ISG176-SPAR
JANUARY 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 performed for changes under Modification P305 'Electricity Balancing Significant Code Review Developments'. This will be published in spring 2016.

1 SYSTEM PRICES

This report covers the month of December. 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. This tends to result in prices 'flipping' between prices of around £50/MWh when the System is short, and prices of around of around £35/MWh when the System is long, reflecting the underlying value of Buy and Sell actions respectively.

	System Price (Long)				
Month	**Min**	**Max**	**Median**	**Mean**	**Std Dev**
December 2016	-73.48	42.00	29.25	26.67	10.94

	System Price (Short)				
Month	**Min**	**Max**	**Median**	**Mean**	**Std Dev**
December 2016	39.00	140.00	48.99	53.53	15.33

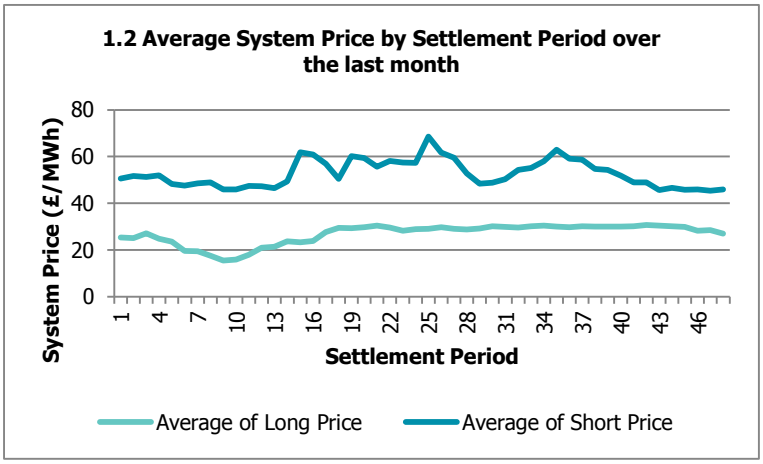
1.1 System Price summary by month (£/MWh)

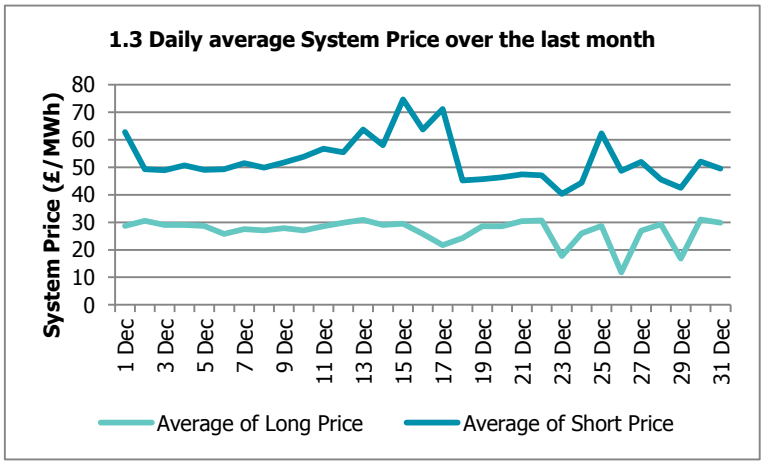
The lowest price in December was -£73.48/MWh, occurring at Settlement Period 15 on 26 December. This price was made up of negatively priced Offers from 5 wind generators, with prices that ranged between -£70/MWh and -£75/MWh. There were also negatively priced bids in Settlement Periods 13, 14 and 16 of that Settlement Day – prices were set by negatively priced bids from biomass plant in Settlement Periods 13 and 14, and wind BMUs in Settlement Period 15.

The standard deviation is higher for System Prices when the System is short. This reflects the price curve of Offers (and other Buy Actions), which tends to be steeper than that for Bids (and other Sell actions).

[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

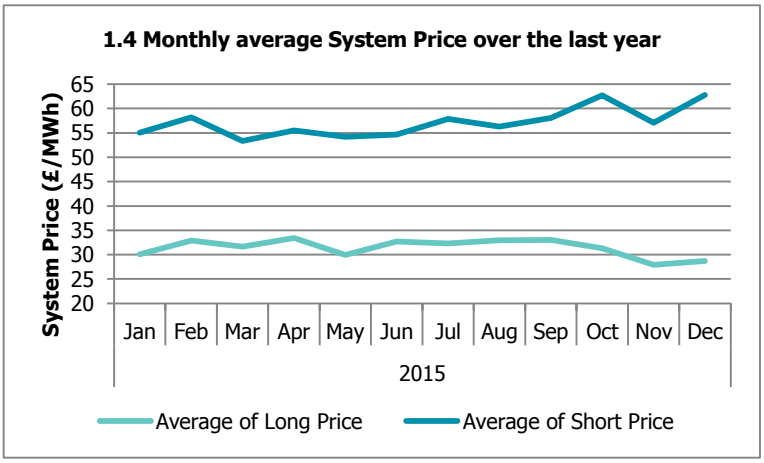
Graph 1.2 shows the variation of System Prices across the day. Prices when the market is long tend to be at their lowest between Settlement Periods 7 and 11. This is likely due to the predictably low demand pattern for this time of day. There is no clear peak in Long Prices. When the market was short, there are several obvious peaks in the month average price; in Settlement Periods 15, 19, 25 and 35.





