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Electricity Balancing Significant Code Review – Draft Policy Decision Impact Assessment

Consultation

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Overview:

In the wholesale electricity market, parties are incentivised to meet their contracted positions through the 'cash-out' price: the price for uncontracted generation or demand in the market. Due to imperfections in the way these prices are calculated, they dampen the incentive for parties to balance their positions.

We launched the Electricity Balancing Significant Code Review (EBSCR) to address these concerns. We published our EBSCR Draft Policy Decision which launched a consultation on our proposed changes. This Impact Assessment sits alongside that document and sets out the evidence base underpinning our decisions.

Our analysis suggests that our proposed changes will improve the calculation of cash-out prices which will have a positive impact on security of supply and the efficiency with which the system is balanced. Further, our reforms will have a neutral impact on consumer bills and will deliver an overall net societal benefit. The changes proposed will complement the Capacity Market introduced under government's Electricity Market Reform.

Context

Ofgem's principal objective is to protect the interests of consumers, present and future, by promoting effective competition where appropriate. We have held long-standing concerns with the balancing arrangements in the GB electricity wholesale market. These issues were raised in Project Discovery and considered further in our 'Electricity cash-out issues paper' published in November 2011. In August 2012, we launched the Electricity Balancing Significant Code Review (EBSCR) with the publication of our Initial Consultation document to explore these issues further and consider whether improvements could be made.

This Impact Assessment (IA) was published alongside our EBSCR Draft Policy Decision which launched a consultation on our proposed changes to these arrangements. This IA is our statutory IA for consultation as required under the Significant Code Review (SCR) process. It aims to identify and assess the key impacts and set out the evidence underpinning our Draft Policy Decision. Responses to the Draft Policy Decision and IA will help inform Authority's EBSCR final decision.

Associated documents

Electricity Balancing SCR: Draft Policy Decision, July 2013, (Reference 124/13)
http://www.ofgem.gov.uk/Markets/WhlMkts/CompandEff/electricity-balancing-scr/Documents1/EBSCR%20Draft%20Decision.pdf

Electricity Balancing SCR: Quantitive Analysis, Baringa, July 2013
http://www.ofgem.gov.uk/Markets/WhlMkts/CompandEff/electricity-balancing-scr/Documents1/Baringa%20EBSCR%20quantitative%20analysis.pdf

The Value of Lost Load (VoLL) for Electricity in Great Britain, London Economics, July 2013
http://www.ofgem.gov.uk/Markets/WhlMkts/CompandEff/electricity-balancing-scr/Documents1/London%20Economics%20Value%20of%20Lost%20Load%20for%20electricity%20in%20GB.pdf

Update on the Electricity Balancing Significant Code Review (EBSCR) and proposed new process to review future trading arrangements, February 2013
www.ofgem.gov.uk/Markets/WhlMkts/CompandEff/electricity-balancing-scr/Documents1/Update%20on%20EBSCR%20and%20new%20process%20to%20review%20Future%20Trading%20Arrangements.pdf

Electricity Balancing Significant Code Review (SCR) – Initial Consultation, August 2012 (Reference 108/12)
www.ofgem.gov.uk/Markets/WhlMkts/CompandEff/electricity-balancing-scr/Documents1/Electricity%20Balancing%20SCR%20initial%20consultation.pdf

Electricity cash-out issues paper, November 2011, (Reference 143/11)
www.ofgem.gov.uk/Markets/WhlMkts/CompandEff/CashoutRev/Documents1/Electricity%20cash-out%20issues%20paper.pdf

Contents

Executive Summary

Electricity Balancing Significant Code Review and options for reform

In the wholesale electricity market, demand and supply are balanced in real time by the System Operator (SO) to maintain system security. Parties are incentivised to meet their contracted positions (or 'balance') through the 'cash-out' price: the price for uncontracted generation or demand in the market.

Ofgem has held long-standing concerns with the balancing arrangements. We are concerned that imperfections in the calculation of cash-out prices are generating prices that do not appropriately reflect the SO's balancing costs and are dampened as a signal of scarcity. We launched our Electricity Balancing Significant Code Review (EBSCR) to consider these issues further. This Impact Assessment (IA) presents the evidence base underpinning our Draft Policy Decision.

We have four considerations under the scope of the EBSCR:

- Cash-out prices do not reflect the cost of the marginal balancing action and are calculated as an average across a volume of actions;
- Emergency demand control actions do not have a cost in the price calculation and consumers are not paid where they are involuntarily disconnected;
- Where Short-Term Operating Reserve (STOR) is used by the SO these actions enter the price calculation at a pre-agreed utilisation fee which does not reflect the true value of these services; and
- There are different prices for long and short imbalances in each period.

Options to address these issues have been grouped into five packages of reform for assessment (Table 1). Table 2 summarises the impacts of these packages to 2030.

Table 1 - Policy packages for assessment

<table>
<tr><th>Package</th><th>More marginal cash-out prices</th><th>Attributing a cost to non-costed actions</th><th>Improving the way reserve is costed</th><th>One (single) or two (dual) prices</th></tr>
<tr><td>'Do Nothing'</td><td>Not marginal</td><td>No</td><td>STOR priced using utilisation fee</td><td>Two</td></tr>
<tr><td>1</td><td>Quite marginal</td><td>No</td><td rowspan="5">STOR priced to reflect value in settlement period</td><td>Two</td></tr>
<tr><td>2</td><td>Marginal</td><td>No</td><td>One</td></tr>
<tr><td>3</td><td>Marginal</td><td>Yes</td><td>Two</td></tr>
<tr><td>4</td><td>Quite marginal</td><td>Yes</td><td>One</td></tr>
<tr><td>5</td><td>Marginal</td><td>Yes</td><td>One</td></tr>
</table>

Impacts of reform options

Cash-out prices are currently dampened as a signal of scarcity, in particular at times of system stress. The packages, principally Packages 3 and 5, will improve prices as a signal of scarcity and increase the value of flexibility. This will have a positive impact on **security of supply** as it increases the incentives for: parties to provide, maintain and invest in flexible capacity; interconnectors to import at times of system stress; and new sources of flexible capacity to come forward, such as Demand Side Response. Having appropriate flexibility will become increasingly important in the future with increasing penetration of intermittent renewables.

The packages will also improve cash-out prices as a reflection of the SO's balancing costs. This will improve the **efficiency** of parties' balancing decisions and will promote **competition** as parties face more appropriate market signals. Our analysis suggests Packages 4 and 5 achieve the greatest improvement in cost-reflectivity.

Table 2 – summary assessment of reform packages to 2030 (Key: red = negative impact; yellow = net neutral impact; green = positive impact)

Option	Security of supply	Consumer bills	Competition and market efficiency	Redistributional Impacts	Sustainability
Do Nothing					
Package 1					
Package 2					
Package 3					
Package 4					
Package 5					

The dual cash-out price (two prices) under the current arrangements creates a distortion which disadvantages smaller suppliers and intermittent generators. Our proposed reforms which improve prices as a signal of scarcity could increase imbalance risk particularly for these parties. A single cash-out price implemented under Packages 2, 4 and 5 will remove the **redistributional effect** of a dual price and could mitigate any increase in risk for these parties associated with our wider proposals. Cash-out reform that includes a single price could have a broadly neutral impact on **sustainability**.

Going forward, the increasing penetration of renewables is likely to increase the costs of balancing the system that are passed through to **consumer bills**. Under the packages, the costs of improving security of supply will be balanced against the benefits of improved balancing efficiency. Hence the impact on bills of reform will be broadly neutral and in some circumstances could reduce bills (impacts range from -£0.64 to +£1.01 change in average annual domestic bill in 2030). Cost-benefit analysis suggests the packages are likely to deliver a net benefit to consumers, with impacts ranging from an annualised cost of -£4m to a benefit of £152m in 2030.

The EBSCR will complement any Capacity Market (CM) introduced under government's Electricity Market Reform (EMR) by delivering benefits through increased balancing efficiency, improved price signals to provide and maintain flexible capabilities and by removing the dual price distortion.

Our analysis indicates that Package 5 would bring about the most preferable set of improvements. There are risks associated with this package, in particular around potential pollution of cash-out prices by actions taken by the SO for non-energy balancing reasons. Given improvements that have been made to the price calculation to remove pollution, we believe the potential benefits of moving to a fully marginal price outweigh this risk.

1. Introduction

Consultation question related to the Impact Assessment[1]:

Question 9: Do you have any comments regarding any of the three approaches we have taken to assess the impacts of the cash-out reform packages?

Question 10: Do you agree with the analysis of the impacts contained in this IA? Do you agree that the analysis supports our preferred package of cash-out reform? Please explain your answer.

Question 11: Do you agree with the key risks identified and the analysis of these risks? Are there any further risks not considered which could impact on the achievement of the policy objectives? Please explain your answer.

Question 12: What if any further analysis should we have undertaken or presented in this document? Do you have any additional analysis or evidence you would like to contribute to support the development of the EBSCR towards its Final Policy Decision?

1.1. The current structure of the wholesale electricity market in Great Britain was introduced under the New Electricity Trading Arrangements (NETA)[2]. Under these arrangements, parties trade bilaterally with other market participants for the electricity they require in half-hour settlement periods.

1.2. To maintain the security and quality of supply across the GB electricity system, the System Operator (SO) balances generation and demand on the system in real time. It takes balancing actions to offset any imbalances that market participants have relative to their contracted positions. Market participants are incentivised to balance against their contracted positions through the cash-out price, which is the price for uncontracted generation or supply in the market.

1.3. Ofgem's[3] principal objective is to protect the interests of consumers, present and future, wherever appropriate by promoting effective competition[4]. We have held long-standing concerns with the current balancing arrangements in the GB electricity wholesale market which were raised in Project Discovery[5]. We are concerned that the

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[1] Questions 1-8 relate to the Draft Policy Decision document and are listed there.
[2] England and Wales operated under the New Trading Arrangements (NETA) introduced in March 2001. The arrangements were expanded in April 2005 with the merging of the Scotland and England and Wales electricity markets.
[3] The terms 'Ofgem' and 'the Authority' are used interchangeably in this document. Ofgem is the Office of Gas and Electricity Markets. The Authority is the Gas and Electricity Markets Authority. The Authority was established under Section 1 of the Utilities Act 2000.
[4] Section 3A of the Electricity Act 1989
[5] Ofgem (2010); 'Project Discovery: Options for delivering secure and sustainable energy supplies'; www.ofgem.gov.uk/Markets/WhlMkts/monitoring-energy-security/Discovery/Documents1/Project_Discovery_FebConDoc_FINAL.pdf

cash-out prices are dampened and provide inefficient incentives for parties to balance, which could detrimentally impact security of supply and balancing efficiency.

1.4. We launched the Electricity Balancing Significant Code Review (EBSCR) in August 2012[6]. Through the EBSCR we intend to explore these issues further and consider whether improvements could be made. The objectives of the SCR are: to incentivise an efficient level of security of supply; to increase the efficiency of electricity balancing through improved cost-reflectivity; and to ensure our balancing arrangements are compliant with the European Target Model (TM) and complement the Electricity Market Reform Capacity Market (CM).

1.5. This Impact Assessment (IA) is published alongside our Draft Policy Decision which launches a consultation on our proposed changes to the balancing market arrangements. This IA sets out the evidence base underpinning our decision. It aims to identify the full range of impacts, costs and benefits of our proposed reforms. To support the development of our Draft Policy Decision and evidence base we commissioned consultants to undertake two key contributions to our analysis: London Economics conducted a study to estimate consumers' Value of Lost Load (VoLL) and Baringa developed detailed quantitative modelling of the likely future impacts of our policy proposals. The results of both studies are published alongside this document.

1.6. Section 5A of the Utilities Act 2000 (UA 2000) imposes a duty on Ofgem to undertake IA's in certain cases. This duty arises in cases where it appears that a proposal is important (unless the urgency of the matter makes it impracticable or inappropriate to comply with the statutory requirements). It is our view that the proposals to which this IA relates, are important for the purposes of Section 5A UA 2000. As such, this IA has been prepared in accordance with section 5A UA 2000 as our statutory IA and is being published for consultation in conjunction with our Draft Policy Decision[7]. In the event that, following consideration of the responses to the Draft Policy Decision, Ofgem materially changes the current policy proposals, consideration will be given as to whether a further statutory IA is required or is desirable in relation to any resulting new proposals.

1.7. Ofgem would like to hear the views of interested parties in relation to the assessment of impacts set out in this document. We would welcome responses to the specific questions in this document. Details on how to respond can be found in Appendix 1 below.

[6] Ofgem (2012a) www.ofgem.gov.uk/Markets/WhlMkts/CompandEff/electricity-balancing-scr/Documents1/Electricity%20Balancing%20SCR%20initial%20consultation.pdf

[7] In accordance with section 10(7)(a) UA 2000 and in line with Ofgem's Guidance on the launch and conduct of Significant Code Review; www.ofgem.gov.uk/Pages/MoreInformation.aspx?docid=197&refer=Licensing/IndCodes/Governance

2. Key issues and options

Chapter Summary

Cash-out prices are an important part of the wholesale electricity market. We are concerned that cash-out prices are dampened as a signal of scarcity and do not appropriately reflect the SO's balancing costs. We have considered a number of options to improve the calculation of prices which are combined into 'packages' of reform for assessment in this IA.

Issues with current balancing arrangements and their impacts

2.1. The cash-out price is an important part of the wholesale electricity market. Market participants are incentivised, but not required, to balance against their contracted positions through the cash-out price. These prices are based on the SO's balancing actions to provide cost-reflective signals. Given cash-out prices are the price for uncontracted energy in the market, they place incentives on parties to balance and signal scarcity to the market. The design of these prices therefore dictates the efficiency with which balancing is delivered and security of supply.

2.2. The electricity market is in transition. Capacity margins are tightening and there is a significant shift in the generation mix towards renewable generation. In this context, it is crucial that parties face efficient market incentives through the balancing arrangements to deliver security of supply to GB consumers.

