

	disconnection, at an administrative Value of Lost Load (VoLL) ³ . Pay consumers for the involuntary DSR they provide. Adjust suppliers' imbalance positions to reflect disconnections.	real costs to consumers. Not including these costs into cash-out dampens the incentives parties face to help prevent these events from occurring.
Reserve Scarcity Pricing (RSP)	Price Short Term Operating Reserve (STOR) actions into cash-out according to their value using a RSP function methodology. No longer use the Buy Price Adjuster (BPA) for STOR availability costs. Price non-BM STOR into the cash-out price.	It is very difficult to price STOR into cash-out in a way that is both cost-reflective and reflects system conditions ⁴ . The RSP allocates STOR costs to different periods more appropriately by taking into account their value to consumers and ensures the cash-out price rises more accurately when margins are tight. Not reflecting the costs of non-BM STOR inefficiently dampens the cash-out price.
Single price	Replace the dual cash-out price with a single price, based on the costs incurred by the SO in balancing the system, which all parties pay or receive ⁵ .	A single price is more cost-reflective as it reflects balancing costs avoided. This particularly helps smaller players who often have reducing imbalances. It also simplifies the arrangements.

1.9. We published an Impact Assessment (IA) alongside our Draft Policy Decision document. This assessed the impacts of five different packages, including four variants of our preferred package above ('P5' in the Draft Policy Decision, now simply referred to as 'our reforms' or 'EBSCR'). Since our Draft Policy Decision consultation we have conducted further analysis, in particular in areas where stakeholders raised concerns with our proposals.

EBSCR Final Policy Decision

1.10. Our Final Policy Decision is broadly consistent with our Draft Policy Decision, apart from two key changes:

³ This is £3,000/MWh before the winter 2018/19 and £6,000/MWh after this date.

⁴ This is due to the payment structure of STOR, whereby prices are agreed in advance for usage ('utilisation fee') and for being available ('availability fees'). Ideally total STOR costs should be reflected in the periods where STOR is used and valued the most. However, it is very difficult to forecast when these periods will be and therefore target availability fees to different periods in advance.

⁵ Currently parties face the 'main price' for same direction imbalances and the 'reverse price' for opposite direction imbalances. The main price is based on the energy actions taken by the SO to resolve the overall energy imbalance each settlement period, whilst the reverse price is based on a market reference price.

- We are proposing to phase the introduction of a fully marginal cash-out price (PAR 1), starting at PAR 250 by early winter 14/15 before moving to PAR 50 by early winter 15/16 and then PAR 1 by early winter 18/19⁶;
- We are proposing not to pay consumers for the involuntary DSR service they provide, in particular because the up-front implementation costs would outweigh the benefits to consumers⁷.

1.11. Following stakeholder feedback to our Draft Policy Decision consultation, we have developed much more detail about how our proposals would work in practice, particularly in relation to pricing Demand Control actions into cash-out and the RSP function. We have also carried out further qualitative and quantitative analysis to ensure our proposals will deliver tangible net benefits for consumers. For more detail about our final package of reforms, please see our Final Policy Decision document.

Purpose of this IA

1.12. This IA is published alongside our Final Policy Decision. It sets out the evidence base underpinning our decisions. It collates our assessment of all the impacts of our reforms, both qualitative and quantitative.

1.13. As the substance of our reforms has not changed, this IA builds on the analysis contained in our Draft Policy Decision IA and refers back to it where appropriate. However, there are some key differences from the last document:

- The primary purpose of this IA is to assess the impact of our Final Policy Decision, rather than to help narrow down a range of reform options;
- We have more certainty about the introduction of the Government's Electricity Market Reform (EMR), in particular the Capacity Market (CM), so our analysis now focuses on a world where the CM is in place;
- We have updated our analysis in response to stakeholder feedback and with the latest available information, in order to improve our assessment and further ensure our reforms are in the interest of consumers.

⁶ This is to allow parties time to get used to lower PAR values and change their behaviour accordingly. Please see our Final Policy Decision document for further information.

⁷ For more detail on the rationale for this decision, please see our Final Policy Decision.

2. Methodology and approach

Chapter Summary

Our reforms are motivated by our strong qualitative arguments. Our quantitative analysis, which includes historical analysis and forward-looking modelling, has been used to test (rather than underpin) the case for reform. We have updated our analysis since our Draft Policy Decision, in particular in response to stakeholder feedback.

Our approach

2.1. Our analysis seeks to assess the key impacts of our Final Policy Decision. Our approach to the assessment of impacts and forming a policy decision is based on both quantitative and qualitative analysis. We have used the quantitative analysis mainly to 'stress-test' our qualitative work, rather than it being the primary driver of our decisions. It has been important in particular for assessing the scale of some of the potentially adverse distributional impacts of our reforms and for establishing the approximate magnitude of different effects.

2.2. Since our Draft Policy Decision consultation, we have undertaken further qualitative and quantitative analysis. Through this analysis, we have endeavoured to respond to the feedback we received from stakeholders. This included requests to:

- Assess the impacts of our reforms on credit requirements and operational risk for different parties;
- Further consider the impact of EBSCR in a world with the CM;
- Further analyse the potential adverse impacts of a single price on intra-day liquidity, incentives to 'chase' the system imbalance and cash-out price manipulation.

Overall assessment of impacts

2.3. Our overall assessment of the impacts of our reforms has drawn on a number of sources including expert and stakeholder feedback, economic theory and the results of our quantitative work. We have used colour-coded ratings to illustrate their net impact in several key areas (see Table 2). We have chosen to use today as a reference point to illustrate dynamic impacts of the 'Do Nothing' scenario.

Table 2 - Assessment of impacts (Key: red = negative impact; grey = neutral impact; green = positive impact)

Strongly negative net outcome	Negative net outcome	Neutral outcome	Positive net outcome	Strongly positive net outcome
				

Quantitative assessment of impacts

2.4. We have endeavoured to quantify the impacts of our policy considerations where possible. Our quantitative analysis takes two approaches: our Historical Analysis looks at the period from 2010-13 and our Forward Modelling assesses impacts over the period to 2030. For some areas of analysis, quantification of impacts was not possible, either because the impacts are intangible, difficult to measure, or adequate data was not available. Where this was the case, we focussed solely on the qualitative impacts.

Historical Analysis

2.5. The first element of our quantitative analysis assessed the impacts of our proposals had they been implemented in the past. This analysis used actual data around individual party and overall Net Imbalance Volumes (NIV) and the balancing actions taken by the SO. In constructing this analysis, we assumed that only the price calculation changed as a result of reform. Hence – in this particular element of our analysis - we inherently assumed that there would be no behavioural response from market participants.

2.6. This assumption limits the conclusions we can draw from this type of analysis as in practice we would expect behavioural change to occur in response to changing price signals. However, it offers a simple and transparent view of the potential impacts of EBSCR. In particular, it helps us understand the change in costs parties may face if they do not change their behaviour in response to our reforms. This can be compared to our Forward Modelling analysis where we do assume that parties change their behaviour rationally in response to price signals.

2.7. A fuller description to our approach and the results of the historical analysis can be found in our Draft Policy Decision IA. In reaching our Final Policy Decision, we have referred back to this analysis where it is relevant. We have also conducted further historical analysis, including to help assess the impacts on operational risk and to gain greater transparency about the potential impact of the RSP function.

Forward Modelling

2.8. In addition to assessing the impacts historically, we are also interested in understanding the impacts of our reforms going forward, taking into account how parties might react to changing price signals. To assess this we commissioned

Baringa to develop a model to simulate cash-out prices in the future. A high-level overview of the cash-out model can be found in Appendix 1. A detailed description is provided in Baringa's report, which is published alongside this.

2.9. For our Final Policy Decision, we asked Baringa to update the cash-out model in order to ensure it is as robust as possible. We also asked them to conduct further analysis using outputs from the updated model based on feedback we received from stakeholders. The key changes to our Forward Modelling are summarised below.

Changes to the cash-out model

2.10. The key change to our modelling approach is that our lead scenario now assumes the CM will be in place. For the purpose of the modelling, we assume that the CM is the key driver of investment in capacity over time and that cash-out reform does not deliver any additional investment in capacity. We have instead explored how wholesale price signals from cash-out reform could change the cost of the procuring capacity through the CM. For simplicity, we have also assumed that price signals from our reforms do not change the *type* of capacity that comes forward (although in reality we expect our reforms to have an impact in this area).

2.11. The robustness of the cash-out model has been enhanced in the following ways:

- Assumptions central to the model have been refreshed to take advantage of the latest available information⁸;
- Interconnector flows are now captured explicitly to better understand the interactions with cash-out reform;
- The representation of wind parties has been improved, informed by a better understanding of the correlation of forecast errors between individual independent onshore and offshore wind farms and by extension their exposure to imbalance costs⁹;
- The treatment of bid volumes in the Balancing Mechanism (BM) is now more sophisticated.

⁸ In particular, it is now calibrated against four years of balancing data as opposed to three and uses DECC's latest 'with CM' input assumptions from their DDM model up to 2030.

⁹ The model now examines the impact on two separate types of independent wind party (onshore and offshore) rather than one generic wind party.

Further analysis using outputs from the cash-out model

2.12. As described above, we no longer assume that increased wholesale prices from cash-out reform directly translate into investment response from generators. We have instead used a more sophisticated approach to understanding how increased wholesale prices impact on revenues for different plant. We assume that this additional expected revenue allows plant to lower their bids in the CM by an equivalent amount, which has an overall effect on the CM clearing price and therefore capacity payments received by all CM participants. There is a clear benefit in exploring the difference in these two revenue streams as they are unlikely to net off. This is due to differences in arrangements between the energy market and the CM, in particular the fact that the CM is Pay-as-clear (PAC). For our cost-benefit analysis (CBA) we have compared the magnitude of these two effects to understand the overall impact on consumers.

2.13. A key area of feedback to our Draft Policy Decision consultation was in relation the potential impact our reforms could have on credit requirements under the Balancing and Settlement Code, and in particular the risk that parties may not be able to meet their ongoing cash-flow requirements. As such, we have created a tool based on existing Elexon credit cover rules and used outputs from the cash-out model in each modelled spot year to assess how our reforms affect the average and volatility of credit requirements for different party types.

Key assumptions and limitations of the forward modelling approach

2.14. Modelling the impacts of changes to cash-out is very difficult and complex. In order to construct the model, a number of simplifying assumptions were made about the workings of the model and parameters within it. We opted to develop a 'top-down' simulation model of the key drivers of cash-out prices that is well calibrated to historic data, rather than a 'bottom-up', fundamentals based approach. This provided sufficient flexibility to capture the detail of our reforms, but also delivered greater transparency in understanding and communicating the modelling results. Further detail about our Forward Modelling and the assumptions made can be found in Appendix 1.

2.15. It is not possible to capture the full complexity of the energy market or know precisely how parties will respond to changing signals, particularly a long way into the future. As such there will be a range of uncertainty around our results and they will be sensitive to the underlying assumptions, eg that parties react rationally to changes based on expectation of imbalance costs. It is important that the results of the Forward Modelling are considered in this context – we view these as illustrative and only one part of our evidence base.

3. Impacts on consumers

Chapter Summary

Our reforms lead to sharper cash-out prices which are more reflective of the costs of imbalances to consumers. This will also lead to sharper intra-day wholesale prices as parties factor cash-out expectations into their trading. These improved price signals will ensure parties' balancing, trading and investment decisions are more closely aligned with the consumer interest, in particular by reflecting the value they place on flexibility and electricity during times of scarcity. This has a positive impact on wholesale market efficiency and complements the CM by reducing the cost of capacity adequacy, which delivers a reduction in consumer bills in the future.

3.1. Reforming the cash-out price calculation and therefore changing price signals incentivises parties to change their behaviour. This chapter examines the direct impacts on consumers as a result of this behavioural change in terms of wholesale market efficiency and ultimately security of supply. We start by examining the impacts of our reforms on the efficiency of electricity balancing in isolation, before looking at impacts on the electricity wholesale market more widely. We conclude by assessing what this could mean for consumer bills. More indirect impacts of cash-out reform that could also affect consumers (eg, impacts on competition and liquidity) are assessed in subsequent chapters.

Balancing efficiency

3.2. Both parties and the SO incur costs in balancing the market. Parties incur costs in managing their imbalance risk and the level to which they hedge this risk before Gate Closure¹⁰, and the SO incurs costs through taking balancing actions in real time. The efficiency of the overall balancing arrangements will reflect both of these costs which are passed through to consumers.

Short term balancing costs

3.3. In theory, to incentivise parties to maximise the overall efficiency of balancing, the cash-out price should as far as possible reflect the SO's costs of balancing at the margin. At this point the cost of an additional unit of imbalance to parties reflects the cost to the SO of resolving that unit of imbalance. Basing the cash-out price on an average of the SO's actions, excluding Demand Control actions and the current approach for reserve costs all mean the main cash-out price is priced below the margin, particularly at times of system stress. This may lead to parties overlooking balancing opportunities available before Gate Closure which may be cheaper than actions available to the SO.

¹⁰ The point, one hour ahead of the start of the settlement period, where parties submit their contacted positions and expected physical positions.

3.4. A dual cash-out price further reduces the cost-reflectivity of cash-out prices. Under current arrangements, the price parties pay or receive for reducing imbalances is set equal to a market reference price. This does not reflect the marginal value these parties provide in reducing the balancing actions the SO is required to take.