Graph 1.3 shows daily average System Prices over the last month. In December, the average System Prices when the system was long was £26.53/MWh. The average System price when the system was short was £53.53.

Graph 1.4 shows the monthly average difference between System Prices when the system is long compared to when the system is short over the last year. For comparison, this represents the 'Main Price' rather than the 'Reverse Price' for Settlement Periods before the implementation of P305. On this average basis, System Prices have been relatively stable although monthly average System Prices when the system is long fell from just under £70/MWh to around £55/MWh at the end of 2014.



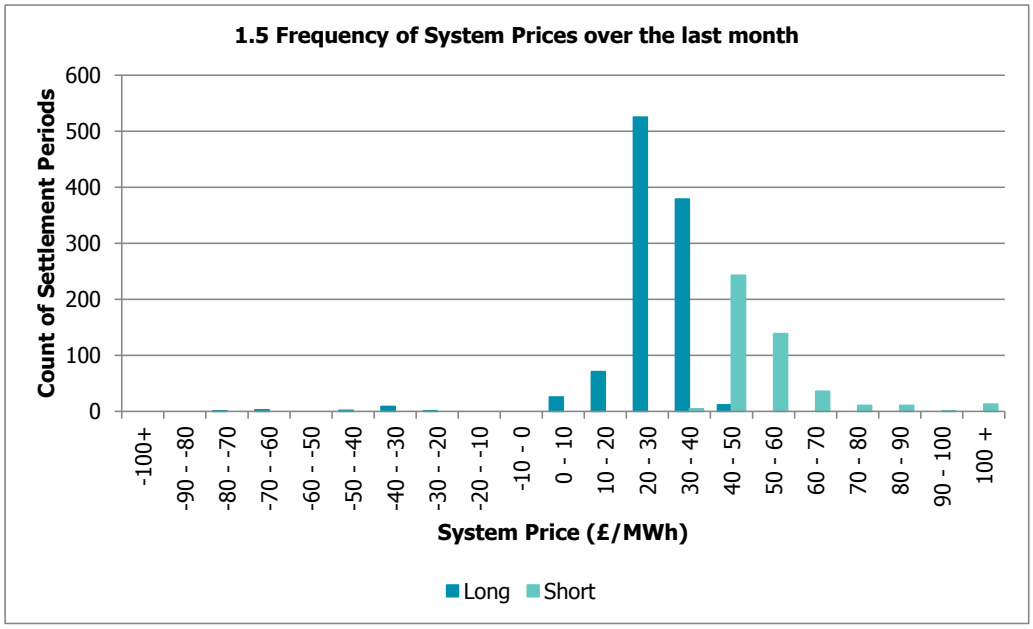
Graph 1.5 shows the distribution of System Prices across Settlement Periods in the last month when the market was long and short.

System Prices were between £20/MWh and £50/MWh in 78% of Settlement Periods. When the System was long 88% of prices were between £20/MWh and £40/MWh, whereas when the System was short 83% prices were between £40/MWh and £60/MWh. This distinction correlates with previous graphs that illustrate how the price curve of Bids and Offers shape the System Price. Prices never rose above £50/MWh when the system was long.

The System Price exceeded £100/MWh 13 times in December (0.08% of Settlement Periods), with the highest System Price of £140/MWh occurring at Settlement Period 15 on 1 December. This price reflects Offers from three pumped storage BMUs, all priced at £140/MWh.

There were 12 incidents of negative System Prices in December. We saw 66 Settlement Periods in 2015 with negative prices (there were 16 in January 2015 and 22 in May 2015).

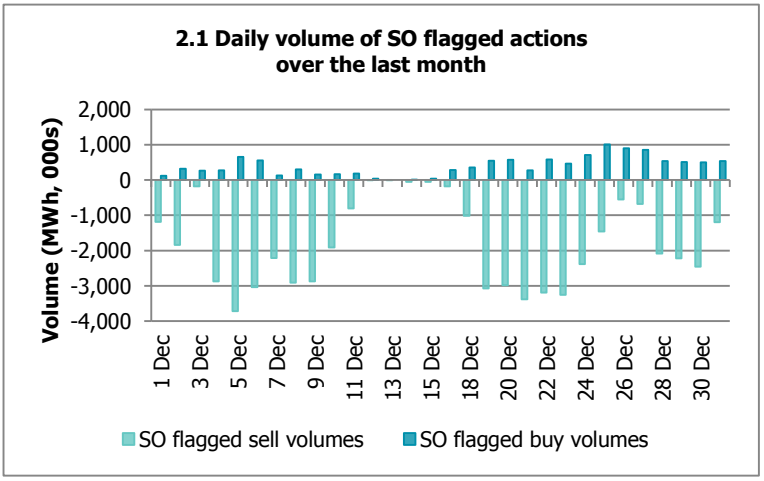
There were 4 incidents of £0/MWh prices in December, occurring on 14, 18 and 26 December, when the system was overall long, and the price was set by £0/MWh Bids from pumped storage plant. There was one other incident of a £0/MWh price in 2015, occurring in November.



