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Analysis of the first phase of the Electricity Balancing Significant Code Review

Working Paper

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Overview:

Imbalance Prices, the prices faced by parties on the difference between what they generate or buy and what they sell or consume, are a key incentive for market participants to balance the system. Ofgem's Electricity Balancing Significant Code Review (EBSCR) concluded in May 2014 and culminated in the implementation of Balancing Settlement Code (BSC) modification P305 on 5 November 2015. This modification introduced substantial changes to the imbalance pricing calculation, with further changes to be implemented on 1 November 2018. These changes seek to incentivise efficiency in balancing and security of supply.

This document is a review of the impact that the changes to the imbalance pricing calculation introduced by the EBSCR, and its subsequent BSC modification P305, have had on the balancing market and the market participants that operate within it. The document focuses on the three high level objectives of the EBSCR and how well the first phase of the modification has been in achieving those objectives.

Context

The electricity market is in transition and has undergone a number of significant changes in recent years. The Capacity Market[1], changes in the generation mix and European reforms aiming to create a single European electricity market, among other initiatives, are all having a significant impact on market arrangements.

Ofgem launched the Electricity Balancing Significant Code Review (EBSCR) in August 2012 to address concerns that there were insufficient signals for the market to balance. We aimed to ensure that the GB system had balancing arrangements that placed efficient incentives on market participants to meet consumer demand and support security of supply.

The EBSCR Final Policy Decision, published in 2014, set out our policy conclusions and formed the basis for our direction to National Grid Electricity Transmission (NGET) to raise modification proposals to the Balancing and Settlement Code (BSC). BSC modification P305 was subsequently approved by Ofgem to be implemented on 5 November 2015, followed by a second phase of changes to come into effect in November 2018. We committed to monitor and evaluate the impact of P305 ahead of the introduction of the second phase of changes.

Associated documents

Ofgem, Balancing and Settlement Code (BSC) P305: Electricity Balancing Significant Code Review Developments, April 2015

Ofgem, Electricity Balancing Significant Code Review: Final Policy Decision, May 2014

Ofgem, Electricity Balancing Significant Code Review: Impact Assessment for Final Policy Decision, May 2014

Baringa/Ofgem, Electricity Balancing Significant Code Review (EBSCR): Further analysis to support Ofgem's Updated Impact Assessment, May 2014

Ofgem, Direction to National Grid Electricity Transmission plc in relation to the Electricity Balancing Significant Code Review, May 2014

London Economics/Ofgem/DECC, The Value of Lost Load (VoLL) for Electricity in Great Britain: Final report for Ofgem and DECC, July 2013

Elexon, P305 Post Implementation Review, February 2017

[1] The Capacity Market was introduced by the Department of Business, Energy and Industrial Strategy as part of the Electricity Market Reform programme to ensure the future security of our electricity supply. More information is available at: https://www.emrdeliverybody.com/cm/home.aspx

Contents

Executive Summary

In August 2012, in response to concerns that cash-out prices were not creating the correct signals for the market to balance supply and demand of electricity, we launched the Electricity Balancing Significant Code Review (EBSCR). The review aimed to address these concerns and, in particular, ensure that flexibility and peaking generation were valued appropriately to improve balancing efficiency and security of supply. In May 2014, we issued our final policy decision, which put forward a set of changes to balancing and cash-out arrangements. These changes would be introduced in two phases, and were to:

- Make cash-out prices more "marginal" by calculating them using the most expensive action the System Operator takes to balance the system (PAR1). This change would be made in a stepped manner, including a reduction to PAR50 in November 2015 and to PAR1 in November 2018.
- Include a cost for disconnections and voltage reduction in cash-out price calculations based on the Value of Lost Load (VoLL) to consumers, and correct supplier imbalance volumes for disconnections. VoLL was to be set at £3,000/MWh from November 2015, and at £6,000/MWh from November 2018.
- Improve the way reserve costs are priced by reflecting the value reserve provides to consumers at times of system stress. To achieve this we introduced a Reserve Scarcity Pricing (RSP) function that prices reserve when it is used based on the prevailing scarcity in the system.
- Move to a single cash-out price for each settlement period to simplify the arrangements and reduce imbalance costs, in particular for smaller parties.

To deliver the changes, we instructed National Grid Electricity Transmission (NEGT) to raise modifications to the Balancing and Settlement Code (BSC). We approved code modification P305 in April 2015.

This review

We committed to monitor and evaluate the effect of the first wave of changes on the balancing system and those operating within it before the second set of changes came into effect. This document presents our findings. We analyse key metrics to identify whether or not the trends in electricity imbalance pricing and behaviour since the introduction of the EBSCR remedies are in line with what we expected to achieve or whether there are any areas of concern.

We have reviewed the effect of the EBSCR changes against the core policy objectives set out in our final policy decision. These are to:

- Incentivise an efficient level of security of supply.
- Increase the efficiency of electricity balancing.

- Ensure balancing arrangements are compliant with the EU Target Model and complement the Capacity Market (CM), introduced as part of the government's Electricity Market Reform programme.

Our findings

Incentivising an efficient level of security of supply: We analysed Imbalance Prices, Net Imbalance Volumes, and the utilisation of the RSP and VoLL for Demand Control Actions before and after the introduction of P305. We found that although Imbalance Prices were, on average, lower following P305, they became sharper, and were higher when the system was short and lower when the system was long. Net Imbalance Volumes decreased, the system was slightly longer on average, and long for more periods of the year. RSP was used twice in the two years following the EBSCR changes, though there was no pricing of Demand Control Actions.

These trends are largely in line with our expectations. We anticipated our remedies would have an impact on Imbalance Prices, and consider that they have not risen or fallen to levels we are concerned about. The longer system was also expected. Although we did not wish to see any Demand Control Actions, we did expect to see the RSP used in more instances. This may mean that the Loss of Load Probability Calculation Statement, which is a subsidiary document of the BSC, should be reviewed once the second phase of the modification has been implemented and enough data is available.

Increase the efficiency of electricity balancing: We analysed Party-Level Imbalance Volumes, Party-Level Cashflows and Bid Offer Behaviour. Party-Level Imbalance Volumes increased in both absolute and net terms. Party-Level Cashflows have changed substantially, with overall imbalance charges falling from £120m to negative £25m. The largest proportion of bids has fallen from £40-£50/MWh to £30-£40/MWh, while offer levels remained relatively stable on average.

The data we have gathered does not show us anything unduly concerning at this stage. The direction and relative changes observed in cash flows are in line with our expectations, as are the differential impacts we have seen for different party types. The changes in Bid Offer behaviour are likely due to changes in market context, rather than as a result of the EBSCR changes.

Ensure balancing arrangements align with the EU Target Model and the Capacity Market: The EBSCR changes were designed to align with the expected final version of the EU Target Model. We will evaluate the new arrangements in 2019 and consider any necessary changes at that stage. The EBSCR changes complement the CM – both aim to improve security of supply, but in different ways. The CM incentivises a greater level of investment in capacity by delivering a secure revenue stream, while the EBSCR changes aim providing stronger signals to appropriately value flexibility.

We welcome stakeholder feedback on the findings presented in this review. We will continue to monitor and evaluate the impact of the EBSCR remedies as the second phase of changes comes into effect.

1. Introduction

In this chapter we outline first the intention of the document followed by the rationale and scope of the review. We then explain what data has been used and the sources of that data. The chapter ends by setting out the structure that has been used for this review.

Background

1.1. Following the Electricity Balancing Significant Code Review (EBSCR), we introduced four changes to imbalance charging: (i) a more marginal main cash-out price; (ii) the inclusion of a cost for Demand Control Actions in cash-out prices; (iii) improvements to the way reserve is incorporated in cash-out prices; and (iv) the introduction of a single cash-out price.

1.2. To deliver the EBSCR remedies we directed the System Operator, National Grid Electricity Transmission, to raise modifications to the Balancing and Settlement Code. We approved modification proposal P305 in May 2015. P305 set out changes to cash-out calculations in two phases – the first wave of changes came into effect in November 2015, and the second will come into force in November 2018.[2] We committed to monitor and evaluate the impact of P305 ahead of the introduction of the second phase of changes.

1.3. In our May 2014 EBSCR final policy decision, we set out the three high-level objectives of the reform. These were to: incentivise an efficient level of security of supply, increase the efficiency of electricity balancing, and to ensure balancing arrangements are compliant with the European Target Model (ETM) and complement the government's Electricity Market Reform (EMR), in particular the introduction of the Capacity Market (CM).

1.4. This document reviews the impact the P305 changes have had in delivering the high-level objectives we set out in our policy decision, and considers the effect on the balancing mechanism and the parties that operate within it. We use key metrics to identify whether trends in electricity balancing pricing and behaviour are in line with the outcomes we expected.

Scope of the Review

1.5. This review is a data driven view of the initial impact of P305. It is not a full evaluation of the policy, and we do not intend to make a full judgement of the

[2] A detailed description of the EBSCR remedies can be found in our policy decision document: Ofgem, Electricity Balancing Significant Code Review: Final Policy Decision, May 2014.

effectiveness of the EBSCR remedies until all modifications set out in our policy decision have been implemented and we have had time to assess their impact.

1.6. For the avoidance of doubt, this review focuses on the impacts of P305 rather than the wider balancing and settlement arrangements. We are aware that some market parties have expressed concerns about other factors influencing cashout. We are monitoring the market and imbalance prices on an ongoing basis, and we welcome further discussions with stakeholders.

1.7. We expect many of the benefits associated with P305 to materialise over the longer term. In particular, we expect market participants to react to the reforms by adapting their trading and investment strategies. This should result in more efficient costs for consumers.

1.8. This review focuses on the short term impacts that we are able to observe at this stage. It examines data trends to establish whether they are broadly consistent with what we would expect to see, taking into account the wider market context.

1.9. The period we have chosen is limited to the two years before and the two years after the reforms were implemented. This static view is to give an equal weighting to seasons to ensure a fair comparison but we note that a different time period may yield different results. We do not consider market changes outside these four years.

1.10. Since the implementation of P305, Elexon have been keeping the market informed of the system prices and balancing market conditions through their regular publications, such as the monthly System Prices Analysis Report[3], and other publications such as the Post-Implementation Review of P305.[4] The market information published by Elexon has ensured that market participants have remained informed of the impact of the modification. Without duplicating that data, this document focuses on how the first phase has performed against the objectives laid out in our final policy decision.

Data Used

1.11. The data used in this review covers the two years either side of the reform, ranging from November 2013 to October 2017. Throughout the document we refer to two different time periods "pre-P305" and "post-P305", these represent the periods between 1 November 2013 and 4 November 2015 and between 5 November 2015 and 31 October 2017 respectively.

1.12. Where we present monthly data for the pre- or post-P305 period, each of the months displayed is the average or sum of those months in both years. For example,

[3] Elexon's System Prices Analysis Report is available on their website: https://www.elexon.co.uk/about/key-data-reports/system-prices-analysis-report/
[4] Elexon, P305: Post Implementation Review, February 2017

the average “pre-P305 January” is the average of January 2014 and January 2015 combined.

1.13. When we discuss the “Pre P305 Scenario” and the “P305 2018 Scenario”, we are referring to the scenarios created by Elexon that take the settlement periods from the implementation of P305 and apply the Imbalance Price calculation used before the modification came into effect and the Imbalance Price calculation that will be used from 1 November 2018 respectively. The P305 Scenario is using the Imbalance Price calculation currently used by the Elexon.

1.14. A large proportion of the data used in this report was given to us by Elexon with permission from the BSC Panel. We would like to thank Elexon for their help in ensuring that we had access to the data we needed.

Structure of the Document

1.15. The remainder of this document is structured as follows:

- Chapters 2, 3 and 4 present the high-level objectives of the EBSCR and use metrics to gauge the potential impacts that EBSCR has had on the market against these objectives;

- Chapter 5 reviews the impact of the EBSCR through the scenarios described above; and

- Chapter 6 presents our conclusions of our review of the first phase of the reform.

2. Objective 1 - Incentivise an efficient level of security of supply

This chapter reviews the impact P305 has had in achieving our policy objective to incentivise an efficient level of security of supply using three metrics: (i) Imbalance Prices, (ii) Value of Lost Load (VoLL) and Reserve Scarcity Pricing (RSP), and (iii) Net Imbalance Volumes (NIV). Imbalance Prices that are more volatile and reflective of the cost faced by the System Operator (SO) to balance the system provide a greater incentive for parties to balance efficiently. The market response to this has been to provide more energy to the system than is needed in a larger proportion of periods and to ensure that energy is provided to the market at times of system stress, leading to a more secure system.

2.1. The first high-level objective we will explore is "to incentivise an efficient level of security of supply". At the time of the EBSCR, the Capacity Market (CM) was being introduced, which had a significant impact on security of supply. This document discusses the interactions between the EBSCR and the CM in greater depth in chapter four.

2.2. When the Imbalance Price reflects the underlying cost to balance the system, and accurately reflects the scarcity on the system, it sends signals for investment in more flexible generation, demand-side response (DSR) services, storage and other flexible technologies. To review these signals, we have assessed trends in three key metrics: Imbalance Prices, VoLL and RSP, and NIV.

Imbalance Prices

2.3. Imbalance Prices are the default price for uncontracted electricity and are a primary incentive on participants to balance their positions. P305 significantly changed the way that Imbalance Prices are calculated, with the aim of making them more cost reflective of the SO's costs of balancing at the margin. Ofgem expected this to create sharper Imbalance Prices and therefore improve the price signals for balancing at times of system stress.

2.4. Imbalance Prices that are more reflective of the SO's costs should incentivise market participants to exhaust all efficient opportunities to balance their position in advance of Gate Closure. This is beneficial to security of supply as it ensures that in times of system stress, the system cost of balancing is at its most expensive, and market participants are incentivised to ensure that their position is balanced or supports the system in meeting electricity needs. This should reward those parties that are able to respond to market conditions and thus incentivise parties to think about flexibility when investing.

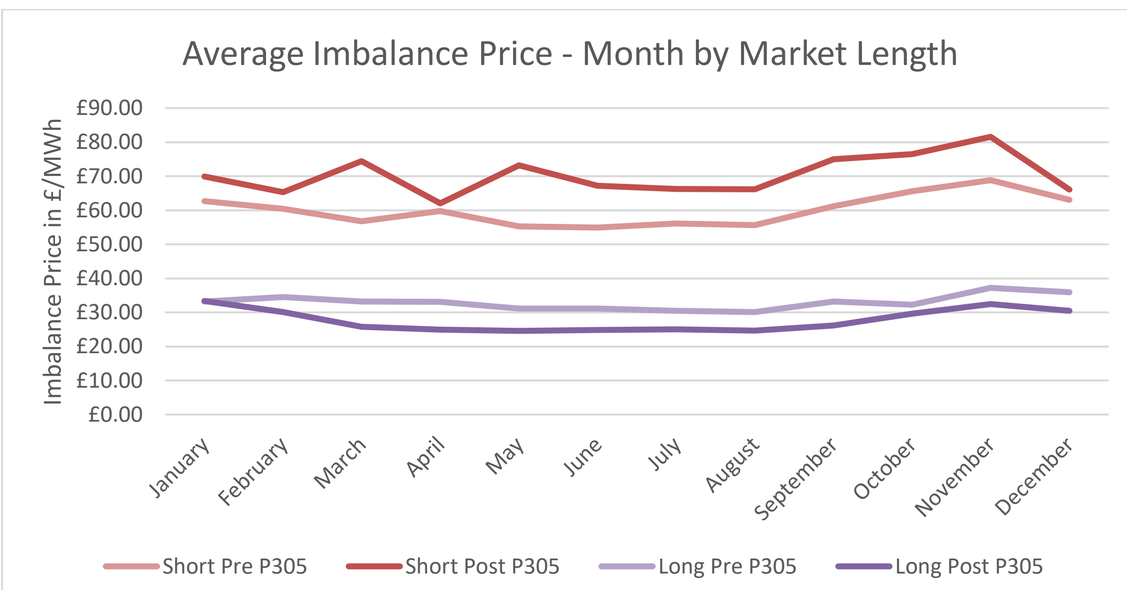
2.5. Imbalance Prices are not impacted by one single aspect of the modification, but rather a combination of all of the changes to the imbalance calculation working both directly and indirectly. We recognise that the impacts of P305 are not the only drivers for changes in the Imbalance Price and that external factors could influence the Imbalance Price in a significant way. See Appendix 1 – Market Context for details about some of the external factors.