2.3. Project Discovery highlighted how issues with the calculation of cash-out prices could be distorting these prices as a signal to market participants. It suggested that cash-out prices are dampened as a signal of scarcity and do not appropriately reflect the SO's balancing costs. Under the EBSCR, Ofgem has taken forward four key issues with the current balancing arrangements. These are:

2.3.1. ***Cash-out prices are not 'fully marginal':*** Cash-out prices are calculated as a weighted average of the costs of the most expensive 500MWh of actions taken by the SO to balance, rather than reflecting the cost of the marginal balancing action. This volume on which the price calculation is based is known as the Price Average Reference (PAR);

2.3.2. ***Emergency disconnections are not costed:*** Where emergency actions are taken by the SO to balance the system at times of stress, the cost of these actions is not included in the calculation of cash-out prices and consumers are not paid when they are involuntary disconnected;

2.3.3. ***Reserve costs do not reflect scarcity:*** Where reserve is used by the SO, these actions are priced at pre-agreed contract levels. These prices do not reflect the true value of these services in the periods in which they are used which would rise with system scarcity; and

2.3.4. ***Different cash-out prices for long and short imbalances:*** There are two prices for imbalances. The price faced by parties who are out-of-balance in the opposite (rather than the same) direction to the system does not reflect the resulting cost savings to the SO[8].

2.4. As a result of these issues, cash-out prices do not appropriately reflect scarcity on the system and hence do not sufficiently value flexibility (the ability to ramp up or down quickly in response to market conditions). This dampened signal of scarcity contributes to 'missing money' for flexible capacity[9]. This will reduce security of supply[10] for consumers over time as: generators, Demand Side Response (DSR) and storage providers have insufficient incentives to provide, maintain or invest in flexibility; interconnectors may export at times of system stress; and plant dispatch and maintenance times may not be optimised[11]. Flexibility will become increasingly important to ensure consumers have access to secure supplies in a system with a growing share of intermittent generation.

2.5. In addition, these issues will create cash-out prices which do not appropriately reflect the SO's costs of balancing. Not pricing imbalances at the margin means that parties are not incentivised to take actions which maximise the overall efficiency of balancing. Further, a dual cash-out price creates an artificial spread between the prices parties face for long and short imbalances in a given period which is not cost-reflective. This could have a distributional impact which disadvantages small and intermittent generators who tend to have higher levels of imbalance.

Policy options and packages considered

2.6. We have considered a number of different options to address these issues. These were set out in our Initial Consultation. Following further policy development, analysis and stakeholder engagement, we have identified lead policy options under each design consideration which have been assessed in this IA[12]. These options are:

2.6.1. Making cash-out prices more marginal by reducing the volume of actions on which the cash-out price is based (PAR) to either 50MWh or 1MWh (a 'fully marginal' cash-out price);

[8] Further detail on the current structure of market arrangements can be found in Appendices 2 and 3 of our Initial Consultation document: Ofgem (2012a); ibid

[9] 'Missing money' refers to a shortage of available revenue streams to allow capacity providers to recover costs. Further information is included in Box 1 of our Initial Consultation.

[10] Security of supply refers here to both adequacy and reliability of capacity. This is distinct from the definition taken in our Capacity Assessment which refers only to capacity adequacy.

[11] DECC's Capacity Market (CM) IA explored these risks further and illustrated that margins could tighten over time due to dampened cash-out prices: see Figure 2 in DECC (2012); 'Electricity Market Reform – Capacity Market: Final Impact Assessment'; www.gov.uk/government/uploads/system/uploads/attachment_data/file/66039/7103-energy-bill-capacity-market-impact-assessment.pdf

[12] Further detail on our policy proposals can be found in chapter 4 of the Draft Policy Decision

2.6.2. Introduce a cost in the cash-out arrangements for voltage control (brown-outs) and disconnection (black-outs) emergency balancing actions. The price for both these actions would be set at £6,000/MWh in the case where a CM is introduced[13]. Further, consumers are paid for disconnection at a price that reflects their average VoLL;

2.6.3. Improve pricing of reserve by amending the price of Short Term Operating Reserve (STOR) actions in the cash-out price calculation such that they are based on a Reserve Scarcity Pricing function (RSP). This would replace the 'utilisation fee' and Buy Price Adjuster (BPA) and Sell Price Adjuster (SPA) which previously fed into the price calculation; and

2.6.4. Implement a single cash-out price for all imbalances in a given settlement period.

2.7. In order to capture any interaction effects between the different options we have grouped them into 'packages' for assessment. This approach also reflects the fact that any changes to the existing balancing arrangements under the EBSCR are likely to be introduced together. Taking into account discussions with stakeholders during our Initial Consultation and Technical Working Group (TWG) meetings, we decided to focus our analysis on the packages shown in Table 3. These range from a 'Do Nothing' scenario which implies no change to the current arrangements to a package which would deliver efficient price signals (Package 5).

Table 3 - Policy packages for assessment

<table>
<tr><th>Package</th><th>More marginal cash-out prices</th><th>Attributing a cost to non-costed actions</th><th>Improving the way reserve is costed</th><th>Single or dual cash-out price</th></tr>
<tr><td>'Do Nothing'</td><td>PAR 500 MWh</td><td>Demand control actions non-costed</td><td>STOR priced using utilisation fee and BPA for availability</td><td>Dual</td></tr>
<tr><td>1</td><td>PAR 50 MWh</td><td>Demand control actions non-costed</td><td rowspan="5">STOR priced using the greater of Reserve Scarcity Pricing (RSP) function or utilisation fee. BPA and SPA removed</td><td>Dual</td></tr>
<tr><td>2</td><td>PAR 1 MWh</td><td>Demand control actions non-costed</td><td>Single</td></tr>
<tr><td>3</td><td>PAR 1 MWh</td><td>Apply VoLL and pay interrupted parties</td><td>Dual</td></tr>
<tr><td>4</td><td>PAR 50 MWh</td><td>Apply VoLL and pay interrupted parties</td><td>Single</td></tr>
<tr><td>5</td><td>PAR 1 MWh</td><td>Apply VoLL and pay interrupted parties</td><td>Single</td></tr>
</table>

[13] We propose introducing graduated pricing where the value for emergency actions rises from £3,000/MWh when first introduced to £6,000/MWh in 2018. In the case where a CM is not introduced, the price for disconnections will rise to £17,000/MWh.

3. Methodology and approach

Chapter Summary

Our approach to assessing the likely impacts of our policy proposals is based on both quantitative and qualitative analysis. We have developed two strands of quantitative analysis to investigate the key impacts: Historical Analysis of what the impacts could have been over the period from 2010-12, and Forward Modelling which illustrates potential impacts over future years. Where quantitative analysis has not been appropriate or possible, we present qualitative analysis to illustrate the impacts.

3.1. Our analysis seeks to assess the key impacts of the proposed packages of cash-out reform and provide evidence on how our proposals might best facilitate the objectives of the EBSCR. Our approach to the assessment of impacts and forming a policy decision is based on both quantitative and qualitative analysis.

3.2. 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 2010-12 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 assessed qualitatively the likely impacts.

Quantitative analysis: Historical Analysis

3.3. The first approach to our quantitative analysis assessed the impacts of our proposals had they been implemented in the past. We took the calendar years from 2010-12 as our reference period as there were no significant changes to the methodology for calculating cash-out prices in this period and to remove seasonal affects.

3.4. This analysis used actual data around individual party and overall net imbalance volumes and the balancing actions taken by the SO. No changes were made to the flagging and tagging methodology in place post Balancing and Settlement Code (BSC) Modification P217A[14]. Taking the data from the historical period, we applied the changes to the price calculation under the different packages[15] and used actual out-turn prices as our Do Nothing counterfactual.

[14] BSC Modification P217A was implemented in November 2009: Ofgem (2009); 'Modification Proposal P217A – final decision letter'; www.ofgem.gov.uk/Licensing/ElecCodes/BSCode/BSC/Documents1/P217D.pdf
[15] Elexon provided substantial support to the Historical Analysis, both in providing data and applying changes to the cash-out price calculation under steer from Ofgem.

3.5. Although there were no observed disconnections to costumers over the period as a consequence of emergency SO actions, voltage control occurred in four settlement periods on 11 February 2012. In order to assign these actions a price, we used information provided by National Grid regarding the volume of demand reduction achieved and assigned this action a price of £6,000/MWh[16]. Suppliers' positions were also adjusted to derive final imbalance positions. The methodology for adjusting positions is not yet finalised and will be developed with industry through this consultation. For this analysis we used a simplified approach which allocated demand control volumes based on market share of off-take in the relevant periods[17].

3.6. To apply the RSP in the price calculation, we removed BPA and SPA and identified all Balancing Mechanism (BM) and non-BM STOR actions. We then assigned these actions a price based on the higher of their utilisation fee or the RSP function. The final form of the RSP function is also not yet set and will be developed with industry through this consultation. For this analysis we used a simplified function based on the high-level principles for design[18] which is shown in Imbalance costs in this analysis (and in the Forward Modelling) are split for different party types. All parties have been aggregated into categories: vertical integrated operators, thermal generators, independent suppliers, independent wind and other. The imbalance costs presented are an average cost per unit of credited energy for a typical party in each category. All results are in 2012 prices and are presented in the IA with notation '2010-12' unless otherwise stated.

3.7. Figure 1[19]. The maximum value that this function assigns to STOR actions is the VoLL for voltage control: £6,000/MWh. This value is reached when margins are low but not zero, reflecting that the SO keeps a minimum level of reserve and starts to use demand control before going beyond this. This RSP was also used for the Forward Modelling.

3.8. In constructing this analysis, we assumed that only the price calculation changed under the different packages. Hence we inherently assumed that there would be no behavioural response from market participants. This assumption limits the conclusions we can draw from this analysis as in practice we would expect behavioural change to occur in response to changing price signals. We include this analysis in the IA as it offers a simple and transparent view of impacts and replicates analysis for previous Modifications and studies (eg our P217A Preliminary Analysis[20]).

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[16] Note this simplification does not reflect the proposed graduated implementation of VoLL.
[17] This methodology is discussed further in Appendix 2 of the Draft Policy Decision document.
[18] As set out in Appendix 4 of the Draft Policy Decision document. The detail of how this function was defined is explained in the Appendix of Baringa's report.
[19] Reserve margin refers to a short term measure of margin, to be defined as part of the process of development of the RSP function. This represents the percentage of demand that can be covered by the available supply in a given settlement period.
[20] Ofgem (2012b); 'Electricity Balancing Significant Code Review: P217A Preliminary Analysis'; www.ofgem.gov.uk/Markets/WhlMkts/CompandEff/electricity-balancing-scr/Documents1/P217A%20Preliminary%20Analysis.pdf

3.9. The Historical Analysis gives us an indication of the impact on average cash-out prices and volatility. Using these prices we calculated subsequent impacts on imbalance charges, Residual Cashflow Reallocation Cashflow (RCRC) and imbalance costs, where imbalance costs represent the cost to parties of facing the cash-out price relative to trading out this position in forward markets (see Table 4 below).

3.10. Imbalance costs in this analysis (and in the Forward Modelling) are split for different party types. All parties have been aggregated into categories: vertical integrated operators, thermal generators, independent suppliers, independent wind and other. The imbalance costs presented are an average cost per unit of credited energy[21] for a typical party in each category. All results are in 2012 prices and are presented in the IA with notation '2010-12' unless otherwise stated.

Figure 1 - Reserve Scarcity Pricing Function

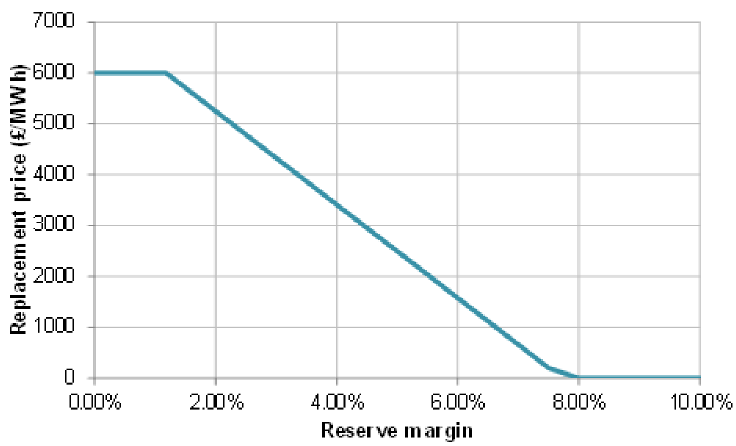


Table 4 - Methodology for calculating imbalance costs

Cash-out price	Party Position	System position	
		Long	Short
Dual price	Long	Party paid SSP Imbalance cost: (MIP–SSP)	Party paid MIP Imbalance cost: (MIP-MIP=0)
	Short	Party pays MIP Imbalance cost: (MIP-MIP=0)	Party pays SBP Imbalance cost: (SBP-MIP)
Single price	Long	Party paid SSP Imbalance cost: (MIP–SSP)	Party paid SBP Imbalance cost: (MIP-SBP>0)
	Short	Party pays SSP Imbalance cost: (SSP-MIP>0)	Party pays SBP Imbalance cost: (SBP-MIP)

Quantitative analysis: Forward Modelling of impacts

3.11. In addition to assessing the impacts historically, we are also interested in understanding the impacts of our proposals going forward. To assess this we

[21] Credited energy refers to the total absolute sum of generation and supply in a given period across all BSC parties.

commissioned Baringa to develop a model to simulate cash-out prices in the future[22]. The results from this model are used for our Forward Modelling analysis.

Overview of the cash-out model

3.12. 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 proposed changes and the comparison between packages, and also delivered greater transparency in understanding and communicating the modelling results.

3.13. For each given settlement period, the model simulates imbalances for individual parties depending on a number of factors (including 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, 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.

3.14. In the model, it is assumed that in the short term parties can change their strategy for hedging imbalance risk before Gate Closure to minimise this risk, which is represented by the imbalance cost for each party (see Table 4). 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 an equilibrium where no further behaviour change is incentivised.

3.15. In the long term, the model assumes that parties can invest in additional flexible capacity to capture changing market signals. The model tests whether investment could be considered economically rational in response to these signals by comparing the difference in MIP between the Do Nothing and packages. Although this does not capture investment decisions in detail, this approach provides an indication of the additional capacity that the market could support as a result of changes to cash-out. Where additional capacity is supported, this is added back into the capacity mix to estimate the consequential impact on cash-out prices.

3.16. The cash-out model estimates the impact of the packages on cash-out prices in spot years going forward (2015, 2020, 2025 and 2030). The model also simulates gross imbalance volumes, imbalance changes, RCRC and imbalance costs for different party types. It also quantifies the level of additional capacity supported through cash-out reform and the impact on the level of Expected Energy Unserved

[22] This section presents an overview of the approach. A detailed description of the model, assumptions, data sources and results can be found in Baringa's report: Baringa (2013); ibid.