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.

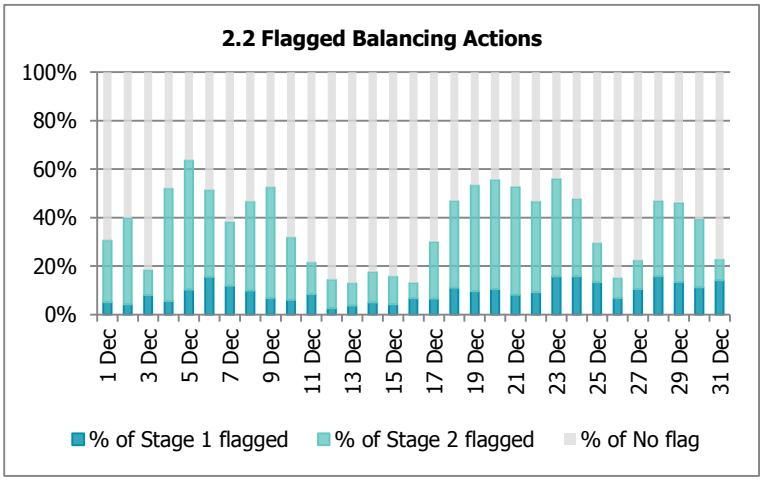


Flagging

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. 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. 65% of the total volume of bids were SO-flagged. Of these 54% came from Coal BMUs and 35% were from wind BMUs. The average price of a flagged bid was £32.49/MWh[2].



12% of total volume of offers were SO flagged. Of these 69.63% came from gas BMUs and 29.53% came from coal BMUs. The average price of a flagged offer was £60.29/MWh[3]. SO-flagged and CADL-flagged actions are known as 'first stage flagged'.

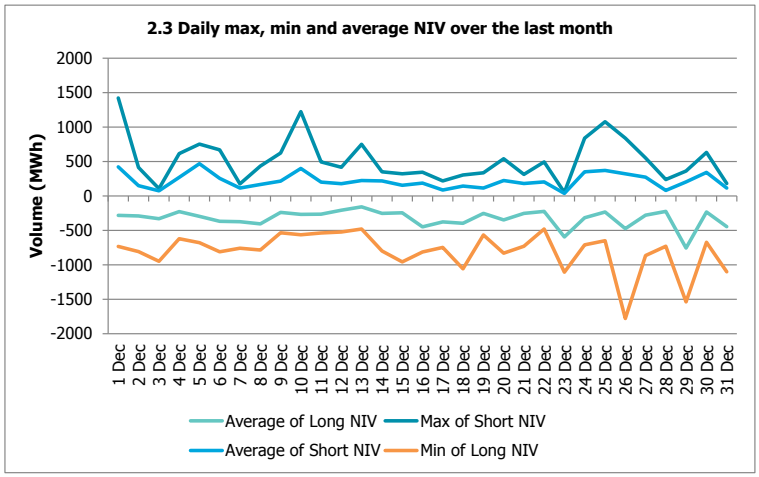
First stage Flagged actions may become 'Second Stage Flagged' depending on their price in relation to other un-flagged actions. If a First Stage Flagged balancing action has a more expensive price than the

[2] This has been corrected from a previous version of SPAR, which reported that the average price for flagged bids was £-28.89/MWh.
[3] This figure has been corrected from a previous version of SPAR, which reported that the average price of a flagged offer was £228.58/MWh

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 taken – only a proportion of these will feed through to the final price calculation.

NIV and NIV tagging

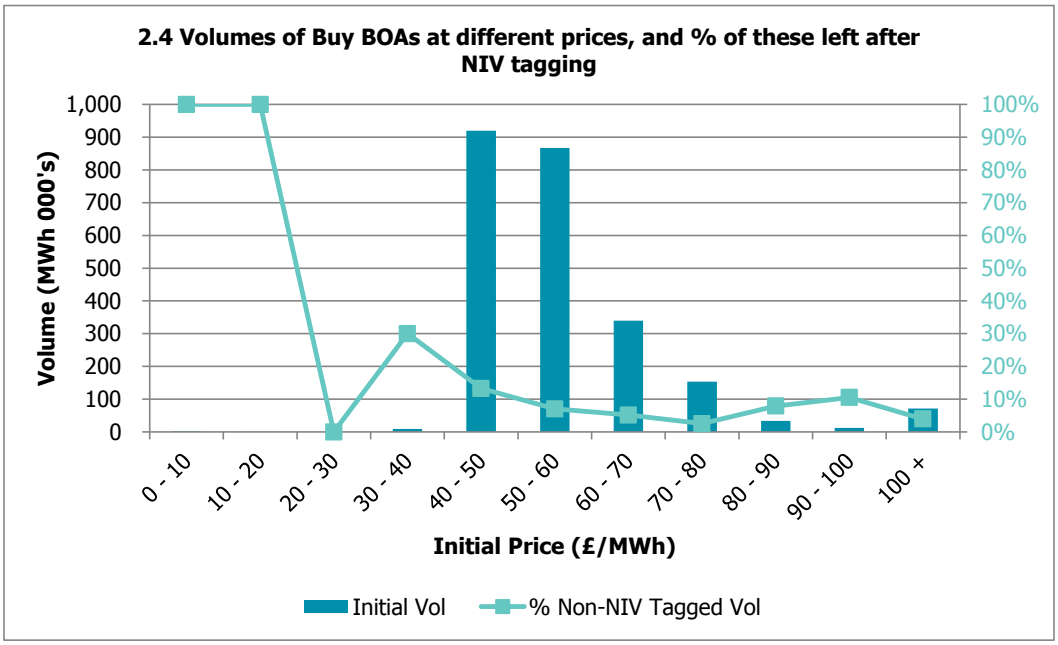
The Net Imbalance Volume (NIV) represents the direction of imbalance of the System – ie whether the system is long or short overall. **Graph 2.3** shows greatest and average NIV's in each direction for each day in December (short NIVs are depicted as positive volumes and long NIVs are depicted as negative volumes).