3.5. As a whole, the EBSCR package of reforms aims to ensure the cash-out price is as cost-reflective as possible. PAR 1, the RSP¹¹ and VoLL pricing aim to ensure that cash-out prices more accurately reflect the SO's energy balancing costs at the margin, whilst a single cash-out price removes the inefficient spread between the price for imbalances in the same direction as the system imbalance ('aggravating imbalances') and reducing imbalances. This should create the most efficient incentives for parties to optimise their trading behaviour, leading to a more appropriate split between how much balancing is undertaken by the market and by the SO than under the existing arrangements.

3.6. In practice, parties don't receive a perfect signal of their cash-out exposure before Gate Closure. This is because cash-out is an ex-post measure based on the costs incurred by the SO within each settlement period. However, more cost-reflective prices are still likely to encourage a more efficient outcome overall, as parties can learn from their cash-out exposure over time and factor this into their trading strategies.

3.7. One concern raised by stakeholders is that the risk of very high cash-out prices that cannot be reasonably anticipated could encourage inefficient balancing behaviour by risk averse market participants. We have carefully designed our policies in view of this. In particular, for the RSP function (which can rise to up to £6,000/MWh depending on the probability of Demand Control) we have specified that National Grid provides information before Gate Closure that will allow parties to easily calculate an indicative RSP price ahead of time. As this RSP price is likely to set the cash-out price during periods with very tight margins¹², this should strengthen the cash-out signal during these times, leading to a greater chance of an efficient response by parties. We have also carried out analysis that shows our reforms are unlikely to result in disproportionate risk for parties (see Chapter 4).

3.8. Our Forward Modelling shows insignificant impacts in this area; an annual benefit of around £2-3m from 2016-2025 and a £3m cost in 2030. However, we note that it is very hard to hard to fully anticipate how market participants may respond to cash-out reform and how their behaviour in the BM might evolve over time. Overall, we consider that there is a strong qualitative case that cash-out reform will deliver improved, short term balancing efficiency, particularly during tight margins when an efficient response is most valued.

¹¹ We recognise that true cost-reflectivity on a settlement period basis is impossible to achieve with STOR costs due to its payment structure. The RSP should better reflect the STOR costs the SO (and consumers) would have been willing to incur in each settlement period, resulting in much more efficient signals than the status quo.

¹² As the SO is likely to instruct a large volume of its STOR capacity in these periods.

Long term balancing costs

3.9. As well as optimising their behaviour in the short term, parties can manage imbalance risk in the long term by investing in measures to improve balancing. This could include investing in the reliability of their generating capacity or in their wind or demand forecasting equipment. The cash-out price and the consequent imbalance costs a party faces will directly affect these decisions as they determine whether investment is economic or not.

3.10. Imbalance costs are likely to increase over time in the absence of reform due to the changing generation mix¹³. As such, the incentives on parties to achieve savings through expenditure on balancing improvements should also increase in the future. By ensuring cash-out prices are cost-reflective, our reforms ensure that the private benefits to parties from any improvements are more closely aligned with the wider benefits to the system and therefore consumers.

3.11. Our Forward Modelling suggests that a dual price places too high imbalance costs on parties on an annual basis compared to the costs incurred by the SO. This over-incentivises parties to balance at times when the system is not tight and over-incentivise parties' efforts to take long term balancing measures. In the absence of reform, the costs incurred by parties to improve balancing in the future would outweigh the benefits from reduced system balancing costs. A single cash-out price ensures parties face long term imbalance costs that are more closely aligned with the costs incurred by the SO, resulting in more efficient investment decisions.

3.12. However, the modelling also shows that by itself a single price would result in insufficient incentives to balance, particularly during tight margins. It suggests that overall balancing costs savings (short and long term) are greatest when a single price is combined with PAR 1, the RSP and VoLL pricing. This ensures that parties face the most appropriate combination of long term incentives to invest in balancing and sharper incentives to balance when the system is tight (where SO balancing costs are greatest as there are fewer available balancing actions).

3.13. Our Forward Modelling suggests our reforms will deliver significant savings to consumers as a result of a more efficient level of expenditure in long term balancing measures, as shown in Table 3. This is particularly the case approaching 2030, when balancing costs are expected to increase significantly due to changes in the generation mix.

Table 3 – Annual savings from lower, more efficient level of expenditure in balancing measures by Industry

	2020	2025	2030
Annual savings under EBSCR (£m)	13	14	36

¹³ A more intermittent electricity system will likely increase the size and volatility of energy imbalances, resulting in more expensive actions being required in each settlement period.

3.14. It is important to note that the cash-out model does not endogenously capture the investment decisions of individual parties or contain detailed information regarding the costs and opportunities to invest in long term balancing measures. Rather, it infers over or under-investment by the industry as a whole according to the difference between the modelled industry imbalance costs and SO costs. In reality it is difficult to capture party response to the potentially opposing effects of lower incentives to be balanced in benign periods and much greater incentives in tight periods as a result of sharper cash-out prices, as this will depend on their risk aversion and imbalance expectations. Parties may invest more to cover exposure to peak conditions where expected imbalance costs could be very large, in particular in measures with low set-up costs (offset by high utilisation payments).

Summary

3.15. There is strong qualitative evidence that our package of reforms will lead to more efficient balancing behaviour by market participants in response to different system conditions, both in the short term and the long term. This is supported by our quantitative analysis which shows annual savings to consumers of approximately £30m by 2030 as a result of the industry facing cash-out charges that are more reflective of the costs incurred by the SO.

Table 4 – Overall summary of impacts of our reforms on balancing efficiency

Option	Rating	Rationale
Do nothing		Prices are a poor reflection of SO's costs: prices are highly averaged and do not value all actions taken by the SO; dual price places too high imbalance costs on parties during normal conditions
EBSCR		Prices most closely reflect SO's costs: Single price based on marginal cost leads to much greater balancing efficiency in the short term and long term

Wider wholesale market efficiency and security of supply

3.16. As well as encouraging more efficient balancing behaviour, more cost-reflective cash-out signals would have a positive impact on the wholesale market by improving the efficiency of parties' trading and investment decisions. This should complement the CM and support the cost-effective delivery of security of supply.

Cash-out reform and signals for flexibility

3.17. By ensuring parties more accurately face the costs to consumers of their imbalances, our reforms more efficiently signal the value consumers place on flexibility¹⁴. This directly impacts parties' investment decisions and may alter their incentives to contract with providers of flexibility. The value of flexibility should also

¹⁴ Demand or generation which can act quickly in response to price signals.

be more accurately revealed through prices in intraday markets, as parties have an incentive to trade out their potential imbalance positions before Gate Closure to the extent that this is expected to be better than facing cash-out.

3.18. PAR 1 will sharpen cash-out price expectations in all periods, which increases incentives on parties to have access to flexibility. It also increases the price parties would be willing to pay for electricity in intraday markets (when the system is expected to be short) and lowers the price they would be willing to sell at (when the system is expected to be long). A single price on the other hand will offer parties the opportunity to gain from having reducing imbalances, which could counter these effects by lowering expected exposure.

3.19. The strongest impact on incentives, and therefore strongest potential impact on wholesale prices, will likely be when the system is tight. This is because the RSP and VoLL could significantly increase the expected cost to parties of short imbalances. Our proposal for National Grid to provide indicative information about the RSP price should provide a stronger, ex-ante signal to parties about their potential cash-out exposure during tightening margins. This should enable market participants to more accurately take their potential imbalance exposure into account in their near-term trading, which in turn should increase the accuracy with which prices reflect scarcity on the system.

3.20. Historically there has been a small but robust relationship between cash-out and wholesale electricity prices. This is captured in our Forward Modelling through a regression model which explores the link between cash-out prices and the Market Index Price (MIP)¹⁵. However, as the regression is based on the historic observations, it may not capture how this relationship may strengthen in the future¹⁶. As noted VoLL, RSP and indicative information about the RSP price could significantly strengthen this relationship during tight margins.

3.21. Our Forward Modelling shows that our reforms should lead to sharper, more volatile cash-out prices in the future compared our to 'Do Nothing' scenario (DN). Figure 1 shows the impact of EBSCR on average System Buy Prices (SBP) and the System Sell Prices (SSP) from 2015-2030¹⁷. There is a much more significant impact on SBPs than SSPs, as SBPs are affected by the RSP and also because the BM offer curve is relatively steeper than the bid curve¹⁸, resulting in a greater impact from

¹⁵ The MIP is a weighted average of intraday electricity prices which has been used to calculate the reverse cash-out price (the price for reducing imbalances).

¹⁶ Please see Appendix A of Baringa's report supporting our Draft Policy Decision IA: <https://www.ofgem.gov.uk/ofgem-publications/82296/baringa-ebscr-quantitative-analysis.pdf>

¹⁷ The SBP is the price parties pay for uncontracted energy when they are short (ie, have not contracted for enough electricity) and the SSP is the price they pay when they are long. Figure 1 only looks at SBPs when the system is short and SSPs when the system is long.

¹⁸ Historically, there is less price variation between bids than offers. This is assumed going forward as a large amount of subsidised wind enters the system which is similarly priced given consistency in the subsidies these parties receive.

PAR 1 on average. There is also a significant increase in the volatility of SBPs as shown in Figure 2. The modelling also shows that cash-out prices are much more responsive to system conditions and should rise to VoLL before Demand Control. This is illustrated in Figure 3 which shows the top 0.5% of SBPs in 2020 and 2030.

Figure 1 – Average SBP (main), SSP (main) and MIP in each spot year

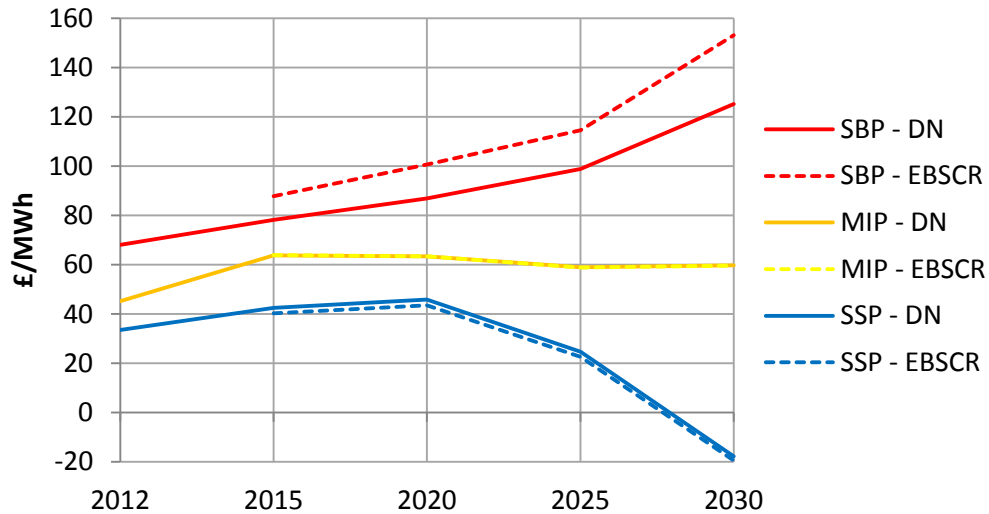


Figure 2 – Volatility of SBP

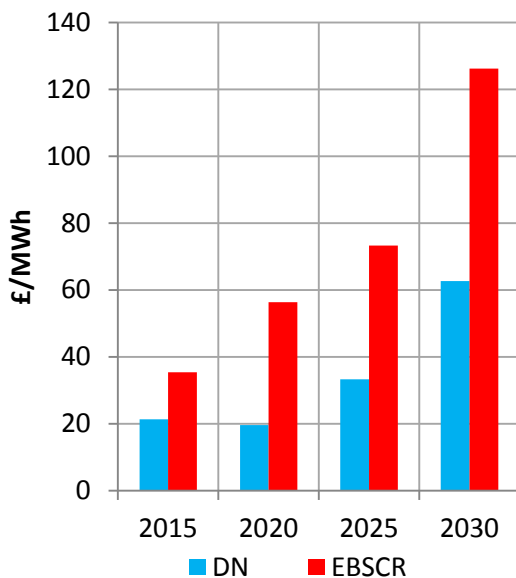
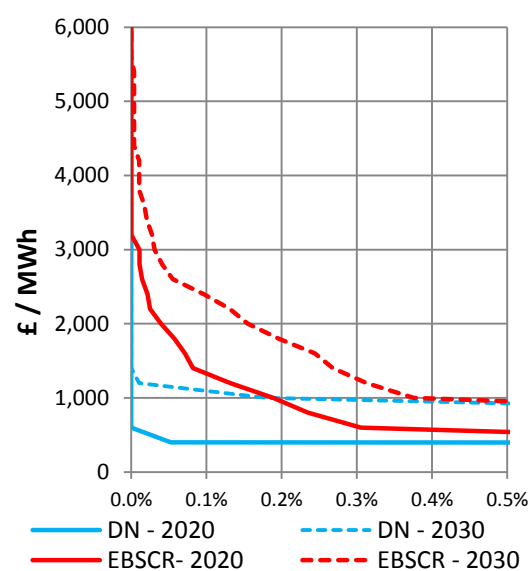


Figure 3 – High SBP cumulative distribution



3.22. As our reforms are likely to sharpen SBPs more than SSPs, the net average impact is a likely increase in near-term prices. Our Forward Modelling suggests that the impact on intraday prices, as represented by the MIP, is relatively small on average. However it shows the MIP can increase significantly in individual periods across the year when the system is very short. Our modelling therefore suggests that the strongest additional signals from cash-out reform could be for flexibility that is used relatively infrequently but can provide significant value during tight margins.

Impacts of improved price signals

3.23. Our reforms lead to stronger signals for the utilisation and uptake of Demand Side Response (DSR). Sharper, more volatile prices increase the value to electricity suppliers of having customers whose load can be shifted dynamically. This in turn increases the incentives suppliers have to offer innovative time-of-use (ToU) tariffs to their customers. A more flexible demand-side is likely to drive significant efficiency gains in the future, and the formation of efficient price incentives is one of the barriers to realising these benefits.