What happened to Imbalance Prices?

2.6. Since the implementation of P305 we have seen the average Imbalance Price fall. The majority of Imbalance Prices now lie within the range of £20-30/MWh, rather than £30-£40/MWh as previously observed. The Imbalance Price has, however, become more volatile, especially when the system is short. The Imbalance Prices have become sharper – the price when the system is long is lower across all settlement periods, and the price when the system is short is higher, predominantly between settlement periods 12 and 45.

2.7. Figure 1 shows the monthly average Imbalance Price when the system was long and when the system was short. It shows that the average Imbalance Price when the market was short has increased, while the average Imbalance Price when the market was long has fallen since the introduction of P305. The impact is fairly uniform across all of the months with few exceptions. The increase in the average short system price and the decrease in the average long system price is in line with the expectations set out in our EBSCR Impact Assessment.

Figure 1: Average Imbalance Price for each Month by Market Length



Source: Imbalance Prices provided by Elexon

2.8. Table 1 below shows the minimum, maximum, average and standard deviation of the Imbalance Prices pre- and post-P305, taking into account whether the market was long or short. It re-emphasises the impact observed in Figure 1 above, showing that system prices have fallen after P305 was introduced but the volatility and range of the prices have increased.

Table 1: Imbalance Price Statistics

	Minimum	Maximum	Average	Standard Deviation
Pre-P305	-£78.00	£429.10	£43.38	£19.30
Post-P305	-£100.00	£1,528.72	£41.34	£39.65

Source: Imbalance Prices provided by Elexon

2.9. The increase in volatility and range of prices was expected, as prices are now able to increase and decrease in order to reflect the marginal cost to the SO. The maximum Imbalance Price post-P305 is more than three times higher than the maximum Imbalance Price pre-P305. This increased incentive to balance in the periods of tight margins forms the most significant contributor to security of supply.

Table 2: Imbalance Price Statistics by System Length

		Minimum	Maximum	Average	Standard Deviation
System Long	Pre-P305	-£78.00	£109.91	£32.90	£6.30
	Post-P305	-£100.00	£248.44	£27.48	£9.84
System Short	Pre-P305	£21.50	£429.10	£60.33	£21.12
	Post-P305	£18.43	£1,528.72	£70.67	£58.55

Source: Imbalance Prices provided by Elexon

2.10. Table 2 above shows the increase in volatility, demonstrated by the increased standard deviation of Imbalance Prices. The impact is more significant when the system is short. This, alongside the increase in the average Imbalance Price when the system is short, sharpens the incentives for parties to avoid being short. This is particularly the case given that the increase in Imbalance Prices when the system is short outweighs the decrease observed when the system is long.

Table 3: Average Imbalance Prices by month and system length

Average System Price by Month		
	System Short	
	Pre-P305	Post-P305
January	£62.64	£69.88
February	£60.45	£65.34
March	£56.79	£74.41
April	£59.81	£62.04
May	£55.25	£73.24
June	£54.92	£67.17
July	£56.13	£66.23
August	£55.66	£66.14
September	£61.15	£74.96
October	£65.58	£76.45
November	£68.83	£81.58
December	£63.05	£66.06

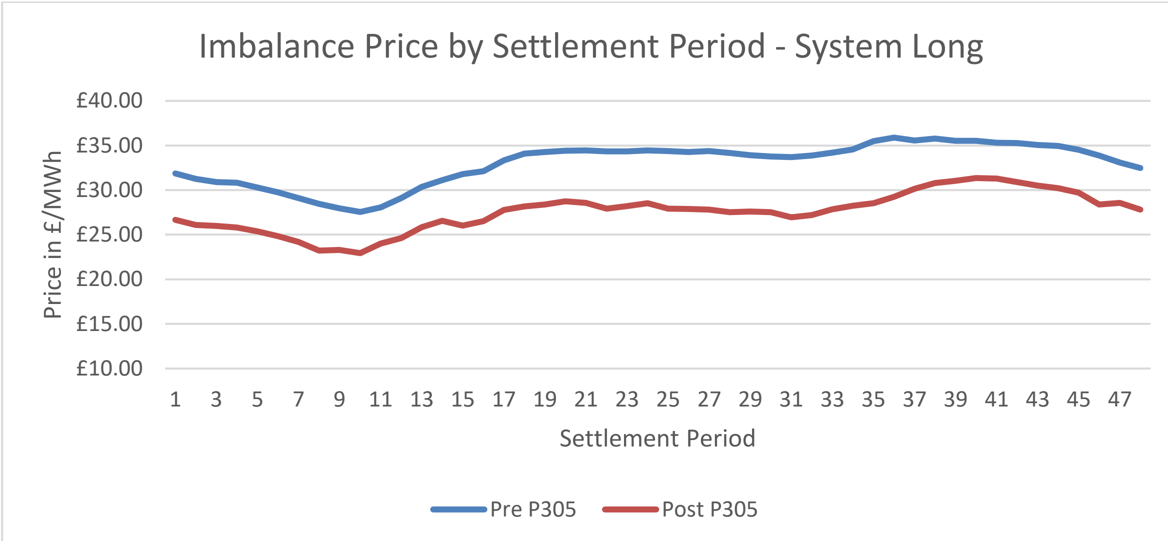
Average System Price by Month		
	System Long	
	Pre-P305	Post-P305
January	£33.18	£33.36
February	£34.54	£30.07
March	£33.24	£25.77
April	£33.09	£24.94
May	£31.17	£24.57
June	£31.13	£24.81
July	£30.49	£25.01
August	£30.10	£24.70
September	£33.24	£26.16
October	£32.26	£29.64
November	£37.21	£32.47
December	£35.95	£30.50

Source: Imbalance Prices provided by Elexon

2.11. Table 3 above shows the monthly average prices from the pre- and post-P305 periods. As expected, prices sharpened in all months for both long and short systems. This is with the exception of the long system in January of both pre- and post-P305 where the price likely reflects differing system conditions, such as wind levels, fuel prices and margins.

2.12. Figure 2 below shows that the Imbalance Price when the system is long decreases quite uniformly across settlement periods, with an average difference of £5.43/MWh, and a range of just under £3/MWh in price difference, between the pre- and post-P305 periods. The maximum difference can be observed in settlement period 35 at just under £7/MWh.

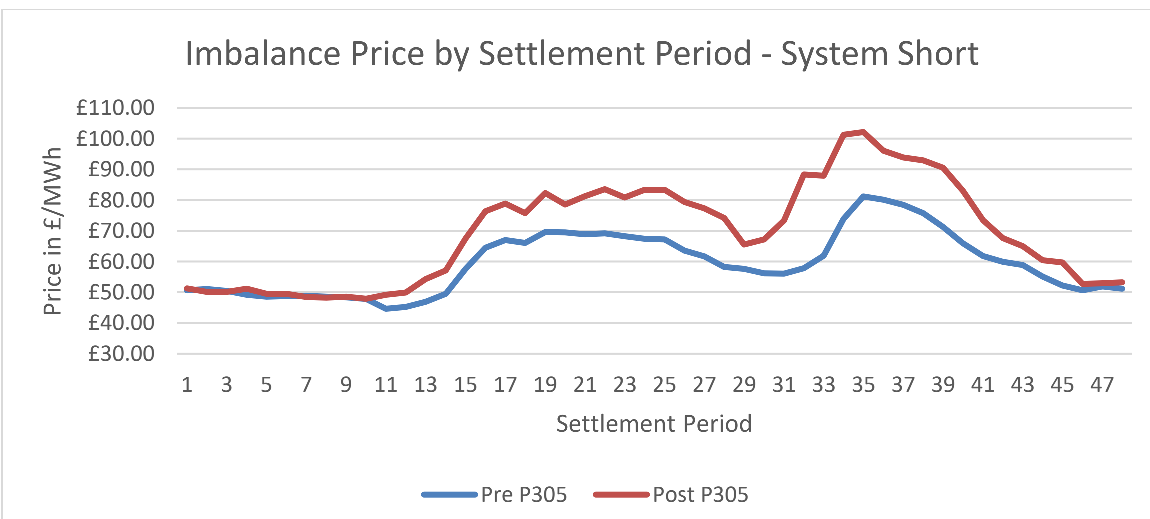
Figure 2: Imbalance Price by Settlement Period when the system is long



Source: Imbalance Prices provided by Elexon

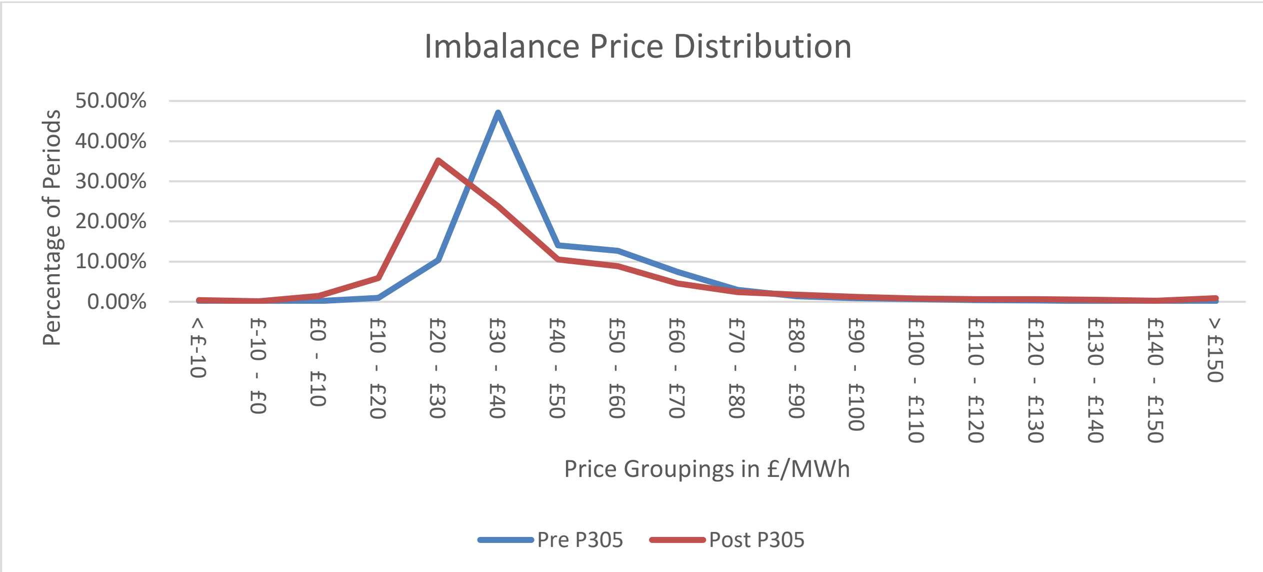
2.13. The short market in Figure 3 below does not show a uniform price increase. Settlement periods 1-10 all have a difference between the pre- and post-P305 periods of under £1 whilst settlement period 32 has an average price increase of just over £30/MWh. The average price difference across the settlement periods is just over £10/MWh in the short market.

Figure 3: Imbalance Price by Settlement Period when the system is short



Source: Imbalance Prices provided by Elexon

Figure 4: Imbalance Price distribution



Source: Imbalance Prices provided by Elexon

2.14. Figure 4 above shows the flattening of the price distribution post-P305. This is down to a shift in the level at which the highest proportion of Imbalance Prices peak – from 47% of Imbalance Prices in a single price bracket (£30 - £40/MWh) down to a peak of 35% in a lower price bracket (£20 - £30/MWh). This not only shows that the curve flattened, but also reflects the average price drop from the pre-P305 period to the post-P305 period.

2.15. In the pre-P305 period there were 72 periods that contained a negative Imbalance Price. This increased to 191 periods in the post-P305 period. The average negative Imbalance Price also fell from -£30.28 to -£33.69. This increase in the number of negative prices would have contributed to the overall fall in the Imbalance Price when the system is long. This may increase the risk for parties going long when the system is long, as the price is now negative more often.

Is this in line with our expectations?

2.16. These changes to Imbalance Prices are all in line with our initial expectations. The sharper Imbalance Prices, especially at times of tight margins, contribute to increased security of supply as parties have greater incentives to be in balance, or for their imbalance to be in the opposite direction to the system length. The shift towards a longer position reflects the asymmetry of risk to both parties and the system. A longer system can also have benefits to security of supply, which we will explore later in this section.

Value of Lost Load and the Reserve Scarcity Price

2.17. Value of Lost Load (VoLL) pricing and the Reserve Scarcity Price (RSP) are two aspects of the Imbalance Price calculation introduced through the EBSCR. VoLL and RSP are intrinsically linked as RSP is calculated by multiplying the Loss of Load Probability[5] (LoLP) by VoLL. Both of these functions were introduced in an attempt to ensure that prices rise to reflect the value of energy reserve at times of scarcity and system stress more accurately and are therefore key to sending the appropriate signals for investment.

2.18. VoLL pricing is the treatment of Demand Control Actions as a balancing action. By including the VoLL in the calculation of the cash-out price we aimed to ensure that the average value consumers contribute to security of supply is accounted for in the Imbalance Price. This value was set at £3,000/MWh from November 2015 and will increase to £6,000/MWh on November 1 2018.

2.19. Short Term Operating Reserve (STOR) actions were priced in the imbalance calculation at their Utilisation Price, a predetermined price that does not reflect scarcity on the system or the availability price the provider also receives. When this service is used in times of system stress it causes an underestimation of the Imbalance Prices' value to the market.

2.20. The RSP seeks to accurately reflect the value of STOR to the system as it is derived from the VoLL and the LoLP. The RSP then replaces the Utilisation Price of STOR providers in the imbalance calculation when the RSP exceeds the Utilisation Price.

What has happened?

2.21. Whilst there have been tight margins and high prices, there have been no instances of Demand Control Actions in the two years since P305 was implemented. There were seven occasions where STOR actions were repriced with the RSP. However, of these instances, there were only two periods where this had an impact on the Imbalance Price (see Table 4). On the other five occasions, the STOR actions were "tagged"[6] out of the price calculation. We cannot know whether or not there would have been Demand Control Actions or tighter margins had EBSCR not been implemented but the lack of Demand Control Actions and the relatively few periods where the RSP replaced the Utilisation Price, are a good sign of a secure supply.

[5] The Loss of Load Probability Calculation Statement is a subsidiary document to the BSC.
[6] See the Elexon Pricing Guidance for more information on tagging: https://www.elexon.co.uk/wp-content/uploads/2016/10/Imbalance_Pricing_guidance_v11.0.pdf

Table 4: Occasions where actions were both STOR and RSP flagged

Date	Settlement period	Number of BM STOR actions that were repriced	Number of non-BM STOR actions that were repriced	Reserve Scarcity Price
09/10/2016	39	3	24	£829.92
31/10/2016	35	2	0	£644.29

Source: Data provided by Elexon

Is this in line with our expectations?

2.22. Whilst we expected and hoped that there would be no instances where the pricing of disconnection was needed, we expected to see more than two instances where the RSP was deployed. The lower than anticipated times the RSP was used suggests that either margins were higher than we expected in the two years following the implementation of P305 or that the LoLP calculation methodology is not as sensitive to tight margins as we had previously expected.

2.23. The RSP doesn't need to be regularly used for it to have a beneficial impact on the market. The potential for the RSP to rise during stress situations should ensure parties take more actions in advance to mitigate the risk of being short at the wrong time, helping to minimise the chance of system stress events. We note that the LoLP Calculation Statement is a BSC code subsidiary document that the BSC Panel are required to review from time to time.