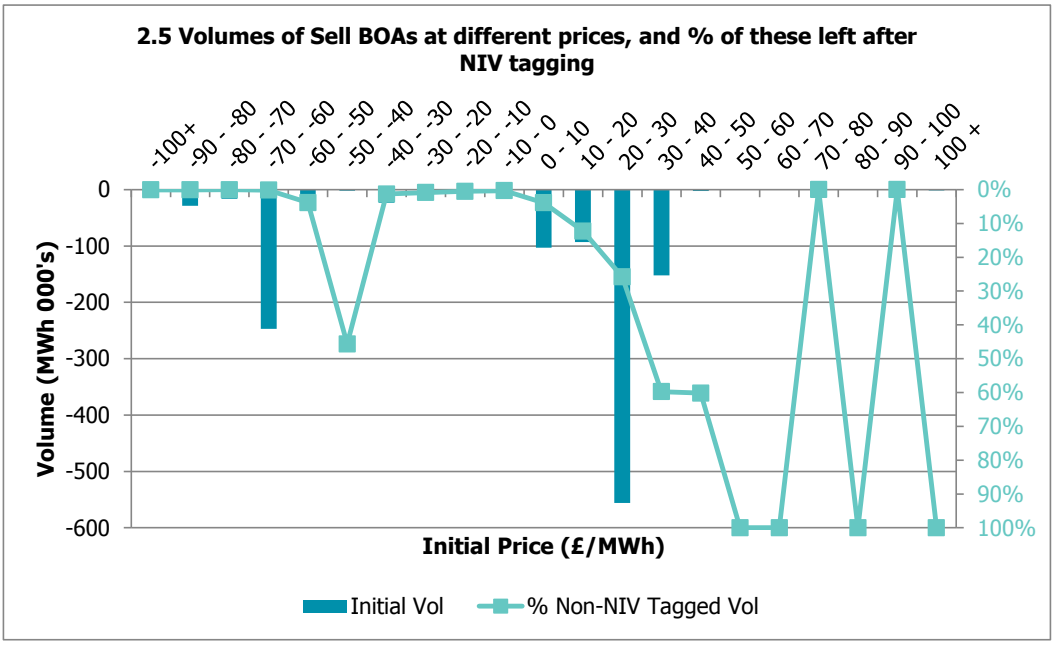
In almost all Settlement Periods the System Operator will need to take balancing actions in both directions (buys and sells) to balance the system. However for the purposes of calculating an imbalance price there can only one imbalance in one direction (the Net Imbalance). 'NIV tagging' is the process 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. 47% of actions were NIV tagged in December. Because the most expensive actions are NIV tagged first, NIV tagging has a dampening effect on prices when there are actions in both directions.

Graph 2.4 illustrates the impact of NIV tagging in determining which buy actions will be left in the price stack. These illustrate that a higher proportion of more expensive actions are excluded from the price stack as a result of NIV tagging.