(EEU) in modelled years when this capacity is added in[23]. Some of the outputs of the modelling are taken together with exogenous assumptions to produce cost-benefit analysis (CBA) and consumer bills impacts (see Appendix 5 for further detail). All results of the Forward Modelling are denoted by years 2015, 2020, 2025 or 2030 in this IA unless otherwise stated, are in 2012 prices and are the final results including the impacts of additional capacity incentivised. Intermediate outputs removing the effect of new capacity are presented in Appendix 2 for information.

Key assumptions and limitations of the modelling approach

3.17. 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. The assumptions and data sources used in the model are set out in detail in Baringa's report.

3.18. For the core modelling runs we assumed a baseline where no CM is in place. We made this assumption due to the uncertainty around the final detail of the CM design when the model was being developed and also so we could assess cash-out reform in isolation. Given the key interaction with the CM, we have assessed the impacts of the packages under a scenario with a CM in place. This is a simplified scenario as only the underlying capacity mix changes in response to a CM; no further detail is captured regarding how a CM may impact on parties' balancing behaviour.

3.19. To be able to test the impact of cash-out reform with and without a CM in place, we took scenarios for the underlying capacity mix and other parameters going forward from DECC's EMR IA[24]. There are significant differences in the underlying assumptions used to form DECC's scenarios and our Capacity Assessment (CA) and ideally we would use a baseline consistent with the CA. Our choice of baseline for this IA reflects only that DECC's scenarios offered the flexibility of having scenarios with and without a CM and also a baseline to 2030. However, in the IA we focus on the incremental impact of the packages relative to the Do Nothing which somewhat reduces the significance of using a different baseline. We also tested a sensitivity using National Grid's 2012 Gone Green scenario[25] to assess the sensitivity of the results to the baseline. These results are presented in Baringa's report.

3.20. The model also assumes some, but not perfect, correlation between the forecast error of wind parties. The model contains two separate independent wind parties into which all individual wind parties are aggregated. Forecast errors are perfectly correlated between parties within these groups but we assumed zero

[23] EEU is the volume of lost load per year. This metric is also produced for the Capacity Assessment. However, the methodology for calculating EEU is not the same: our model does not use a probabilistic approach and hence a simplified estimation.
[24] DECC (2013); 'Electricity Market Reform – ensuring electricity supply and promoting investment in low-carbon generation [January 2013 update]: Impact Assessment' www.parliament.uk/documents/impact-assessments/IA13-002.pdf
[25] See www.nationalgrid.com/NR/rdonlyres/2450AADD-FBA3-49C1-8D63-7160A081C1F2/56766/UKFutureEnergyScenarios2014.pdf

correlation between the two aggregated parties. We made this assumption because analysis of historical wind forecast errors suggested low levels of correlation. We also test a sensitivity with perfect correlation of errors across all independent wind parties (see Section 6 below).

3.21. The model makes a number of other simplifying assumptions which may somewhat influence the modelling results and are set out in more detail in Baringa's report. These include; parties' bidding strategies do not change over time; the SO' is not required to take system balancing actions; interconnectors are assumed at float; emergency actions are instructed in a strict order[26]; and imbalance shares across party types remain constant over time.

3.22. As noted above, modelling the impacts of cash-out reform is difficult, in particular capturing the behavioural response of parties. As such there will be a range of uncertainty around our results and they will be sensitive to these underlying assumptions. It is important that the results of the Forward Modelling are considered in this context however we have taken the most suitable approach given the complexity involved and the need for transparency and clarity. This modelling approach was shared and tested with industry experts in the early stages of model development through our TWG. This group recognised the difficulties intrinsic with such modelling and provided useful comments regarding improvements to the modelling approach which were subsequently incorporated.

Qualitative assessment of impacts

3.23. Alongside our quantitative analysis, we have also developed qualitative assessments to illustrate the likely impacts of the policy options where quantification of impacts was not possible. To compile this analysis we have drawn on a number of sources including logic, expert and stakeholder feedback and economic theory.

3.24. The qualitative assessment applies a colour-coded rating to each package (see Table 5 below). This illustrates the net impact of each package going forward over both the short and longer term. We have chosen to use today as a reference point to also illustrate the potential impacts of the 'Do Nothing' scenario.

Table 5 - Assessment of net qualitative impacts

Strongly negative net impact	Negative net impact	Neutral impact	Positive net impact	Strongly positive net impact

[26] This assumption is based on the input received from National Grid and it is consistent with Ofgem's Capacity Assessments for 2012 and 2013.

4. Impacts on consumers: security of supply, balancing efficiency and bills

Chapter Summary

The proposed reforms will significantly improve cash-out prices as a signal of scarcity. This will increase the incentive for parties to provide flexible capability and improve security of supply for consumers. Increasing the extent to which prices reflect the SO's balancing costs will increase the overall efficiency of balancing. Although actions taken to improve security of supply are likely to have associated costs, none of the packages imply a bill increase exceeding around £1 per annum and some of the packages, including our favoured option Package 5, could deliver a reduction in bills under certain circumstances. Consumers will also be paid for involuntary disconnections under our favoured reform package.

Impact on security of electricity supply

Incentives to provide and invest in flexible capacity

4.1. The immediate impact of reforming the cash-out price calculation under the packages will be on the out-turn cash-out prices themselves. These price changes will have a subsequent knock-on effect on the wider market and participant behaviour, which will have a further subsequent impact on cash-out prices. This feedback loop between prices and parties' behavioural responses will have impacts for security of supply which is discussed in this section.

4.2. In the first instance, the packages are likely to sharpen cash-out prices and increase their volatility[27]. When the system is short, reducing PAR, pricing uncosted actions and the RSP will all increase the System Buy Price (SBP) and its volatility relative to the Do Nothing. Taking into account only a response by parties through changes in position bias in the short-term, all five packages produce similar increases in SBP's over the forward modelled years. Package 3 and 5 produce the highest increases in SBP as a fully marginal price and pricing uncosted actions significantly sharpen prices, in particular at times of system stress. Packages 1 and 2 produce lower prices relative to packages 3 and 5 due to not pricing uncosted actions; and packages 1 and 4 produce lower prices due to a larger value of PAR.

4.3. When the system is long, the packages have a much less significant impact in the first instance on System Sell Price (SSP) relative to the Do Nothing. The reduction in PAR has only a small impact on the average SSP and volatility of this

[27] Further detail on the intermediate impacts on cash-out prices and near-term market prices is included in Appendix 2.

price due to a relatively flat bid curve[28]. The RSP and pricing of uncosted actions have no impact on SSP.

4.4. Given that cash-out prices are the cost in the market for uncontracted energy, these prices have a strong influence on near-term forward market prices as parties incorporate cash-out price expectations into their forward trading. Historically there has been a strong correlation between cash-out and forward market prices[29]. Sharpening SBP and SSP will impact on average near-term forward prices in opposing directions, as sharper SBP's inflate prices when the system is anticipated to be short, and vice versa for SSP's when the system long. As the packages sharpen SBPs more than SSPs, the net impact on average is to increase near-term prices under all packages on average.

4.5. The more significant impact is to increase the volatility of near-term prices through sharper cash-out prices at times of system stress. The packages increase the value of flexibility in the market as price spikes at times of system stress offer an opportunity for flexible capacity providers to earn additional revenue in the near-term market. In response, security of supply for consumers could improve as there would be a greater incentive for: parties to provide, maintain and invest in flexible plant; parties to schedule maintenance appropriately; interconnectors to be more responsive to scarcity on the GB system[30]; and for DSR[31] and other flexible technologies to develop. These signals will be strongest under packages 3 and 5.

4.6. In practice, there are a number of factors which influence investment in new capacity. In particular, stakeholders have noted that the bankability (the extent to which these signals can be anticipated and captured) of more volatile cash-out prices and a CM raise the risk that new investment may not materialise in response to cash-out reform. Given this uncertainty, the model considers whether new investment could be considered broadly rational in response to changes in cash-out.

4.7. The Forward Modelling suggests that there could be a signal that additional investment would be economically rational across all packages (see Figure 2). This signal reduces to 2020 as margins increase but increases to 2030 as margins reduce. This signal is greatest under packages 3 and 5 due to sharper cash-out prices

[28] 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 could receive.
[29] Correlation between main cash-out price and near-term market price 3 settlement periods before was 0.4 and 0.6 for short and long periods respectively over 2010-12.
[30] Responsiveness of interconnector flows to scarcity on the GB system may also be dampened by lags between the trading period for interconnectors and Gate Closure. However, this could change going forward as a consequence the Capacity Allocation and Congestion Management network code; www.entsoe.eu/major-projects/network-code-development/capacity-allocation-and-congestion-management/
[31] Ofgem's consultation 'Creating the right environment for demand-side response' considers whether current regulatory and commercial arrangements constrain DSR development: www.ofgem.gov.uk/Markets/sm/strategy/dsr/Documents1/20130430_Creating%20the%20right%20environment%20for%20demand-side%20response.pdf

feeding through to higher near-term forward market prices. Other packages produce smaller investment signals due to a larger PAR value or not pricing uncosted actions.

Figure 2 - Investment signal in each year relative to Do Nothing[32]

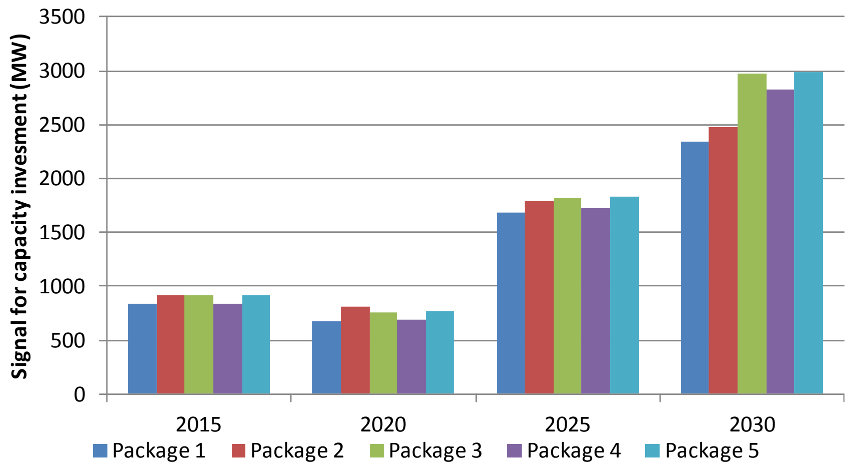
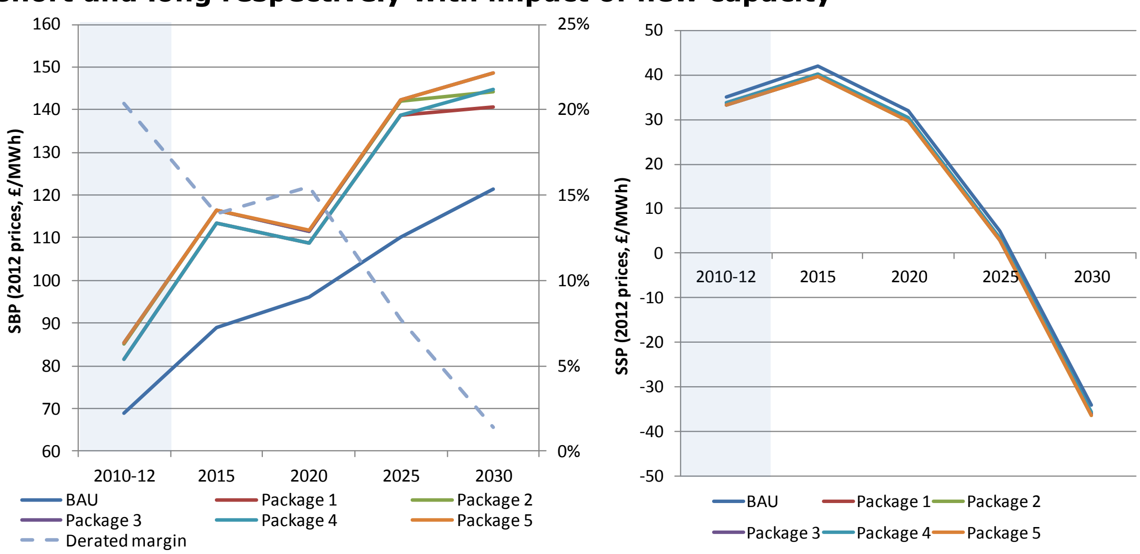


Table 6 – EEU in 2030 under policy packages

EEU in 2030	Do Nothing	Package 1	Package 2	Package 3	Package 4	Package 5
Disconnection (GWh)	0.5	0.1	0.1	0.0	0.1	0.0
Voltage reduction (GWh)	15.6	5.5	5.3	5.1	5.4	5.1

Figures 3 and 4 – Impact of packages on average SBP and SSP when system short and long respectively with impact of new capacity[33]



[32] Investment signal is for each year in isolation and is not cumulative between years. Further, this assumes no changes in response to interconnector flows.
[33] New capacity assumed here is CCGT for illustration.

Table 7 – Volatility of cash-out prices

Standard deviation of price (£/MWh)	Year	Do Nothing	Package 1	Package 2	Package 3	Package 4	Package 5
SBP	2010-12	26	175	186	191	180	191
	2030	92	175	177	223	223	222
SSP	2010-12	6	7	8	8	7	8
	2030	20	23	21	27	21	21

4.8. Where parties respond to this signal and invest in new flexible capacity, this could improve security of supply. The additional flexible generation would be added to the capacity mix and could be available to meet demand at times of system stress. This additional capacity reduces EEU which is lowest under Packages 3 and 5 as these packages signal the highest level of additional capacity[34] (see Table 6).

4.9. The ultimate impact of the packages will be to sharpen cash-out prices, in particular at times of system stress. Hence the packages will also increase the volatility of prices relative to the Do Nothing. However, the new capacity introduced in response to the packages will slightly reduce these effects relative to the intermediate impacts on prices. After 2025 the model shows that SSP is negative on average. This is a consequence of the increasing penetration of wind on the system which both increases the volatility of NIV, increasing the amount of bids the SO is required to take, and the volume of negatively priced wind bids available to the SO[35]. In practice, this effect would increase the risk of facing the SSP as parties would now pay for the excess energy that they provide to the system.

4.10. By improving cash-out prices as a signal of scarcity and making prices sharper, all packages will increase the incentive for parties to balance at times of system stress. This is particularly the case under Packages 3 and 5 which produce the sharpest cash-out prices. We include an example of how the packages could have affected prices in the scarcity event on 11th February 2012 at Appendix 3 to further illustrate the improved reflection of scarcity under the packages.