Net Imbalance Volumes

2.24. Net Imbalance Volumes (NIV) represents the volume of balancing actions remaining after the volume of the Buy balancing actions ("Offers"), are netted off against the volume of Sell balancing actions ("Bids"). This reveals the length of the market in a single direction for a given settlement period. The larger the NIV in either direction, the higher the volume of actions that will feed into the Imbalance Price calculation. When the SO has to take more actions it usually means that the price of those actions become increasingly expensive to the SO. This is then reflected in a higher Imbalance Price when the system is short and a lower Imbalance Price when the system is long.

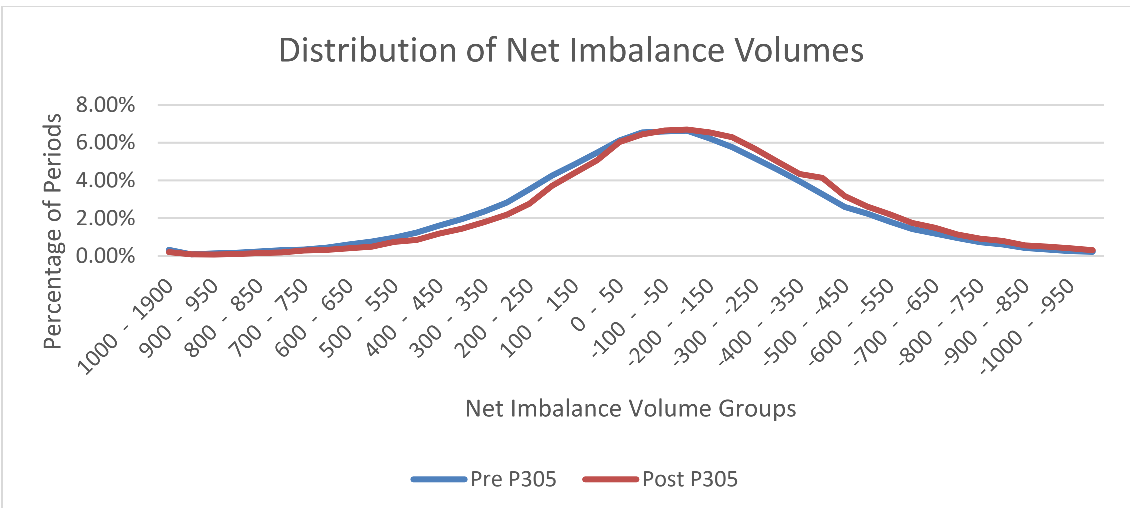
2.25. The NIV as a metric is more a reflection of party response to the change in the balancing arrangements, than the direct effect of the change in the balancing arrangements themselves.

2.26. The EBSCR changed the Imbalance Price calculation to include non-BM STOR which would, in some periods, increase the NIV before accounting for behaviour change. Actions that were previously not being reflected, are now part of the calculation. We expected the market to become longer as a result of the changes made by the EBSCR. This expectation was based on the change in the risk-reward profile caused by the move to a single Imbalance Price, combined with more volatile Imbalance Prices.

What happened to Net Imbalance Volumes?

2.27. Figure 7 below shows changes in the NIV from pre-P305 to post-P305. The shape of the distribution has remained very similar, with the peak occurring at the same height. The entire distribution curve has shifted to the right as the system is now consistently longer than it was during the pre-P305 period. On average the system is now 55MW longer than the pre-P305 period.

Figure 7: Distribution of Net Imbalance Volumes

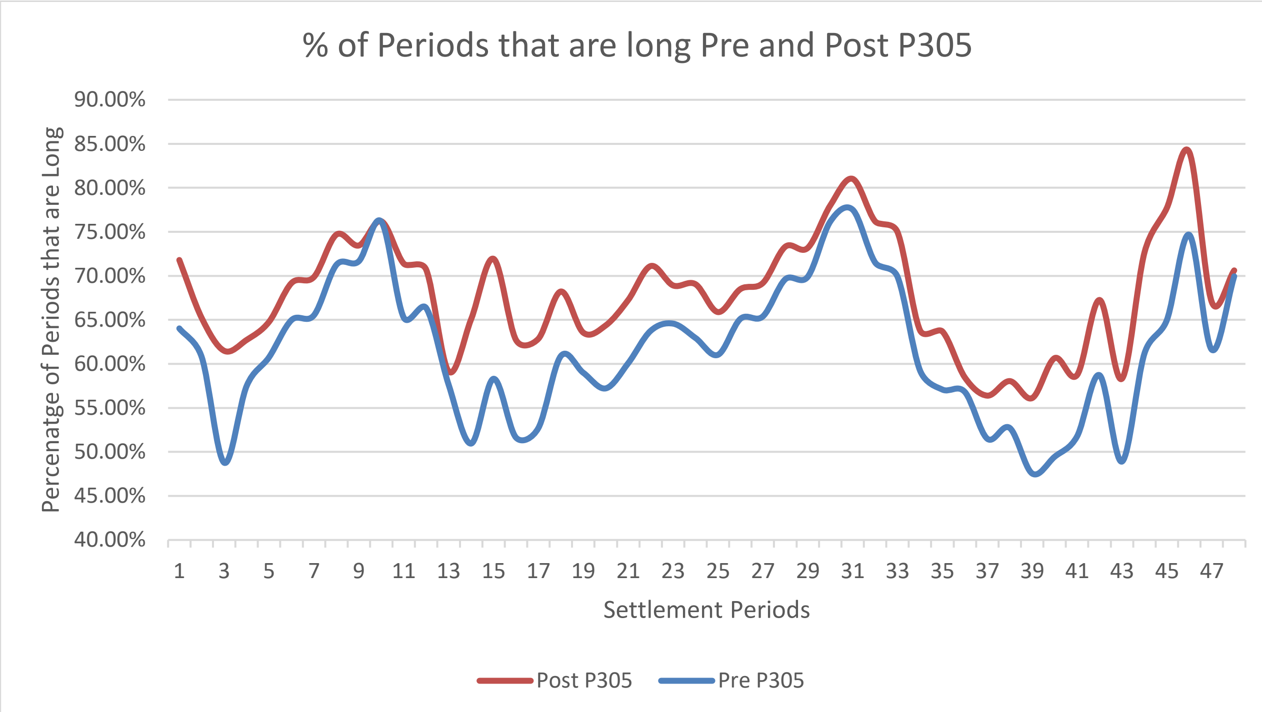


Source: NETA Reports Website

2.28. In the two years before P305 was implemented, the market was long 62%, and short 38%, of the time. In the two years since the implementation of P305, the market has been 68% long and 32% short. This shift to a longer market is minor but in line with our expectations that with a single price and sharper Imbalance Prices, the risks associated with being long or short have changed. It is too early to say whether the changes have led to market participants choosing to hedge a longer position.

2.29. Figure 8 below shows that while the NIV has increased by ~6% on average from the pre-P305 period, the increase is not uniform. Some settlement periods, such as 14–17, have increased by more than 10%, while settlement periods 10 and 48 have seen less than a 1% increase. It is notable, however, that all settlement periods have increased in the number of long periods compared to the pre-P305 period.

Figure 8: Percentage of periods that are Long by Settlement Period



Source: NETA Reports Website

Is this in line with our expectations?

2.30. This decrease in the NIV and the longer system on average are in line with our expectations. The decrease in NIV from the pre-P305 period to the post-P305 period is most likely the result of behavioural change on the part of market participants in response to the change in risk associated with being short or long.

2.31. The additional energy on the system can be beneficial to security of supply, as it reduces the likelihood/need for Demand Control Actions. However, increased system length is not always beneficial. When the system is long, the SO has to take actions to reduce the system length, this could entail reducing output on inflexible or subsidised plants. In these instances Imbalance Prices should reflect the additional strain on the system through economically inefficient Imbalance Prices.

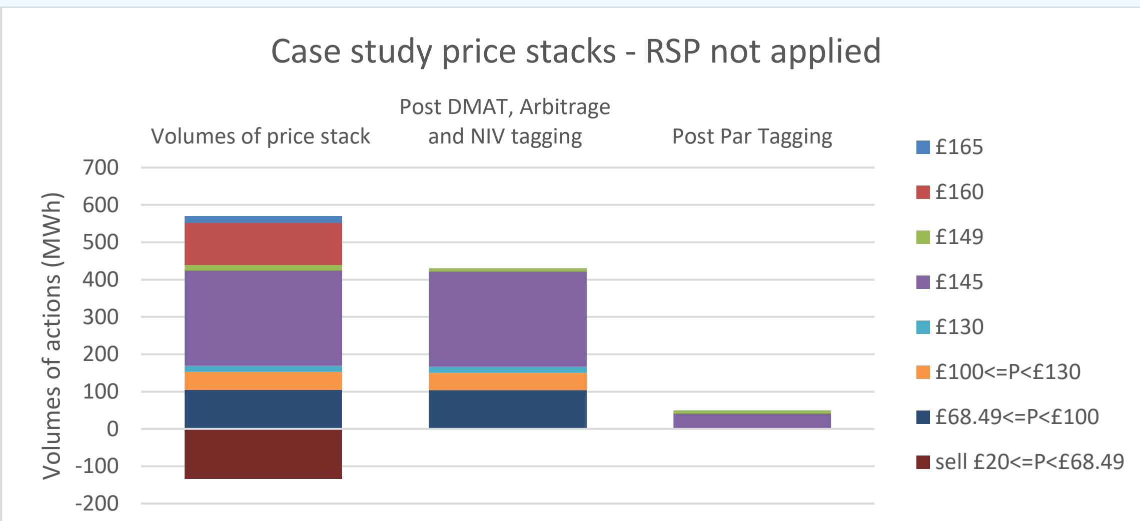
2.32. We consider that a slightly longer system could be an efficient response to the asymmetric costs of balancing and forward market costs. We will continue to monitor the NIV and would expect that if the NIV becomes inefficiently long persistently, market participants would react to the Imbalance Prices.

Case Study: 9th October 2016, Settlement Period 39

On the 9th October 2016 the RSP had an impact on the Imbalance Price in settlement period 39. The price stack contained a combination of non-BM STOR and BM STOR actions[7] and at £829.72, the RSP was greater than the Utilisation Price of the providers.

Figures 5 and 6 demonstrate how the RSP impacted the Imbalance Price. Figure 5 first demonstrates the Imbalance Price calculation assuming the RSP had not been introduced, whilst Figure 6 includes the RSP to show what actually happened. It shows that the Imbalance Price was £843.10 (once the Buy Price Adjustment[8] was included) but would have been £159.06 had there not been an RSP. In this example the introduction of the RSP has increased the Imbalance Price by £684.04/MWh.

Figure 5: Price stacks illustrating when RSP and VoLL are not applied



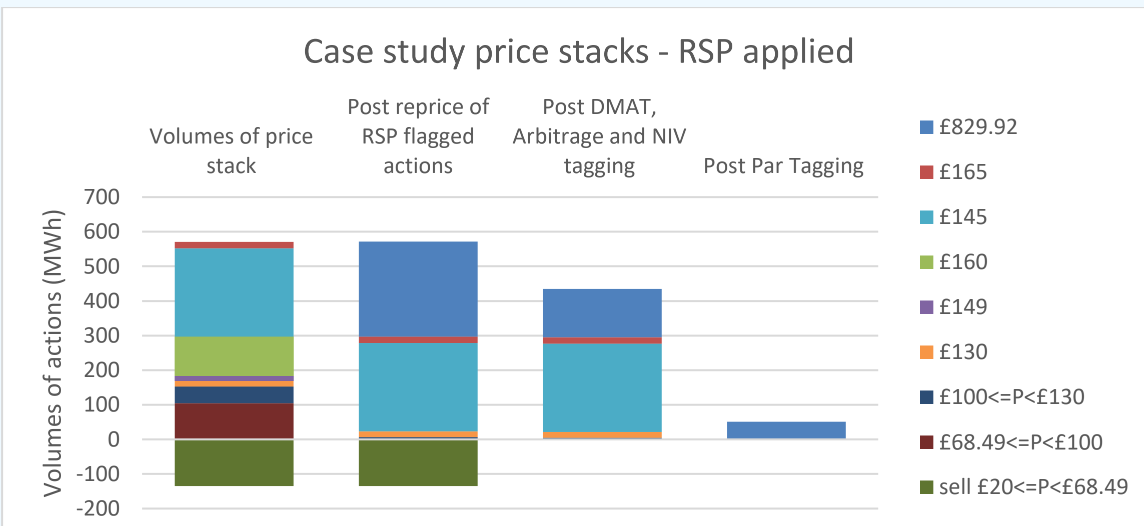
Source: Detailed System Prices provided by Elexon

[7] Note that at the time there was discrepancies with the implementation of non-BM STOR actions being accurately repriced in the cash out price calculation, this has been resolved and consulted on by the SO. Figure 10 shows what would have happened if RSP was accurately applied to both BM STOR actions and non-BM STOR.
[8] The Buy Price Adjustment (BPA) is a reflection of the costs to the SO of regulating reserve and BM start-up. It does not have a volume. It is added to the imbalance calculation at the end of the process. For more information on this see the Elexon Imbalance Pricing Guidance: https://www.elexon.co.uk/wp-content/uploads/2016/10/Imbalance_Pricing_guidance_v11.0.pdf

The column on the left shows the total volume of actions and their associated prices. They have been organised by price from highest to lowest. The middle column shows the actions that remain once the Net Imbalance Volume tagging process has been completed[9]. We see that the volume of negative actions has been removed from the column, as has the same volume of positive actions, with the highest priced actions being removed. The right column shows the highest priced remaining 50MW/h of actions. This shows that the Imbalance Price is being set by two actions, a small volume at £149 and a larger volume at £145.

Figure 6 below shows the same process but with a column added between the left and middle column. This is the repricing of STOR actions with the RSP price. It shows that the same volume of actions are taken but some of the lower priced actions in the column are priced at £829.92, which moves them to the top of the column. This time when the negative volume and corresponding most expensive positive volume are removed, the 50MW/h remaining in the far-right column is all priced at the RSP price of £829.92.

Figure 6: Price stacks illustrating when RSP and VoLL are applied



Source: Detailed System Prices provided by Elexon

[9] For more information on the flagging and tagging used in the imbalance pricing calculation see the Elexon Imbalance Pricing Guidance: https://www.elexon.co.uk/wp-content/uploads/2016/10/Imbalance_Pricing_guidance_v11.0.pdf

3. Objective 2 - Increase the efficiency of electricity balancing

In this chapter we review EBSCR policy objective 2, which is to "increase the efficiency of electricity balancing". We make use of three metrics: Party Level Imbalance Volumes, Party Level Cash Flows and Bid Offer Behaviour. Party Level Imbalances have increased whilst the total imbalance charges have decreased. The increased efficiency in balancing has not impacted parties equally. Vertically Integrated parties, Interconnectors and Non-Physical Traders have faced a reduction in cash flows while Suppliers, Renewable Generators and Independent Generators have seen an increase in cash flows.

3.1. The second high-level aim of the EBSCR remedies is "to increase the efficiency of electricity balancing". It is important to note that an efficient level of electricity balancing does not necessarily mean a move to a more balanced system. Balancing efficiency takes into account both the costs parties incur to balance their positions and the costs borne by the SO.

3.2. We held that EBSCR would be beneficial for competition and efficiency as parties would bear a more accurate reflection of the system costs and benefits associated with their imbalances. As part of this we expected some party-level distributional impacts.

3.3. In our Impact Assessment[10] we considered both short- and long-term balancing costs for balancing efficiency. We have not included these metrics in this assessment, as many factors drive balancing costs and it is too soon for the longer-term impacts to be clear.

3.4. In this chapter, we review the impacts of P305 at a BSC party level, looking at metrics such as party-level imbalances as well as costs and cash flows, to see whether the impacts are broadly in line with expectations. To do this we have assigned each BSC party to a party type. Each party type is then averaged or aggregated in order to see the impact on both party-level imbalances and party-level cashflows. The party types used in this analysis include: Independent Generators, Interconnectors, Non-Physical Traders, Renewable Generators, Suppliers and Vertically Integrated Parties. We also consider the accepted bids and offers in the market to see if EBSCR had any knock-on effects to competition in the Balancing Mechanism.