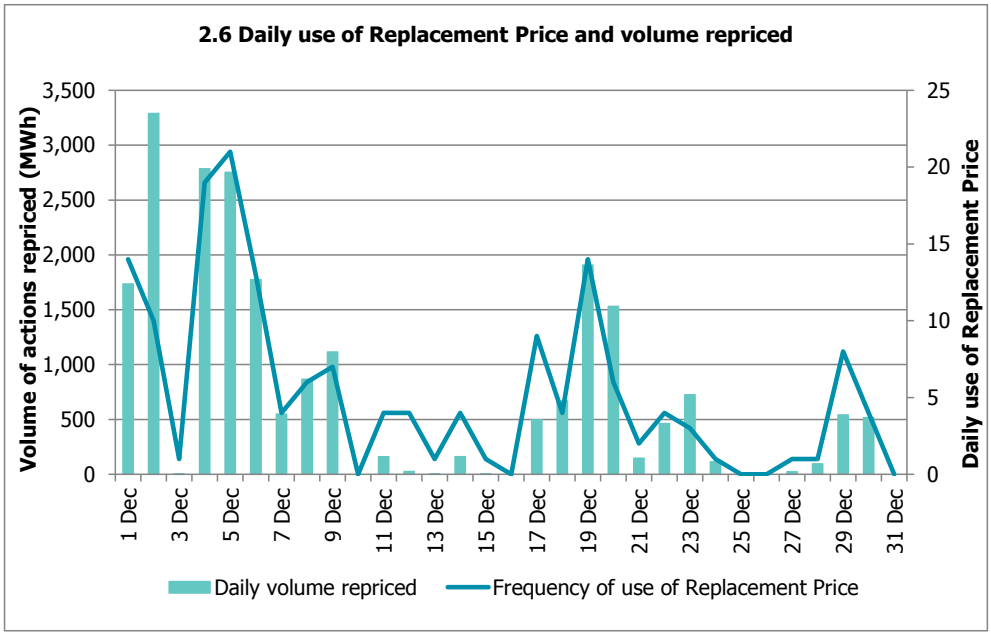
Graphs 2.5 illustrates the impact of NIV tagging in determining which sell actions will be left in the price stack.



The Replacement Price

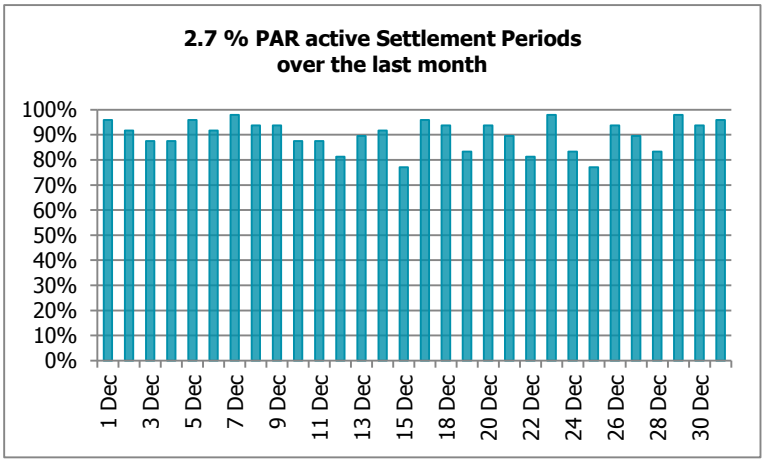
If there are 'second stage' flagged action volumes left in the NIV these will be unpriced, and therefore require a Replacement Price. This price is currently based on the most expensive 1MWh of un-flagged actions.

Graph 2.6 shows how frequently the Replacement Price was used in the price calculation, and what volumes these applied to.



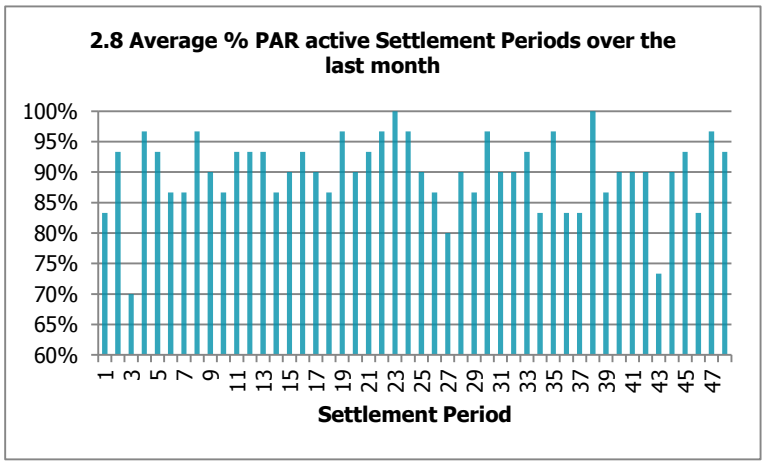
PAR tagging

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 2.7**. 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 2.8 shows the proportion of Settlement Periods over the last month when PAR tagging was active.

