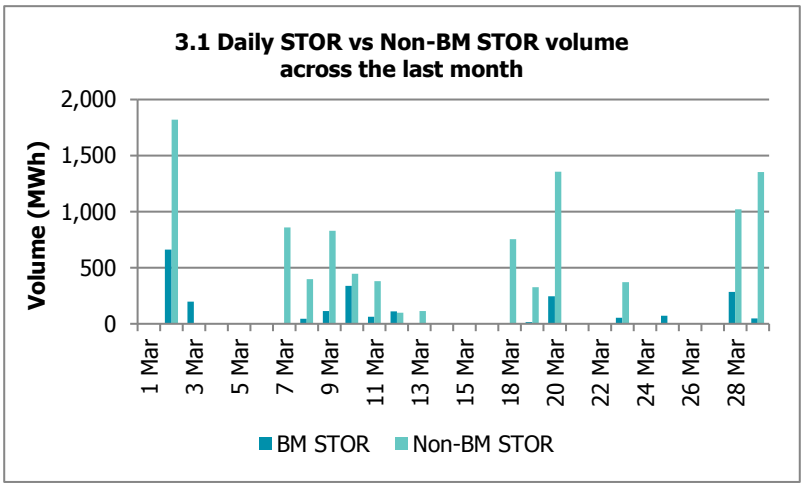


3 BALANCING SERVICES

Short Term Operating Reserve (STOR) costs and volumes

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

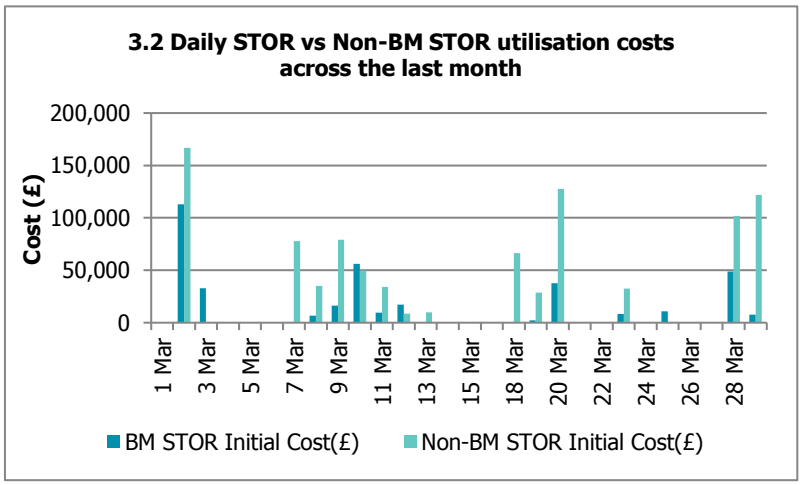
In addition to Bids and Offers available in the Balancing Mechanism, the SO can enter into contracts with providers of balancing capacity to deliver when called upon. These additional sources of power are referred to as reserve and most of the reserve that the SO procures is called Short Term Operating 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 dispatched via BM STOR and non-BM STOR. **Graph 3.2** shows the utilisation costs of this capacity.

The average Utilisation Price for STOR capacity in March was £102.78/MWh (for BM STOR it was £158.19/MWh, and for non-BM STOR it was £93.11/MWh). The maximum Utilisation Price for STOR was £300.02/MWh.