3.24. Our reforms should also affect the *type* of generation capacity that could come forward. More accurately signalling the value of flexibility through cash-out prices, and in turn wholesale prices, should lead to more efficient decisions by parties to contract with flexible providers or invest in flexibility themselves (either to mitigate cash-out exposure or earn greater revenues in the wholesale market). This increases the ability for the market to respond to sudden variations in demand or generation, supporting security of supply. More efficient signals also ensure that the rewards from innovation and R&D in flexible technologies, such as electricity storage, are more accurately linked to the potential consumer benefits they deliver. Such technologies could deliver significant savings to consumers in the future, particularly given the move to a more intermittent generation mix.

3.25. Improved conditions for DSR, flexible generation and innovation in flexible technologies are key benefits from our reforms. However, we have not been able to quantify these effects, as it is very difficult to anticipate how suppliers and generators will react to sharper price signals or what technologies this could help to bring forward.

3.26. While higher electricity prices present costs to consumers, these increases are in consumers' interest because they more accurately reflect the value they place on having secure, uninterrupted electricity supplies. High prices when supplies are scarce will increase the likelihood of electricity flowing into GB through interconnectors when required, which should result in GB demand being met more efficiently and securely. Higher electricity prices will also compensate investors for part of the 'missing money' that generators have been unable to earn in the electricity market, which has led to under-investment in capacity.

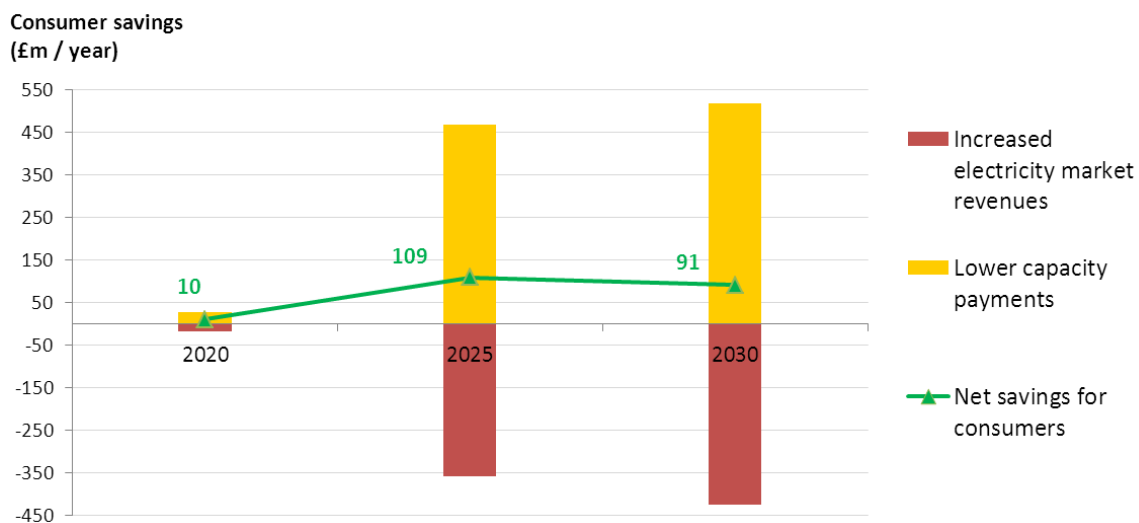
Cash-out reform and the CM

3.27. Our reforms complement the CM in delivering security of supply for consumers. Whilst the CM is likely to provide the main signals for investment in capacity, our reforms are a key driver of flexibility. We expect our reforms to reduce the cost of achieving security of supply through the CM due to their impact on the level at which capacity providers will bid into the CM auctions and, depending on the future treatment of interconnected capacity in the CM, potentially on the volume of capacity needed in these auctions.

3.28. Sharper prices from cash-out reform should increase flexible generators' revenue expectations and therefore lower the amount of missing money that they need to recoup through the CM. This in turn should alter their bids in the CM leading to a lower CM clearing price and lower capacity payments to all CM participants. In theory, the reduction in revenues from capacity payments should offset the increased wholesale market revenues, resulting in a neutral impact for consumers. However, these effects are unlikely to exactly offset in practice due to differences between the energy market and the CM. In particular, unlike payments for electricity in the forward market, where there are different prices for different types of plant over different timeframes, capacity payments to all plant are based on the CM clearing price. Also, not all generators that benefit from cash-out reform may participate in the CM.

3.29. We have carried out analysis to determine the net impact of these opposing effects. As shown in Figure 4, our Forward Modelling suggests that savings in the CM could in fact outweigh the increase in wholesale price revenues, leading to net savings to consumers. This is intuitive as short term wholesale price spikes will only benefit certain flexible capacity providers at specific times when the system is tight; as opposed to these plant reflecting this missing money into their CM bids which could increase the CM clearing price which all CM participants receive.

Figure 4 – Changes in wholesale market revenues due to cash-out reform



3.30. The modelling results for 2020 indicate that these savings are likely to be relatively modest in the first years of the CM. This is because margins are reasonably stable and there is still a relatively low proportion of intermittent generation on the system, meaning imbalance volumes are less extreme and there is less impact on prices from PAR 1 and the RSP. In addition, according to our model, the clearing plant in the CM auction in this year is a baseload/mid-merit plant. These plant tend to contract for the majority of electricity production in advance, so are likely to gain less from cash-out reform, which mainly affects intraday prices. In 2025 and 2030 savings appear to be much more significant. This is because our modelling suggests

the clearing plant in the CM is likely to be a peaking plant (eg, an Open Cycle Gas Turbine (OCGT)). Peaking plant are the biggest beneficiaries of price spikes from cash-out reform, and as such we see much greater consumer savings from lower capacity payments to all CM participants¹⁹.

3.31. These results should be treated with some caution for a number of reasons. First, our cash-out model does not explicitly model the dispatch decisions for different generators. Instead, the impact of our reforms on wholesale prices is inferred from a regression model which simulates the link between cash-out prices and the MIP. In addition, the large savings in 2025 and 2030 are sensitive to the result that a peaking plant clears the auctions in these years²⁰ and the assumption that parties will fully reflect these expected revenue increases into their CM bids. It is therefore advisable not to put too much weight on the absolute size of the effects.

3.32. Our reforms could also affect the cost of capacity in the CM indirectly through the impact on interconnector flows. As mentioned, sharper electricity prices should lead to interconnectors becoming more reliable as a source of capacity during peak periods. Depending on how interconnected capacity is ultimately treated in the CM, these benefits could materialise in different ways. If interconnectors are not CM participants, the effect could be a reduction in the volume of capacity needed to achieve the GB reliability standard. Alternatively, if interconnectors or foreign plants were to participate directly in the CM, an improved de-rating factor for interconnectors as a result of our reforms could increase competition in the CM, and put downward pressure on the CM clearing price. We examined the first of these possibilities through our Forward Modelling²¹. As can be seen in Table 5, this found modest additional savings to consumers of approximately £3-7m per year²².

Table 5 – Annual savings in CM from lower interconnector de-rating factor

	2020	2025	2030
Annual savings under EBSCR (£m)	5	3	7

Cash-out reform without the CM

3.33. The introduction of the CM is now relatively certain. However, there will remain some uncertainty when looking far into the future. Our Forward Modelling has assumed the CM will remain in place for all years up to 2030. If, for any reason, the CM ceased to exist or was not introduced, we still expect cash-out reform and sharper wholesale prices to deliver benefits for consumers. Indeed, cash-out reform is one of the potential factors that, by addressing missing money, may enable exit

¹⁹ Further detail about our approach is contained in Annex 1 and in Baringa's report.

²⁰ We note that we have not modelled the years in between 2025 and 2030.

²¹ We chose this particular approach for ease, given the information available at the time.

²² In order to establish the potential change in de-rating factors for interconnectors in each year, we examined the impact of our reforms on flows on a characteristic January day across the evening peak (an effect which is now endogenously captured as part of the model).

from the CM in the future. Our analysis for the Draft Policy Decision IA shows that in the absence of the CM, cash-out reform would improve security of supply and efficiency. Our reforms could also lead to a reduction in unserved energy in the years before the CM is introduced directly through their impact on interconnectors²³ and potentially prevent mothballing of some flexible capacity.

Summary

3.34. There is strong theoretical evidence that existing cash-out prices do not accurately reflect the value consumers place on flexibility and scarce electricity, which could be dampening signals for flexible demand, generation and new flexible technologies to be brought forward. Our reforms aim to correct this failure. Although we have been unable to quantify some of these effects, our modelling supports our conclusions that reform will lead to sharper price signals, particularly during tight margins, and that this should reduce the cost of capacity adequacy.

Table 6 – Overall summary of impacts of our reforms on wider wholesale market efficiency and security of supply

Option	Rating	Rationale
Do nothing		CM delivers strong signals for capacity adequacy. However there are still insufficient signals for flexibility and scarcity. This could increase the cost of meeting consumer demand.
EBSCR		Improved price signals that much more accurately reflect the value consumers place on flexibility and electricity during scarcity, helping to deliver security of supply efficiently.

Consumer bills

3.35. As an extension of our CBA (see Chapter 7), we have developed an illustration of the potential impacts on consumers' bills as a result of our reforms. The impact on an average domestic consumer in each modelled spot year is presented in Table 7²⁴.

3.36. Our Forward Modelling suggests that in the absence of cash-out reform the costs to the SO of balancing will increase to 2030, in particular because more balancing actions will be required to balance greater intermittency. This cost increase is likely to be passed through to consumers, inflating consumer bills under the DN scenario over time. As shown in Table 7, our Forward Modelling indicates a modest annual reduction in bills in the medium and long term compared to DN as a result of our reforms. This is due firstly to the lower overall costs associated with balancing (£0.20-0.30/annum) and secondly to the reduction in capacity payments in the CM.

²³ Our Forward Modelling suggests the (small) volume of unserved energy modelled under the DN scenario in 2015 is fully removed as a result of EBSCR.

²⁴ We expect impacts on consumers with different consumption levels to be broadly proportionate (however this could vary depending on suppliers' pricing strategies and balancing performance). We assume all costs are passed through to all consumers by suppliers.

There is a modest increase in bills in the near term as a result of greater wholesale prices, which are not offset by reductions in capacity revenues as the CM does not exist before winter 2018/19²⁵.

Table 7 – impact on average annual domestic consumer bill (-ve = savings for consumers)

	2016	2020	2025	2030
Change in average bill compared to Do Nothing (£/year)	1.60	-0.32	-1.40	-1.32

3.37. It is important to reiterate that a number of potential impacts from cash-out have not been captured by our Forward Modelling. Dynamic efficiency gains resulting from sharper, more efficient price signals (such as innovations in flexible technologies) could lead to significant savings in the future, which could lead to much greater reductions in bills. The bill impacts also do not account for any changes in supplier risk premiums or for any impacts on competition. However, our analysis has shown there are unlikely to be any significant impacts in these areas.

Table 8 – Overall summary impacts of our reforms on consumer bills

Option	Rating	Rationale
Do nothing		Unnecessary costs involved with balancing the system and achieving security of supply feed into bills.
EBSCR		Medium to long term bill reductions from lower balancing costs and greater savings in the CM, which outweigh the initial small increase in bills. Potentially significant unquantified savings over time resulting from investment and innovation in flexible technologies

²⁵ For further discussion please see Chapter 7 and Appendix 2.

4. Impacts on competition, distributional impacts and operational risk

Chapter Summary

This chapter underlines the positive effect on competition of enhanced cost-reflectivity of price signals. Our reforms allow parties that are most adept at managing their energy imbalance²⁶ to enjoy a competitive advantage that reflects the value they deliver to the consumer. While reform may be expected to benefit some existing parties and dis-benefit other existing parties, our analysis suggests that party-level impacts are in many cases positive, and in other cases modest, and with the steps parties can take to reduce risks we conclude impacts are manageable.

4.1. In this chapter we assess competition, distributional and operational risk impacts. Concerns raised by stakeholders in this area include: that intermittent renewables will face worse terms on PPAs from higher and more volatile cash-out exposure; sharper cash-out prices may stunt competition by disadvantaging small independent parties to the greatest extent²⁷, in particular through an increase in risk premiums or the cost of capital; and a few low probability but high impact events could bankrupt parties who have historically been proficient at managing imbalances.

Competition²⁸

4.2. Cash-out prices have an impact on competition through the incentives they place on market participants. This section identifies the affected parties, presents a framework for assessing competitive impacts of reform, and our assessment of these impacts.

Key affected parties

4.3. The affected parties are GB wholesale market energy participants who provide products or services that deliver energy balance. These are most notably generators and suppliers, but also include providers of DSR, infrastructure for the flow of energy from outside GB (interconnectors), and innovative solutions such as storage. Related markets are the GB retail market and wholesale energy markets of Ireland and mainland Europe.

²⁶ We define 'managing energy imbalance' as: minimising costs imposed on the SO, noting these costs and cost savings will be most significant during times of energy tightness.

²⁷ Owing to the fact that historically, they have been the poorest balancers.

²⁸ This section follows our IA guidance which considers criteria based on the OFT's 'Completing competition assessments in Impact Assessments':

http://www.ofg.gov.uk/shared_ofg/reports/comp_policy/ofg876.pdf

Competitive effects of distortions in existing arrangements

4.4. Compared with a baseline of perfect cost-reflectivity, imperfections in existing balancing arrangements impose the following distorting effects:

- Dampened cash-out prices create favourable prices for parties who aggravate the system imbalance. This unduly reduces net costs for parties with aggravating imbalances;
- A dual cash-out price creates unfavourable prices for parties who reduce the system imbalance. This unduly increases net costs for parties with reducing imbalances.