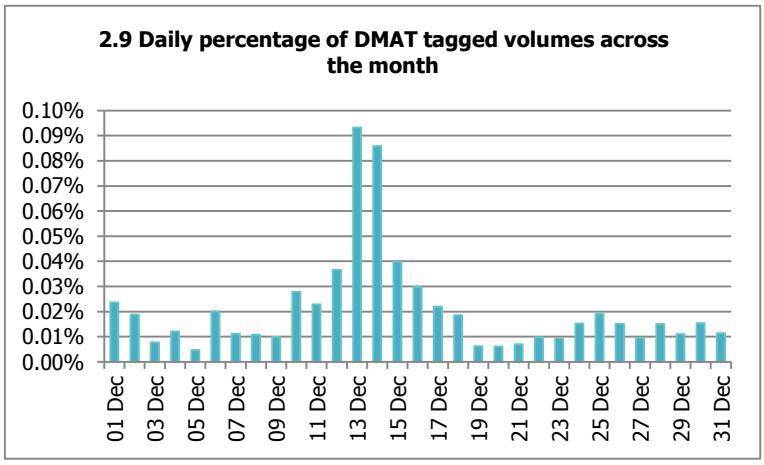


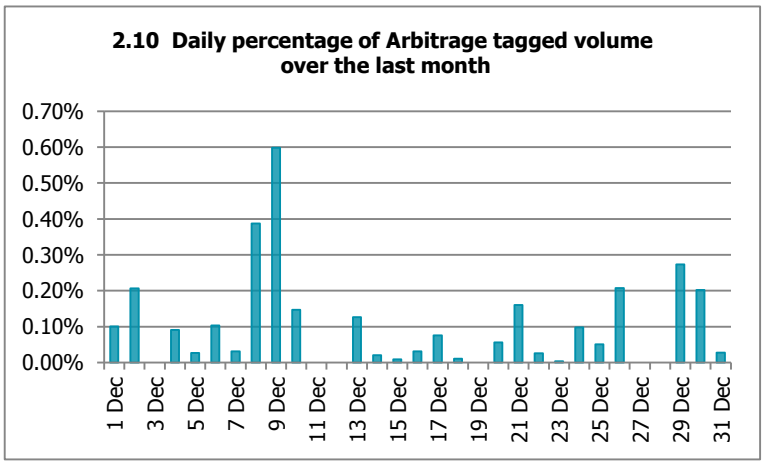
DMAT and Arbitrage Tagged Volumes

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

Graph 2.10 shows the volumes of actions that were removed to Arbitrage tagging.

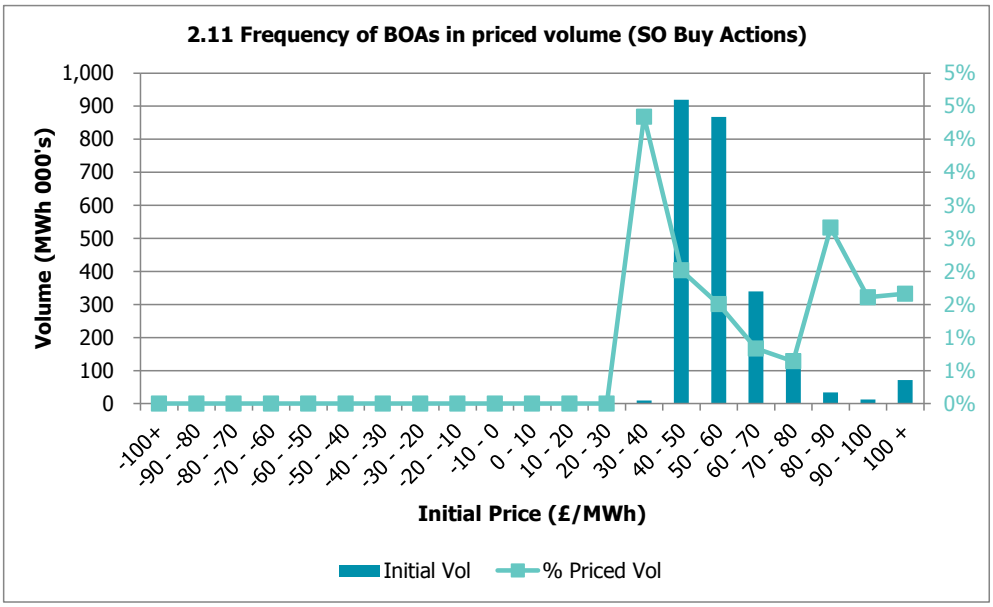




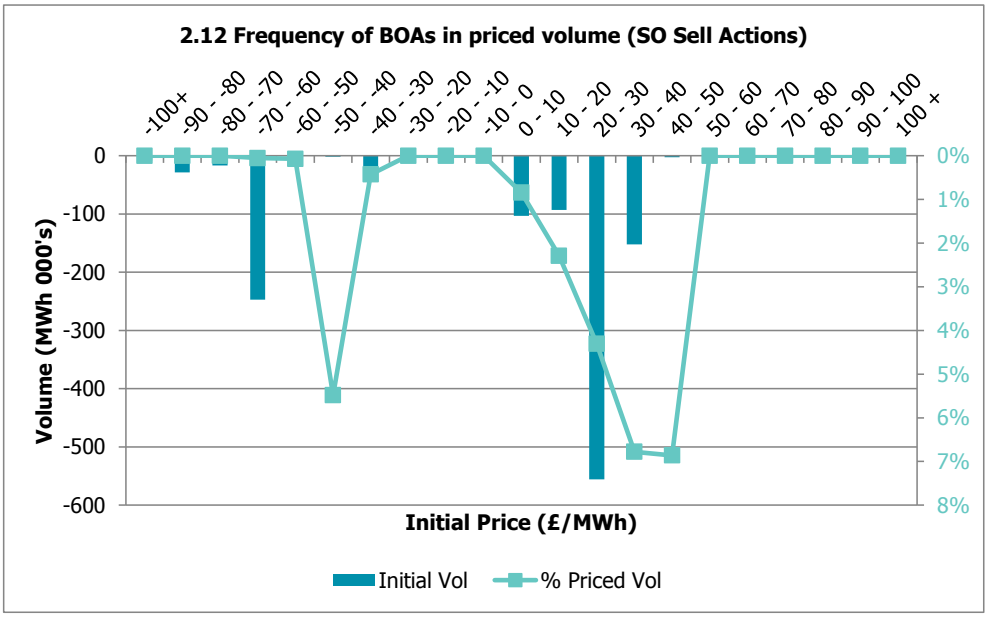
Impact of pricing rules on balancing actions reflected in the price

Next we consider the impact of these pricing rules on which actions feed through to the imbalance price calculation. Actions may not feed through to the imbalance price because of the impact of price calculation rules such as NIV and PAR tagging, flagging and replacement price.