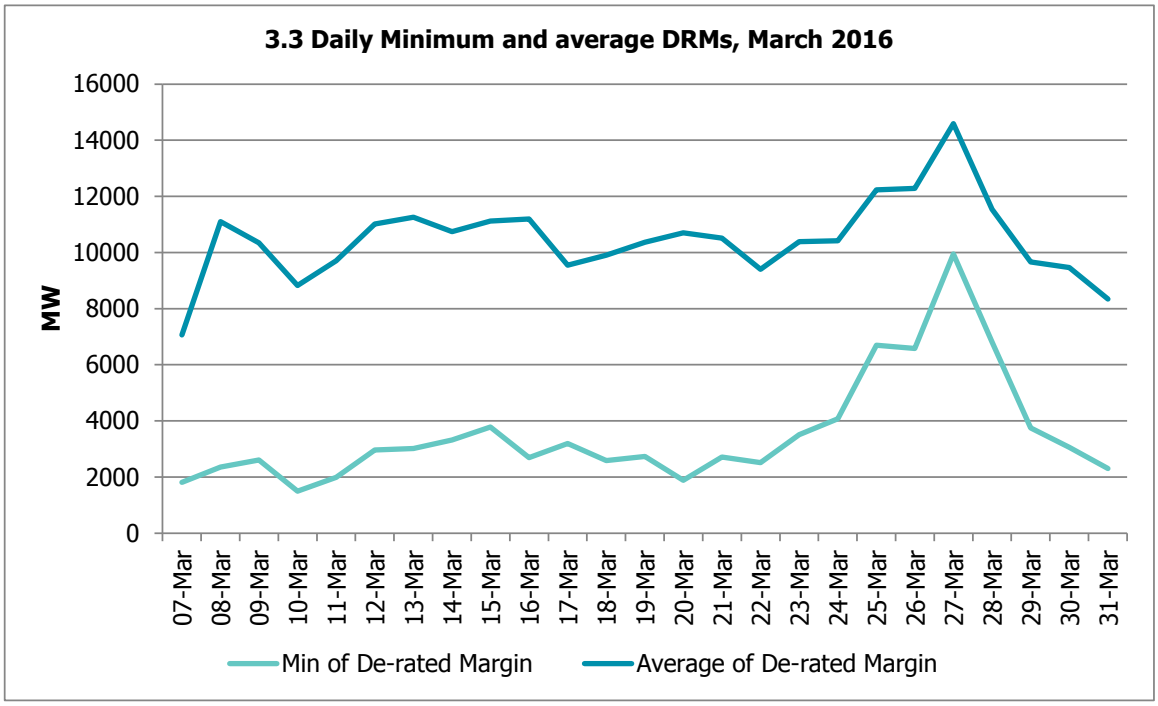
On 11 March, National Grid began reporting non-BM STOR as individual, disaggregated actions. Before this point, they were submitted as a single, aggregated action (see ELEXON circular EL02392). As expected the overall volumes submitted do not appear to have changed as a result, but the number of actions attributed to non-BM STOR is greater: we now receive an average of 24 individual non-BM STOR actions when it is used. The overall price impact of submitting these files on a disaggregated basis is ambiguous, as their impact will depend on how a greater number of smaller actions relate to other balancing actions taken in that Settlement Period. However, we can see the impact on an individual Settlement Period basis[3].

[3] For example, on 23 March 2016 there were 6 individual BSAAs reflected in the volume that the price was based on, resulting in a System Price of £97.07/MWh. Had this value been aggregated into a single price and a single volume, the price would have been £96.66/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 since 7 March. These calculations were introduced as part of BSC Modification P305 on 5 November 2015, but there were issues with this data until 7 March 2016 (see ELEXON circular EL02392). As such, we have data for these parameters from 7 March. The lowest DRM in March was 1,496MW, and the average DRM across the month was 10,537MW.



The System Operator has determined a relationship between each DRM and the LOLP which will determine the RSP[4]. In March the lowest DRM of 1,496MWh, resulted in the highest LoLP and therefore the highest Reserve Scarcity Price (RSP) of £48.88/MWh.

The RSP will then be used to re-priced 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 March, as RSPs did not exceed STOR Utilisation Prices in any periods; the lowest STOR Utilisation Price in March was £67.77/MWh.

Date	Settlement Period	De-rated Margin	LoLP	RSP	RSP Used
10-Mar	37	1,496.48	0.0162932	48.8796	No
10-Mar	38	1,582.23	0.0119106	35.7318	No
07-Mar	37	1,813.48	0.0047988	14.3964	No
20-Mar	39	1,881.98	0.0035879	10.7637	No
07-Mar	39	1,965.74	0.0024881	7.4643	No

3.4 Top 5 LOLPs in March 2016

[4] 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:

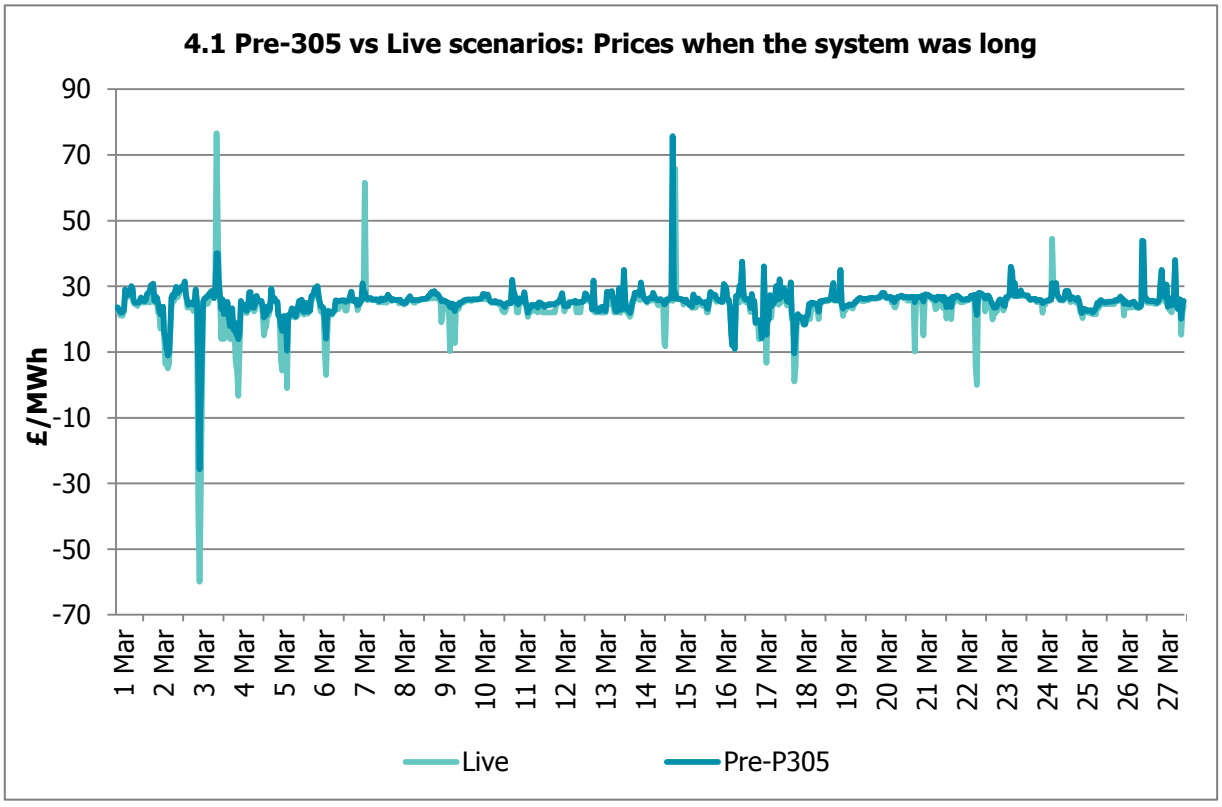
- A PAR of 500MWh, and an RPAR of 100MWh;
- No non-BM STOR volumes or prices included in the price stack;
- No RSP, and instead a Buy Price Adjuster (BPA) that recovers STOR availability fees; and
- No Demand Control, Demand Side Balancing Reserve (DSBR), or Supplementary Balancing Reserve (SBR) actions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

Graph 4.1 compares live System Prices when the system was long with prices re-calculated using the pre-305 pricing scenario (for comparison we use the Main Price calculation). On average, live prices were £1.56/MWh lower when the system was long compared to the pre-305 calculation. This is expected, in particular because of the reduction of PAR from 500MWh to 50MWh to make prices 'more marginal'.