Competitive effects of reform

4.5. PAR 1, RSP and VoLL pricing remove the distortion that places too low costs on parties with aggravating imbalances, while a single price removes the distortion that places too high costs (or too low a benefit) on parties with reducing imbalances. **Our reforms therefore allow parties best able to manage their energy imbalances to gain a competitive advantage according to the value delivered to the consumer, and ultimately support free and fair competition.** Key to achieving this will be efficient recourse to flexible technologies, accurate forecasts, efficient hedging and trading strategies, innovation, maintenance to ensure reliability of plant and other tools.

4.6. There may also be other competition impacts from our reforms, for example, if they were to indirectly limit the number or range of affected parties or create barriers to entry.

4.7. Change in the net costs of entering or exiting an affected market:

- Our reforms are unlikely to affect the cost of the process of entering or exiting the market. They may however alter the *incentives* for parties to enter the market. Current inefficiencies could limit the potential for some parties, in particular those offering services that facilitate flexibility and balance (such as DSR or storage), to participate in the wholesale electricity market. Our reforms will remove a distortion that undermines incentives for these parties to enter and participate.

4.8. Change in net costs for small businesses:

- Sharper cash-out prices could be expected to disadvantage small independent parties to the greatest extent, owing to the fact that historically they have incurred proportionally higher imbalance volumes. However, as described in the following sections, small independent parties have reducing imbalances relatively often, and will therefore benefit relatively more from a single price. They are

unlikely to face significantly higher imbalance risk and will likely benefit from our reforms overall.

4.9. While our reforms may be expected to benefit some parties and dis-benefit others, our analysis suggests that party-level impacts are in many cases positive, and in other cases modest and with the steps parties can take to reduce risk we conclude impacts are manageable. The following section describes this in greater detail.

Distributional impacts

4.10. While sharper cash-out prices in isolation would increase the costs to parties associated with imbalances, the introduction of a single price has the opposite effect as parties could gain from having reducing imbalances. The impact of our reforms on different parties is therefore not only likely to be determined by the relative size of their imbalance volumes, but also their likelihood of having reducing imbalances. Smaller parties have smaller absolute imbalances than larger parties. They therefore are less likely to drive the overall system length and more likely to have reducing imbalances.

4.11. Our Forward Modelling has helped us understanding how our reforms could impact on the costs parties face in the future. The model simulates impacts for different parties based on historical balancing behaviour, assuming they respond rationally to changing price signals. While the results are sensitive to these underlying assumptions, they have been informative for assessing the weight of opposing effects of sharper prices and a single price. We have chosen to look at both the opportunity cost to a party of being out of balance²⁹ and Residual Cashflow Reallocation Cashflow (RCRC) to assess costs to parties of their imbalances (referred to from here as 'imbalances costs').

4.12. Figure 5 shows expected imbalance costs in 2020, 2025 and 2030 under DN and EBSCR for different party types, whilst Table 9 shows the expected percentage change from DN to EBSCR. As can be seen, we expect imbalance costs to be lower in each spot year for every party type except vertically integrated and independent offshore wind. However, vertically integrated parties are still expected to face negative imbalance costs³⁰ in every year. This is because they are generally good balancers and their imbalance volumes are small relative to their contracted energy. Although imbalance costs increase for independent offshore wind generators, their impact appears to be small (even in 2030, when they are assumed to make up approximately 20% of the capacity mix).

²⁹ Opportunity costs are the difference between the amount a party pays for being out of balance (cash-out) and what they would have paid if they had traded out their position intraday. This is a more appropriate metric to assess the cost of being out of balance than to just look at cash-out charges.

³⁰ Because the RCRC they receive back outweighs their higher opportunity costs.

4.13. These broadly positive results highlight that the move to a single price is likely to have a significant impact. This is because the dampening effect on imbalance costs from single pricing will impact every settlement period, whilst our other reforms (in particular the RSP and VoLL) only contribute to imbalance costs when margins are tight³¹.

Figure 5 - Expected OCs, RCRC and imbalance costs per unit of credited energy in 2020, 2025 and 2030 under DN and EBSCR, for different party types

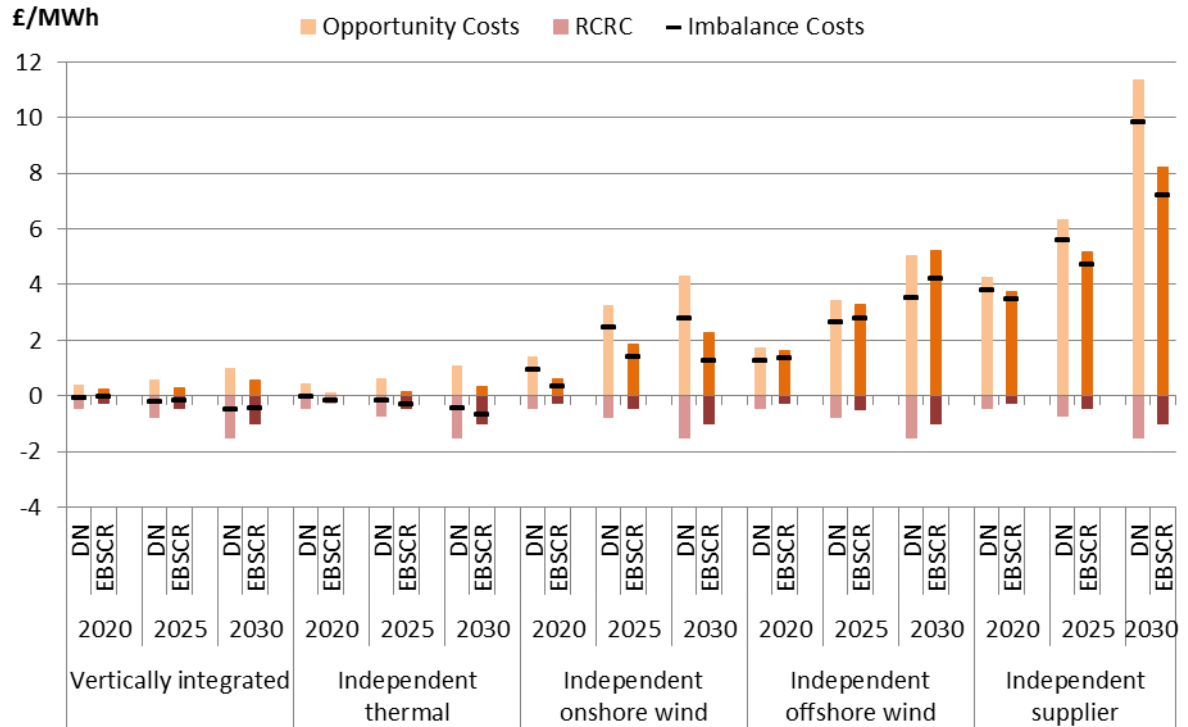


Table 9 - Percentage change in expected ICs per unit of credited energy from DN to EBSCR in 2020, 2025 and 2030, for different party types

Imbalance Costs (DN to EBSCR)			
	2020	2025	2030
Vertically integrated	62%	14%	13%
Independent thermal	-288%	-97%	-46%
Independent onshore wind	-63%	-43%	-55%
Independent offshore wind	5%	5%	20%
Independent supplier	-9%	-15%	-27%

³¹ This could in part be due to relatively flat bid and offer curves for small imbalances, as as such relatively little impact from a move to PAR 1 in most periods.

4.14. Overall we expect the net effect of our reforms on party imbalance costs to be broadly positive, in particular for smaller parties.

Table 10 – Overall assessment of impacts of our reforms on competition and distributional impacts

Option	Rating	Rationale
Do nothing		Distortions in the existing arrangements from dampened cash-out price have a negative impact on competition. Parties face undue imbalance costs going forward, particularly smaller parties.
EBSCR		Cost-reflective prices remove distortions to competition. Parties face more accurate costs. Distributional impacts are likely to be in favour of smaller parties.

Operational risk

4.15. Imbalances costs do not fully capture the potential impacts of our reforms on imbalance risk. This may also be affected by the volatility of cash-out prices. We decided to use two additional metrics to gain a fuller understanding of the expected impacts of our reforms on operational risk.

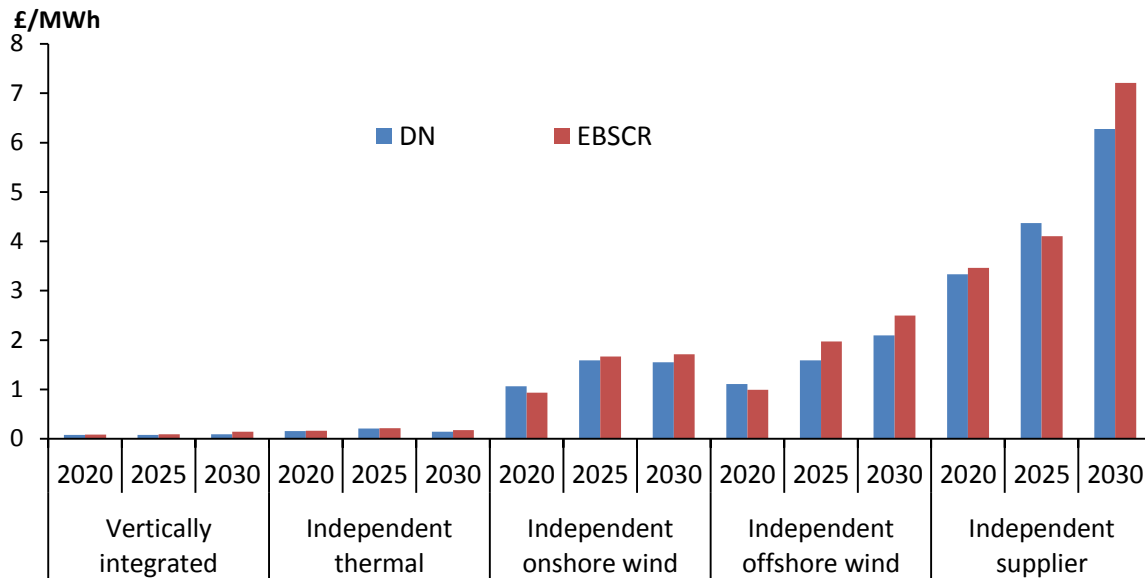
4.16. First we looked at the volatility of credit requirements³². Under the BSC, parties pay or receive Trading Charges³³ 29 calendar days after the settlement day on which they were incurred. Therefore, at any point in time, a party will have debts or be due payments in respect of Trading Charges over the previous 29 settlement days. To ensure they can repay these debts if they default, parties lodge credit with ELEXON. If they don't lodge enough credit, parties will trigger the Level 1 Credit Default process. Our volatility of credit requirements metric measures the standard deviation³⁴ of the amount of credit that parties need to post to avoid triggering this process. If cash-out prices become more volatile, the amount of credit parties will have to post may also become more volatile, placing additional risk on parties. We looked at what this metric is expected to be in the future under DN and EBSCR through our Forward Modelling. Figure 6 shows the expected volatility of credit requirements in 2020, 2025 and 2030, under DN and EBSCR for different party types.

³² http://www.elexon.co.uk/wp-content/uploads/2013/11/credit_cover_guidance_v6.0_cgi.pdf

³³ These are made up of Account Energy Imbalance Cashflow, RCRC and a number of other cashflows.

³⁴ This is a measure of the dispersion of data points from the average. A large standard deviation indicates the data points are spread out over a large range of values.

Figure 6 - Expected volatility of credit requirements in 2020, 2025 and 2030, under DN and EBSCR for different party types



4.17. This chart shows that, although the volatility of credit requirements is likely to increase going forward, our reforms are not expected to cause a significant 'step-up' in risk for any party type in any of the snapshot years. For some it could even lead to a reduction. This result can partly be attributed to the dampening effect of single pricing, but it is also a reflection of behavioural changes simulated in the cash-out model (which assumes parties react rationally to cash-out price signals) and the expected infrequency of extreme events going forward (given the margins we're likely to see in a world with the CM). Relatively small parties aren't expected to be disproportionately worse off under our reforms, as they're more likely to benefit from single pricing than larger parties.

4.18. The second metric we used was a 'Severe Exposure' figure. This was based on the analysis of a number of hypothetical 'severe' events, which allowed us to gain an understanding of the potentially 'worst-case' impact on parties if cash-out prices were to repeatedly spike to high levels, and an indication of whether our reforms are likely to place unmanageable risk on parties.

4.19. More specifically, we looked at the Account Energy Imbalance Cashflow (AEIC) a given party would have incurred if a two hour disconnection event (during which the cash-out price was equal to £6,000/MWh) coincided with the settlement period when that party was shortest from 2010 to 2012, and the subsequent three settlement periods³⁵. We then added three additional two hour periods before or after this event in the same year where the cash-out price was assumed to be

³⁵ We assumed the disconnection event persisted for two hours, as this is the amount of time that has to elapse before a party can react to sharp cash-out prices

£500/MWh, and the party in question was as short as was the case during the disconnection event. The sum of AEIC over these four events gave us a Severe Exposure figure for each party.

4.20. We compared these figures to annual revenues for a number of parties³⁶. For nearly all parties, the value would have been less than 1%³⁷. In view of this, and given the very low probability of these stylised severe exposure events (ie, a party being at their extreme shortest during all 16 settlement periods in question) as well as the steps parties can take to reduce this risk we conclude it's very unlikely our reforms will place unmanageable risks on parties.