Capacity Market and security of supply impact of cash-out reform

4.11. Government's CM is designed to ensure there is enough overall capacity in the market to meet demand and is likely to increase available capacity when implemented. This additional capacity is likely to dampen cash-out prices both under the Do Nothing and packages relative to a scenario without a CM. Higher margins and more balancing options available to the SO will both dampen prices under a scenario where a CM is in place.

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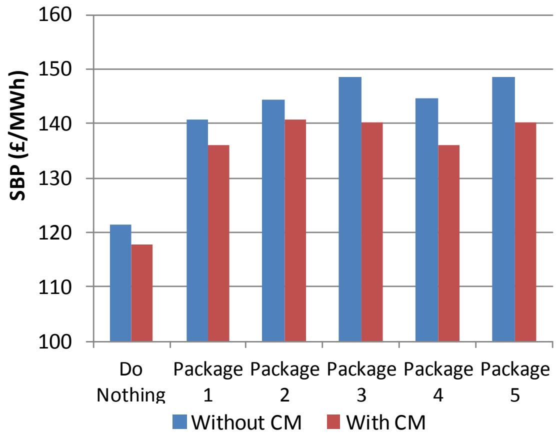
[34] This impact does not consider any further possible reductions in EEU through other behavioural changes, eg improved interconnector response which is not captured in the model.
[35] Wind generators price bids negatively to reflect the lost subsidies they would have received had they not had a bid accepted.

Figures 5 and 6 – SBP and SSP in 2030 when system short and long respectively with a CM



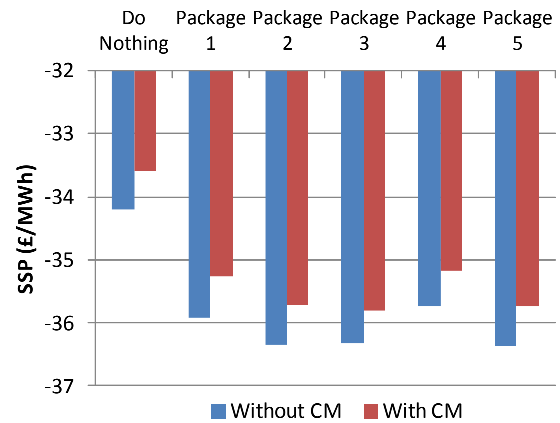


Table 8 – Standard deviation of prices under CM

Standard deviation of price (£/MWh)	Year	Do Nothing	Package 1	Package 2	Package 3	Package 4	Package 5
SBP	2030	30	63	86	74	69	74
SSP	2030	17	17	21	18	21	21

4.12. In addition, given that the CM will be designed to incentivise an appropriate level of capacity in the market to meet demand, it is likely that this will significantly reduce any signal through cash-out reform for additional capacity to be provided. We have not been able to estimate the extent to which this signal would be reduced given the limitations of the cash-out model. However, the packages will still have a significant impact on cash-out prices, making them sharper and more volatile.

4.13. Even in the case where a CM is implemented, cash-out reform is still vital as these price signals are important to signal to need for flexibility in any decision to invest in additional capacity and to provide necessary flexibility and balancing resources at appropriate times. Further, reform will improve signals to parties outside the scope of the CM, for example, interconnectors.

Cost-reflectivity and efficiency of balancing arrangements

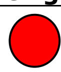
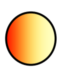
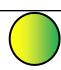
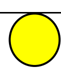
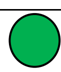
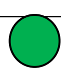
4.14. Both parties and the SO incur costs in balancing the market. Parties incur costs in managing their imbalance risk and the level to which they hedge this risk before gate closure, and the SO incurs costs through taking balancing actions in real time. The efficiency of the overall balancing arrangements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

4.15. 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 that resolving that unit of imbalance places on the SO. Pricing below the margin (as is currently the case) may lead parties to overlook balancing opportunities available before Gate Closure which may be cheaper than actions available to the SO to resolve the resulting imbalance. Hence if the price signal is efficient, it incentivises parties to optimise their trading behaviour, leading to a better balance between how much balancing is undertaken by the market and by the SO.

4.16. Under the current arrangements, cash-out prices are dampened and parties do not face the true cost of their imbalances. Further, a dual cash-out price creates a spread between prices for different imbalances. This further reduces cost-reflectivity as imbalances in the opposite direction to the overall system should reduce the balancing actions the SO is required to take in an energy only system. Hence to be cost-reflective, these imbalances should be assigned a price based on the value of the avoided balancing costs for the SO.

4.17. All packages will improve the cash-out price as a reflection of the SO's balancing costs. In particular, packages 4 and 5 will produce arrangements which are most reflective of the balancing costs of the SO at the margin. Further, a single price assigns an appropriate value to imbalances in the opposite direction to the overall system. These packages will therefore improve the incentives for parties to balance ahead of Gate Closure and their decisions around managing imbalance risk. These packages should increase the efficiency of the balancing arrangements and minimise the overall costs of balancing across the packages of reform options.

Table 9 – Qualitative impacts of packages on balancing efficiency

Option	Rating	Rationale
Do nothing		<u>Prices are poor reflection of SO's costs:</u> Cash-out prices are highly averaged, do not value all actions taken by the SO, reserve is priced at pre-set price and dual price distorts incentives
Package 1		<u>Prices improved as reflection of SO's costs:</u> Price signal slightly improved through smaller PAR and reserve price reflecting scarcity, but prices still averaged, not all actions have a cost and dual price distorts incentives
Package 2		<u>Prices improved as reflection of SO's costs:</u> Single, marginal pricing and scarcity pricing of reserve improve reflectivity of price, but not all actions have a cost
Package 3		<u>Prices improved as reflection of SO's costs:</u> Prices are based on marginal cost; but not all actions have a cost and dual price distorts incentives
Package 4		<u>Prices more closely reflect SO's costs:</u> Emergency actions have a cost, single price and reserve price reflects scarcity, but prices slightly averaged
Package 5		<u>Prices most closely reflect SO's costs:</u> Single price based on marginal cost; all actions do have a cost and reserve price reflecting scarcity

4.18. In response to an improved reflection of the SO's balancing costs, parties will have improved incentives to maintain and invest in the reliability of their generating capacity or in their forecasting of generation or demand. Where such opportunities are possible and economic, this could reduce parties' average levels of imbalance and the level of balancing actions required by the SO.

4.19. Party decisions around these investments will be driven by potential cost savings. A dual price creates an artificial spread between prices, increasing overall imbalance charges. Our Forward Modelling suggests that, all other aspects aside, a dual price could lead to too stringent incentives for parties to balance at times when the system is not tight and *over*-incentivise parties' efforts to improve in forecasting or reliability. This is because the private benefits to these improvements could outweigh the wider benefits to the market. As such, a single price could deliver further efficiency benefits by dampening this over-investment. This is discussed in further detail in Appendix 5.

4.20. The packages would still deliver these efficiency benefits where a CM is introduced as reform would still be required to ensure that the cash-out prices are an appropriate reflection of the costs to the SO of balancing. The packages will still ensure that efficient incentives are placed on parties to balance and invest in reliability or forecasting where these are economic.

Impact on consumer bills and payments for disconnection

4.21. As an extension of the CBA undertaken (see Section 8 below), we have developed an illustration of the potential bill impacts on consumers of cash-out reform. The average impacts of the packages on domestic consumers in 2020 and 2030 are presented in Table 10 below. This analysis assumes all costs are passed through to all consumers and spread evenly over all units of consumption. These bill impacts present impacts on an average domestic consumer. However, it is likely that there could be differences between consumers depending on the balancing performance of each individual supplier and their imbalance costs.

4.22. Going forward, our modelling suggests that all else being equal, the costs to the SO of balancing will increase to 2030 as more balancing actions will be required to balance greater wind capacity on the system. This cost increase is likely to be passed through to consumers, inflating consumer bills under the Do Nothing scenario over time. Against this counterfactual, actions taken by parties to improve security of supply will incur costs, but these are balanced against the efficiency benefits of the packages which reduce the overall costs of balancing the system. Hence cash-out reform could have a negligible impact on average domestic bills and could even reduce bills under certain circumstances. There could be a greater impact in later years to 2030 as the impact of the packages becomes stronger as margins decrease, stimulating a greater behavioural response from market participants.

4.23. Across all sensitivities, packages 2, 4 and 5 tend to have the most favourable bill impacts as a single price incentivises significant efficiency improvements. Packages 4 and 5 have a slightly worse impact on bills relative to 2 as they incentivise greater investment in new capacity and which leads to larger reduction in lost load for consumers. However, the value benefit of reduced lost load is not reflected in bills as this does not represent a monetary benefit to consumers.

4.24. There is significant uncertainty around bill impacts, in particular around the investment impacts of cash-out reform (discussed further in Appendix 5). Hence we present the bill impacts under two investment sensitivities. Where DSR is assumed to respond to investment signals, this implies a more positive impact for consumers relative to a scenario where additional Combined Cycle Gas Turbine (CCGT) capacity is brought forward. Bill impacts are more moderate in the presence of a CM as the investment impacts of cash-out reform (and hence investment costs) will be reduced, increasing the influence of the efficiency benefits of reform on bills.

Table 10 – average annual bill impact for domestic consumer

£/year change relative to Do Nothing	2020					2030				
	P1	P2	P3	P4	P5	P1	P2	P3	P4	P5
CCGT investment and no CM	0.15	-0.06	0.16	-0.06	-0.06	0.83	0.02	1.01	0.11	0.12
DSR investment and no CM	0.07	-0.15	0.07	-0.14	-0.14	0.24	-0.61	0.25	-0.61	-0.64
With CM	0.08	-0.13	0.08	-0.13	-0.14	0.24	-0.52	0.31	-0.53	-0.50

Payments for disconnection

4.25. Consumers inherently value the supply of electricity that they receive, hence disconnecting consumers will have a real cost to those affected. Currently consumers can be involuntarily disconnected and provide a balancing service to the SO for which they are not paid. Under the policy option to price uncosted actions, we propose that payments are made to non-half-hourly (NHH) metered consumers where they are involuntarily disconnected as a result of an emergency demand control action taken by the SO at a price that reflects the average VoLL across this group[36]. We do not propose to pay half-hourly metered (HH) consumers.

4.26. Under packages 3, 4 and 5, consumers will be paid for disconnection. These payments will increase the balancing costs to the SO but would also directly reduce the bills of interrupted consumers. In theory, there could be no impact on the *average* consumer as the payment represents a distributional benefit from consumers that have not been disconnected to consumers that are disconnected. As such, payments for disconnection are not apparent in the average bill impacts above.

4.27. Our Forward Modelling suggests that the packages reduce the likely incidence of interruptions through the incentives they place. As such under packages 3, 4 and 5, the model suggests disconnections do not occur until 2030[37]. When disconnection does occur, the total payment to interrupted consumers is likely to be small: the maximum impact is less than £1m per annum in 2030 across packages 3, 4 and 5. However, the model may not capture the full benefit of these payments as it is assumed that disconnections happen after voltage control and MaxGen services are taken but emergency actions may not be taken in this order in practice.

[36] See chapter 4 of the Draft Policy Decision document for further detail on our proposals.
[37] Note this is not the first incidence of lost load. Smaller levels of lost load could occur through voltage control before 2030.

5. Impacts on competition and distributional impacts

Chapter Summary

Cash-out reform could improve free and fair competition as parties will face a more appropriate costs for their imbalances, in particular under Packages 4 and 5. Smaller suppliers and intermittent generators are more likely to be out-of-balance hence cash-out reform could have distributional impacts across parties. However, any increase in imbalance risk could be mitigated for these parties through a single cash-out price.

Impacts on competition[38]

5.1. Cash-out prices have an impact on competition in the market through the incentives that they place on market participants. If cash-out prices appropriately reflect the costs that out-of-balance parties place on the market, generators and suppliers that are better at balancing their inputs and offtakes will be able to gain a competitive advantage over their rivals. Where prices do not appropriately reflect balancing costs, this distorts incentives in the market to compete as the most efficient balancers will not be appropriately rewarded.

5.2. As discussed in above, our proposed packages will improve the cash-out price as a reflection of the SO's costs of balancing the system, with Packages 4 and 5 achieving the greatest improvements. As a consequence, the packages will strengthen the competitive advantage of parties with a better balancing performance by more appropriately reflecting the true costs of imbalances on parties that create them. This would promote free and fair competition in the market by placing more appropriate signals on market participants.

5.3. In addition, our proposals could also improve the transparency and simplicity of the cash-out arrangements. A single price (proposed under Packages 2, 4 and 5) and a fully marginal price (Packages 2, 3 and 5) could make the arrangements easier to understand and reduce the burden to market participants. However, introducing the RSP (all packages) and costing demand control actions (Packages 3, 4 and 5) would both add additional elements to the price calculation and could increase complexity. In developing these options with stakeholders we will seek to minimise the burden that they could place on industry.

[38] This section follows our IA Guidance which considers criteria based on the OFT's 'Completing competition assessments in Impact Assessments - Guideline for policy makers'; www.oft.gov.uk/shared_oft/reports/comp_policy/oft876.pdf

5.4. The current inefficiencies in the cash-out prices could limit the potential for some parties to participate in the wholesale electricity market, such as DSR or storage. By removing these inefficiencies, the packages would improve incentives for these parties to enter and participate. To the extent that balancing risk is a barrier to entry for prospective participants, the packages could also increase barriers. However a single price proposed under Packages 2, 4 and 5 could mitigate increases in imbalance risk, particularly for smaller parties (discussed in further detail below).

5.5. Stakeholders have expressed concern that some of our proposals could increase the susceptibility of cash-out prices to manipulation through market power. In particular, stakeholders noted that pricing uncosted actions at VoLL could lead to this price becoming a 'target price' for offers submitted to the BM and also that a more marginal price set on fewer balancing actions could be more open to manipulation. We believe these risks are unlikely to become apparent in practice (these risks and mitigating factors are discussed further in Section 7).

Imbalance risk and distributional impacts

5.6. Smaller suppliers and intermittent generators tend to have higher levels of imbalance relative to their contracted positions. This could either be due to less experience with balancing or greater inherent uncertainty associated with intermittent generation. Our proposed cash-out reforms could have a greater impact on these parties as they are more often exposed to cash-out and hence could have distributional impacts across market participants.