Graph 2.11 shows buy actions as volumes (on the left axis) and what proportion of these were reflected in the imbalance price (on the right axis).



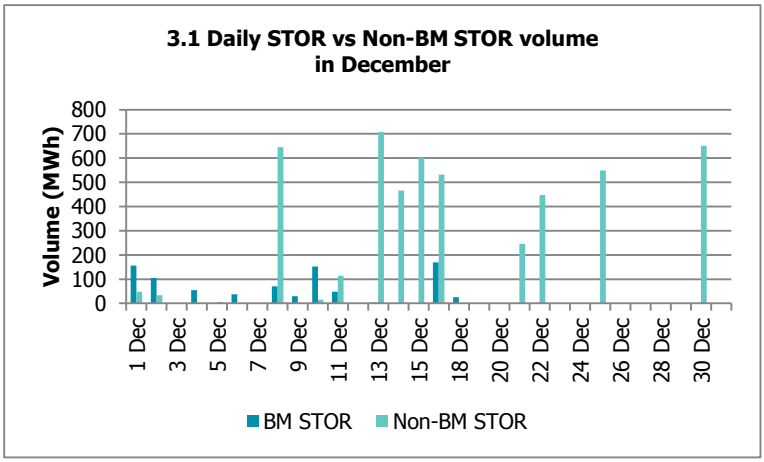
Graph 2.12 shows sell actions as volumes (on the left axis) and what proportion of these were reflected in the imbalance price (on the right axis).



3 BALANCING SERVICES

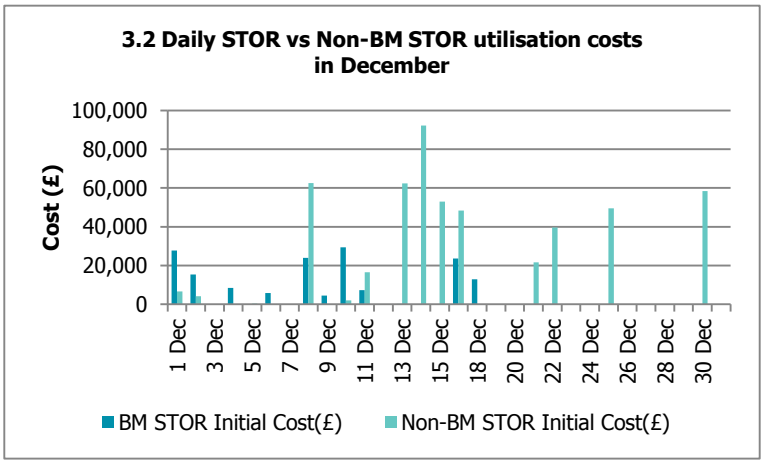
This section deals with balancing services that the System Operator takes outside the balancing mechanism, and how these interact with the imbalance price.

In addition to balancing actions 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 volumes of Short Term Operation Reserve (STOR) that were called upon during the month – split into volumes dispatched via the Balancing Mechanism (BM STOR) and volumes dispatched outside the Balancing Mechanism (non-BM STOR). **Graph 3.2** shows the utilisation costs of these plant.

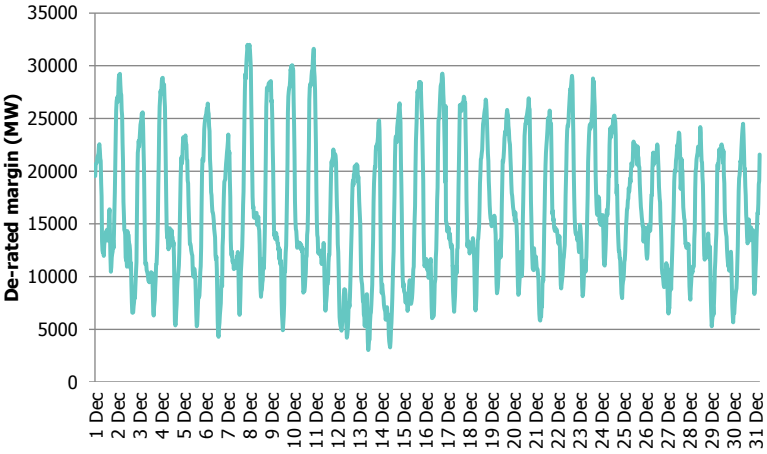


There are times when the Utilisation prices of STOR plant are uplifted using the **Reserve Scarcity Price (RSP)** in order to calculate imbalance prices. The RSP is designed to respond to capacity margins so that it rises as the system gets tighter (the gap between available and required generation narrows). 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 DRMs for the month of December, as forecast by the System Operator and reported at Gate Closure. These ranged from 3,020MW to 31,988MW. The average DRM across the month was 16,035MW and during peak periods it was 12,386MW.