Risk Mitigations

4.21. Despite the conclusions reached above and our view that the single price policy significantly reduces risk we have put in place further measures to limit any remaining risk from our reforms:

- The introduction of more marginal pricing will be phased and indicative imbalance prices based on different PAR levels will be published by ELEXON as soon as possible;
- Indicative Loss of Load Probabilities (LOLPs) will be provided to the market ahead of Gate Closure, which should provide a signal to the market ahead of potential stress events;
- The LOLP used to determine the RSP price in a given settlement period will be calculated at Gate Closure, rather than at the beginning of that settlement period. This limits the risk of parties facing relatively high cash-out prices that they were unable to respond to;
- The value of VoLL will increase to £6,000/MWh in steps, starting at £3,000/MWh by winter 2015/16 and increasing to £6,000/MWh by winter 2018/19, allowing parties to adapt. It is also worth noting that £6,000/MWh is relatively low VoLL figure, in comparison to the range of estimates calculated for the study we commissioned from London Economics³⁸;
- We are leaving the option of pricing automatic low frequency demand disconnection in cash-out to industry.

4.22. Finally – in case residual concerns about risk remain – we would encourage industry to consider proposing changes to the current rules via a separate BSC mod,

³⁶ For independent suppliers, we estimated revenues by looking at customer bill and customer number data. For larger firms with more than one Party ID, and where the constituent parties where shortest in different years, we calculated annual revenue as the average of revenue in the relevant years.

³⁷ The figure wouldn't have been higher than 2.5% for any party

³⁸ <https://www.ofgem.gov.uk/ofgem-publications/82293/london-economics-value-lost-load-electricity-gb.pdf>

for example around credit requirements (if there's a view that credit requirements under the BSC could be made more appropriate, given our reforms).

Table 11 – Overall summary of our reforms on operational risk for market participants

Option	Rating	Rationale
Do nothing		Parties face relatively low imbalance risk. However, this risk is borne instead by consumers.
EBSCR		Strikes the appropriate balance between efficient incentives and avoidance of unmanageable risk. Very small increase in operational risk for some parties that is manageable with the steps parties can take to reduce risk.

5. Impacts on sustainable development

Chapter Summary

Our reforms are unlikely to significantly impact on the uptake of renewables and the achievement of government's renewable targets. However, greater incentives for investment and innovation in flexible technologies could help with the integration of intermittent sources and therefore play a role in the transition to a low carbon economy. Consumer bills should fall slightly as a result of our reforms compared to the status quo, although we don't expect this to significantly impact on fuel poverty.

5.1. Our principal objective of protecting the interests of existing and future consumers requires us to have regard to the need to contribute to the achievement of sustainable development. This section assesses the impact of our reforms on two key strategic and longer-term sustainability considerations: playing a role in the transition to a low carbon economy (including ensuring consistency with GB's low carbon commitments) and contributing to tackling fuel poverty and protecting vulnerable consumers. The impact on another key strategic government goal - ensuring secure and reliable energy supplies - is discussed extensively elsewhere in this document.

Transition to a low carbon economy

5.2. Government has committed to reduce greenhouse gas emissions (GHGs) and increase the amount of energy provided by renewable sources as part of the transition to a low carbon economy³⁹. It has put in place a number of policies, including, Feed-in Tariff with Contracts for Difference (FiT CfDs) under EMR, to incentivise the roll-out of low carbon electricity generation and reduce the emissions intensity of the capacity mix in order to achieve these targets. We consider here how our proposals could impact on the achievement of these targets.

Impact on uptake of intermittent renewable generation

5.3. Intermittent generation is inherently more unpredictable and uncertain than other types of generation. These generators have therefore had historically high imbalance risk relative to other parties. Changes to the cash-out calculation could further affect this risk. It could, for example, have a knock-on impact on the contracts offered to intermittent renewable generators for Power Purchase Agreements (PPAs) or affect the cost of competitively allocated FiT CfDs. Cash-out

³⁹ The UK has legally binding targets to reduce GHGs by at least 80% (from the 1990 baseline) by 2050 (www.gov.uk/government/policies/reducing-the-uk-s-greenhouse-gas-emissions-by-80-by-2050) and to meet 15% of the UK's energy demand using renewable sources by 2020 (www.gov.uk/government/policies/increasing-the-use-of-low-carbon-technologies).

reform could therefore directly influence investment decisions in renewable capacity and the cost of meeting government targets.

5.4. Our Forward Modelling suggests that under current arrangements independent wind parties, the main renewable generation on the system, will face higher imbalance costs in the future in the absence of reform. This is because wind parties will feel a share of the cost of larger and more variable system imbalances in the future. Also, as wind penetration on the system increases, so too does the likelihood that imbalances from wind generation (ie, due to a differences between forecasted and actual wind conditions) will drive the overall system imbalance, causing these parties to more often face the main cash-out price.

5.5. As explained in Chapter 4, our reforms are likely to reduce imbalance costs for onshore wind and only modestly increase them for offshore wind compared to DN. This is because although wind generators are likely to be impacted relatively more by sharper cash-out prices (as they have relatively greater imbalance volumes), their greater variability also means that they can also gain relatively more from a favourable cash-out price under a single price. The extent to which they benefit from this effect depends on how likely they are to have reducing imbalances. Smaller parties tend to have reducing balances more often as they are unlikely to drive the overall system imbalance due to their size. In the future, offshore wind parties are more likely to drive the overall system imbalance than onshore wind parties as they become increasingly larger in size and take up a greater share of the overall generation mix.

5.6. The results of our modelling depend heavily on our assumptions about the correlation of wind parties' wind forecast errors to other wind parties. We have therefore improved the robustness of our wind party modelling for our Final Policy Decision, by taking a 'bottom-up' approach to understanding the correlation between different wind farm's forecast errors. This also takes into account any correlation between onshore and offshore wind (further details on this can be found in Baringa's report).

5.7. Overall, our analysis implies a roughly neutral impact on wind parties. We therefore do not consider that changes to the imbalance arrangements under our reforms will directly impact on the uptake of renewable generation and the achievement of government targets.

Integration of variable renewable generation

5.8. In the long term, increased variability will be a major challenge for electricity system. Increased electricity system flexibility will be key to integrating renewable generation and ensuring system resilience. As our reforms create a better environment for investment and innovation in flexibility, they indirectly help accommodate the growing intermittency on the system in the future.

Impact on overall emissions intensity of electricity generation

5.9. The direct effect of our reforms on the overall emission intensity of electricity generation is likely to be minimal. However, as our reforms could incentivise a more flexible generation mix this could help accommodate the increase in intermittent renewable generation like wind and therefore indirectly support carbon reduction.

5.10. Flexibility in the market has traditionally been provided by emissions intensive generation. However, sharper prices will also provide a better environment for the development of other flexible capacity, such as DSR or storage, which may be less emissions-intensive. Our reforms may not lead to a total emission change from a global perspective as GB power sector emissions fall under the scope of the EU Emissions Trading Scheme (EU ETS). However, there could be some small impact on the demand for and hence price of allowances which any investment in carbon intensive technologies will need to internalise.

Tackling fuel poverty and protecting vulnerable consumers

5.11. Our reforms are unlikely to have a major impact on fuel poverty and protecting vulnerable consumers. There is likely to be a modest reduction in consumer bills in the medium and long term, although this could be more significant depending on the size some of the dynamic gains that could result from more efficient price signals (see chapter 3).

Table 12 – Overall summary of impacts of our reforms on sustainable development

Option	Rating	Rationale
Do nothing		Wind parties face increasing balancing costs in the future. Balancing costs are also likely to increase, which could lead to increases in bills.
EBSCR		Reform has a roughly net neutral impact on wind parties, but ultimately supports sustainable development by removing barriers to the flexibility required to accommodate growing intermittency on the system.

6. Risks and unintended consequences

Chapter Summary

Previous chapters have discussed how improved price signals should drive more efficient party behaviour that should deliver benefits for consumers. However, there are a number of risks and unintended consequences that may impact on our desired outcomes. These include risks to the achievement of efficient price signals (eg, from cash-out pollution) and indirect impacts on party behaviour that could have negative consequences for consumers (eg, through reduced liquidity or market manipulation). We consider that the benefits from our reforms far outweigh these risks. However, we intend to monitor the impact of our reforms going forward.

6.1. In this chapter we assess the key risks and unintended consequences of our reforms. It does not present an exhaustive list of the analysis we have conducted in response to stakeholder feedback, as this much of this has been addressed elsewhere in this document.

Risks to efficient price signals

6.2. As reiterated throughout this document, we strongly consider that improving the cost-reflectivity of cash-out prices will encourage more efficient behaviour from market participants that will deliver benefits to consumers in the long run. However, we recognise that the structure of the existing arrangements and the precise implementation of our reforms could impact the achievement of efficient price signals in practice. This has been a key consideration during the design of our policies.

Cash-out price pollution

6.3. Cash-out prices are designed to reflect the overall energy imbalance in a given half-hour settlement period. However, in its role as residual balancer, the SO balances over a longer time horizon (ie, over the course of several hours) and balances both system and energy imbalances together. As such, cash-out prices are at risk of being 'polluted' by actions taken by the SO for non-energy balancing reasons. Under the current balancing arrangements, flagging and tagging processes are in place to remove potential polluting actions. However, were these processes to not work effectively, this could lead to inefficient signals to balance which could unnecessarily increase balancing costs for consumers.

6.4. Some stakeholders have previously expressed concerns that a move to PAR 1 potentially increases the risk that the price is distorted by a 'system' action, as it would reduce the number of actions feeding into the price. We assessed this risk during the development of our Draft Policy Decision and concluded that it is unlikely to be a significant issue. This is mainly because our analysis suggests that BSC Modification P217A has been successful in reducing the large amount of pollution caused by system constraint actions; existing arrangements may actually be over-compensating in their removal of pollution; and that under PAR 1, more than one

action would feed into the cash-out price calculation on average, which reduces the likelihood that the price calculation could be solely based on one unrepresentative action⁴⁰. We have not received any further evidence to change this conclusion. In addition we note National Grid is effecting a change that allows ex-post correction of mis-flagged or tagged actions⁴¹. This is due to come into effect in June 2014 and further mitigates concerns that parties have raised over possible system pollution.

RSP and VoLL pricing

6.5. VoLL pricing ensures parties factor in the costs to consumers of Demand Control actions into their trading and investment decisions. However, in practice there is no one VoLL that will perfectly reflect the costs to different consumers in the event of Demand Control. We have therefore adapted a cautious approach when choosing an administrative level of VoLL for cash-out purposes. We consider that our chosen VoLL level of £3,000/MWh before winter 2018/19, and £6,000/MWh after, which has been informed by our VoLL study, strikes the right balancing between keeping risk manageable and improving balancing incentives.

6.6. The RSP should much improve the reflection of the costs the SO (and consumers) would have been willing to incur in each settlement, resulting in much more efficient signals than the status quo. However, we recognise that the price signal is highly dependent on the LOLP calculation and VoLL level. We also note that accurately reflecting the total costs incurred by the SO on an overall basis is not guaranteed. For this reason we have carried out detailed qualitative and quantitative analysis during our development of the RSP. Our quantitative analysis backs up our reasoning that the RSP should lead to a much improved reflection of reserve costs on a settlement period basis, and indicates that it is unlikely to be worse (and could even be better) at achieving cost-reflectivity on an overall basis. This is explained further in Appendix 3.

Indirect impacts on party behaviour

Position deviations and uncertainty for the SO

6.7. The wholesale market is currently structured such that trading is completed at Gate Closure. At this point parties notify the SO of their final contracted positions and their expected physical positions. The period following Gate Closure allows the SO time to optimise the system in the most efficient way.

6.8. Under a single cash-out price, parties could benefit from having reducing imbalances by facing a more favourable (cost-reflective) price through cash-out than

⁴⁰ For more information please see our Draft Policy Decision IA.

⁴¹ See Final Report CP1400 December 2013 http://www.ellexon.co.uk/wp-content/uploads/2013/09/CP1400_Final-Report_v1.0.pdf

the price they could face through trading in the energy market before Gate Closure. Some stakeholders have previously raised concerns that this could create additional uncertainty for the SO as parties may try to anticipate the system length and adjust their positions, either before or after Gate Closure, to take advantage of this favourable price ('chasing NIV'). This increases the risk that SO balancing actions need to be undone, increasing the total cost of balancing.

6.9. Our previous analysis has suggested that there is significant uncertainty about the system direction and imbalance volume before Gate Closure⁴². Further, the more parties adjust their positions to try and achieve a reducing imbalance, the lower that level of net imbalance is likely to be and hence the lower the cash-out price. In this sense chasing NIV is a self-defeating strategy. Given these factors, we consider that it is highly unlikely that parties would consistently try to anticipate the system direction and spill⁴³ before Gate Closure; the dominant strategy should be to trade forward and balance.

6.10. In addition, we do not think that there is a significant increased risk of parties intentionally deviating from their submitted physical positions after Gate Closure (for example to counter imbalances across their portfolio). This is because this behaviour is restricted under existing Grid Code arrangements⁴⁴. Where evidence of non-compliance with codes is found, we can impose penalties⁴⁵.

6.11. We agree with the majority of respondents to our Draft Policy Decision consultation that moving to a single price is a positive change and no additional measures (such as imbalance information charges) are needed.

Liquidity

6.12. Several respondents to our Draft Policy Decision consultation noted the potential impacts of our reforms on intraday liquidity and we have conducted further qualitative analysis in this area. As mentioned above, we consider that uncertainty about the system length and direction will lead parties to adopt a dominant strategy of trading out their imbalance position ahead of Gate Closure, which is likely to increase liquidity. However, if we do assume for this analysis that parties are able to

⁴² Over the period from November 2009 to December 2012, the direction of the SO's initial indication of imbalance was incorrect in 34% of settlement periods. Further, where the SO's indication of the direction of imbalance was correct, there was still substantial variation between the size of forecast and outturn imbalance.