[10] Ofgem, Electricity Balancing Significant Code Review: Impact Assessment for Final Policy Decision, May 2014

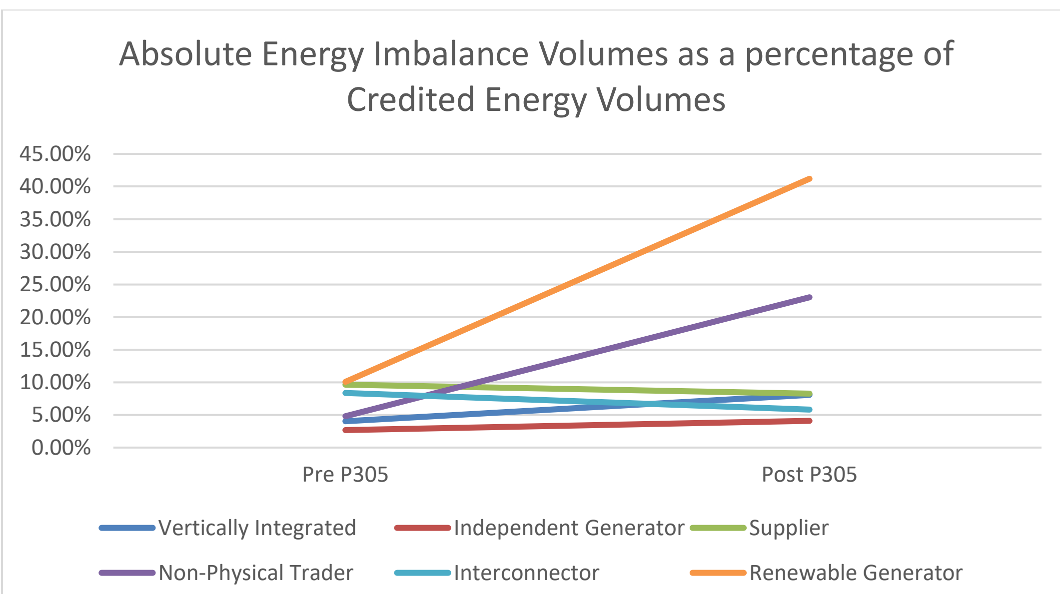
Party-Level Imbalance Volumes

3.5. For this review we have broken down imbalance volumes into two categories – absolute and Net Imbalance Volumes. The absolute imbalance volume is the imbalance volume for every settlement period treated as a positive value regardless of direction and aggregated by month. The Net Imbalance Volume is the imbalance volume for each settlement period, where a short imbalance is treated as a negative value and a long imbalance is treated as a positive value. These values are also aggregated on a monthly basis. Imbalance volumes are represented as a proportion of credited energy volume aggregated by party type.

3.6. Absolute imbalance volumes allow us to review the impact that P305 has had on imbalance volumes, regardless of length, which is beneficial as it does not "hide" party imbalances by aggregating positive and negative volumes. However, it may not always provide a fully accurate picture. Under a single price, parties may choose not to reconcile their production and consumption accounts – a short imbalance in a settlement period has the same price as a long imbalance, thus resulting in a zero sum.

3.7. Across the board, all party types have a higher sum of absolute imbalance volume in the post-P305 period than in the pre-P305 period. However, solely reviewing the total imbalance volumes does not take into account how the market share has shifted amongst party types. To do this we have looked at the imbalance volumes as a proportion of credited energy volumes.

Figure 10: Absolute Energy Imbalance Volumes as a percentage of Credited Energy Volumes

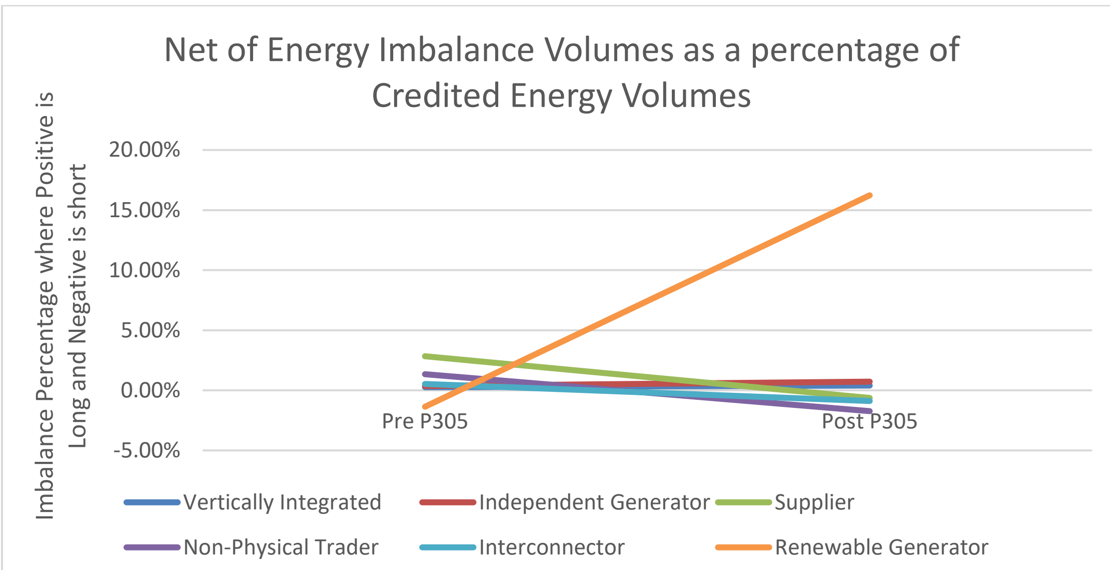


Source: Data provided by Elexon

3.8. Figure 10 above shows, as a proportion of absolute credited energy volumes, the imbalance for Suppliers and Interconnectors has fallen slightly. The absolute imbalance as a proportion of credited energy has increased slightly for Vertically Integrated parties and Independent Generators, increased significantly for Non-Physical Traders and even more significantly for Renewable Generators.

3.9. Net Imbalance Volumes as a percentage of credited energy volumes allow us to review whether parties are in general longer or shorter and how that has changed from the pre-P305 period to the post-P305 period. Figure 11 shows in the pre-P305 period all party types were generally long except for renewable generators. However, in the post-P305 period Non-Physical Traders and Interconnectors are generally short while Renewable Generators are now long overall. Vertically Integrated parties, Suppliers and Independent Generators all remained long overall.

Figure 11: Net Energy Imbalance Volumes as a percentage of Credited Energy Volumes



Source: Data provided by Elexon

Is this in line with our expectations?

3.10. Our monitoring in this area has focussed on whether there have been any potential unintended consequences for competition and efficiency of balancing as a result of the EBSCR reforms. The data we have gathered does not show us anything unduly concerning at this stage, but does show that there has been some behaviour change in balancing positions. We will continue to monitor this metric.

Party-Level Cash Flows

3.11. The party cash flows consist of the Energy Imbalance Charge[11] (EIC) and the Residual Cashflow Reallocation Cashflow[12] (RCRC) faced by a party. These two cash flows are then combined to create the party cash flow. This review uses net cash flows, meaning that the cash flow for each party is treated as a positive if the party is receiving the cash flow, and a negative if the party is charged the cash flow. These values are then aggregated from settlement period values to monthly values.

3.12. The net party cash flows described above are only one part of total revenue for most parties. These cash flows can come at the expense of other revenue streams, such as the forward, day ahead and intraday markets. For example, while a party may receive imbalance revenue from adopting a long position, that party would also have either paid additional money (or lost out from not selling) that surplus electricity in the wholesale market. Equally, a party adopting a short position may pay charges through cash-out for the missing electricity, but the full impact will depend on how much it could have paid for that electricity in the wholesale market.

3.13. EIC and RCRC are directly related to the Imbalance Volume of the parties and therefore larger imbalances in either direction are likely to result in corresponding cash flows.

3.14. Net cash flows, the amount of money that is paid to or by parties, have seen a significant change since the introduction of P305. The EIC in the pre-P305 period amounted to a £122m charge to parties, compared with a £27m credit to parties in the post-P305 period. The impact of the single price and the change in risk associated with a short system has meant that the cash flows to and from parties have been reversed. This in turn had a mirror effect on RCRC which has gone from a £122m credit to parties in the pre-P305 period to a £27m charge to parties.

3.15. Vertically Integrated parties have seen the largest decrease in overall cash flows. Non-Physical Traders and Interconnectors have also seen a reduction in cash flows while Independent Generators and Renewable Generators have seen the largest increase. Suppliers have remained more consistent with a slight increase in cash flows. It should be noted, however, that these changes may be misleading as they do not take into account the market share of party types. A large decrease in overall cash flows may only represent a small decrease in cash flows per credited energy volume.

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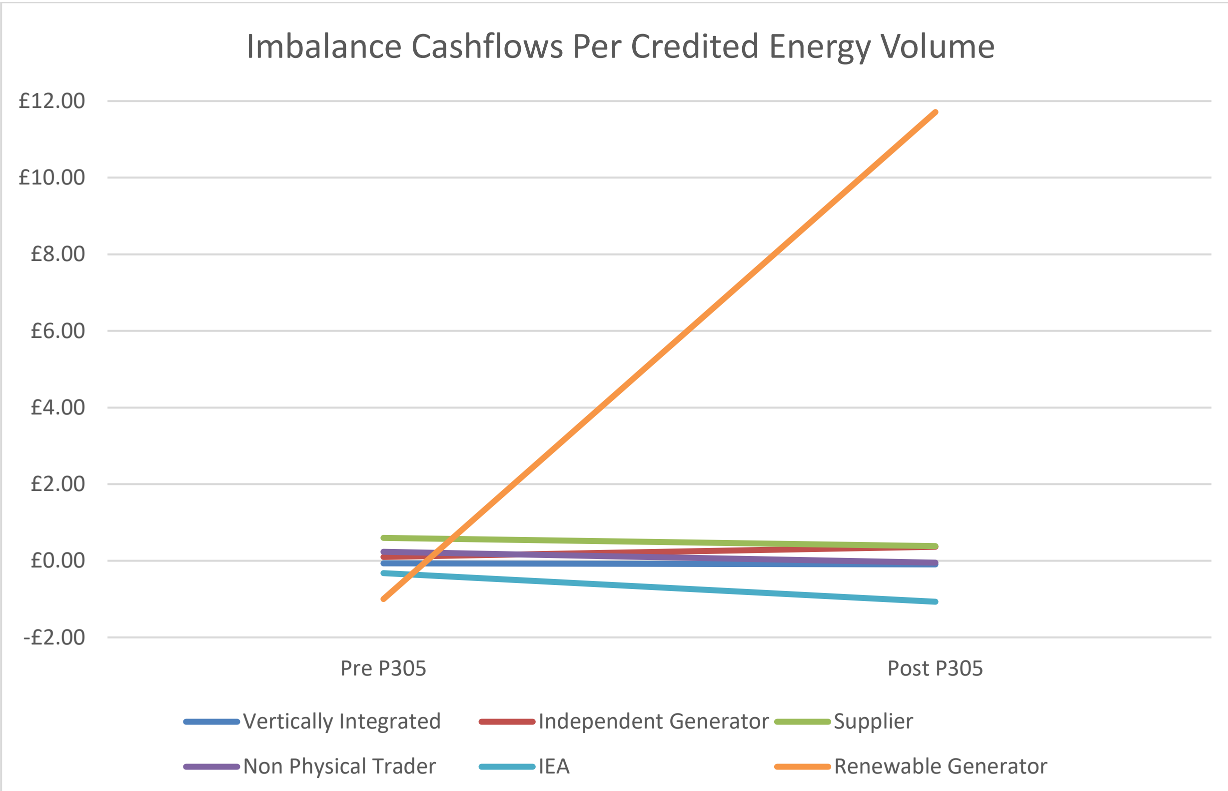
[11] These are payments by Trading Parties at the Information Imbalance Price on the magnitude of any deviations of BM Unit Metered Volumes from Final Physical Notification.

[12] Any excess or shortfall in cashflow after all BSC Parties have paid their Imbalance Charges is redistributed amongst BSC Parties on a scale proportional to their volume of non-interconnector Credited Energy. This redistribution is paid as Residual Cashflow Reallocation Cashflow (RCRC). RCRC data is presented on a £/MWh basis.

3.16. Cash flows per credited energy volume takes market share into account and gives a different view of the changes to cash flows from the pre-P305 period to the post-P305 period.

Figure 12: Imbalance Cashflows Per Credited Energy Volume



Source: Data provided by Elexon

3.17. As shown in Figure 12 above, the largest decrease in cash flows per credited energy volume are Interconnectors, followed by Non-Physical Traders and Suppliers. Vertically Integrated parties faced the smallest decrease in cash flows. Of the two remaining party types that increased their cash flow per credited energy volume, Independent generators increased slightly whilst Renewable Generators increased very significantly.

3.18. The increase in cashflow per credited energy volume by Renewable Generators corresponds with the significant increase in energy imbalance volumes as a percentage of credited energy volume discussed above. Increased cash flows gained by having a larger imbalance position are at the expense of potential increase in volume that could be sold in the power market.

Is this in line with our expectations?

3.19. The direction and relative changes we have seen are in line with the modelling presented in the EBSCR Impact Assessment. The modelling for 2020 suggested a significant reduction in cash flows for Vertically Integrated parties, a large increase in cash flows for Independent Generators and a smaller increase in cash flows for Independent Suppliers. Renewable Generators were not modelled as one, but split into offshore and onshore wind. We expected onshore to see a large increase in cash flows and offshore a small decrease. This matches the overall increase of renewables, though perhaps not to the extent we are currently seeing in the post-P305 period. Interconnector and Non-Physical Traders were not modelled but the results seem coherent. We have seen no evidence of any significant short-term disruption to the market or competition in our monitoring.

Bid Offer Behaviour

3.1. This section focuses on whether the bid and offer behaviour of parties has changed since the implementation of P305 or whether any significant trends can be identified. While the changes to the calculation of Imbalance Prices do not directly impact the bids and offers of parties there may be indirect impacts on behaviour. To analyse this, we review only accepted bids and offers.

3.2. The statistics in Table 5 below show that the behaviour of market participants has changed significantly in terms of the average level and deviation of bids, while remaining within roughly the same price range.

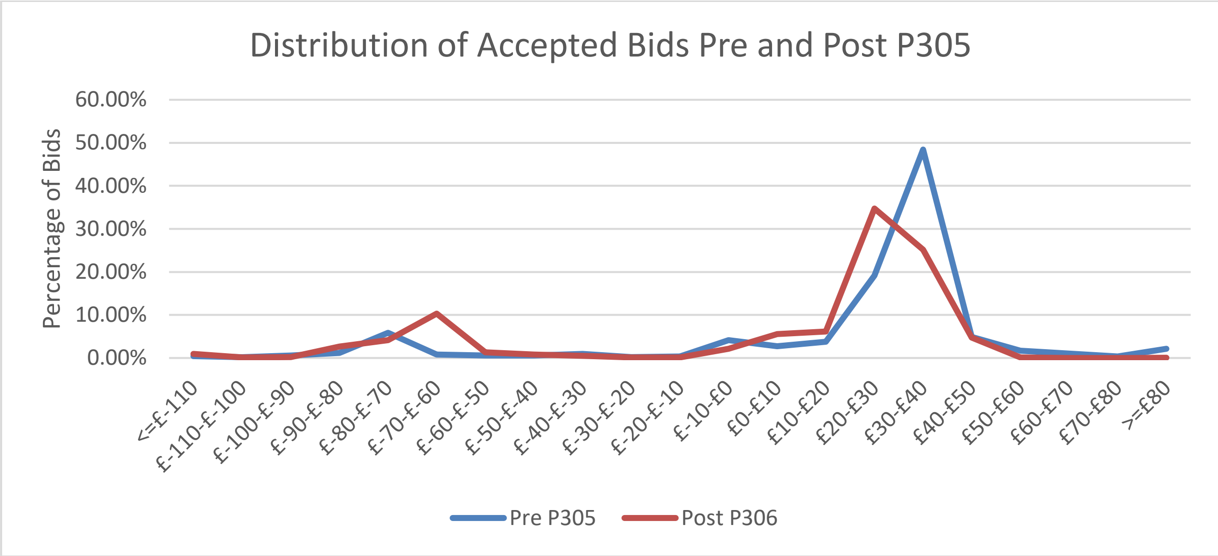
Table 5: Accepted Bid Statistics

Bids	Maximum	Minimum	Average	Standard deviation
Pre-P305	£493.90	-£293.75	£17.31	£35.33
Post-P305	£580.00	-£286.18	£5.65	£53.06

Source: Detailed System Prices provided by Elexon

3.3. Figure 13 below shows the distribution of accepted bids in both the pre- and post-P305 periods. The distribution of both periods is twin peaked. The largest peak, representing the bids of mainly thermal generators, shows that the largest proportion of bids has fallen from the £40-£50/MWh group to the £30-£40/MWh group. This shift in distribution is likely due to the increased penetration of renewable generation rather than any significant shift in market participant behaviour.