The System Operator has determined a relationship between each DRM and the LOLP which will determine the RSP[4]. In December the lowest DRM was 3,020MWh, resulting in the highest LoLP and therefore the highest Reserve Scarcity Price (RSP) of £0.02/MWh. No STOR actions were re-priced using the RSP in December, as RSPs did not exceed STOR utilisation prices in any periods when STOR was used.

3.3 De-rated Margins in December



Settlement Date	Settlement Period	De-rated Margin	LoLP	RSP	RSP Used
13/12/2015	36	3,020.359	0.000	£0.02	No
14/12/2015	37	3,287.523	0.000	£0.00	No
13/12/2015	37	3,492.308	0.000	£0.00	No
14/12/2015	36	3,538.459	0.000	£0.00	No
01/12/2015	1	0.000	0.000	£0.00	No

3.4 Top 5 De-rated Margin and LoLP in the last month

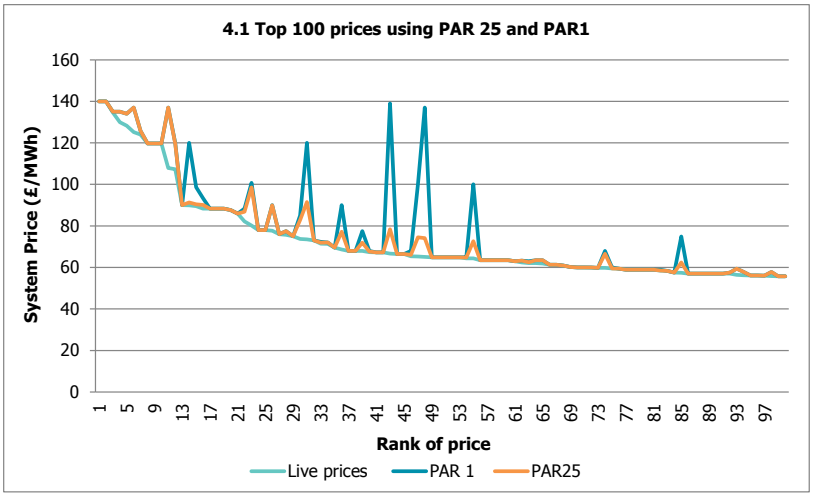
[4] The System Operators methodology for LOLP is set out in the LOLP Methodology statement: https://www.elexon.co.uk/wp-content/uploads/2014/10/37_244_11A_LOLP_Calculation_Statement_PUBLIC.pdf

4 P305 - SPECIFIC ANALYSIS

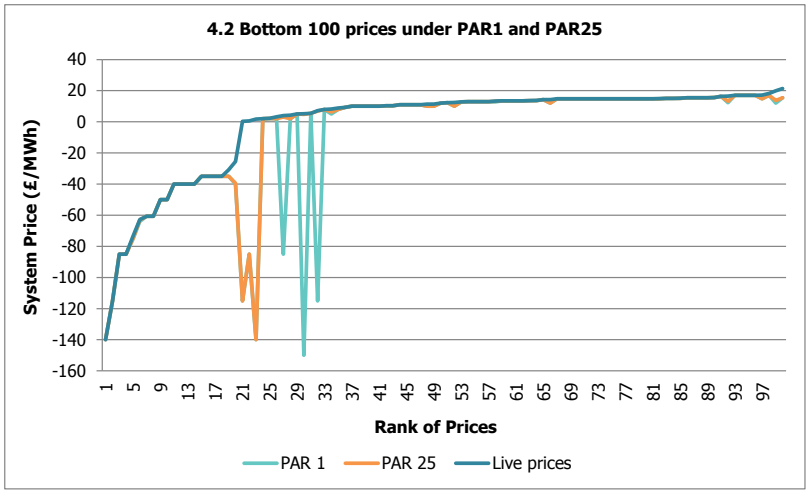
There are three changes to the imbalance price parameters that are due to come in on 1 November 2018. These were approved by BSC Modification P305. These are:

1. A reduction in the PAR value to 1MW h. RPAR will remain at 1MWh.
2. The introduction of a 'dynamic' LOLP function[5].
3. An increase in the VoLL to £6,000MWh. This will apply to all instances of VoLL in arrangements, including the RSP function.

In this section, we set out what prices would look like using a number of different PAR levels.



Graph 4.1 shows the impact of a range of different PAR values on the top 100 prices in December.



Graph 4.2 shows the impact of a range of different PAR values on the bottom 100 prices in December.

[5] This means that LOLP will be calculated for each Settlement Period using up-to-date information, rather than the historical LOLP/De-Rated Capacity Margin relationships set out in the LOLP Calculation Statement

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.