⁴³ Intentionally going longer and incurring a higher level of imbalance.

⁴⁴ The Grid Code requires parties to submit accurate Final Physical Notifications and follow these - see Section BC2.5.1 'Accuracy of Physical Notifications' of the Grid Code: www.nationalgrid.com/NR/rdonlyres/66D4AB26-8AE6-4405-ADF6-8D34B86B6B6C/59916/21_BALANCING_CODE_2_I5R3.pdf

⁴⁵ Decisions on whether to take enforcement action are taken in accordance with our enforcement guidelines: <https://www.ofgem.gov.uk/ofgem-publications/37567/enforcement-guidelines-2012.pdf>

predict their position relative to the system, incentives to trade ahead of Gate Closure may be affected by our reforms in three different ways, which are set out in Table 13.

Table 13 - Incentives to trade ahead of Gate Closure under 'Do nothing' and the EBSCR (*assuming parties can predict their position relative to the system)

Package	Party position		
	Aggravating imbalance	Reducing imbalance	
	Incentive to trade out position	Incentive to trade out position	Incentive to increase imbalance through trading
'Do nothing'	+	0*	0*
EBSCR	++	-	+

6.13. In theory, under our reforms, there could be a greater incentive to trade ahead of Gate Closure if a party expects to have an aggravating imbalance (as they would be exposed to sharper cash-out prices), which could have a positive impact on liquidity. However, under single pricing, there is a disincentive to trade ahead of Gate Closure if a party expects to have a reducing imbalance (as they would receive a more favourable price through cash-out), which could have an adverse impact on liquidity. However, if a party is sufficiently confident it will have a reducing imbalance, it may seek to increase this imbalance through trading (i.e. 'chase NIV'), which in turn could have a positive impact on liquidity.

6.14. This indicates that even if parties could predict their position relative to the system (which is very difficult) there would still be a number of opposing effects on liquidity. As mentioned in Chapter 4, we also do not expect our reforms to have a significant impact on the level of concentration in the market and therefore the number of market participants trading in near-term markets. For this reason, and in view of the uncertainty and risk associated with 'chasing NIV' our conclusion remains that trading out their position is likely to be a dominant strategy for parties, and as such the net effect on liquidity is likely to be positive or at worst neutral.

Manipulation of cash-out prices

6.15. Some stakeholders have suggested that the incentives and opportunity to manipulate cash-out prices could increase as a consequence of our reforms. Under a single cash-out price, parties may have an incentive to inflate the cost of balancing through the BM, as this would result in a more favourable price for reducing imbalances⁴⁶. Further, under more marginal pricing, there could be a greater chance

⁴⁶ For example, if a party were able to raise the SBP when it was long and the system was short, it would gain by receiving even more through cash-out relative to the market price. This is not the case under existing arrangements where parties always face a market reference price for reducing imbalances.

that the cash-out price is set by the bids or offers of a single market participant. An additional concern is that the RSP price would be derived from information submitted by parties, which could increase the opportunity for manipulation. We examined these concerns during the development of our Draft Decision and concluded that our proposals would not significantly increase the opportunity or incentives for parties to manipulate cash-out prices. We have explored this further for our Final Decision but have found and received no further evidence to change this conclusion.

6.16. We do not consider that opportunities for manipulation are significantly increased because it is very difficult to predict if and how an individual balancing action will enter the cash-out calculation, in particular because flagging and tagging procedures remove a number of actions⁴⁷. It is also not clear which direction the system imbalance will be in a given settlement period and therefore whether the price will be calculated using buy or sell actions. The chance of a party successfully anticipating whether its bid or offer is the marginal action in cash-out appears to be very low.

6.17. The RSP price would be even more difficult to manipulate as it is based on information from a number of sources, not just parties participating in the BM. As the RSP is likely to set the cash-out price when the margins are very tight⁴⁸, arguably when there is the greatest opportunity for manipulation, the RSP could actually *reduce* the ability for parties to manipulate cash-out prices overall.

6.18. Even if cash-out price manipulation were possible, the incentives appear to be low, firstly because the potential gains are limited. In particular the cash-out price cannot be earned by BM participants as the BM is not PAC. Although there is a relationship between the cash-out price and wholesale market price, this only an indirect relationship involving significant short-term uncertainty, particularly during normal system conditions. A more obvious way parties could gain from cash-out price manipulation is through cash-out itself. For example, when the system is likely to be short (perhaps due to a large plant trip) and party with a long position may have an incentive to attempt to inflate the cash-out price to benefit from the single price⁴⁹.

6.19. In any case, we consider that these limited potential gains are far outweighed by the financial, legal and reputational risks involved. Parties risk hurting themselves by artificially inflating the cash-out price, as there could be unexpected changes in their own imbalance position. In addition, given the inherent difficulties with

⁴⁷ NIV tagging in particular will more often than not remove the top price action. In 90% of short periods and in 77% of long periods from November 2009 to November 2012, the most expensive action accepted did not enter the price calculation due to NIV tagging.

⁴⁸ During very tight margins we expect the SO to use large volumes of STOR, which would all likely share the same, high RSP price (as this a function of VoLL and the Loss of Load Probability), decreasing the chance that the cash-out price is set by a bids in the BM.

⁴⁹ As cash-out is a zero-sum game overall, this gain would be at the expense of the parties with short positions who would have to pay artificially higher cash-out charges.

anticipating the size and direction of the system, it may take a number of bids or offers to be successful, which could lead to lost revenue in the BM. Uncompetitive pricing behaviour could also result in challenges under competition law and under the Regulation on Wholesale Energy Market Integrity and Transparency (REMIT)⁵⁰. Finally, any party responsible for setting the cash-out price at unjustifiably high levels at the expense of other parties could suffer serious reputational damage.

6.20. We will continue to monitor parties' behaviour as part of our market monitoring role, including as part of our work under the REMIT. Through REMIT we have powers to investigate and request any information from parties suspected of market abuse in the BM, as well as impose financial penalties.

Ongoing monitoring and post-implementation review

6.21. Following implementation of the EBSCR we intend to review its impact and the extent to which it achieves its objectives.

6.22. Where possible, we will monitor indicators, such as price signals and behaviours, to assist evaluation of our reforms⁵¹. We may also monitor indicators of operational risk such as incidence of credit default. Monitoring will allow us to make an informed assessment of whether in-depth analysis – for instance modelling to disentangle the effect of EBSCR from other developments – would add value.

6.23. Our preferred option is to review the impact of our reforms after the main package (implemented by early winter 2015/16) has had time to take effect but in advance of the final step (coming into effect by early winter 2018/19). A second stage may review impact of reforms after the final step has had time to take effect.

⁵⁰ Regulation (EU) No. 1227/2011 on wholesale energy market integrity and transparency; Article 7 (2): eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2011:326:0001:0001:EN:PDF

⁵¹ As provided for instance in Elexon's Trading Operations Reports

7. Other impacts, cost benefit analysis and conclusions

Chapter Summary

Our reforms will have a number of associated implementation and ongoing administrative costs, but these will be greatly outweighed by the benefits they bring. Our reforms are also unlikely to have any significant impacts on the gas market. We have developed an illustrative CBA from our Forward Modelling results which suggests that our reforms will deliver a NPV to consumers of ~£430m from 2016-2030.

Implementation and ongoing administrative costs

7.1. Our reforms will have a number of associated implementation and ongoing administrative costs which are ultimately likely to be passed on to consumers. In policy design, the costs of administration and implementation are an important factor and we have aimed to minimise the burden on market participants and therefore consumers. This is one reason why we are proposing not to pay consumers for involuntary DSR as a balancing service to the SO.

7.2. Overall, we anticipate that the administration and implementation costs of our final proposals should be relatively small in comparison to wider costs and benefits associated with reform. Making prices more marginal and a single price are likely to imply very small implementation costs associated with changes to Elexon's systems and parties' trading strategies. The implementation of RSP and VoLL pricing might have slightly higher associated costs according to discussions with stakeholders⁵² however a full assessment of such costs will be carried out as part of the industry modification process.

Impacts on the gas market

7.3. Gas-fired power stations represent a significant proportion of the GB capacity mix. They are also some of the largest consumers of gas. This means that the electricity market and gas market are strongly linked. The projected changes in the GB generation mix will mean an increase in the interdependency of these two markets in the future.

7.4. The CM is likely to be the key driver for investment power stations, including gas-fired power stations. Our reforms should strengthen incentives to provide,

⁵² Likely in the low 6-figures range

maintain and invest in flexible capacity. One such example of flexible capacity is OCGTs. If, for example, our reforms were to lead to a greater proportion of OCGTs in the overall generation mix, this could lead to greater and more volatile gas demand. It is possible that this could in turn lead to higher and more volatile wholesale gas prices. However, the overall impact in this scenario is likely to be small as gas demand would only increase to the extent that OCGTs replace other sources of flexibility at times of tight margins (e.g. involuntary Demand Control).

7.5. In addition, there is a lot of uncertainty about how the market might respond to sharper cash-out prices. It could be that sharper, more efficient price signals lead to investment and innovations in other flexible technologies, or result in much more responsive interconnector flows or greater provision of voluntary DSR. This could actually reduce the need for gas-fired power stations, both in terms of overall capacity and system flexibility. Therefore, we do not consider it appropriate to draw strong conclusions about the impact of EBSCR on prices for gas, other than the effect is likely to be marginal.

Illustrative cost-benefit analysis of reform

7.6. The packages of reform will have a number of impacts on the wholesale electricity market, which will imply costs and benefits for market participants, and ultimately consumers. As part of this IA, we have developed a cost-benefit analysis (CBA) in order to understand the potential weight of the different impacts. The annualised costs and benefits for four future modelled years (2016, 2020, 2025 and 2030) are presented in Table 14 below. We have also included a Net Present Value (NPV) for the reforms today over this period until 2030. Further detail on our approach to the CBA and the results can be found in Appendix 2 and Baringa's report.

Discussion of results

7.7. The CBA collates our key Forward Modelling results (set out and discussed in Chapter 3) in order to gauge the overall impact of reform and assess the magnitude of different effects. It illustrates that cash-out reform is likely to drive benefits for consumers in the medium to long term. There are likely to be some costs in the early years after implementation until the market has fully absorbed the changes and the CM is introduced. However, these are more than offset by the gains of EBSCR in the medium to long term from 2018/19. This results in an overall positive NPV to consumers of £435m.

7.8. We have also presented an alternative NPV for illustration. This focusses solely on the balancing savings. This is useful as the absolute size of the wholesale market revenues (and by extension CM effects) involve a significant amount of uncertainty. It also gives an indication of the potential 'societal impact' of our reforms given that these wholesale market revenue impacts can be viewed as transfers between producers and consumers.

Table 14 – Summary of cost-benefit analysis

£m/year (2012 prices) (positive = benefit for consumers)	2016⁵³	2020	2025	2030
Total balancing efficiency gains	17	14	16	33
Increased electricity market revenues	-166	-17	-360	-426
Reduction in capacity payments	0	27	468	517
Interconnector impact on CM	0	5	3	7
Total	-149	29	127	131
Average annual domestic bill impact (-ve: reduction)	1.60	-0.32	-1.40	-1.32
NPV (all effects)	£435m			
NPV (balancing effects only)	£202m			

7.9. The CBA also shows net costs for consumers in the near term. However implementation from 2016 is in the interest of consumers. This is because parties bid into the CM several years in advance⁵⁴. Greater experience of the impact of cash-out reform on wholesale prices could increase the confidence parties have in the resultant revenue increases, which in turn could affect the likelihood that consumers benefit from overall savings in the CM. In addition, there are a number of benefits from more efficient, spikier wholesale prices that we have been unable to capture in the model. One benefit relevant to the pre-CM years is a potential increased level of security of supply due to the prevention or delay of mothballing decisions.

7.10. Although it represents a best attempt to capture the full impact of our reforms, the CBA is intended to be illustrative and not a precise estimation of the full costs and benefits of our reforms. This analysis is useful because it supports the wider quantitative and qualitative evidence that has been presented in this IA. However, it should be noted that there is likely to be a wide range of uncertainty around the costs and benefits identified, particularly results that relate to changes in wholesale price signals. Further, the CBA does not capture all the costs and benefits associated with our reforms as many effects are very difficult to quantify. In particular, the model does not capture: the benefits of other new technologies which could be brought forward (eg storage); the impact of a more active demand-side; the impact of a more flexible generation mix; any impacts on competition and innovation in the market and sustainability.

⁵³ Our model can produce results for 4 spot years; 2015, 2020, 2025 and 2030. However, the full EBSCR package is not due to come into effect until winter 15/16 at the earliest. We have used a model run of the full EBSCR in 2015 as a proxy for 2016.

⁵⁴ The first CM auctions, for winter 2018/19, are occurring in winter 2014.

Conclusions and overall assessment

7.11. There is strong evidence that GB's existing balancing arrangements are not working for consumers as well as they could be⁵⁵. Through the EBSCR we have carried out detailed analysis and engaged extensively with stakeholders in order to consider how the arrangements could be improved in light of these concerns. Our Final Policy Decision represents the culmination of this work and this IA contains the evidence base underpinning our decisions.

7.12. There is strong qualitative evidence that our reforms deliver net benefits for consumers. In particular, by more accurately reflecting the costs to consumers of imbalances in cash-out prices, our reforms drive greater efficiency in balancing and in the delivery of secure electricity supplies to consumers. Our Forward Modelling, which we use to test – rather than underpin – the case for reform, supports our qualitative analysis and presents comforting evidence in relation to potentially negative distributional and risk impacts.