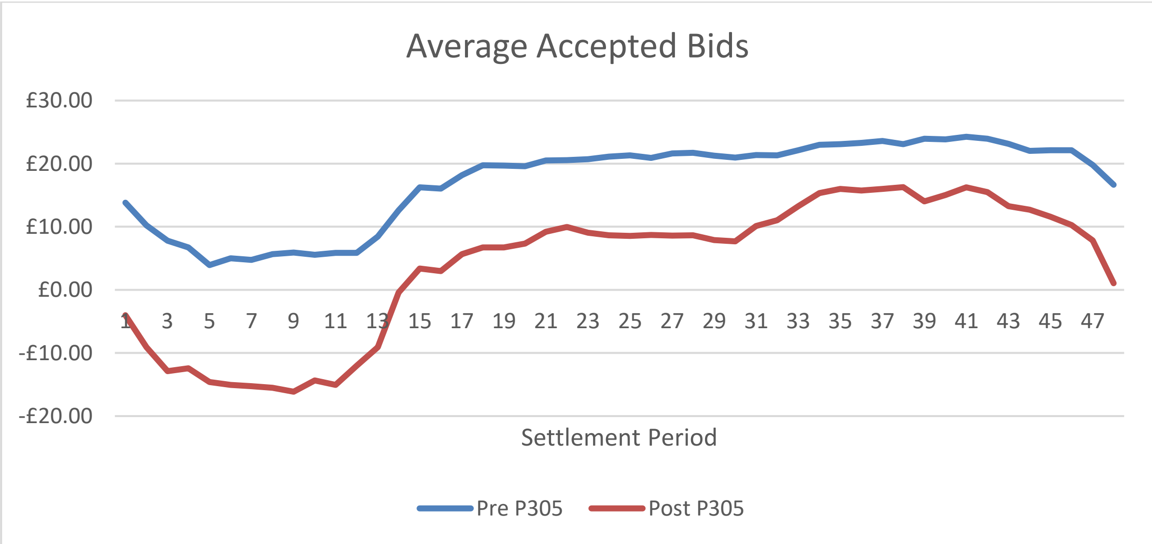
Figure 13: Distribution of Accepted Bids Pre and Post-P305



Source: Detailed System Prices provided by Elexon

3.4. Figure 14 below displays the accepted bids in the pre- and post-P305 periods by settlement period. The average decrease in accepted bids is clear and relatively uniform across the settlement periods, with the largest decreases overnight and the smallest decreases at the evening peak. This is expected as it corresponds with the largest and smallest average NIVs. The negative averages seen in settlement periods 1 to 14 are interesting, though in line with expectations.

Figure 14: Average Bid Prices by Settlement Period



Source: Detailed System Prices provided by Elexon

3.5. Table 6 below, shows that the average accepted offer remains very similar and in fact drops slightly, and the range remains relatively stable. The only significant change is that in the post-P305 period the volatility of accepted offers is much higher.

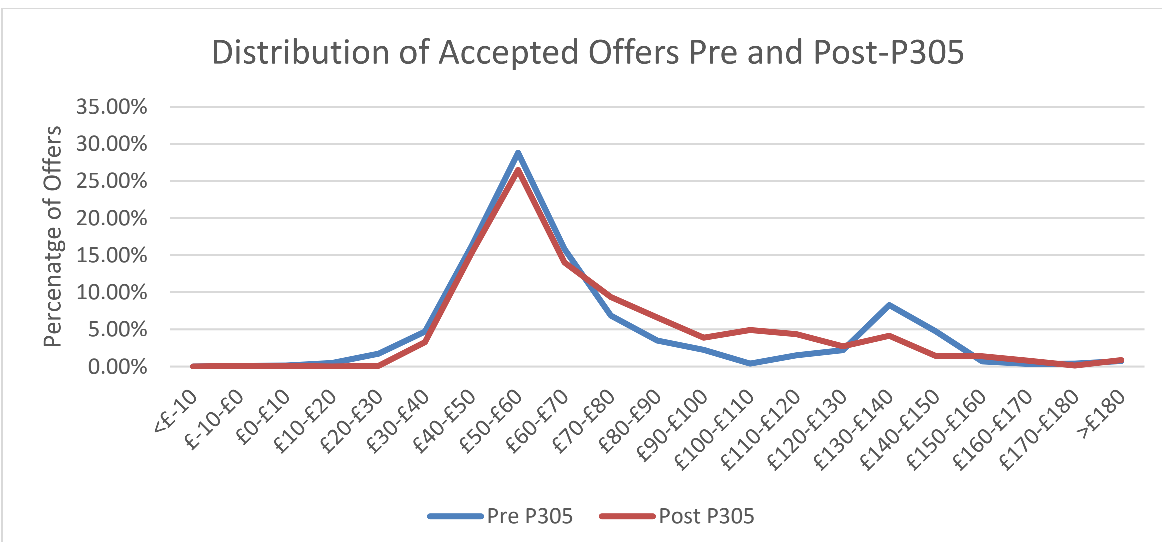
Table 6: Accepted Offer Statistics

Offers	Maximum	Minimum	Average	Standard deviation
Pre-P305	£9999	-£82.55	£78.21	£46.92
Post-P305	£9999	-£115.44	£77.19	£75.30

Source: Detailed System Prices provided by Elexon

3.6. Figure 15 below shows the distribution of the accepted offers in both the pre- and post-P305 periods. The largest peak remains in the same place in both periods at £50-£60/MWh. The second peak in the pre-P305 period is ay £130-£140/MWh. In the post-P305 period this secondary peak is not evident – instead there is a more gradual distribution. This increase in the number of offers between the peaks could represent the pricing of scarcity between the marginal cost of one generation type and the marginal pricing of another.

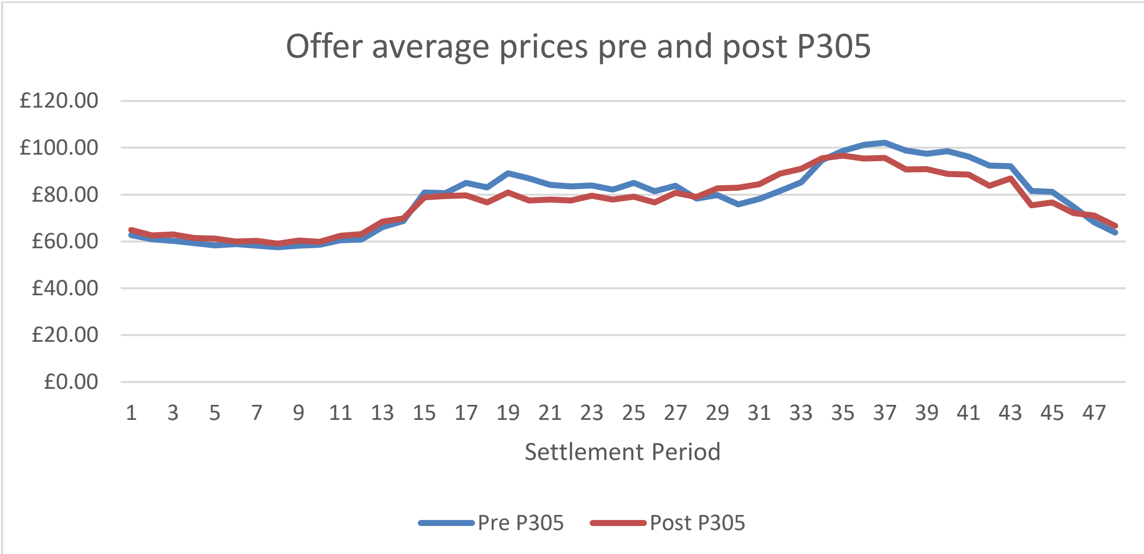
Figure 15: Distribution of Accepted Bids Pre- and Post-P305



Source: Detailed System Prices provided by Elexon

3.7. Figure 16 below shows the accepted offers in the pre- and post-P305 periods by settlement period. They have remained similar with a slight flattening of the average price across the settlement periods.

Figure 15: Distribution of Accepted Bids Pre- and Post-P305



Source: Detailed System Prices provided by Elexon

Is this in line with our expectations?

3.8. We did not hold any expectations for changes in bid or offer behaviour as a result of the EBSCR remedies. However, with the increased penetration of renewables and falling coal generation the increase in the prevalence of negative prices and greater volatility in bids and offers were not unexpected. These changes to the balancing market appear to be more driven by the changes in the market context than the introduction of the EBSCR.

4. Objective 3 - European Target Model and the Capacity Market

The final high-level objective of the EBSCR remedies is "to ensure balancing arrangements are compliant with the European Target Model (EU TM) and complement the government's Electricity Market Reform (EMR) Capacity Market (CM)." As this objective is not particularly suited to quantitative assessment we have performed a qualitative review.

Compliance with the European Target Model

4.1. Because of the nature of this objective we have conducted an assessment of how the EBSCR remedies were compliant with the EU TM at the time of implementation, as well as assessing the compliance of the second phase of changes later in 2018.

4.2. The European Target Model sets out the policy framework and operational obligations required to facilitate European energy market integration and cross-border trade. The Target Model establishes common rules to encourage the harmonisation of European wholesale market arrangements. In 2012, ACER's Framework Guidelines on Electricity Balancing[13] requested that Transmission System Operators (TSOs) establish an Electricity Balancing Network Code that should include requirements for Imbalance Prices to be settled in a non-discriminatory, transparent, fair and objective way. ACER's Guidelines requested that market participants should be incentivised to support the system in an efficient way and/or balance their portfolio before real time actions are necessary from the TSOs. Imbalance Prices should reflect the costs of balancing the system in real time. The EBSCR and the development of the Network Code for Electricity Balancing were conducted concurrently. The version[14] of the Network Code submitted by TSOs to ACER in 2014 was used to align EBSCR to the European Target Model.

4.3. The Network Code on Electricity Balancing of 2014, sets out certain requirements for imbalance calculation within Article 60, the Imbalance Price within Article 61 and the settlement period outlined in Article 62. EBSCR was compliant with the ETM requirements at the time, and made preparations for the direction of travel for the additional requirements that would be later included in the Electricity Balancing Guideline, for example introducing a single Imbalance Price.

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[13] ACER, Framework Guidelines on Electricity Balancing, September 2012
[14] ENTSOE Network code for Electricity Balancing (2014), Article 61-63: Imbalance settlement outlines the requirements of the imbalance calculation, Imbalance Price and imbalance settlement period that EBSCR should adhere to: ENTSOE, ENTSO-E Network Code on Electricity Balancing, August 2014

4.4. Since EBSCR's implementation, the Network Code for Electricity Balancing further evolved, and the final version[15], known as the Electricity Balancing Guideline (EGBL), was approved by Member States in early 2017 and entered into force in late 2017.

4.5. The EGBL is a legally binding European Regulation. The relevant imbalance requirements, set out in Articles 52 to 55, largely mirror those in the version submitted to ACER in 2014. The EBSCR decision to move from a dual to a single cash-out price specifically aligns with Article 52.

4.6. We are aware that there are EBGL articles that may require changes in future years. In 2019 we expect to evaluate the impact of any new arrangements regarding the harmonisation of the Imbalance Price calculation, and assess the need for changes to the calculation of the GB Imbalance Price.

Complementing the Capacity Market

4.7. The CM was introduced in 2014 as part of the Government's Electricity Market Reform (EMR) programme to maintain sufficient levels of capacity to ensure security of electricity supply. The CM provides revenue in the form of capacity payments to potential capacity providers. In return, participants commit to delivering electricity at times of system stress and face penalties if they fail to do so. Capacity payments are determined via competitive auctions held four years (T-4 Auction) and one year (T-1 Auction) before each delivery period. The T-1 auctions are used to 'top-up' the target capacity for the delivery year and spread the risk. Prospective capacity providers must meet certain eligibility requirements and prequalify before they can participate in the CM auctions.

4.8. The energy sector has evolved over the past two decades. Closures of coal power stations and the transition towards renewable energy have resulted in a greater need for flexible generation. The CM provides the long-term signals for the market to provide a reliable level of capacity to meet the projected increase in demand for electricity as transport and heating will be converting to an electric form of fuel[16]. The reform of the cash out price incentivises market participants to invest in the type of capacity required to balance the system. The CM incentivises the capacity while the EBSCR changes reward flexibility.

4.9. There are a number of areas in which the EBSCR remedies and the Capacity Market complement one another's aims. We note some of these below.

[15] European Commission, Commission Regulation (EU) 2017/2195 establishing a guideline on electricity balancing, November 2017
[16] DECC, Capacity Market Impact Assessment, June 2014

The "missing money" problem

4.10. The European Commission outlines in its State Aid clearance for the Capacity Market[17] that the falling levels of generation adequacy may be due, in part to a "missing money" market failure. The "missing money" problem occurs when the market does not send the appropriate signals to incentivise investment – this could be because electricity prices do not rise to reflect system scarcity, or because there is uncertainty among investors that government or regulators will allow prices to rise even if they can.

4.11. Ofgem sought to address part of this problem through the EBSCR by addressing the deficiencies in the calculation used to set the Imbalance Price. The changes introduced through the EBSCR will increase the cash-out price during times of system stress, providing the incentive for market participants to balance their positions efficiently. This should also have a consequential impact on wholesale market prices, as market participants would place more value on contracting for enough flexible electricity at times of system tightness.

4.12. The CM finds the marginal value of capacity for future years through a competitive auction process, which gives an investment signal for new plants to be built or for existing plant stay open. This is intended to bridge the "missing money" gap.

Short- and long-term price signals

4.13. EBSCR seeks to ensure short-term price signals are accurate by implementing changes that result in a sharper Imbalance Price during system tightness. The CM's purpose is to incentivise market participants to invest. This should mean more capacity is available to balance the system, creating greater competition between flexible generators and should reduce the number of times the system is in stress, concluding to a reduced Imbalance Price. The CM does not have dispatch instructions but instead it relies on short-term price signals in the market to incentivise parties to generate during periods of system stress. Making these short term price signals more efficient is the aim of the EBSCR.

[17] European Commission, European Commission State aid SA.35980 (2014/N-2) – United Kingdom Electricity market reform – Capacity market, July 2014

5. Scenario analysis

This chapter reviews the impacts of the three scenarios produced by Elexon on Imbalance Prices and the RSP. The scenarios reveal what the Imbalance Prices would have been under different price calculations. With market behaviour being equal, Imbalance Prices are on average higher under the P305 Scenario than in the Pre P305 Scenario. Imbalance Prices were highest under the P305 2018 Scenario. RSP would have repriced STOR in more periods in the P305 2018 scenario and those prices would have impacted the Imbalance Price calculation in more periods.

5.1. This chapter will focus on three Imbalance Price calculations:

- The Imbalance Price calculation used before the implementation of P305, referred to here as the "Pre P305 Scenario", or scenario 1. This scenario has no RSP, VoLL or priced non-BM STOR. PAR is set at 500 and there is dual pricing.

- The Imbalance Price calculation that is currently used, PAR 50 and VoLL set at £3,000/MWh, referred to here as the "P305 Scenario", or scenario 2.