5.7. We have measured the effects of our proposals across different party types on imbalance costs and RCRC. Imbalance costs measure by how much each party 'misses out' through facing the cash-out price for their imbalances relative to the price they would have faced had traded these out in the forward market. This reflects the 'cost' to parties of being out-of-balance and does not reflect actual 'imbalance charges' paid or received by parties through facing the cash-out prices. RCRC is also presented given this market cash-flow will change under different packages. These are both presented per unit of credited energy for a typical party in each party type.

5.8. Our analysis (both in the Historical Analysis and Forward Modelling in Figures 7 and 8 below) shows that under Packages 1 and 3 (the packages with dual cash-out prices), the total level of imbalance costs increases in comparison to the Do Nothing as cash-out prices become sharper. Given smaller suppliers and intermittent generators tend to have higher levels of imbalance, imbalance costs rise more for these parties relative to other party types. In addition, given total imbalance charges also increase, RCRC also increases under the Packages 1 and 3.

5.9. Taking these impacts together, the increase in imbalance costs for smaller parties and intermittent generators is likely to outweigh any increase in RCRC, making these parties relatively worse off overall. However, for vertically integrated and independent thermal generators, the increase in RCRC could balance (if not exceed) the increase in balancing costs. This creates a redistributional effect from smaller and intermittent parties to other market participants.

Figure 7: Imbalance costs and RCRC per unit of credited energy by party type (Historical Analysis 2010-12)[39]

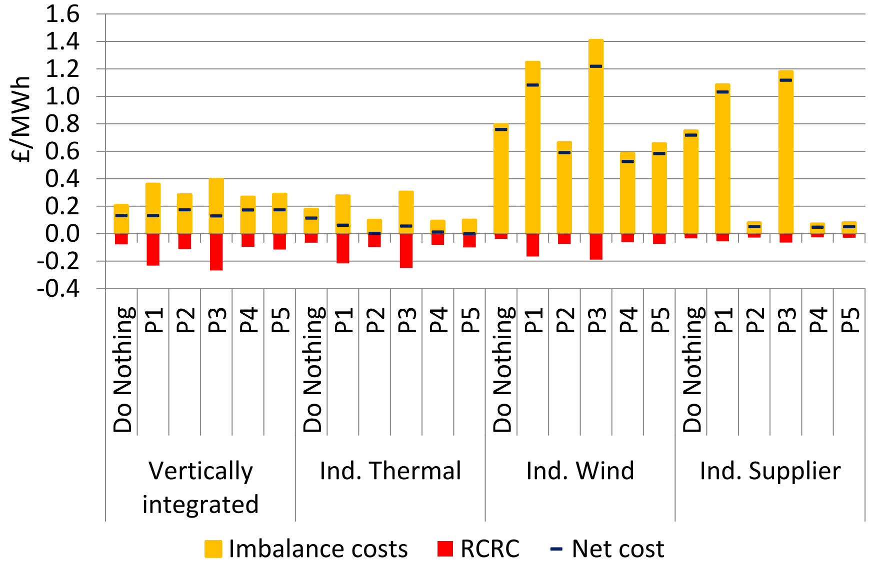
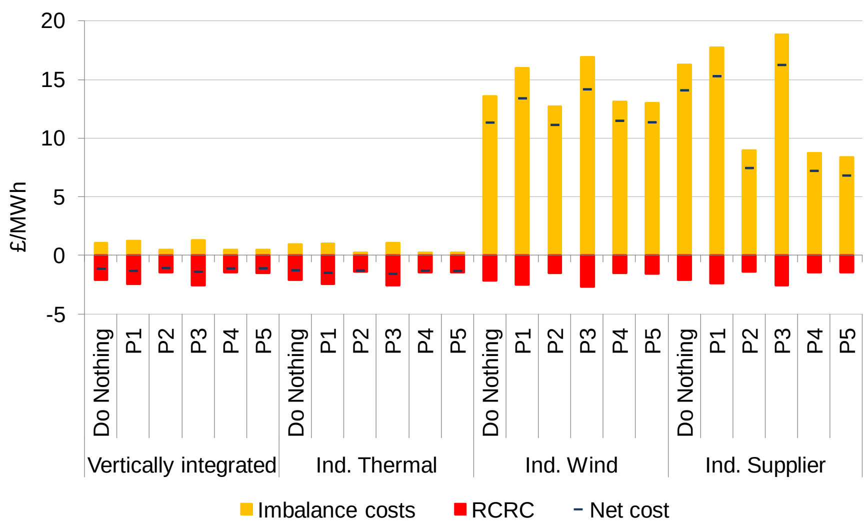


Figure 8: Imbalance costs and RCRC as a proportion of total credited energy by party type (Forward Modelling - 2030)[40]



5.10. Implementing a single price would remove the spread between cash-out prices. Further, parties would face a more favourable price (in comparison to the existing reverse price or forward market prices) if they are out-of-balance in the opposite direction to the system. Under packages 2, 4 and 5, although the main cash-out price becomes sharper, implementing a single price reduces total imbalance costs relative to the Do Nothing and imbalance costs across party types. In addition, a single price also decreases RCRC by reducing the total imbalance charges.

[39] Positive values represent costs to parties.
[40] Results include impact of new capacity on cash-out prices.

5.11. Independent wind generators and smaller suppliers achieve the greatest reductions in imbalance costs under a single price. As these parties tend to be more out-of-balance, they also tend to have the largest volumes of imbalance in the opposite direction to the system length. These parties would gain most overall from a single price as the reduction in imbalance costs outweighs the reduction in RCRC[41]. Imbalance costs for vertically integrated and independent thermal generators also reduce under Packages 2, 4 and 5, but these reductions are likely to be outweighed by the reductions in RCRC accruing to these parties.

5.12. Any increase in imbalance risk for intermittent wind generators under the packages could be further mitigated in practice. Many will not be directly exposed to additional risk as they sell their power through Power Purchase Agreements (PPAs)[42]; embedded wind would also only be indirectly exposed through profiling in the settlement process; and this analysis assumes no improvement in the balancing performance of parties and any forecasting improvements which might be expected in practice. A more detailed discussion of the impacts for intermittent renewable generators is included in Section 6.

5.13. Dual cash-out prices create an inefficient distortion in the market which increases imbalance costs for out-of-balance parties. This creates a redistributional effect from weaker to stronger balancers. This distortion could be exacerbated by our proposed reforms to sharpen prices under Packages 1 and 3. A single cash-out price would remove this distortion from the market and would also mitigate the negative distributional effects of our other policy proposals which sharpen prices. Under Packages 2, 4 and 5, imbalance costs for smaller suppliers reduce relative to the Do Nothing and for intermittent renewable parties these costs are smaller or comparable to levels of risk under the Do Nothing.

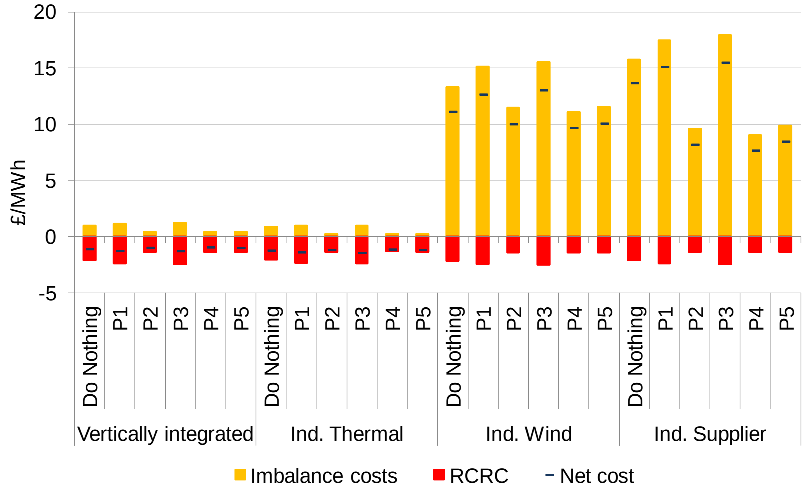
Sensitivity to implementation of the Capacity Market

5.14. Under a scenario where a CM is in place, the conclusions remain similar to the scenarios without the CM. Packages 1 and 3, which maintain a dual cash-out price, increase imbalance costs for all parties and particularly for smaller suppliers and intermittent generators compared to the Do Nothing scenario. This exacerbates the distributional effect of dual prices from poorer to stronger balancers.

5.15. Under Packages 2, 4 and 5 (with a single cash-out price), imbalance costs for intermittent generators and smaller suppliers reduce relative (or are at worst comparable) to the Do Nothing. Hence with a CM, implementing a single price would still be beneficial to remove the distortive impact of a dual cash-out price.

[41] Appendix 4 illustrates a hypothetical example of imbalance costs under a single price.
[42] A PPA is a contract between wind generators and a purchaser of electricity that guarantees generators certain revenue stream for their energy and removes the imbalance risk.

Figure 9: RCRC and imbalance costs as a proportion of total credited energy (2030) with a CM



Risk of price volatility and other financial impacts

Volatility of cash-out prices and risk of high balancing costs

5.16. Market participants face three cash-flows in relation to imbalance settlement: Balancing Services Use of System (BSUoS) charges, imbalance charges and RCRC. The packages are likely to impact on all three cash-flows and could place additional financial risk on market participants as a result.

5.17. Packages 3, 4 and 5 propose paying firm consumers for disconnections. These payments would increase BSUoS charges for market participants. However, the likelihood that these payments could increase financial risk for parties is small. Our modelling suggests that parties will be incentivised through cash-out reform to reduce the occurence disconnections: the maximum total payment to consumers for disconnections across all packages is less than £1m per annum in 2030[43]. Further, BSUoS is spread across all parties according to market share.

5.18. At a market-wide level, the total net imbalance charges are redistributed to market participants through RCRC. However, at an individual party level, there may be a significant difference between the imbalance charges a party faces and what it receives back through RCRC in a given period. Although total imbalance charges are redistributed, this differential at party level could create financial risk for parties.

5.19. The maximum net imbalance charge per settlement period across all market participants[44] and the number of periods with high net imbalance charges both

[43] Figure represents payments after taking into account impact of new capacity on lost load.
[44] In practice financial risk depends on a party's imbalance charge and RCRC. Any change in risk for individual parties will be proportional to the change in overall imbalance charges.

increase under all packages. However, the impact on average net imbalance charges is much less significant and the number of high price periods is very small as a proportion of all settlement periods: the number of periods where net charges are greater than £1m is approximately 0.1% of all periods. In addition, this Historical Analysis does not incorporate any behavioural response from parties which could reduce system stress, cash-out prices and subsequently risk in practice. Further, where prices rise to high levels, we expect that parties will respond to these prices and reduce the risk that these prices could endure for long periods.

Table 11 – Average and range of total net imbalance charges per settlement period across all parties (Historical Analysis assuming no CM)

	Do Nothing	Package 1	Package 2	Package 3	Package 4	Package 5
Average net imbalance charge per settlement period (£'000s)	2.7	8.2	3.9	9.5	3.4	4.1
Max. net imbalance charge per settlement period (£'000s)	620	12,200	10,100	12,700	11.300	11,700
Average number of periods per annum with >£1m net charge	0	19	16	21	14	16

Impacts on credit and collateral requirements and cost of capital

5.20. The purpose of credit cover is to ensure that, should a trading party default, sufficient collateral is available to pay any debts. Increased credit requirements affect smaller parties disproportionately in comparison to to larger parties as they tend to lodge cash as collateral, rather than a letter of credit. This creates potential cash-flow problems for smaller parties. The impact of the packages on the amount of credit and collateral parties need to lodge will be proportional to the impact on overall imbalance charges. Although imbalance charges for smaller parties increases under Packages 1 and 3, a single price under Packages 2, 4 and 5 reduces imbalance charges and largely mitigates any additional burden for smaller parties. Further, Ofgem's 'Secure and Promote' (S&P) licence condition[45] includes Supplier Market Access rules which could help smaller suppliers generally with credit requirements.

5.21. Over the longer term, higher or more volatile cash-out prices could increase the perceived riskiness of participating in the wholesale electricity market. This could increase the cost of capital for market participants. Risk premiums vary significantly and are dependent on a range of factors including: the overall risk grade of the customers; the nature of the instrument (financial/physical); and the investment opportunity. EBSCR reforms could increase imbalance risk at times of system stress, but could also increase the value of flexible generating and demand side capacity. Hence any impact of reform on cost of capital is likely to be mixed and case specific.

[45] Ofgem (2013b); 'Wholesale power market liquidity: final proposals for a 'Secure and Promote' licence condition'; www.ofgem.gov.uk/Markets/RetMkts/rmr/Documents1/Liquidity%20final%20proposals%20120613.pdf

6. Impacts on sustainable development

Chapter Summary

Our proposed packages (in particular Packages 3 and 5) will improve prices as a signal of scarcity, helping improve security of supply. A single price under Packages 2, 4 and 5 will mitigate any increase in imbalance risk for intermittent generators as a result of wider reforms. Intermittent generators are further sheltered for any additional risk through the agreements which provide a route to market for these parties. Reform will increase the incentive for other potentially low carbon technologies (eg DSR) to develop.

6.1. Our principal objective of protecting the interests of existing and future consumers requires Ofgem to have regard to the need to contribute to the achievement of sustainable development when performing its functions. Ofgem has five sustainable development themes[46]:

- Ensuring secure and reliable gas and electricity supplies;
- Managing the transition to a low carbon economy;
- Promoting energy saving;
- Supporting improvements in all aspects of the environment; and
- Eradicating fuel poverty and protecting vulnerable consumers.

6.2. This section assesses the impact of the proposals on four of these themes. We do not believe there are any substantial impacts on supporting improvements in all aspects of the environment and so this theme is not discussed here.

Cash-out and a secure and reliable electricity supply[47]

6.3. Cash-out prices are currently dampened as a signal of scarcity in the market due to imperfections in the calculation of these prices. Improving the price calculation to better reflect system scarcity will increase the value of flexibility in the market. This could improve security of supply for consumers by providing a greater incentive for: improved interconnector flows during periods of system tightness; the development of new flexible technologies, such as DSR or storage; optimising the maintenance of flexible capacity; and for parties to provide, maintain and invest in flexible capacity on the system, in particular in the long term.