7.13. We summarise the overall assessment of the impact of our reforms in six key areas in Table 15.

Table 15 – Overall assessment (Key: red = negative impact; grey = neutral impact; green = positive impact)

	Balancing efficiency	Efficiency of secure electricity supplies	Consumer bills	Competition and distributional impacts	Operational Risk	Sustainable development
Do Nothing						
EBSCR						

⁵⁵ These concerns were raised in Project Discovery in 2010 and subsequently in our cash-out issues paper in 2011.

Appendices

Index

Appendix	Name of Appendix	Page Number
1	Overview of Forward Modelling analysis	44
2	Cost-benefit analysis approach and limitations	48
3	Reserve Scarcity Pricing function analysis	53
4	Feedback Questionnaire	57

Appendix 1 – Overview of Forward Modelling analysis

7.1. This appendix provides an overview of our Forward Modelling analysis. It includes a description of the cash-out model developed by Baringa; the additional analysis carried out using outputs from the model; and some of the key assumptions and limitations of the modelling approach. For more detailed information, please see Baringa's report.

Overview of the cash-out model

7.2. There are a number of possible approaches to modelling the impacts of changes in the cash-out arrangements. We opted to develop a 'top-down' simulation model of the key drivers of cash-out prices that is well calibrated to historic data. This approach provided sufficient flexibility to capture the detail of our proposals and also delivered greater transparency in understanding and communicating the modelling results. The model estimates how changes in the cash-out price calculation impact on party behaviour in each settlement period of a characteristic day in each month, in four spot years going forward (2015, 2020, 2025 and 2030).

7.3. For each given settlement period, the model simulates imbalances for individual parties depending on a number of factors (eg, demand forecast errors). These are aggregated to form a Net Imbalance Volume (NIV) which is compared to a representative bid-offer stack of balancing actions available to the SO to derive cash-out prices. These stacks were constructed using historic data (post P217A implementation) and adjusted over time to reflect changes to the underlying generation mix and other variables. Using the cash-out prices generated, and other simulated variables, the model estimates a Market Index Price (MIP) using a fixed regression relationship derived from historic data. MIP is used to represent both the reverse price under dual cash-out price arrangements and near-term market prices in the model in forward years.

7.4. In the model, it is assumed that in the short term parties can change their strategy for hedging imbalance risk before Gate Closure, which is represented by the imbalance opportunity cost for each party⁵⁶. As parties change their hedging to minimise this cost, this has a further impact on cash-out prices. The model runs a number of iterations of changing prices and hedging adjustments before reaching equilibrium where no further behaviour change is incentivised.

⁵⁶ Opportunity costs are the difference between the amount a party pays for being out of balance (cash-out) and what they would have paid if they had traded out their position in the intraday market. This is a more appropriate metric to assess the cost of being out of balance than to just look at cash-out charges only.

7.5. Interconnector flows are now endogenously captured as part of the model in order to explore the interactions with cash-out price changes. These are simulated after the short term iterations by comparing the simulated MIP in GB with simulated prices in interconnected markets, taking into account the loss factors on different interconnectors⁵⁷. As changes in interconnector flows could have a subsequent knock on impact on cash-out prices and wholesale prices, an iterative calibration is undertaken until a broad equilibrium position between MIP and flows is reached. As changes to the cash-out calculation under our reforms can impact upon the MIP, this can also lead to change in interconnector flows compared to Do Nothing (DN) (eg, if it was previously at float in a period and the price increased this may be sufficient to lead to imports). As a result, the model can also simulate changes in the volume of energy unserved that can occur due to changes in the cash-out calculation.

7.6. In the long term, the model assumes that parties can invest in additional measures to allow them to better manage their imbalance risk (eg, forecasting and reliability improvements) and minimise their imbalance opportunity costs. The impact of this investment is overlaid onto the final positions from the short term simulation.

7.7. The model also simulates imbalance volumes, imbalance charges, Residual Cashflow Reallocation Cashflow (RCRC) and imbalance opportunity costs for different party types. Comparing these results provides us with an understanding of the potential distributional impacts of our reforms.

Additional forward-looking analysis

7.8. Results from the cash-out model can be used to conduct further analysis on the future impact of our reforms. We asked Baringa to carry out forward-looking analysis in two key areas. First we wanted to understand how our reforms could impact on the parties' bids in the Capacity market (CM) auctions and secondly we wanted to gain further insight about the impact of our reforms on parties' ongoing credit cover requirements under the Balancing & Settlement Code (BSC).

7.9. The CM auction analysis used the MIP results under both DN and EBSCR runs to understand the potential impact of our reforms on wholesale prices throughout the different spot years. A separate electricity wholesale market model, Baringa's Transmit Decision Model⁵⁸, was then used to understand which plant would likely be running in these periods under the DN scenario and how the different prices under

⁵⁷ Price distributions for GB and interconnected markets and assumptions about the correlation between these price distributions were developed for each month in each spot year using the same analytical framework used in Baringa's study for DECC on the 'Impacts of further electricity interconnection on GB':

https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/266307/DECC_Impacts_of_further_electricity_interconnection_for_GB_Redpoint_Report_Final.pdf

⁵⁸ The TDM has been employed as part of Ofgem's Project Transmit analysis. It is an endogenous investment decision model of the wholesale GB electricity market and includes an embedded module to simulate the proposed CM auctions.

EBSCR could therefore impact on expected revenues, and hence bids in the CM and CM clearing prices. An assumption was also made that peaking plant can capture 3 hours of additional electricity revenues under our reforms where the wholesale price is equal to the maximum SBP modelled in each spot year⁵⁹.

7.10. The credit cover analysis uses party level outputs from the model, (such as imbalance charges and RCRC) to create an approximation of the rolling credit cover requirement different parties would need to be post each day to avoid entering the default process under the BSC Energy Credit Cover requirements⁶⁰. The credit cover simulation is run 500 times in order to get a range of results. From this we can then infer the potential volatility and maximum likely BSC cash-flow exposure as a result of our reforms.

Key assumptions and limitations of the modelling approach

7.11. Modelling the impacts of changes to cash-out is very difficult and complex. In order to construct the model, a number of simplifying assumptions were made about the workings of the model and parameters within it. For our updated modelling runs we assumed a baseline where the CM is in place. The underlying capacity assumptions in the model and other parameters going forward (eg, expected hours of disconnections and voltage control) were therefore taken from DECC's DDM 'with CM' modelling results. Given that the CM is likely to provide the main signals for investment in capacity, a key simplifying assumption we have made for the modelling is that cash-out reform does not have an impact on parties' investment decisions. However, in practice, additional expected revenues in the intra-day market would likely affect party decisions (eg, by impacting on the *type* of investment that is made) and therefore the evolution of the electricity system over time. The model is therefore unable to capture some of the key potential benefits of our reforms.

7.12. It is also important to note that the primary focus of the model is on balancing and cash-out prices. It does not explicitly model the wider electricity market or the corresponding dispatch of plant. Rather, the impact on the wider wholesale market is captured indirectly via the MIP regression model. We have assumed that the relationship between cash-out prices (and other system parameters) and wholesale prices in MIP regression model holds into the future. Whilst this is likely to be the best approximation possible, it does not capture the potential for this relationship to change over time as the electricity system undergoes significant transition. It is important that the results are considered in this context, particularly the results of analysis that has been layered on top of the MIP results (such as the changing wholesale revenues and CM effects).

⁵⁹ This is consistent with DECC's assumptions in our 'with CM' baseline that peaking will be running for 3 hours each year during very tight margins.

⁶⁰ http://www.elexon.co.uk/wp-content/uploads/2013/11/credit_cover_guidance_v6.0_cgi.pdf

7.13. In the model, parties are assumed to respond rationally to reduce their expected imbalance exposure in response to cash-out signals by adjusting their hedging strategies and investing in long term balancing measures. Whilst economically rational behaviour is the most transparent and sensible assumption to make for this type of analysis, in practice parties will not have perfect foresight of their imbalance opportunity costs. The behavioural response by different parties is unlikely to be perfectly economically rational in practice, particularly considering parties may have differing levels of risk aversion.

7.14. The model makes a number of other simplifying assumptions which may influence the results. These are set out in Section 3 of Baringa's report.

7.15. It is not possible to capture the full complexity of the energy market and the decisions made by different energy market participants in a model. Given the uncertainty surrounding this type of analysis, we have always considered it to be illustrative and not definite. We have used the model mainly to stress-test our strong qualitative case rather than it being the primary driver of our recommendations.

Appendix 2 – Cost-benefit analysis approach and limitations

1.1. As part of the evidence base to support our Final Policy Decision, we have developed a cost-benefit analysis (CBA). This seeks to illustrate and monetise the key costs, benefits and resulting NPV for our reforms. This appendix sets out in greater detail our approach to the CBA, key caveats and more detailed results.

Methodology and assumptions of CBA

1.2. The CBA shows the difference in results from our Forward Modelling in each of our four modelled spot years: 2016⁶¹, 2020, 2025 and 2030. This includes direct outputs from the cash-out model (such as the impact on balancing costs as a result of changing participant behaviour) and the results of analysis that uses outputs from the model (such as changes to wholesale revenues and capacity payments).

1.3. The CBA looks at the impacts on parties. We assume that all costs and savings are passed through consumers. The CBA contain the following impacts:

- **Net imbalance charges (NIC) and RCRC:** these are direct outputs of the cash-out model and represent the costs of imbalance charges to parties and the redistribution of these charges through RCRC. They are neutral for parties and consumers overall but have party distributional impacts, as described in Chapter 4. Our reforms reduce NIC compared to DN (due to the single price), equally reducing the amount that comes back to all parties via RCRC;
- **Short Term (ST) balancing decisions:** this represents the net change in the total costs of balancing the system resulting from a change in parties' position biases. This is composed of the cost to the SO of accepting bids and offers and the costs to parties of hedging before Gate Closure (the cost of hedging is valued at estimated MIP). Changes in these costs will occur through behavioural responses to changes in cash-out price expectations;
- **Investment in Long Term (LT) balancing:** changing cash-out expectations are likely to have a significant impact on decisions to invest in long term balancing measures (eg, improved forecasting and plant reliability). These decisions are not endogenously captured as part of the model. However, the model is able to assess the likely difference in investment incentives under our reforms compared to Do Nothing (DN) as a

⁶¹ Using 2015 as proxy for 2016

result of different imbalance opportunity costs. A positive number represents the savings to parties from avoided investment;

- **System costs from LT balancing investment:** any investment in LT balancing performance of parties will affect the SO's overall cost of balancing (which will be passed back to parties through BSUoS charges);
- **Wholesale electricity prices:** cash-out reform has a knock on impact on wholesale prices, particularly during tight margins. This will increase revenues for generators and increase costs to suppliers. The CBA shows the increased costs to suppliers of purchasing electricity⁶²;
- **Capacity prices (from lower party bids):** as discussed in Chapter 3, this represents the change in capacity payments to CM parties as a result of changing wholesale market revenues. Lower capacity payments represent savings to suppliers;
- **Impact of interconnectors on CM:** also discussed in Chapter 3, this is the savings in the CM from higher de-rating factors for interconnectors.

Illustrative CBA and modelling limitations

1.4. It is extremely difficult to accurately estimate the costs and benefits associated with changes to the cash-out arrangements. The costs and benefits are strongly dependent on assumptions around how parties respond to changing cash-out signals. This is highly uncertain, in particular in the longer term given the significant changes expected in the wholesale market over the next decade. Further, cash-out is only one of a number of different influences on party behaviour in the wholesale market. The CBA is therefore likely to have a wide range of uncertainty.

1.5. Our Forward Modelling has allowed us to understand how some of the key cash-out parameters may respond to proposed reforms and underlying market trends going forward. It has been important for 'stress testing' our qualitative analysis, in particular establishing potential distributional impacts. However, the model is not able to fully and accurately monetise all impacts associated with cash-out reform given the assumptions made to maximise the simplicity and transparency of the model. Specifically the model does not:

- Capture the evolution of the electricity system over time as a result of changing price signals. Cash-out reform is likely to impact on, amongst other things, the type of investment brought forward; incentives for DSR; and the

⁶² It is assumed that CfDs will insulate suppliers from higher wholesale costs resulting from cash-out reform for the proportion of their demand covered by CfDs (as higher wholesale prices reduce the CfD payments by suppliers).

likelihood of innovation in flexible technologies (such as storage). These could all lead to significant changes in the costs involved with balancing the system and delivering secure, sustainable electricity supplies to consumers;

- Consider in detail parties' strategies around bidding and offering in the BM going forward and how the SO might respond to changes in the system as a result of our reforms, both of which could have an impact on total balancing costs;
- Incorporate the wider impact that changes in competition and distributional effects could have on the market;
- Consider how more volatile cash-out prices and increased imbalance risks could impact on risk premiums they may include in consumer bills. However, our analysis in this area suggests that impact on risk are unlikely to be significant;

1.6. As such, the CBA presented does not include all costs and benefits associated with cash-out reform. In particular, given the above factors, we consider that it is likely to underestimate the benefits of reform overall. However, the CBA does represent a best-attempt to capture and illustrate the key costs and benefits.

Results of CBA

1.7. The annualised estimates of the costs and benefits are included in Table 16. All impacts are expressed relative to the DN option. The NPV has been calculated from 2016-2030 using a linear interpolation between our four modelled spot years and a 3.5% social discount rate⁶³.