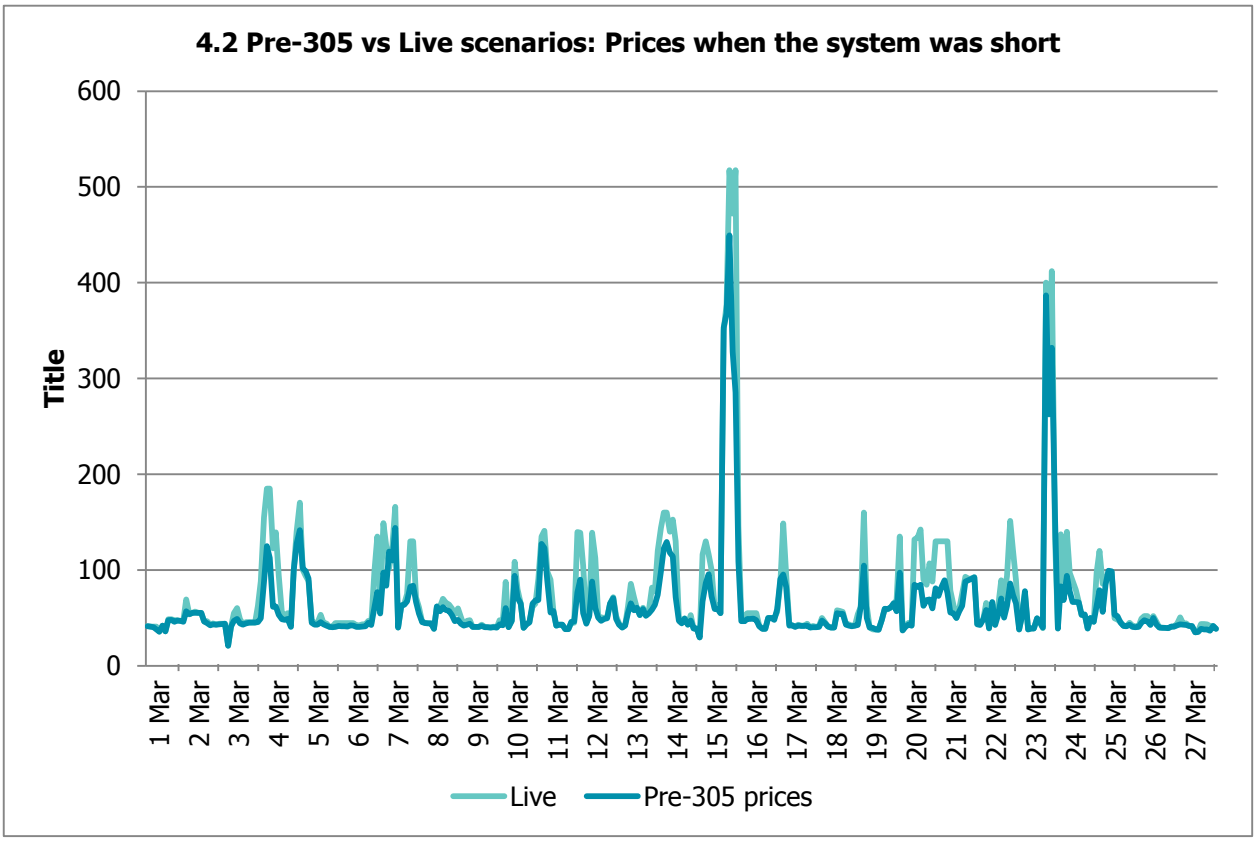
When the system was long, prices were different in 90% of Settlement Periods, and live prices were either unchanged or lower when compared to the pre-P305 price scenario. 59% of long Settlement Periods changed by less than £1/MWh, and 6.32% of long Settlement Periods had changes in price that were greater than £5/MWh.

The biggest 'shift' in prices was £49.35/MWh. This happened when the System was long at Settlement Period 46 on 26 March when the price would have been £23.31/MWh under the old price calculation but was -£39.95/MWh under the live scenario. This was driven by a change in the PAR value – under the old price calculation, a weighted average of the most expensive 500MWh was used to set the price, and this larger volume of actions meant that the price was set by 28 actions from 15 different BMUs, all priced at either £15/MWh or -£39.95/MWh. In the live pricing scenario, the lower PAR meant that the price was set by 50MWh of actions from 2 BMUs priced at -£39.95/MWh (PAR takes an average of the most expensive actions used to balance the system, and for Bids a lower value paid to the System Operator represents a more expensive action).

Graph 4.2 compares live System Prices when the system was short with prices re-calculated using the pre-305 pricing scenario (using the Main Price calculation). Note that data is only available to 27 March 2016 at publication.

Live prices were on average £10.76/MWh higher when the system was short, and 25% of short Settlement Periods had price changes greater than £10/MWh.

The biggest shift in prices when the System was short was £232.23/MWh, which happened on 10 March at Settlement Period 40. The live price was £517.55/MWh, which was the highest System Price that we saw in March. With the larger PAR value of 500MWh, the price would have been £285.32/MWh.