- The Imbalance Price calculation that will come into effect on 1 November 2018, PAR 1 and VoLL set at £6,000/MWh, referred to here as "P305 2018 Scenario", or scenario 3.

5.2. These pricing calculations are all being applied to the time period from 5 November 2015 to 31 October 2017.

Impact on Imbalance Prices

5.3. This section looks at the impact of each of the three different imbalance pricing scenarios on the Imbalance Prices faced by market participants. The scenarios do not take into account the behavioural impacts that these different scenarios would have elicited.

Table 7: Imbalance Price statistics by Scenario

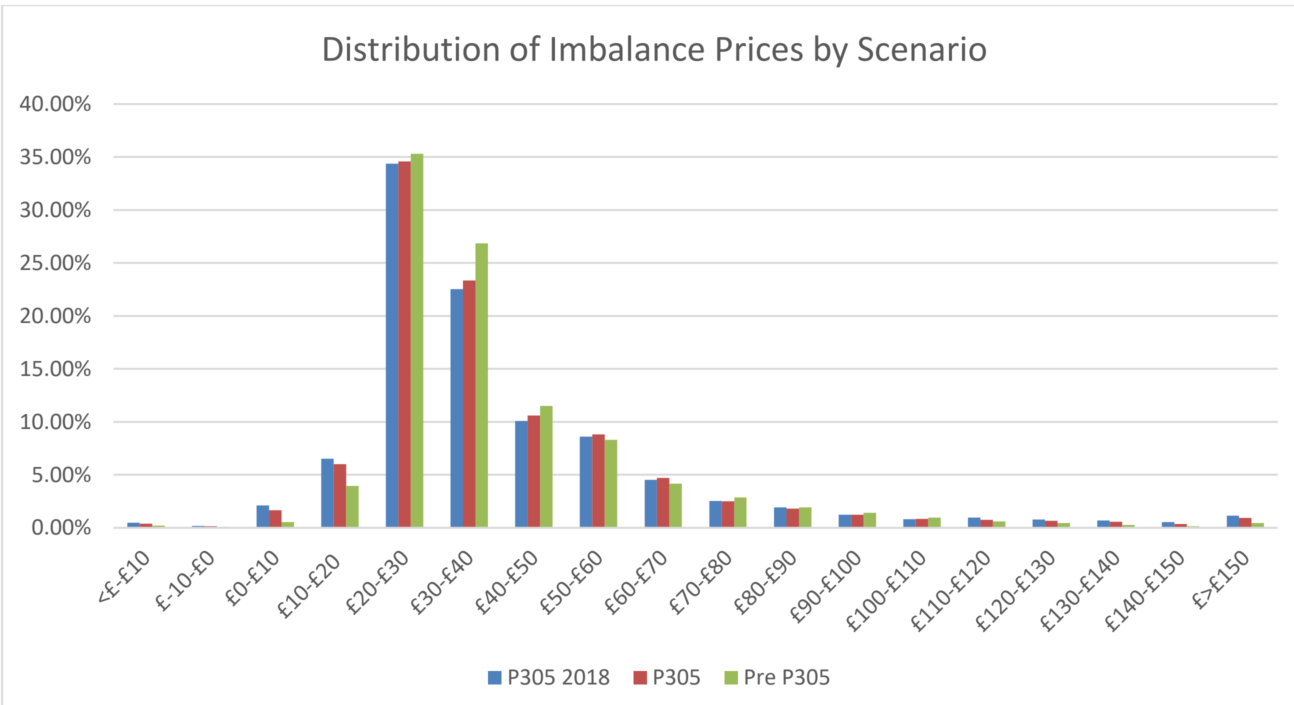
All Periods	Min	Max	Average	Standard deviation
1. Pre P305 Scenario	-£67.02	£1361.89	£40.99	£29.48
2. P305 Scenario	-£100	£1528.72	£41.33	£39.68
3. P305 2018 Scenario	-£158	£1990	£42.15	£44.83

Source: Scenario data provided by Elexon

5.4. The statistics displayed in table 7 are in line with our expectations. Moving through the scenarios from 1 to 3 we see that the minimums get lower, the maximums get larger and the standard deviation increases, reflecting the spikier prices caused by the changes introduced by the EBSCR. The average Imbalance Price increases slightly, which differs from the analysis of the two periods in chapter 3. This difference is likely down to behavioural changes that cannot be replicated in the scenarios.

5.5. Figure 16 below shows the distribution of Imbalance Prices under each of the three scenarios. The graph shows that through the scenarios from 1 to 3 the distribution gets flatter, and the "tails" at each end get taller. The majority of prices remain in the £20 - £30/MWh group for all scenarios.

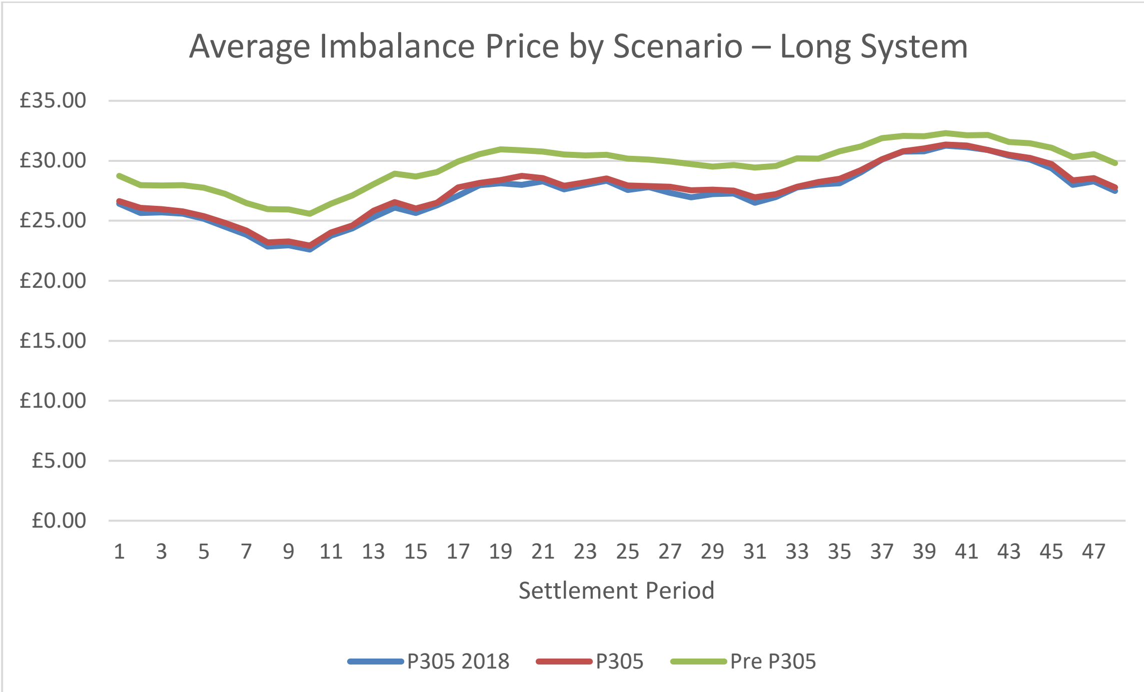
Figure 16: Distribution of Imbalance Prices by Scenario



Source: Scenario data provided by Elexon

5.6. Figure 17 below shows the average Imbalance Price when the system is long for each of the scenarios, broken down by settlement period. It is clear that the difference between scenarios 2 and 3 is minimal, while scenario 1 diverges significantly. This is likely due to having a single price and a significantly reduced PAR. The further reduction in PAR between P305 and P305 2018 does not appear to have a significant impact on the average price when the system is long. This is in line with our expectations as the impact of the move to PAR 50 to PAR 1 will rarely have a significant impact on the system price – this will usually only occur at times of system stress.

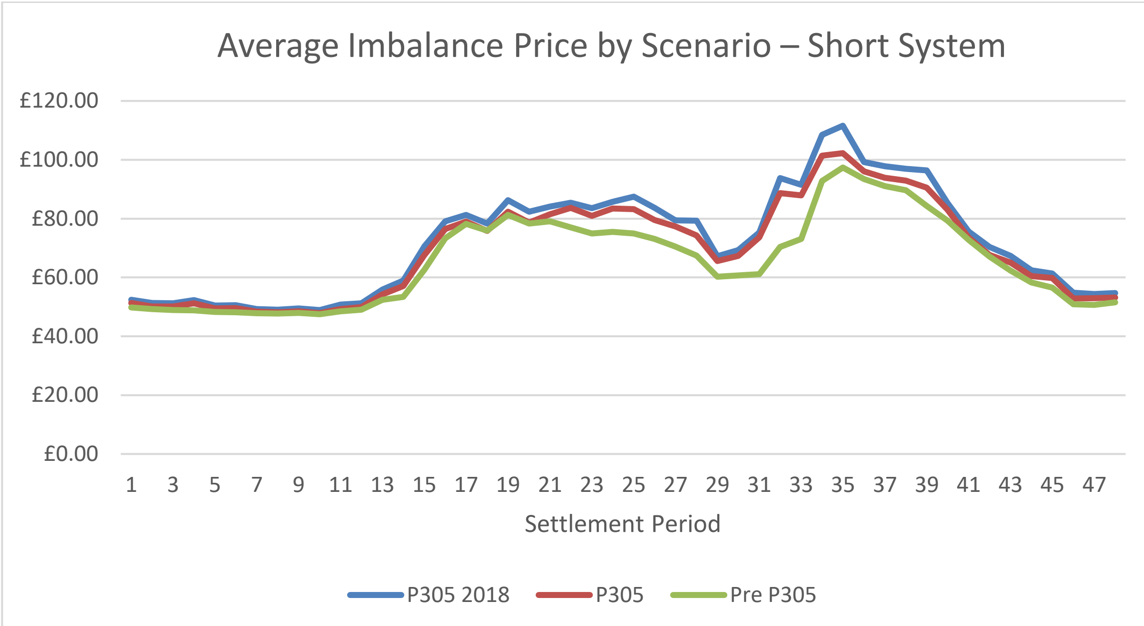
Figure 17: Average Imbalance Price by Scenario – Long System.



Source: Scenario data provided by Elexon

5.7. Figure 18 below shows the average Imbalance Price by scenario when the system is short, broken down by settlement period. It shows that when the system is short the average Imbalance Price does not change much between each scenario. Overall, the largest differences across the scenarios are found between settlement periods 18 and 40. The most notable differences are between scenarios 1 and 2, most significantly around settlement periods 32 and 33. The move from P305 to P305 2018 is much less noticeable across the day – the difference becomes most prominent in settlement period 36 when the average price is at its highest. This is in line with our expectations as the move to PAR 1 and the increase in VoLL from £3,000/MWh to £6,000/MWh will have the greatest impact on the system at times of system stress when the prices are higher.

Figure 18: Average Imbalance Price by Scenario – Short System



Source: Scenario data provided by Elexon

Is this in line with our expectations?

5.8. The differences between the three scenarios were in line with our expectations, and the results of the analysis do not give us cause for concern at this stage. The Imbalance Price rose higher under the P305 2018 scenario at times of tighter margins and was lower when there was significant excess generation.

RSP and VoLL

5.9. From November 2018, VoLL will increase from £3,000 to £6,000 and PAR will change from PAR 50 to PAR 1. This section looks at a case study of a particular day to show the impact of this change.

5.10. Utilising the RSP data of the time from the implementation of 2015, we can illustrate what would happen in the second phase in November 2018. LoLP would be multiplied by a VoLL of £6,000, rather than £3,000. This would double the RSP, making it more likely that RSP would be higher than the utilisation price of STOR at times of system stress and making those periods where it would come into effect more expensive.

5.11. The P305 2018 scenario showed the RSP repricing actions in 14 settlement periods, compared to the P305 scenario which showed RSP repricing actions in 7 settlement periods. Of the 14 settlement periods in the P305 2018 scenario where

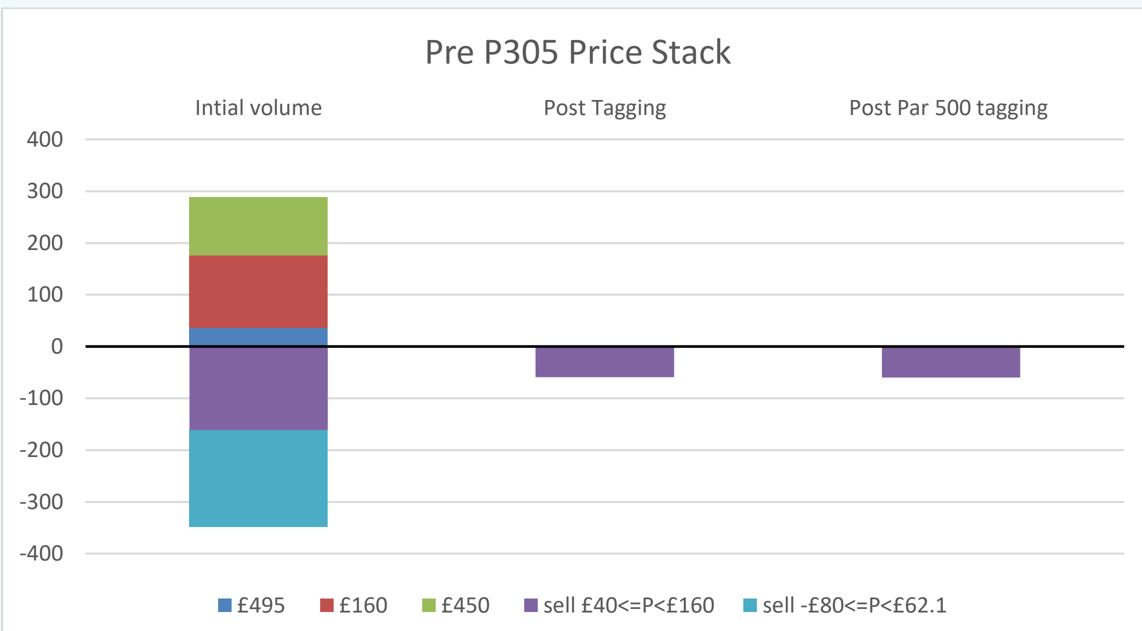
RSP repriced actions, there were only 5 settlement periods where a repriced action fed into the cash-out price. The other 7 settlement periods the actions were tagged out.

The Case Study: 25th October 2016, settlement period 38

Taking a case study of settlement period 38 on the 25 October 2016, the chart below shows the three positions of that day under the pre P305, P305 and the P305 2018 scenarios.

Figure 19 depicts the pre P305 scenario, which resulted in the dual Imbalance Price giving a System Sell Price (SSP) of £40.00/MWh and a System Buy Price (SBP) of £251.56/MWh. The Net Imbalance Volume without the non-BM STOR resulted in a long system.