Table 16 - CBA from consumer perspective (NPV social discount rate of 3.5% real)

£M/year (2012 prices)		EBSCR relative to DN			
		2016 ⁶⁴	2020	2025	2030
	NIC	122	100	162	330
	RCRC	-122	-100	-162	-330
	ST balancing decisions (parties and SO)	2	2	2	-3
	Party savings from lower LT balancing investment	30	26	21	39

⁶³ In accordance with HMT Green Book guidance

⁶⁴ Our model can produce results for 4 spot years; 2015, 2020, 2025 and 2030. However, the full EBSCR package is not due to come into effect until winter 15/16 at the earliest. We have used a model run of the full EBSCR in 2015 as a proxy for 2016.

SO balancing costs from lower LT balancing investment	-16	-14	-7	-3
CM savings	0	27	468	517
Interconnector impact on CM	0	5	3	7
Wholesale electricity prices	-166	-17	-360	-426
Total consumer savings	-149	29	127	131
Average consumer cost change £/MWh ⁶⁵ (-ve = savings)	0.48	-0.10	-0.43	-0.40
Annual domestic bill change (£)⁶⁶	1.60	-0.32	-1.40	-1.32
NPV 2016 – 2030 £M (+ve = benefit)	435			

Note: totals may not sum due to rounding.

1.8. As can be seen, our Forward Modelling suggests that our reforms could deliver a NPV of approximately £430m from 2016 to 2030. As mentioned, there is significant uncertainty about this figure and it is unlikely to capture the full impacts of cash-out reform. In particular it does not capture many of the benefits to parties (and therefore consumers) that could accrue in the wholesale market as a result of more efficient price signals. In addition, the capacity payment results assume that generators perfectly anticipate the additional revenues modelled. In reality, generators do not have perfect foresight and uncertainty about revenues may result in a more cautious approach to reflecting expected wholesale revenues into their CM bids. Nevertheless, we consider that overall the modelling results support our strong qualitative case for reform.

1.9. In addition to the general uncertainty surrounding the Forward Modelling, we note the particular uncertainty about the results for the wholesale market revenue effects and by extension the capacity payment effects. For this reason, we have also presented a CBA and NPV which excludes these two effects in Table 17. This also provides an illustration of the potential net 'societal gains' as a result of our reforms⁶⁷.

⁶⁵ This is calculated by dividing the impact in each year by the modelled demand in each year.

⁶⁶ Assumes typical annual average use of 3.3 MWh

⁶⁷ The wholesale electricity revenue and capacity payment effects can be viewed as transfer between producers and consumers, therefore having zero impact on society as a whole.

Table 17 – CBA (excluding wholesale and CM effects)

£M/year	EBSCR relative to DN			
	2016	2020	2025	2030
ST balancing decisions (parties and SO)	2	2	2	-3
Party savings from lower LT balancing investment	30	26	21	39
SO balancing costs from lower LT balancing investment	-16	-14	-7	-3
Total consumer savings	17	14	16	33
Average consumer cost change £/MWh	-0.06	-0.05	-0.05	-0.10
Annual domestic bill change (£)	-0.18	-0.16	-0.17	-0.33
NPV 2016 – 2030 £M	202			

Appendix 3 – Reserve Scarcity Pricing function analysis

1.1. We consider that pricing Short Term Operating Reserve (STOR) actions into cash-out according to their value, using a Reserve Scarcity Pricing (RSP) methodology, would significantly improve upon the existing cost-based approach (the 'BPA approach')⁶⁸. However, some stakeholders have expressed concern about de-linking the price of STOR in cash-out from actual STOR costs due to a potential deviation from cost-reflectivity. This annex summarises the historical quantitative analysis we have carried out during the development of the RSP to 'stress-test' the RSP approach. This supports our qualitative reasoning that a value approach should create price signals that much more accurately align with the consumer interest and that it is unlikely to lead to a worse reflection of overall STOR costs (eg, each season) in cash-out than the BPA approach⁶⁹.

Qualitative analysis: efficient price signals and cost-reflectivity

1.2. Our reforms have been strongly motivated by the theory that improving the reflection of costs to consumers in cash-out prices encourages parties to behave in a way which is much more aligned with consumers' interests. However, a cost-based approach is less appropriate for pricing STOR actions into cash-out than it is for other balancing actions, due to their payment structure; pre-agreed utilisation prices (which can't rise dynamically in response to system conditions); and payments for being available (which do not obviously fall into any settlement period). In this instance, a value-approach would lead to cash-out signals that more accurately reflect consumers' interests than the BPA approach, particularly in terms of the value they place on balancing during tight margins.

1.3. In theory, a value-based approach should achieve the same outcome as cost-based approach in terms of overall cost-reflectivity (eg, each STOR season)⁷⁰. Whilst we recognise there is a risk that the total STOR costs incurred by the SO are not accurately reflected in the imbalance costs faced by participants, this risk already exists under the BPA approach as it is impossible to predict imbalance volumes and the system direction in advance. We also note that the RSP approach is not completely de-linked from costs as the RSP price only applies when it is greater than the utilisation price for each STOR action.

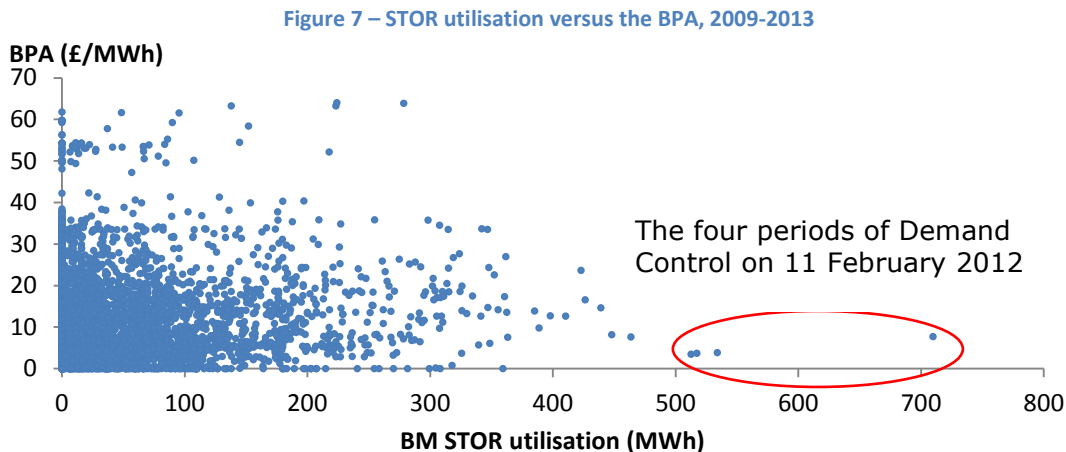
⁶⁸ Please see our Final Policy Decision document for more information about the rationale for and design of the RSP function approach.

⁶⁹ The BPA approach attempts to target availability payments into cash-out by allocating the actual availability payments incurred (which are known in advance of each STOR season) to different periods according to historical STOR usage. However, it is very difficult to know when STOR will be used and most valued in advance, resulting in an arbitrary reflection of STOR availability costs.

⁷⁰ As the SO should in theory use STOR according to the value they provide to consumers.

Historical quantitative analysis: price signals in each settlement period

1.4. Our historical analysis shows that between November 2009 and November 2013 there was a poor correlation between STOR utilisation and the value added to the cash-out price to reflect STOR availability costs under the BPA approach. There were over 8,500 settlement periods where STOR was not used and the BPA was positive⁷¹. In addition, in the four periods of Demand Control on 11 February 2012, arguably the periods in which STOR was most valued in the whole assessment period, the BPA for STOR availability costs was very small.



1.5. In order to understand the potential impact of an RSP approach over the same period, we identified all BM STOR non-BM STOR actions taken in the each settlement period between November 2009 and November 2013. This allowed us to change the price of these actions and re-run the cash-out price calculation. To derive the RSP price associated with the STOR actions in each settlement period we developed a simple Loss of Load Probability (LOLP) model. This calculated a LOLP for each historical period based on the prevailing margin and assumptions around plant failure rate and forecast error.

1.6. This analysis was useful for gaining a transparent understanding of the immediate price impact of a RSP. However, it does not take account of behavioural change; this was explored in our Forward Modelling instead. In addition, while we attempted to as much as possible reflect our LOLP calculation proposals in the LOLP model, we note that the full LOLP methodology is still to be developed.

1.7. Our analysis firstly showed that over the period, applying an RSP price to BM and non-BM STOR actions would have had no impact in 97% of periods, as shown in Figure 8. This is mainly because STOR was not used in the majority of periods, and when it was, it was often fully tagged away. In 15% of periods there was a positive

⁷¹ For this analysis we only looked at the BPA for STOR availability costs, we removed the BPA for BM Start-up costs.

BPA but no potential for the RSP to affect the price. Under our RSP approach, where we remove the BPA, there would therefore have been a reduction in price in these periods (by approximately £9/MWh on average). Despite the RSP only having a potential impact in 3% of periods, this impact could have been significant. Figure 9 which shows the frequency of high cash-out prices in the 70,000 settlement periods assessed under a no RSP and RSP scenario.

Figure 8- Impact on cash-out price of applying RSP methodology to historical periods 2009-2013

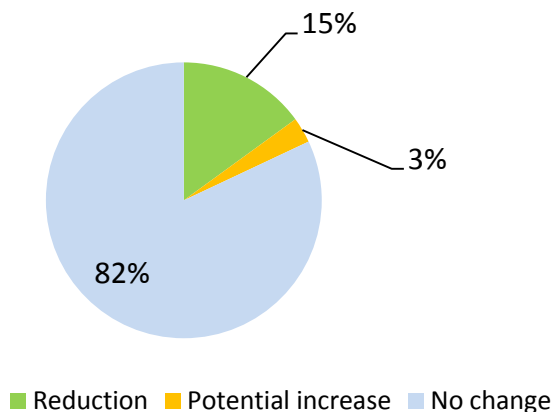
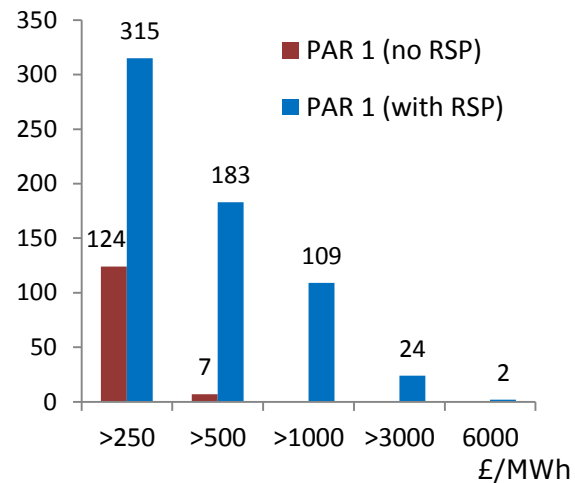


Figure 9- Frequency of high cash-out price periods under no RSP and RSP from 2009-2013



1.8. The RSP would not have been able to affect the cash-out price in the majority of periods because little or no STOR was used. These are arguably the periods when STOR was also least valued by consumers (and when the SO would have been willing to pay a lower proportion of the incurred availability costs). Our historical analysis therefore suggests the RSP shifts costs imposed on parties in these 'low-value' periods to the periods where STOR is used and valued more. This supports our qualitative arguments that the RSP would lead to much more appropriate balancing signals each settlement period than the BPA.

Historical quantitative analysis: reflection of overall STOR costs

1.9. Although the BPA approach is derived from the total STOR availability costs committed in each STOR season, there is no guarantee that the imbalance costs parties face as a result of the BPA will closely reflect these costs. This is because the system direction in each settlement period and the total short volumes cannot be known in advance. In 58% of the periods where the BPA was positive over the assessment period, the BPA did not actually apply because the system was long.

1.10. In Figure 10 we have shown how the imbalance charges parties face as result of the BPA (the 'BPA cost') compare to total STOR availability costs in three historical STOR seasons⁷². This analysis is only intended to be illustrative; however, it suggests the BPA approach may not even be a very good reflection of STOR costs on an overall basis.

Figure 10 – Total STOR availability costs versus BPA costs



1.11. We carried out a similar exercise for the RSP in order to see how it compared to the BPA in 2011/12. To draw a direct comparison to the 'BPA cost' we multiplied the increase in the cash-out price as a result of the RSP by the short volume in each period. This resulted in an increase in imbalance charges of approximately £40m in 2011/12, which is in fact a closer reflection of STOR availability costs than achieved by BPA. This result should be treated with caution because it does not account for likely behavioural change and, as mentioned, it is only intended to be illustrative. Nevertheless, our historical quantitative analysis supports our qualitative analysis by suggesting that the RSP would lead to much improved price signals each settlement period which would not be at the detriment of overall cost-reflectivity.

⁷² To work out the 'BPA cost' we multiplied the BPA by the total short imbalance in each short settlement period. The total STOR availability costs are taken from National Grid's 'STOR End of Year Reports': <http://www2.nationalgrid.com/UK/Services/Balancing-services/Reserve-services/Short-Term-Operating-Reserve/Short-Term-Operating-Reserve-Information/>

Appendix 4 - Feedback Questionnaire

1.12. Ofgem considers that consultation is at the heart of good policy development. We are keen to consider any comments or complaints about the manner in which this consultation has been conducted. In any case we would be keen to get your answers to the following questions:

1. Do you have any comments about the overall process, which was adopted for this consultation?
2. Do you have any comments about the overall tone and content of the report?
3. Was the report easy to read and understand, could it have been better written?
4. To what extent did the report's conclusions provide a balanced view?
5. To what extent did the report make reasoned recommendations for improvement?
6. Please add any further comments?

1.13. Please send your comments to:

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