Despite the P305 changes to the price calculation to make prices 'more marginal,' 12% of live prices when the system was short were lower than pre-305 prices, by an average of £2.06/MWh. These differences were driven by the removal of the portion of the Buy Price Price Adjuster (BPA) that was used to recover STOR availability fees. The proportion of the BPA related to STOR availability fees was removed when the RSP was introduced with P305. As a

result, the frequency of BPAs has decreased – BPAs applied to 8% of short periods in the live price scenario, whereas they would have applied to 49% of short periods in the pre-305 price scenario. However, when BPAs do apply now, they tend to be of a greater magnitude: the average BPA in March was £11.88/MWh, whereas this would have been £2.34/MWh under the pre-305 scenario.

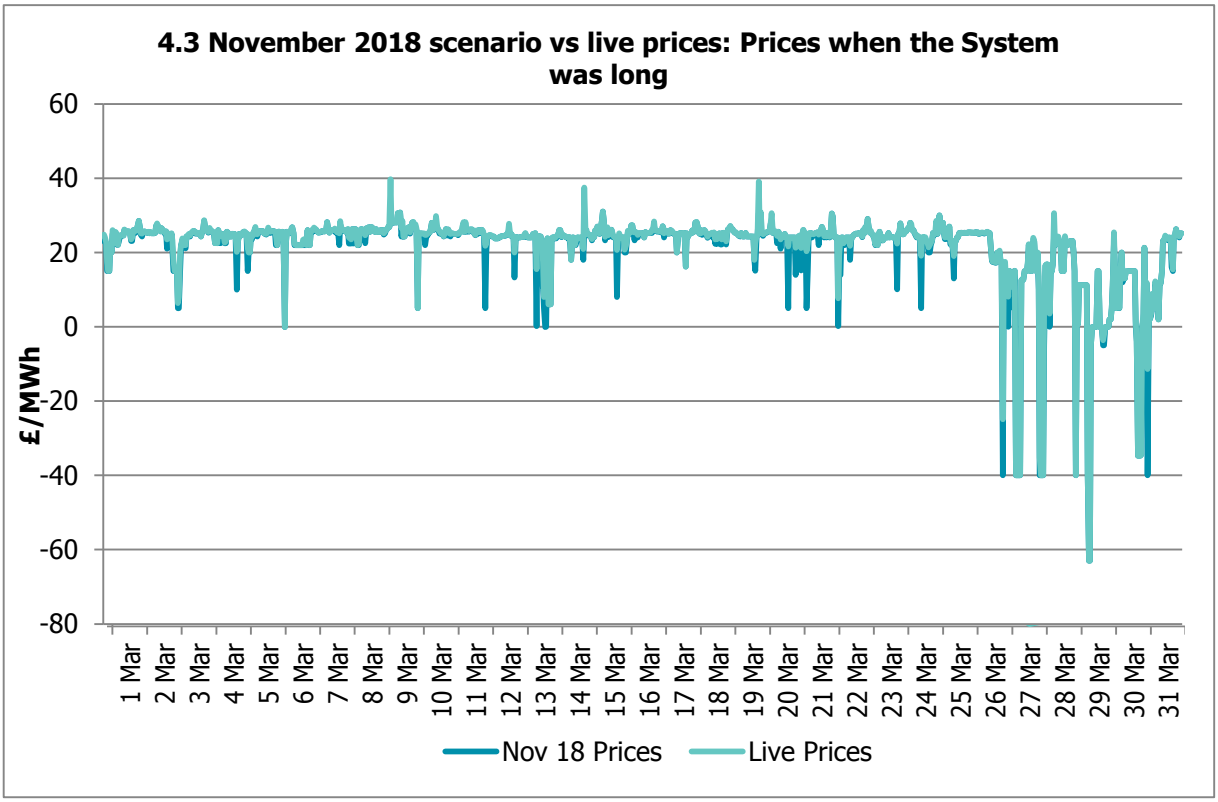
November 2018 Scenario

The average price differences across the month are relatively small under the November 2018 scenario – prices were £0.63/MWh lower when the system was long and £3.99/MWh higher when the system was short. There was no change in prices in 55% of Settlement Periods. When the system was long, prices were always the same or lower, and when the system was short prices were always 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. Of those Settlement Periods that did change price under the November 2018 scenario, the majority of these (76%) were when the system was long. However, 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 84% of Settlement Periods when the system was long (and 26% when the system was short).