Figure 19: Case Study Price Stack – Pre P305 Scenario



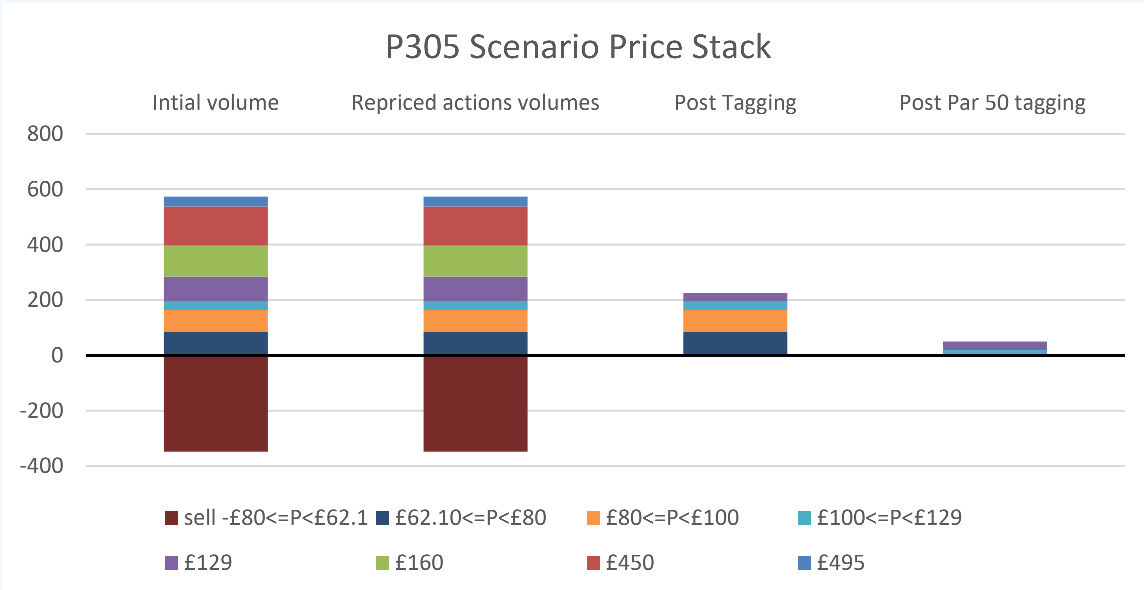
Source: Scenario data provided by Elexon

The first column shows the initial volume of balancing actions taken in this settlement period. This volume does not account for non-BM STOR actions. The second column represents the volume remaining once the flagging and tagging process has taken place, resulting in 60MW/h of actions feeding into the PAR. This remains at 60MW/h as the PAR is set at 500MW/h, as shown by the third column.

Figure 20 depicts the P305 scenario – what actually happened in the settlement period in question. The volume of actions in this scenario include the volumes of non-

BM STOR taken for that settlement period. The system was short in this scenario, with an Imbalance Price of £251.56.

Figure 20: Case Study Price Stack – P305 Scenario

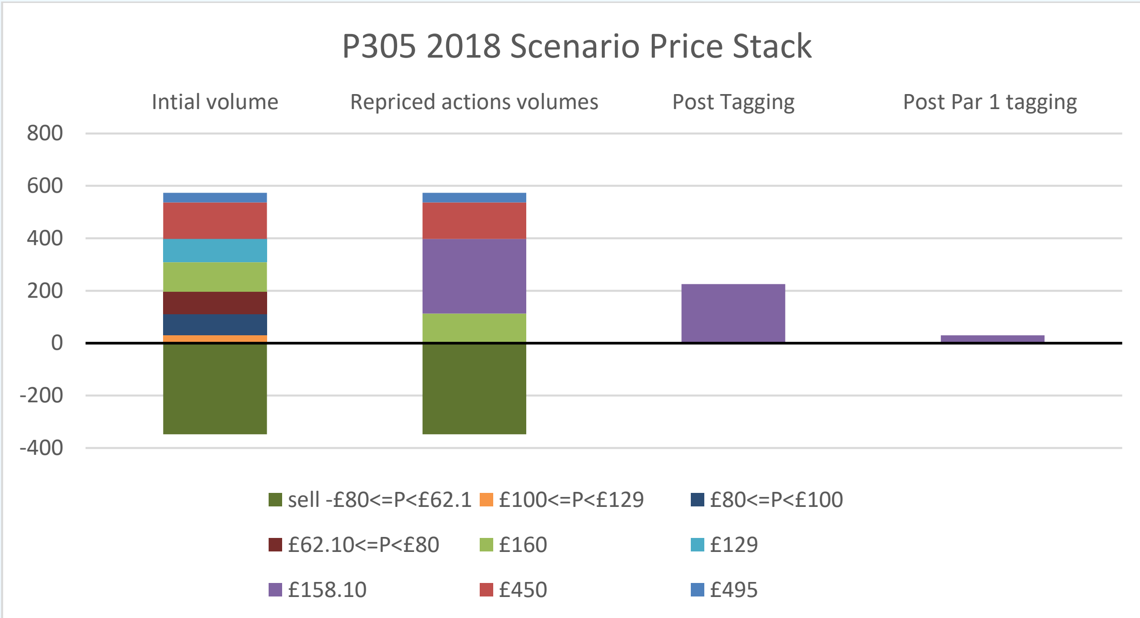


Source: Scenario data provided by Elexon

In this scenario, the inclusion of non-BM STOR actions makes the system short overall shown by the positive value in the third column. The first two columns show that in this scenario the RSP price did not meet the utilisation price of the STOR used, and therefore no actions were repriced. However, this is not fully accurate as there was some slight repricing, though the RSP only reached £78 and so remains in the same price category. With 225MWh of balancing actions remaining after tagging, the most expensive 50MWh of actions are used to calculate the final Imbalance Price as seen in fourth column.

Figure 21 below represents the price stacks for the P305 2018 scenario. This volume includes the non-BM STOR actions, and VoLL is set at £6,000/MWh. The change in VoLL has caused a greater volume of STOR flagged actions to be repriced with the RSP of £158.10, increasing from 83.5MWh of repriced actions for the P305 Scenario to 285MWh under the P305 2018 Scenario. The tagging reduced the volume of actions remaining to 225MWh, in this case leaving only repriced actions. The most expensive MWh of actions then sets the Imbalance Price.

Figure 21: Case Study Price Stack – P305 2018 Scenario



Source: Scenario data provided by Elexon

This case study highlights the impact of RSP alongside a reduced PAR and a single price. It reveals that in times of system stress the Imbalance Price rises to reflect the scarcity on the system and rewards those imbalances that help the system.

Is this in line with our expectations?

5.12. As with the RSP and VoLL section in Chapter 2, pricing of disconnection would not have been necessary, and the RSP would not directly affect the Imbalance Price as often as we would have expected. With a VoLL of £6,000/MWh we might have expected more settlement periods to have been affected by the RSP. The fewer than expected instances of RSP repricing could be due to higher margins, either as a result of market conditions, the behaviour change caused by the initial phase of the EBSCR remedies, or the LoLP Calculation Statement not being as effective as we had hoped.

5.13. This analysis does not take into account the impact of potential behavioural change in the second phase of the modification. The LoLP Calculation Statement is overseen by the BSC Panel and we expect them to monitor the impact of this as more data is made available.

6. Conclusions

Security of Supply

6.1. Imbalance Prices have become sharper in both directions. The combination of the PAR reduction, RSP pricing and VoLL pricing appear to have strengthened the incentives for market participants to avoid being short at times of scarcity.

6.2. This change in the incentive to balance has been reflected in changes in NIV across the pre- and post-P305 periods. Market participants are more likely to go long due to the greater risks associated with being short. This has led to an overall reduction in the NIV in all periods. The system is now on average longer by 55MW in the post-P305 period and, correspondingly, the market is now long 6% more often than it was in the pre-P305 period.

6.3. This shift towards going long is beneficial to security of supply for the most part. It reduces the likelihood that Demand Control Actions are needed and is likely to lead to a lower cost to balance the system as bids are on average cheaper to the SO than offers for the same volume. Additional length may not always be beneficial, however, for instance when the system becomes so long that the SO has to take significant numbers of actions to reduce the system length, which could entail reducing output on inflexible plant or subsidised plant. The sharpening of Imbalance Prices, and in particular the increasing number of negative Imbalance Prices seen in the post-P305 period, should reduce the likelihood of the system going too long.

6.4. Overall it is clear that the incentive for market participants to balance in favour of security of supply has increased as the Imbalance Price is now far more reflective of the costs faced by the SO to balance the system. Based on our analysis, we expect the second phase of pricing changes to continue the improvement in the post-P305 period, though in a less pronounced manner than the first phase. This does not account for behavioural impacts, however, so we will continue to monitor the impacts as the second phase comes into effect.

6.5. Over time we would expect behavioural changes among market participants to lead to stronger incentives to invest in flexible generation, which will help to support security of supply. However, it is too early to make any judgements about that at this stage.

Balancing Efficiency

6.6. We expected the EBSCR remedies to be beneficial for competition and efficiency as they will more accurately pass on to parties the benefits or costs their imbalances create for the system. As part of this we expected some party-level distributional impacts. We also concluded there would not be disproportionately high-cost impacts that could create short term disruption or inefficiency.

6.7. To assess the impact of the EBSCR on balancing efficiency we tracked metrics on party-level imbalance volumes and cashflow, as well as Bid and Offer behaviour. Party behaviour has changed substantially in terms of Energy Imbalance Volumes – parties have both a higher absolute imbalance volume and a higher Net Imbalance Volume in the post-P305 period. This increase is mostly due to market participants going longer in response to the change in risk associated with imbalances. Imbalance volumes as a proportion of credited energy volumes have increased for most party types, most notably renewable generators, while they have decreased for interconnectors and suppliers.

6.8. Bids into the BM have become noticeably lower while Offers have remained similarly priced. This is most likely down to the increased volume of renewables in the BM rather than as a result of the EBSCR remedies. The Maximum Offer price in the BM has remained £9,999 which shows that in times of system stress the SO will utilise high priced offers, as they did before the EBSCR.

6.9. The volatility of both Bid and Offer prices has increased since the implementation of P305. Their distribution is also interesting as they have twin peaks. This shows that when the market is only slightly out of balance the price is likely to be at one price level, but when the system becomes significantly more imbalanced the price is likely to jump to the other price level, rather than gradually increase or decrease.

6.10. This has had an interesting impact on Party Level Cashflows. Vertically integrated parties, non-physical traders and interconnectors have faced the largest reductions in cashflows, while independent and renewable generators now receive significantly higher cashflows. As a proportion of credited energy, the impact on cashflows has been between -75p and 27p/MWh of credited energy for most parties. Only renewable generators have seen a dramatic increase due to the high percentage of their credited energy volumes that goes into imbalance rather than forward trades.

6.11. The metrics reviewed are not the whole picture of balancing efficiency as it is difficult to gauge the impacts of the EBSCR on efficiency at this stage. The metrics do, however, give a fair indication that the market has developed broadly in line with our expectations. With the limited metrics, it appears that parties' balancing behaviour has become more efficient as imbalance charges overall have decreased significantly – down from approximately £120m in negative charges in the two years before the reform to a positive net receipt of £25m in the two years after. Treating these as absolute figures, there has been a £95m reduction in imbalance charges despite the increase in imbalance volumes.

European Target Model and the Capacity Market

6.12. The EBSCR remedies aimed to balancing arrangements with the framework set by the ETM at the time of publication and account for the direction of travel expressed in the working level discussions being held at the time. The Electricity Balancing Guideline provides additional legally binding requirements, including harmonisation of the balancing arrangements of all participating countries. In 2019 we will evaluate the impact of the new arrangements and any potential changes that will need to be made to the GB imbalance calculation in order to comply.

6.13. The EBSCR changes complement the CM – both aim to improve security of supply, but in different ways. The CM incentivises a greater level of investment in capacity by delivering a secure revenue stream, while the EBSCR changes aim is providing stronger signals to appropriately value flexibility. This supports investment in flexible generation, as parties who are able to provide flexibility have the potential to benefit from additional energy market revenues at times of system stress.

Next Steps

6.14. The second phase of the modification takes effect on 1 November 2018, reducing the PAR from 50MWh to 1MWh and increasing the VoLL from £3,000/MWh to £6,000/MWh. The RSP will be determined by a dynamic LoLP rather than the static curve that is currently used.

6.15. Ofgem will continue to monitor the impacts of the P305 modification before and after the implementation the second phase of the modification. We are keen to hear the views of industry regarding the impacts of the modification and on the wider balancing arrangements.

Appendices

Index

Appendix 1 – History of the Electricity Balancing Significant Code Review

This appendix sets out a brief overview of why we conducted the Electricity Balancing Significant Code Review and the process that the review went through ahead of the implementation of its remedies.

Before the intervention

In 2001, the New Electricity Trading Arrangements (NETA) introduced the current trading arrangements, which are based on bilateral trading and a residual balancer (the SO). Under these arrangements, market participants are exposed to "cash-out" prices when they generate or consume more or less electricity than they have contracted for. The cash-out price is therefore the default price for uncontracted electricity and a primary incentive on participants to trade and invest in flexible solutions to help balance their positions.

Ofgem had previously raised concerns about balancing arrangements, most notably in Project Discovery (2010)[18], where we identified the electricity balancing arrangements as critical in delivering more secure electricity supplies. A notable concern was that arrangements that existed before P305 served to dampen cash-out price signals and thereby provided insufficient incentives on parties to balance – in particular during periods of system tightness. This meant market participants did not have sufficient incentives to provide, or invest in flexibility, such as flexible generation capacity, demand response or storage. It could also have resulted in reduced efficiency of the interconnector flows.

EBSCR

To address these concerns, Ofgem published its Final Policy Decision in 2014, which formed the basis for the direction to NGET that followed it. The direction to NGET contained four elements:

- more marginal main cash-out price;
- including a cost for demand control actions in cash-out prices;
- improving the way reserve is incorporated in cash-out prices; and
- single cash-out price.

[18] Project Discovery Options for delivering secure and sustainable energy supplies, 3 February 2010 http://www.ofgem.gov.uk/Markets/WhlMkts/monitoring-energysecurity/Discovery/Documents1/Project_Discovery_FebConDoc_FINAL.pdf.

The direction formed the backbone of the BSC modification proposal[19] raised by NGET in 2014.

BSC Modification P305

The modification proposal became the BSC modification P305, for which the Final Modification Report[20] was published in March 2015. This report proposed the following solutions:

- reduce the Price Average Reference (PAR) value to 50MWh and the Replacement PAR (RPAR) value to 1MWh upon implementation, and reduce the PAR value further to 1MWh on 1 November 2018;
- introduce a single Imbalance Price;
- improve the way Short Term Operating Reserve (STOR) actions are priced by introducing a Reserve Scarcity Price (RSP) which is determined with reference to a ‘static’ Loss of Load Probability (LoLP) function upon implementation before switching to a ‘dynamic’ function on 1 November 2018; and
- introduce pricing for demand control actions and a process for correcting participants’ imbalance volumes following such an event.

In this document we refer to the immediate changes to the arrangements as Phase 1 and the changes that come into effect on 1 November 2018 as Phase 2.

The proposed modification was approved by Ofgem in the decision letter published in April 2015.

[19] https://www.elexon.co.uk/wp-content/uploads/2014/05/P305.pdf
[20] https://www.elexon.co.uk/wp-content/uploads/2014/05/P305-Final-Modification-Report.zip

Appendix 2 – Market Context

Summary

This appendix outlines the various influences affecting Imbalance Prices outside the imbalance calculation itself. It highlights how the electricity industry has changed since November 2013 – average Demand Forecasts and average Forecasted Indicated Margin have fallen, causing possible increases in the Imbalance Prices. Coal generation has rapidly decreased. There have been substantial advancements within renewable energy, instigating a greater reliance on more flexible generation to balance the system. Gas's role in balancing the Transmission System has become more important and gas now accounts for the largest proportion of generation.

System Prices are driven by both the Imbalance Price calculation and wider market conditions and as such we cannot look at Imbalance Prices in isolation. In order to give some wider context to the prices and trends found in this document we have included some key factors that could have influenced the market.

There are numerous factors that could cause the Bid and Offer Prices to rise or fall, influencing the actions that feed into the calculation of the cash-out price. The factors that could affect the cash-out price include but are not limited to: forecast demand for electricity, forecast indicated margin, generation mix, installed capacity of renewables and fuel prices.

Demand for Electricity and Indicated Margin

As part of the electricity system balancing of the transmission system, NGET balances demand for electricity with supply of electricity through contracting arrangements with generators. In times when the system is "short", demand for electricity is greater than supply of electricity. When systems are "long", supply of electricity is greater than demand for electricity.