6.4. The improved incentives placed on market participants through cash-out reform will provide greater flexible resources to the market and the SO. Our analysis suggests that this would reduce the need for the SO to use emergency demand

[46] Ofgem (2012), 'Sustainable Development Focus 2011-12'; www.ofgem.gov.uk/Sustainability/SDR/Documents1/Sustainable%20Development%20Focus%202011-12.pdf
[47] See Section 4 above for detailed discussion of security of supply impacts.

control actions to balance the system and in turn EEU for consumers. As price signals are most responsive to scarcity under Packages 3, 4 and 5, these packages are likely to drive the strongest improvements in security of supply.

6.5. As noted above, there is an important interaction between cash-out reform and a CM introduced to deliver a given level of capacity to meet demand. Even in the case where a CM is implemented, cash-out reform is still vital as these prices send important signals for the need to invest in appropriate flexibility and to provide the necessary balancing resources at appropriate times, in particular outside periods where demand control is likely. Further, reform will improve signals to parties outside the scope of the CM, for example, interconnectors.

Transition to a low carbon economy

6.6. Government has committed to reduce greenhouse gas emissions (GHG's) and increase the amount of energy provided by renewable sources as part of the transition to a low carbon economy[48]. It has put in place a number of policies 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. It is important for us to consider how our proposals could impact on the achievement of these targets.

Impact on take-up of intermittent renewable generation

6.7. The take-up of new renewable generation capacity in the coming years will be mainly driven by incentives put in place by Government policies, in particular FiT CfDs introduced under the EMR programme. Through its impacts on imbalance risk, our cash-out proposals could influence investment decisions in renewable capacity.

6.8. Under the current arrangements, intermittent wind generators face proportionally higher imbalance costs per unit of electricity relative to other market participants. This is because their generation is inherently more unpredictable and uncertain. Hence these parties are not as able to control output and accurately forecast generation, leading to higher levels of imbalance. Going forward, wind capacity is likely to increase substantially to 2030 (as reflected in our modelling baseline). As a consequence, imbalance costs for wind generators will increase as wind forecast errors will increasingly drive the overall system imbalance. This will increase the incidence that wind generators face the main cash-out price but also the volatility of imbalances and sharpness of prices facing out-of-balance parties.

6.9. Relative to this baseline, Packages 1 and 3 will make cash-out prices sharper and more volatile under a dual price system. This will further increase balancing

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[48] The UK has legally binding targets to reduce GHG's by at 80% (from the 1990 baseline) by 2050 (www.gov.uk/government/policies/reducing-the-uk-s-greenhouse-gas-emissions-by-80-by-2050) and a 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).

costs for intermittent generators relative to other market participants as wind parties have greater volumes of imbalance facing the main cash-out price. Under Packages 2, 4 and 5, although main prices are again sharper, a single cash-out price reduces imbalance costs for all parties and particularly for wind generators: their imbalance risk under these packages is close to or even less than that under the Do Nothing. This is because although wind generators are likely to have greater overall volumes of imbalance and a greater proportion of these are in the same direction as the system (as they increasingly drive overall system length), their greater variability also means that they have greater absolute imbalance volumes in the opposite direction to system length relative to other market participants. Where this is the case, wind parties are able to gain more from a favourable cash-out price relative to near-term forward prices under a single price relative to thermal generators.

6.10. We tested how sensitive these results are to our assumption of no correlation of forecast errors between the two aggregated independent wind parties in the model (see Section 3). Under an extreme scenario where all forecasts errors are perfectly correlated, independent wind generators no longer benefit from a single price as there are extremely few instances where these parties are out-of-balance in the opposite direction to the system. Hence, imbalance risk for these parties would increase across all packages. However, we believe that this is an extreme scenario given forecast imbalances have historically low correlation across parties[49].

6.11. Although independent wind parties gain on average from a single relative to a dual cash-out price, these parties could still face some increase in imbalance risk, in particular at times of system stress. Where this is the case, wind parties are unlikely to be directly exposed to additional risk as many sell their generation through Power Purchase Agreements (PPAs) with aggregators or larger suppliers: wind parties would only face an indirect impact through the level of discount they have to accept in return for this route to market. However, parties purchasing electricity through PPAs could mitigate this additional risk through diversification across their portfolios. This discount is also impacted by a number of other factors, such as the competitiveness of the PPA market. DECC is working on improving competitiveness in this market to ensure renewables have a viable route to market.

6.12. Further, where wind capacity is embedded, this will also only indirectly face any additional risk as their generation is settled (and therefore diversified) against demand. Finally, there is greater scope for independent wind parties to reduce imbalance costs through investment in forecast improvements in comparison to other market participants[50]. We will consider the integration of renewables and their impact on balancing further as part of our Future Trading Arrangements work[51].

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[49] Correlation between imbalances of independent wind parties were 0.07 on average in 2012.
[50] See Appendix C of Baringa's report for more information
[51] Ofgem (2013c); ' Update on the Future Trading Arrangements consultation and invitation for applications to participate in the new Future Trading Arrangements Forum'; www.ofgem.gov.uk/Markets/WhlMkts/CompandEff/Documents1/FTA%20Forum%20Launch%20Letter%20(24%2005%2013).pdf

Impact on overall emissions intensity of electricity generation

6.13. Thermal generation are more concerned about significant plant trips relative to intermittent wind which faces imbalance risk through difficulties in forecasting or controlling output. In our analysis, imbalance costs for vertically integrated parties and independent thermal generators also increase under the dual price packages but reduce significantly under single price packages compared to the Do Nothing. As such, Packages 1 and 3 could encourage part-loading of thermal plant as a method of mitigating risk of forced outages from cold-starts. This could increase emissions where plants are less efficiently used or relatively carbon intensive plants are substituted for this withheld capacity. Lower overall levels of imbalance risk under a single price could reduce this effect under Packages 2, 4 and 5.

6.14. Where this occurs, these impacts may not necessarily lead to more total emissions overall 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 impact on the demand for and hence price of allowances and any investment in carbon intensive technologies will need to internalise these costs of allowances or the carbon price floor.

6.15. Our proposals will increase the value of flexibility in the market, which has traditionally been provided by emissions intensive generation. Sharper prices that better respond to system stress will also provide a better environment for the development of other flexible capacity, such as DSR or storage, which may be less emissions intensive. Although DSR is still in early stages of development, in particular in respect to the arrangements for domestic customers, better price signals are an essential condition for the set up of an appropriate framework for DSR[52]. However, whether DSR delivers emissions reductions or not will depend on the how this service is provided: eg DSR providers may use emissions intensive back-up generation to replace lost load rather than reducing or shifting demand.

Eradicating fuel poverty and protecting vulnerable consumers

6.16. Improving cash-out prices under the packages of reform will likely imply costs for consumers as market participants change their behaviour to improve security of supply. However, these costs will be balanced against potential efficiency improvements delivered under the packages. Our analysis suggests the effect on average domestic consumers bills is likely to be negligible (and even positive in certain circumstances) under all packages and hence is unlikely to have a significant impact on fuel poverty (See Section 4). Further, our analysis suggests that all packages will reduce levels of EEU and where disconnections do occur, Packages 3, 4 and 5 propose paying consumers for this interruption. Improving security of supply and paying consumers affected by interruption both improve conditions for vulnerable electricity consumers.

[52] Development of DSR will also depend on a number of other factors, such as smart meter roll-out and reform of the settlement arrangements for non half-hourly metered suppliers.

7. Risks and unintended consequences

Chapter Summary

There are a number of risks associated with the implementation of cash-out reform that may impact on desired outcomes. We believe that the risks of increasing uncertainty under single price and manipulation of cash-out prices through market power are unlikely to materialise in practice. However, we do recognise that the impacts of system pollution could increase under smaller levels of PAR. We believe the rationale for introducing a fully marginal price outweighs this risk given the improvements that have been made to the price calculation to reduce pollution.

Risk of pollution of cash-out prices

7.1. Cash-out prices are designed to reflect the overall energy imbalance in a given half-hour settlement period only. 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[53]. As such, the calculation of cash-out prices in any settlement period are at risk of being 'polluted' by actions taken by the SO for non-energy balancing reasons. Where cash-out prices are polluted, this could lead to inefficient signals to balance which could unnecessarily increase balancing costs for consumers.

7.2. Moving to a smaller value of PAR would reduce the number of actions feeding into the price. This potentially increases the likelihood that the price is distorted by a 'system' action'. However, there are arguments to suggest that even under a smaller PAR, this risk could be low and somewhat mitigated[54].

7.3. Under the current balancing arrangements, the flagging and tagging processes are in place to remove potential polluting actions. In 2009, BSC Modification P217A introduced SO flagging of actions taken to resolve constraint issues in the calculation of prices. Follow-up analysis[55] suggests that this procedure is having the anticipated impacts and annual SO reports on the flagging procedure[56] indicate a high level of accuracy in implementation. In fact, the current flagging and tagging rules could actually be *over*-compensating in their removal of system pollution, dampen cash-out prices in the process, in the following ways:

[53] The role of the SO has two components: 1) residual energy balancer of the overall imbalance of parties against their contracted positions ('energy balancing'); and 2) provision of system balancing services such as frequency response and constraint management that are efficiently managed by the SO on behalf of the whole market ('system balancing').
[54] A single price could also increase the risk of pollution as the prices for both long and short imbalances would be based on the actions taken by the SO to balance.
[55] Ofgem (2012b); ibid
[56] See www.nationalgrid.com/uk/Electricity/Balancing/transmissionlicencestatements/SMAF/

- NIV tagging does not account for plant dynamics and consistently removes the most expensive actions from the price calculation. As such, a relatively expensive energy balancing action could be NIV tagged, even though there may have been no alternative for resolving that energy imbalance;

- Where actions are taken to resolve both an energy and system imbalance simultaneously, the full volume of that action is flagged rather than just the volume associated with resolving the system imbalance; and

- Where actions are repriced following SO constraint flagging, they are assigned a lower price based on the 'Replacement Price Average Reference' (RPAR). This simulates what the price of a balancing action would have been to resolve only the energy imbalance and is likely to be a lower bound for this price.

7.4. The analysis conducted as part of the P217A IA[57] provided an assessment of the potential sources of price pollution. The results suggested that the introduction of SO constraint flagging would remove a large amount of pollution. Further, following the implementation of P217A, it noted the key remaining source of potential pollution is 'reserve creation'[58]. Reserve creation could incorrectly inflate prices where reserve is created, and dampen prices where this reserve is subsequently used.

7.5. We have considered the case for flagging and repricing 'reserve creation' actions in the period in which they are taken, and assigning a higher cost to periods where reserve is then used. However, discussions with stakeholders and the SO revealed that this would be difficult to implement and could increase the complexity of the arrangements. In addition, the P217A IA suggested that not flagging these actions would create higher prices on average in peak periods[59]. Hence it could be suggested that not flagging these actions creates sharper price signals in appropriate periods on average.

7.6. Finally, a marginal price would in theory be set on the most expensive action taken by the SO to balance. However, even under a PAR of 1MWh, more than one action would feed into the cash-out price calculation on average (see Table 12 below). Where more than one balancing action has the same price, these actions contribute pro-rata to the price calculation. Hence this will significantly reduce the likelihood that the price calculation could be solely based on one unrepresentative action.

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[57] Ofgem (2008); 'BSC Modification Proposal P217 'Revised Tagging Process and Calculation of Cash-out Prices'; www.ofgem.gov.uk/Markets/WhlMkts/CompandEff/CashoutRev/Documents1/P217%20IA_FINAL.pdf

[58] Where the SO takes a bid or offer through the BM to create reserve for future periods. For example, the SO may turn down a flexible plant from 4-5pm so that it is in a position to ramp up rapidly to meet the 5pm peak.

[59] See Figure 6 of P217A IA

7.7. We recognise that reducing PAR to 50MWh under Packages 1 and 4, and to 1MWh in packages 2, 3 and 5, would increase the risk of system pollution. Further, reducing PAR from 50MWh to a fully marginal price is likely to carry increased risk of pollution. However, we feel that given the mitigating factors noted above and the fact that there have been significant improvements in the calculation of cash-out prices to remove this risk, the benefits to security of supply and efficiency outweigh the increased risk of pollution, even under a marginal cash-out price.

Table 12 – average number of Bid-Offer Acceptances (BOAs) in cash-out price calculation under different PARs across all periods

	Do nothing (PAR 500MWh)	Packages 1 and 4 (PAR 50MWh)	Packages 2, 3 and 5 (PAR 1MWh)
Average number of BOAs feeding into price calculation	15.5	6.0	3.6
% of periods where price based on 1 action	3%	10%	22%

Risks of manipulation of cash-out price

Market power and manipulation of cash-out prices

7.8. It has been suggested that the incentives and opportunity to manipulate cash-out prices could increase as a consequence of the EBSCR considerations. Parties may have an incentive to manipulate prices upwards under a single cash-out price as being out-of-balance in the opposite direction to the system could be more favourable to forward market prices. Further, more marginal prices would be based on fewer balancing actions and the RSP would derive prices from information submitted by parties which could both increase the opportunity to manipulate prices.

7.9. In order for any party to be able to manipulate the cash-out price it would need to be able to predict that its action will enter the price calculation. However, in most periods, the flagging and tagging processes remove a number of actions from the price calculation. For example, in 90% of short periods and in 77% of long periods since P217A was implemented, the most expensive action accepted did not enter the price calculation due to NIV tagging.

7.10. RSP pricing would be even more difficult to manipulate as it is likely to derive prices based on information from a number of sources, not just parties participating in the BM. Further, STOR actions are subject to the flagging and tagging mechanisms as BOAs currently are. In developing the RSP with industry and the SO, we would look to minimise the extent to which it could be manipulated.

7.11. In addition, our analysis suggests that there is significant uncertainty around the overall system imbalance (see section on single cash-out price below) and their own imbalance position. As such, there is a risk that parties could harm themselves through attempts to manipulate prices by placing high-priced bids in the BM.

7.12. In conclusion, it is not clear that our proposals increase the ability or the incentive to manipulate cash-out prices for their benefit. Hence we do not think there is evidence that suggests that our reforms are likely to increase the risk of price manipulation. However, it is necessary to ensure that the mechanisms in place to prevent market manipulation work effectively. We will continue to monitor parties' behaviour as part of our market monitoring role, including as part of our work under the Regulation on Wholesale Energy Market Integrity and Transparency (REMIT)[60].

VoLL as a target price

7.13. Some stakeholders have raised concerns that incorporating VoLL into the arrangements could cause offers submitted in the BM to congregate around that price: VoLL would become a 'target price'. Parties would require market power in the BM initially to be able to bid at VoLL and earn significant revenues from the BM, which could in turn distort cash-out prices in the process.