5.8% of price changes were greater than £5/MWh when the system was long, with some notable shifts in price. The biggest shift in price was £28.56/MWh. This happened at Settlement Period 48 on 28 March 2016 when the price would have been -£39.95/MWh under the November 2018 scenario, whereas the live System Price was -£11.39/MWh. This was driven by the smaller PAR volume under the November 2018 scenario.

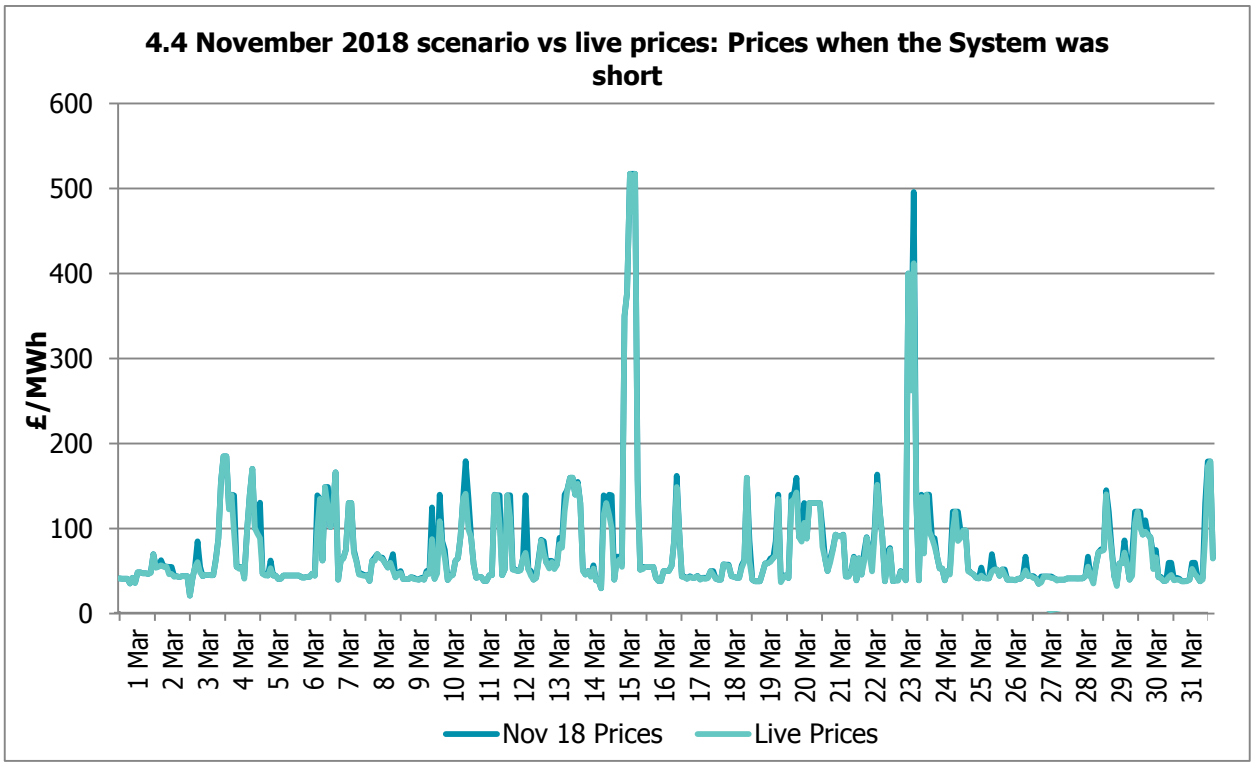
Under the November 2018 scenario there would have been 36 Settlement Periods with negative System Prices, compared to 34 under the live scenario.



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 46% of short Settlement Periods under the November 2018 scenario. Of those prices that did change, 39% of these changed by more than £5/MWh under the November 2018 scenario, and 26% by more than £10/MWh. The biggest shift in price was £83.97/MWh at Settlement Period 38 on 22 March. The price would have been £495.92/MWh under the November 2018 scenario, whereas the live price was £411.95/MWh.

Under the November 2018 scenario there would have been 81 Settlement Periods in March with prices over £100/MWh, compared to 69 periods under the live scenario.

There were no Demand Control, DSBR or SBR actions taken during the month. Under the November 2018 scenario these actions would be priced at a VoLL of £6,000.00/MWh (rather than £3000.00/MWh). Note that this scenario does not capture the impact that a move to a dynamic LoLP methodology will have.



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.