Both average Demand[21] and average Indicated Margin Forecast[22] follow a cyclical seasonal pattern, particularly from November 2015 through to 2017, as illustrated in Annex Figure 1. Forecast demand, as a component of indicated margin, is intrinsically linked to the forecast indicated margin and therefore a trend is expected. During the winter months Indicated Margin Forecast is higher, which shows there is

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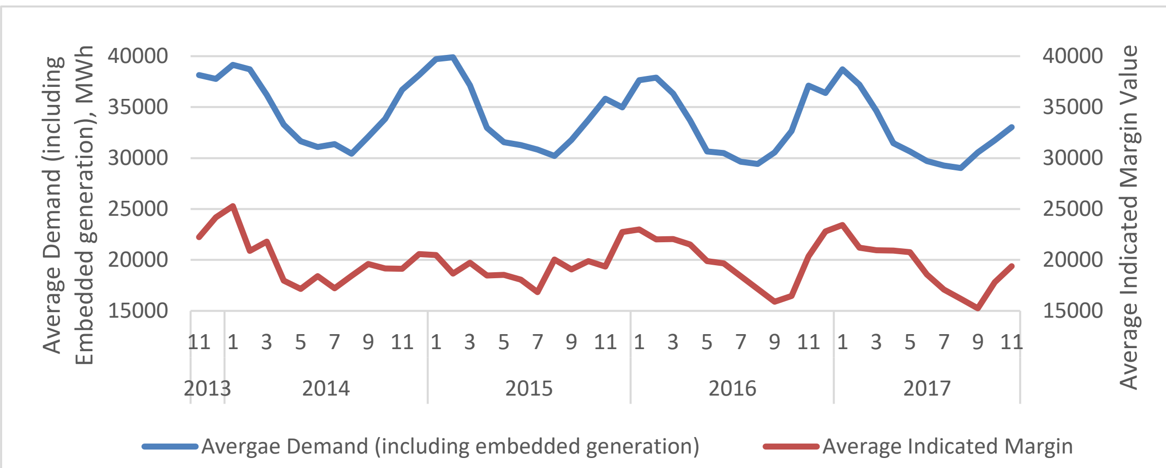
[21] Average Demand shown in Annex Figure 1 is derived from the Initial National Demand Out-Turn (INDO) Plus Embedded Demand data. The INDO averages demand (MW) for a Settlement Period, including transmission losses but excluding station transformer load, pumped storage demand and interconnector demand. The INDO is made available by the System Operator within 15 minutes after a Settlement Period, based on their operational metering. This data was obtained from Neta Reports.

[22] The average Indicated Margin Forecast explains the difference between the sum of Maximum Export Limits (MELs) and National Demand Forecast made by the System Operator.

more available generation capacity forecast than there is demand forecast. There is usually more demand in the winter months than in summer months due to colder temperatures, leading to greater available generation as plants come on line to meet demand.

Average Demand is falling at a faster rate, by 86.44 MWh per month, compared to Average Indicated Margin, where the margin value is falling at 34.3 per month, from 2013 to 2017. With demand falling at a faster rate than Indicated Margin this should increase Indicated Margin Forecasts. However, lower Indicated Margin could have an inflationary effect on Imbalance Prices because bid and offer prices could increase in response to a reduced supply. This could, in turn, push up the cash-out price. The movement towards PAR1 as part of the EBSCR implementation, lowers margin and taking the highest priced action could make the cash-out price increase rapidly more frequently.

Annex Figure 1: Average Demand Forecast (including Embedded Generation) and Average Indicated Margin Forecast



Source: Neta reports

Changes in the Generation Mix

Average total generation has fallen from of 91.7 TWh in quarter 4 2013 to 75.4 TWh in quarter 3 2017. This could have in part been driven by the lower average demand and various government schemes, such as the carbon price floor and the large combustion directive[23].

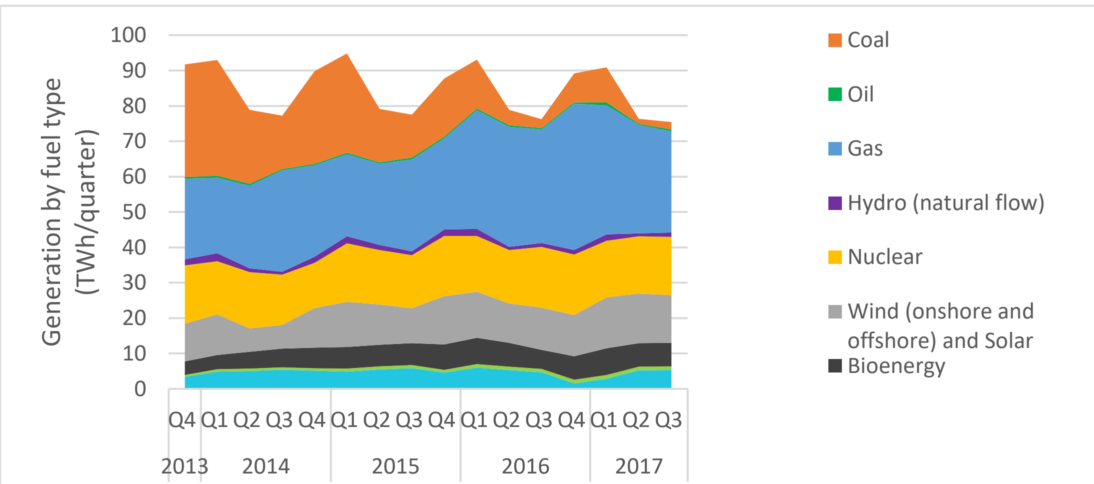
Coal has reduced from 31.9 TWh to 2.1 TWh between the quarter 4, 2013 to quarter 3, 2017, also reducing its proportion of total generation from 34.7% to 2.7%, as illustrated in Annex Figure 2. Since the implementation of P305, coal generation has fallen as a contribution to total generation by 16.6%. This is demonstrated in Annex

[23] https://www.gov.uk/government/publications/environmental-permitting-guidance-the-large-combustion-plants-directive

Figure 2 below. Coal prices were falling at a slower rate than gas, 0.26% between 2013 and the winter of 2016. This was due in part to the large combustion directive causing coal plants to burn through their remaining fuel before exhausting their remaining running hours causing an oversupply.

On 21 April 2017 GB power generation experienced its first coal-free day since the Industrial Revolution and in April 2018 the system experienced no coal generation for three days in a row. Lower coal generation could have caused lower Imbalance Prices; however, since 2016 coal prices have increased to a maximum of £69.31 in November 2017. With the changes introduced by P305, such as PAR50, which takes the most expensive 50 actions within that settlement period, in tight periods coal price spikes could have pushed up the Imbalance Price in the later months of 2017.

Annex Figure 2: Electricity generation mix by quarter and fuel type (GB)



Source: BEIS's Energy Trends publication[24]

Increased role of Renewable Energy

Renewable installed capacity has nearly doubled since 2013, as shown in Annex Figure 3, largely driven by technological advances and government incentive schemes targeting energy suppliers and households, such as the Renewable Obligation (2002) and the Feed in Tariffs (2010).

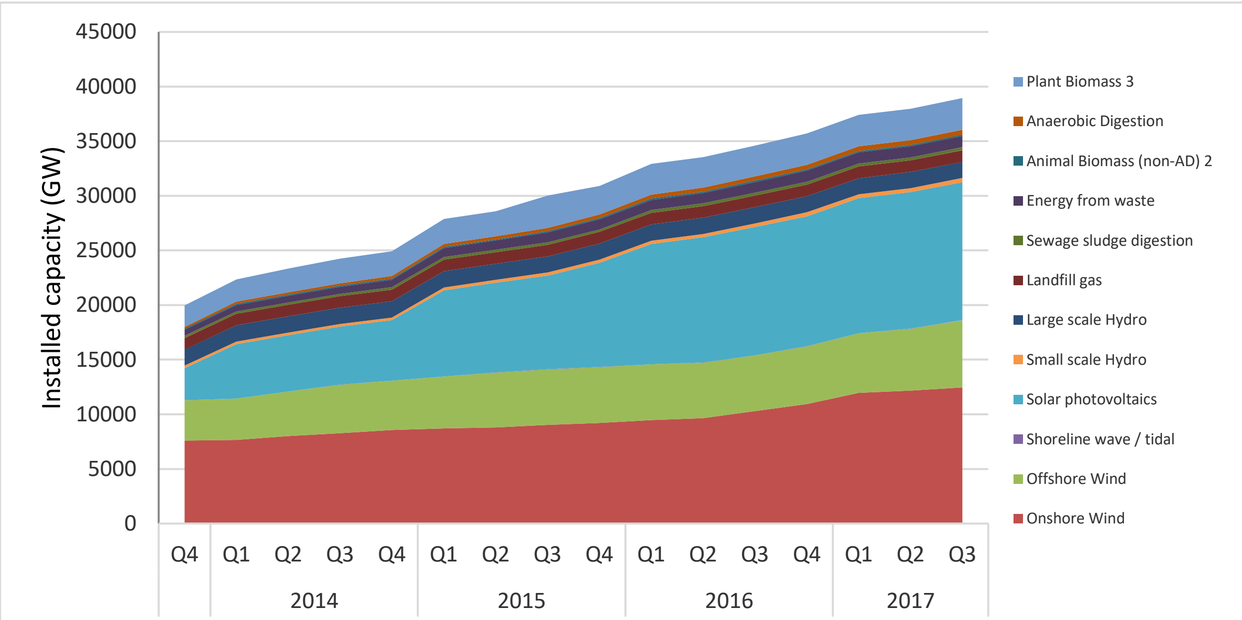
Wind and solar has increased and contributed 11.6 percent out of 17.8 percent of total generation within the same periods (Annex Figure 2). Similarly, onshore and offshore wind installed capacity has increased from 9.0 GW in quarter 4 2013 to 18.6GW in quarter 3 2017, as shown in Annex Figure 3. However, solar has had a

[24] Note: data for quarter 3, 2017 are provisional results obtained from BEIS's Energy Trends Publication.

more rapid increase in installed capacity of the renewable total, with a contribution of 15.7% to 32.4% within the same period.

Wind and solar are non-dispatchable generation types, therefore unexpected changes can affect the level of supply of electricity and could cause a greater reliance on other generation to balance the system. These other forms of generation include gas and coal, which are relatively expensive to turn up compared to renewable generation.

Annex Figure 3: Renewable energy installed capacity



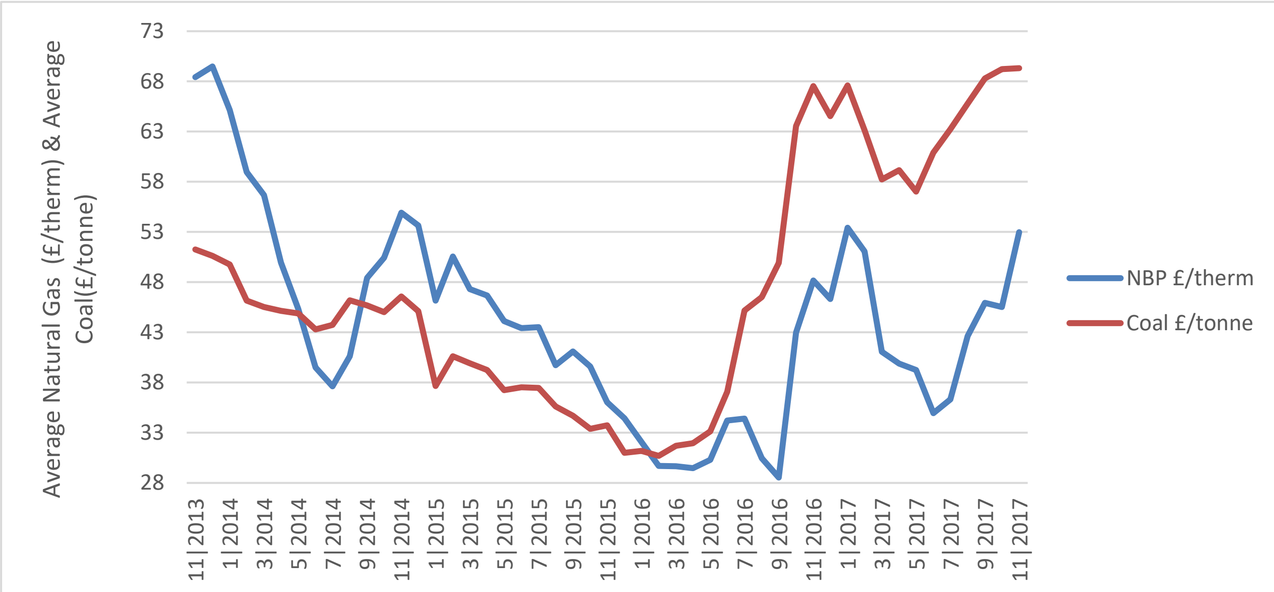
Source: BEIS's Energy Trends Publication[25]

Changes to Fuel Prices

Corresponding with the fall in coal generation, gas output accounted for 37.9% of the fuel mix in quarter 3 2017, as shown in Annex Figure 2. As gas has the largest contribution to generation, it could be argued that gas prices have a significant impact on the cash-out price. Gas prices fell from £68.42 in November 2013 on average to £31.19 in January 2016. Since the early stages of the implementation of P305, gas prices have risen to £52.98 in November 2017. With gas as the largest source of electricity generation, the price of gas is likely to have a significant impact on the Imbalance Price when it is used to balance the system.

[25] Note: data for quarter 3, 2017 are provisional results obtained from BEIS's Energy Trends Publication.

Figure 4: Natural gas and coal average monthly price



Source: Bloomberg. Gas prices from Brokers/ Third Parties and Coal prices from BB OTC Composite

Appendix 3 - Glossary

A

Alternative Modification

Where appropriate the Modification Group, develop an alternative Proposed Modification which, as compared with the Proposed Modification, would better facilitate achievement of the Applicable BSC Objectives.

Absolute Imbalance Volume

The difference between a party's metered position and contracted position on a half-hourly basis treated as a positive number for every period.

B

Bid

A decrease in Export or increase in Import of the relevant BM Unit.

Bid Price

Bid prices are sell balancing actions within the Balancing Mechanism to increase generation or decrease demand. Bid prices are accepted by the System Operator to reduce electricity on the system.

C

Credited Energy Volumes

Credited Energy Volume is the allocation of metered volume from BM Unit to Energy Account in Settlement Period, taking account of Transmission Loss Multipliers and applying any Metered Volume Reallocation Notices that are in force.

D

Demand Forecasts

The volume of national demand forecast by national grid that can be compared to the National Demand Outturn (INDO).

Demand Control Actions

Demand Control Actions are instructions from the System Operator – when it considers there to be insufficient supply to meet demand – to Network Operators to reduce demand, through either voltage reduction ('brownouts'), or firm load disconnection ('blackouts').

E

Energy Imbalance Charge

These are payments by Trading Parties at the Information Imbalance Price on the magnitude of any deviations of BM Unit Metered Volumes from Final Physical Notification

F

Forecasted Indicated Margin

The difference between the sum of Maximum Export Limits (MELs) and National Demand Forecast made by the System Operator.

G

Gate Closure

The point in time by which all contract notifications and Final Physical Notifications must be submitted for each settlement period. Parties should not change their positions other than through instruction by the System Operator after gate closure. It is currently set at one hour before the start of the relevant settlement period.

I

Imbalance Prices

The price per MW paid by parties to the SO when their positions are short, and the SO receives the price per MW from parties when their position is long.

Imbalance Volume

Imbalance volumes are represent the difference between a party’s metered position and contracted position on a half-hourly basis.

L

Long System

In the event where the Transmission System had too much electricity, the system is said to be long. The Imbalance Price calculation utilises the actions the SO takes to reduce generation or increase demand.

N

Net Imbalance Volume

Net imbalance volume (NIV) is the volume of balancing actions remaining after the volume of Offers are netted off against the volumes of Bids.

O

Offer

An increase in Export or decrease in Import of the relevant BM Unit.

Offer price

Offer prices are buy balancing actions within the Balancing Mechanism to decrease generation or increase demand.

R

Residual Cashflow Reallocation Cashflow

The net cashflow received by Elexon through energy imbalance charges and which is reallocated amongst participants based on their credited energy volumes on a half-hourly basis.

S

Short System

In the event where the Transmission System had too little electricity, the system is said to be short. The Imbalance Price calculation utilises the actions the SO takes to increase generation or reduce demand.

System Operator

The entity charged with operating the Great Britain high voltage electricity transmission system, currently National Grid Electricity Transmission Plc.