7.14. There is currently a very high limit on the pricing of bids and offers in the BM which is significantly above the level of VoLL proposed to be introduced. Experience has shown that this limit has not acted as a target price which suggests there is a level of competition in the BM which will reduce the opportunity for VoLL to act as a target price. In addition, if a participant anticipated the scarcity on the system, it is likely that intra-day market prices would rise to reflect this scarcity. In placing a high-priced offer, that participant would forgo a relatively certain revenue from selling capacity in the forward market in place of trying to earn more uncertain revenue in the BM. Further we will continue to monitor parties' behaviour as part of our work under REMIT.

Other risks of cash-out reform

Liquidity and ability to trade out risk

7.15. Through the packages, cash-out prices will better reflect the economic fundamentals of the market. Where parties anticipate higher cash-out prices, they will be incentivised to do more to manage their imbalance risk. In practice, if parties are unable to trade to manage risk, the SO could be required to take more expensive balancing actions on behalf of parties to resolve any resulting additional imbalance. Further, it could leave parties facing greater imbalance risk than necessary, which could have a detrimental impact on their ability to compete. Low liquidity could therefore increase balancing costs and reduce the efficiency benefits of cash-out reform.

[60] 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

7.16. We believe that the risk of low liquidity in near-term markets is small. Ofgem's liquidity project focuses on improving liquidity and access to appropriate products in the market. This project focuses on encouraging liquidity further along the curve rather than in the near-term market as liquidity at the day-ahead and intra-day stages is considered to be relatively sufficient[61]. In addition, it is likely that increasing imbalance risk under the packages could itself encourage greater liquidity in the near-term markets: the packages will increase the value of flexible generation in near-term markets, potentially increasing the volume and variation in trade.

Single cash-out price and uncertainty for the SO

7.17. The wholesale market is currently structured such that trading is completed at Gate Closure. The period following Gate Closure allows the SO time to optimise the system in the most efficient way. It is important therefore that parties finalise their positions at Gate Closure and do not deviate unless otherwise notified by the SO.

7.18. Under a dual cash-out price, parties are always incentivised to trade forward. However under a single cash-out price, parties could benefit from being out of balance in the opposite direction to the overall system. Implementing a single price under Packages 2, 4 and 5 could therefore create additional uncertainty for the SO as parties may try to anticipate the length of imbalance and adjust their positions, either before or after Gate Closure, to take advantage of this favourable price. In extreme cases, this could cause the direction of anticipated overall system imbalance to flip from long and short or vice versa ahead of the settlement period. Where parties do try to anticipate system length, this increases the risk that SO balancing actions need to be undone, increasing the overall costs to the SO of balancing.

7.19. Ahead of any settlement period, it is very difficult to predict the direction and size of the net imbalance of the system. This is in part because imbalances are driven by forecasting errors in demand and wind generation, and generation failures, which may only become apparent in real time. This unpredictability of NIV is exemplified in the SO's own indication of potential net imbalance before gate closure. Over the period from November 2009 to December 2012, the direction of the SO's forecast of imbalance[62] 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. As such, there would be significant uncertainty around any strategy to try to anticipate NIV and spill in the opposite direction.

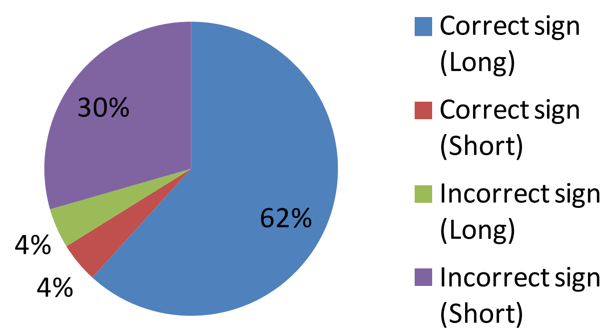
7.20. Further, the more a party spills to try to take advantage of a certain direction of imbalance, the lower that level of net imbalance is likely to be and hence the lower the cash-out price. As such, the more a party tries to take advantage of being in the opposite direction to NIV, the lower the incentive for it to do so. Given these factors, we believe it is highly unlikely that parties would consistently try to anticipate NIV

[61] See Section 5 of Ofgem (2013c); ibid.
[62] 15 minutes before the settlement period.

and spill, either before or after Gate Closure to try to take advantage of this. As such, parties will retain a dominant strategy to trade forward in the market.

7.21. Even though NIV is highly uncertain, parties under a single price would still retain an incentive to spill to counter imbalances across their portfolio. Where parties have a known imbalance on one account, there is an incentive to go out-of-balance in the opposite direction on another account as imbalance charges across the two would net off under a single price. However, this behaviour is unlikely to occur as this would be against the existing Grid Code arrangements[63]. Further, it is unlikely that there would be substantial improvements in information between Gate Closure and the settlement period that parties could act on: as noted above, many imbalances are only likely to be realised over the settlement period.

Figure 10 – Comparison of SO predicted imbalance to actual imbalance



7.22. The impact of a single price on party incentives is uncertain. Given the arguments above, we believe the risk that a single price could create additional uncertainty for the SO in balancing is small. Uncertainty before real time and existing Grid Code arrangements will provide parties with a strong incentive to trade forward. As part of the development of the single price policy, we considered whether additional measures could be required to mitigate this incentive. These included use of information imbalance charges, enhanced monitoring, a performance standard (similar to that used in the Netherlands) or hybrid pricing structures considered in the Initial Consultation. At this stage we are minded that no further measures are required given the existing arrangements. We welcome stakeholder's feedback on this issue and will continue to work with the SO to ensure that appropriate arrangements are in place to mitigate this risk under a single price.

[63] 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

8. Other impacts and cost-benefit analysis

Chapter Summary

Our cost-benefit analysis of the proposed packages suggests that reform could deliver a net benefit for consumers, with the benefits of reform increasing over time. It should be noted that there is uncertainty around this result depending how parties respond to improved cash-out prices. The packages will also imply some implementation and ongoing administrative costs, but these are likely to be negligible in comparison to the overall benefits of reform.

Implementation and ongoing administrative costs

8.1. The cash-out reform options proposed could have a number of associated implementation and ongoing administrative costs. These costs will be placed on different market participants, and ultimately are likely to be passed on to consumers.

8.2. Of the packages, 1 and 2 are likely to have the lowest administration and implementation costs. Making prices more marginal and a single price are likely to imply only small implementation costs associated with changes to Elexon's systems and parties' trading strategies. A single price could also reduce Elexon's ongoing costs associated with the calculation of the Market Index Price. Under both of these packages, the highest costs will be associated with the implementation of the RSP, which is a part of all packages. There will be costs for developing the RSP, generating a price and publishing this regularly. There would be additional costs for Elexon to ensure it has the appropriate data flows and systems to identify STOR actions and apply the scarcity price.

8.3. The implementation of VoLL in Packages 3, 4 and 5 is likely to carry the highest costs across all the considerations. Adjusting supplier positions is likely to imply costs for the SO, Distribution Network Operator's (DNO), data collectors and aggregators, Elexon and market participants through identifying interrupted parties, estimating counterfactuals and volumes of demand control, allocating volumes across suppliers and amending parties contracted and metered positions. Paying consumers for interruption would also accrue additional costs for the SO, DNO or parties depending on the allocation of roles in identifying interrupted parties and delivering payments.

8.4. In policy design, the costs of administration and implementation are an important factor and we will aim to minimise the burden on market participants. As such we anticipate that the administration and implementation costs could be relatively small in comparison to wider costs and benefits associated with reform.

Health and safety impacts

8.5. The packages considered are likely to have no impact on health and safety as they imply changes to market parameters and monetary flows through the market. It is unlikely that these reforms will have an indirect impact through changing incentives given the existing safety rules in place which guide how parties operate physical assets.

Cost-benefit analysis of policy packages

8.6. The packages of reform will have a number of impacts on the wholesale electricity market, its participants and consumers. These impacts will imply costs and benefits for market participants, and ultimately, consumers. As part of this IA, we have developed a CBA of the likely impacts. We have done this to demonstrate what the weight of the different costs of reform could be. The annualised costs, benefits and Net Present Value (NPV) for two future modelled years (2020 and 2030) are presented in Table 13 below. Further detail on the approach to and results of the CBA can be found in Appendix 5.

Table 13 – Summary of cost-benefit analysis

£(2012 prices) m/year	2020					2030				
	P1	P2	P3	P4	P5	P1	P2	P3	P4	P5
NPV (CCGT investment and no CM)	-14	5	-15	5	5	13	99	-4	89	89
NPV (DSR investment and no CM)	-7	14	-7	13	13	59	148	59	148	152
NPV (with CM)	-7	12	-7	12	13	-24	55	-31	57	53

Discussion of results

8.7. The CBA illustrates that in the short term up to 2020, cash-out reform could have relatively small costs and benefits. This is primarily due to healthy capacity margins in 2020 and only a small level of lost load which will dampen the impact of cash-out reform. However, reform is still likely to deliver benefits through efficiency improvements in balancing behaviour of parties due to a more cost-reflective cash-out signal. Parties improve their balancing behaviour such that the balance of overall costs between parties hedging and SO balancing reduces.

8.8. Efficiency benefits are also achieved through changes in investment in reliability and forecasting improvements. Our analysis suggests that under the Do Nothing and Packages 1 and 3, a dual cash-out price *over*-incentivises parties to invest in reliability and forecasting improvements. This is because the private benefits to these improvements could outweigh the wider benefits to the market. As such, where these improvements occur in the modelling, their cost outweighs the consequential benefit of reducing the SO's balancing costs. Under a single price (Packages 2, 4 and 5), a reduction in overall imbalance costs to the market reduces investment in reliability and forecasting. This increases SO balancing costs, but the benefit of reduced investment outweighs this additional cost.

8.9. In the longer term, there is a significant improvement in the benefits of cash-out reform with many packages showing a positive NPV by 2030. Alongside the efficiency improvements of a more cost-reflective cash-out price, consumers also now benefit from reduced lost load under the packages. The introduction of new capacity in response to sharper cash-out prices increases the balancing resources available to SO. This new capacity has an associated fixed (investment) or variable (bid or offer price) costs, but the total cost of this new capacity is outweighed by the value benefit that consumers place on reduced lost load. Further reductions in lost load are assumed to be captured by improved interconnector flows, which more actively react to stress on the GB system in response to sharper cash-out prices.

8.10. As noted in Appendix 5, there is significant uncertainty around investment response to improved cash-out signals. In particular, the model does not forecast if and what investment may respond to an improved value of flexibility. The CBA illustrates that greater investment in DSR could deliver a higher net benefit than investment in fixed generation assets such as CCGT, as DSR is likely to have a lower fixed investment cost. However, even under the CCGT sensitivity, all packages either show a strong net benefit or are broadly cost neutral. In practice, where parties respond to investment signals, they will do so according to which opportunities are most economic and likely through a range of different investment options.

8.11. The CBA also provides an illustration of what the weight of costs and benefits could be in the case where a CM is introduced. In the presence of a CM, it is likely that a large proportion of the possible benefit through reducing lost load and the cost of additional investment associated with cash-out reform could be diminished. However, the packages still show that there would be a net benefit to reform due to efficiency improvements, in particular under the single price packages (2, 4 and 5). The dual price packages still show a net cost where parties over-invest in reliability and forecast improvements.

8.12. This CBA is intended to be illustrative and not an accurate estimation of the costs and benefits. However, this is a useful illustration and is broadly representative of the potential benefits of cash-out reform. This CBA illustrates that cash-out reform is likely to be net beneficial in particular in the longer-term, and could deliver stronger benefits under a single price. 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. As such, given the small differences in NPV between the reform packages, with the exception of the single or dual price distinction, these differences are likely to fall well within the bounds of uncertainty.

8.13. Further, the CBA does not capture all the costs and benefits associated with cash-out reform. In particular, the model does not capture: fully the likelihood and benefits of improved interconnector flows; the benefits of other new technologies which could be brought forward to assist the SO in balancing; the benefits for competitiveness in the BM and wider market of a single price; or any additional cost associated with higher volatility of cash-out prices.

9. Conclusions

9.1. We launched the EBSCR to consider possible improvements to the balancing arrangements given our long-standing concerns. We are particularly concerned that cash-out prices are dampened and do not appropriately reflect scarcity at times of system stress. In this IA we have set out our analysis of the possible impacts of reform options and the evidence base underpinning our Draft Policy Decision.

Table 14 –summary assessment of reform packages to 2030 (Key: red = negative impact; yellow = net neutral impact; green = positive impact)

Option	Security of supply	Consumer bills (both short and long run)	Competition and market efficiency	Redistributional Impacts	Sustainability
Do Nothing					
Package 1					
Package 2					
Package 3					
Package 4					
Package 5					

9.2. All cash-out reform packages will improve the cash-out price as a signal of scarcity. Hence all reform packages are likely to have a positive impact on **security of supply** as scarcity is better signalled in forward prices, increasing the value of flexible capacity. Packages 3 and 5 achieve the largest improvement through a fully marginal price with all balancing actions fully costed. These packages produce the strongest signal to invest in new capacity and greatest reduction in EEU.

9.3. Balancing costs are likely to increase going forward as a consequence of greater intermittent generation in the capacity mix which will increase **consumer bills** over time. Under the packages, the actions taken by parties to improve security of supply are likely to have associated costs, but these will be balanced against the benefits of improved balancing efficiency. Our analysis indicates that the impact on bills will be broadly neutral, and in some circumstances could deliver a net reduction in bills (impacts range across packages from -£0.64 to +£1.01 change in average annual domestic bill in 2030). Cost-benefit analysis suggests reform is likely to deliver a net benefit to consumers with impacts ranging across packages and scenarios from annualised net cost of -£4m to net benefit of £152m in 2030.

9.4. By improving the cash-out price as a signal of scarcity, cash-out reform is likely to have a positive impact on **competition** in the market, in particular in those packages which most accurately reflect the true economic signal. These reforms support freer and fairer competition by ensuring appropriate allocation of imbalance risk on parties. This is particularly the case under Packages 4 and 5. In addition, by most accurately reflecting the marginal costs to the SO of balancing, these packages are likely to deliver the greatest **efficiency** benefits through improving parties' balancing behaviour.

9.5. Given smaller suppliers and intermittent generators are more likely to be out-of-balance, making cash-out prices sharper could generate **redistributional impacts** between party types. Package 1 and 3 are likely to increase imbalance charges for these parties relative to other parties in the market. However, single price reform would remove the distortive impact of a dual price in the market which disadvantages these parties. Under Packages 2, 4 and 5, intermittent generators and smaller suppliers in particular benefit from this reform, mitigating the increase in imbalance risk associated with the other proposed reforms.

9.6. Alongside the mitigating impacts of a single price, it should also be noted that many intermittent generators would only face any increase in imbalance risks indirectly. Many renewable generators supply power under the terms of a PPA with a larger party who can hedge any additional risk against a larger portfolio. Further, the efficiency and competition benefits could support long-run renewables deployment and cash-out reform could incentivise other low carbon technologies to come forward, such as DSR and storage. Given reform is likely to have a small impact on bills it is also likely to have an insignificant effect on fuel poverty. Taken together, cash-out reform is likely to imply a broadly neutral picture for **sustainability,** but slightly more negative under Packages 1 and 3 given the distortion of a dual price.

9.7. Our analysis suggests that Package 5 is the most appropriate reform to achieve our objectives. This package would provide the greatest improvement in efficiency and security of supply and minimise possible redistributional impacts. We believe that cash-out reform would complement any CM put in place under Government's EMR programme. Although the incentive to invest in additional capacity will mainly come through the CM, cash-out reform would still deliver benefits through improved efficiency and competition, improved signals to provide and maintain flexible capabilities and a single price could remove the existing distortion in the arrangements caused by a dual price.

9.8. We note that there are risks with cash-out reform, in particular, we are concerned about the risk of pollution of going to a more marginal price. There are substantial existing rules in the market to remove pollution from the price calculation. As such we believe that the arguments for improving the efficiency of the cash-out signal and security of supply outweigh these concerns.

Appendices

Index

Appendix 1 - Consultation Response and Questions

1.1. Ofgem would like to hear the views of interested parties in relation to any of the issues set out in this document and the other documents published as part of the EBSCR Draft Policy Decision consultation.

1.2. We would especially welcome responses to the specific questions which we have set out at the beginning of each chapter heading and replicated below. These questions have also been included in the Draft Policy Decision document as part of a wider set of consultation questions.

1.3. Parties are not required to submit separate responses to the different documents under the Draft Policy Decision consultation and are advised to amalgamate responses to both documents into one submitted response. Further details on how to respond to the Draft Policy Decision consultation can be found in Appendix 1 of the Draft Policy Decision document.

Question related to the Impact Assessment:

Question 9: Do you have any comments regarding any of the three approaches we have taken to assess the impacts of the cash-out reform packages?

Question 10: Do you agree with the analysis of the impacts contained in this IA? Do you agree that the analysis supports our preferred package of cash-out reform? Please explain your answer.

Question 11: Do you agree with the key risks identified and the analysis of these risks? Are there any further risks not considered which could impact on the achievement of the policy objectives? Please explain your answer.

Question 12: What if any further analysis should we have undertaken or presented in this document? Do you have any additional analysis or evidence you would like to contribute to support the development of the EBSCR towards its Final Policy Decision?

Appendix 2 – Intermediate price impacts of packages

Intermediate price impacts of packages

1.1. The primary impact of changes to the cash-out price calculation will be on the prices themselves which will respond immediately to the change in calculation. This change will subsequently have a wider impact on the market and participant behaviour, which in turn is likely to have a further feedback impact on cash-out prices until an equilibrium is reached.

1.2. Our modelling work suggests that these intermediate price changes in response to cash-out reform will create an incentive for investment in additional flexible capacity. Where parties respond to this signal, any additional capacity delivered will have a further impact on out-turn prices. The results included in Section 4 above present the final equilibrium impacts of the packages, including any impact of new capacity which is added under the modelling. This Appendix sets out the intermediate impacts of the packages on prices only taking into account the short-term response of parties through changing position bias hence before any potential impact of new capacity.

1.3. The immediate impact of the packages is to make cash-out prices sharper and more volatile. When the system is short, reducing PAR, pricing uncosted actions and the RSP all increase the SBP and its volatility relative to the Do Nothing. This result is consistent across the Historic Analysis and Forward Modelling presented in the charts and tables below.

1.4. Reducing PAR has the most significant impact in particular in the short term. But as margins decrease over time, the impact of the RSP and pricing uncosted actions increase. The impact of the latter only becomes significant in 2030 when the volume of EEU increases in the underlying capacity scenario. The modelling suggests that a single price will have a negligible impact on SBP when the system is short given this only has a small impact on the overall system length.

1.5. All five packages produce similar increases in SBPs both historically and over the forward modelled years. Packages 3 and 5 produce the highest increases in SBP as a fully marginal price and pricing uncosted actions significantly sharpens prices, in particular at times of system stress. Packages 1 and 2 produce lower prices relative to packages 3 and 5 due to not pricing uncosted actions; and packages 1 and 4 produce lower prices due to a larger value of PAR.

1.6. When the system is long, the packages have a much less significant impact both historically and over future modelled years on SSP relative to the Do Nothing. The reduction in PAR has only a small impact on the average and volatility of SSP due to a flat bid curve, which was both observed historically and assumed going forward. The RSP and pricing of uncosted actions have no impact on SSP.

Figures A1 and A2 – Impact of packages on average SBP and SSP when system short and long respectively

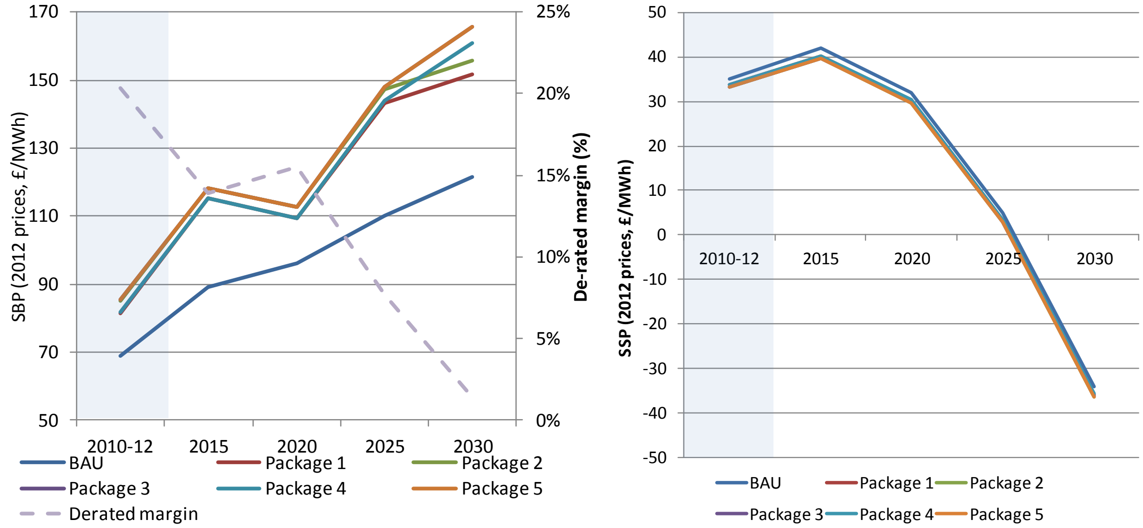
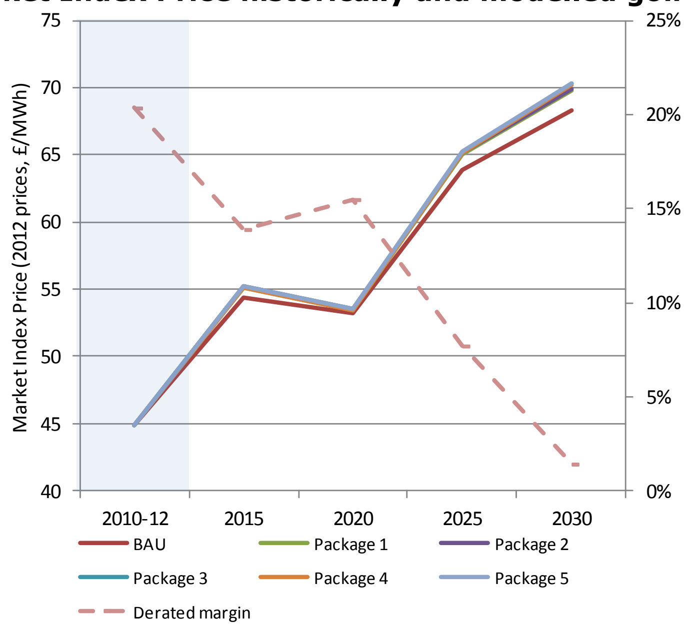


Figure A3 – Market Index Price historically and modelled going forward



1.7. The cash-out price is the cost in the market for uncontracted energy. As such, the cash-out price has a strong influence on near-term forward market prices as parties incorporate expectations of this price into their forward trading.

1.8. All packages impact make SBP and SSP sharper which will impact on average near-term forward prices in opposing directions. As the packages have a greater impact on SBPs than SSPs, the net impact is to increase near-term prices under all packages on average. The impact on market prices is similar across all packages due to the relatively small differences in impacts on cash-out prices across the packages. The more significant impact of the packages is to increase the volatility of near-term prices, in particular at times of system stress.

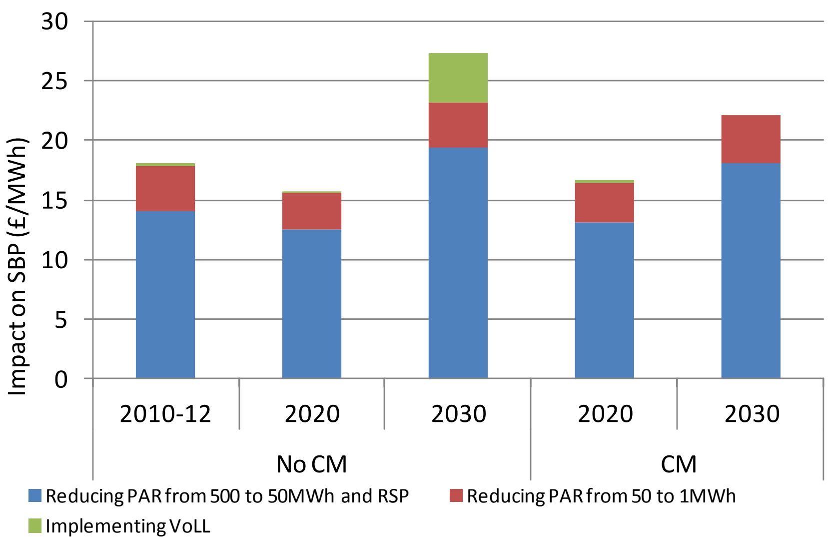
Table A1 – volatility of cash-out prices and MIP

Standard deviation of price (£/MWh)	Year	Do Nothing	Package 1	Package 2	Package 3	Package 4	Package 5
SBP	2010-12	26	175	186	191	180	191
	2030	92	275	280	372	364	371
SSP	2010-12	6	7	8	8	7	8
	2030	20	30	21	37	20	21
MIP	2010-12	12	12	12	12	12	12
	2030	19	26	26	31	30	31

Break-down of final price impacts by policy consideration

1.9. For further information, we have included in this Appendix an illustration of what the individual impact of each policy consideration underneath each package could be. This analysis is only illustrative given the considerations were assessed as packages and hence capture interactions between the policy options. Here we use the package results to draw out at a high level what the individual impacts of each option is.

Figure A4 – Illustrative split of SBP impact by policy option relative to Do Nothing



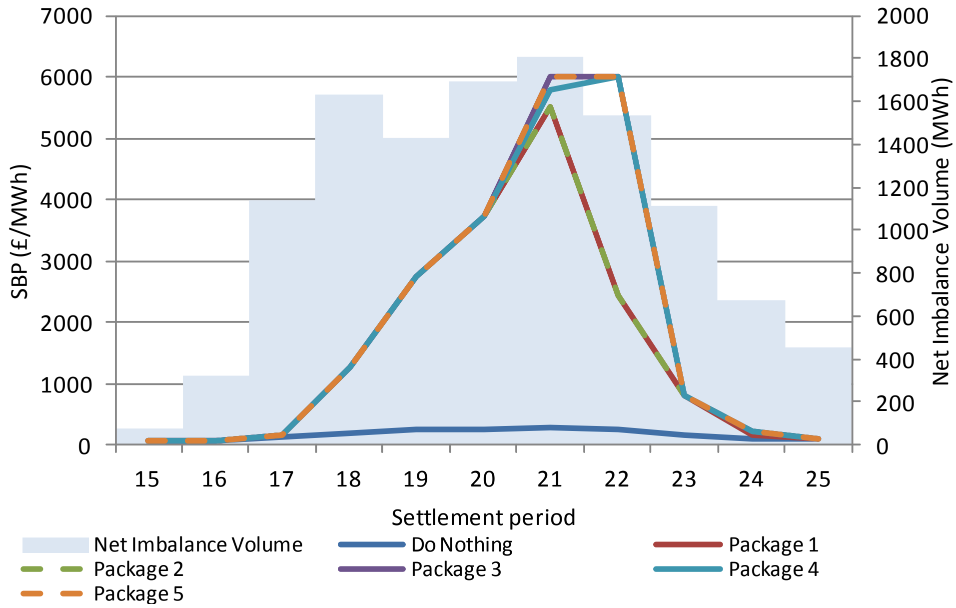
1.10. Figure A4 above shows the illustrative impact of each policy on the SBP (including the impact of additional capacity added under the scenarios) relative to the Do Nothing. Across both the with and without CM scenarios, it is clear that reducing the level of PAR from 500 to 50MWh and the RSP have the most significant impact on price. Reducing PAR further from 50MWh to 1MWh has a relatively smaller impact but is still significant in each year and scenario.

1.11. Implementing a price for unpriced actions has a significant impact in 2030 under the without CM scenario. However, the impact is negligible in 2020 across both a with and without CM scenario and in 2030 in the with CM scenario due to low levels of disconnection in these years under both scenarios.

Appendix 3 – Example of cash-out as a signal of scarcity

1.1. The extent to which prices reflect the economic fundamentals under the different packages is explored further in the following example of 11th February 2012. The chart below shows cash-out prices for settlement periods on that day, and the prices re-calculated under the different packages in a manner consistent with our Historical Analysis methodology set out above (ie assuming no behavioural impact).

Figure A5 – NIV and recalculated cash-out prices for 11 February 2012



1.2. On 11 February 2012, the system was under significant stress. In order to balance the system, the SO requested demand control between settlement periods 21 to 24, which was delivered through voltage control. In this event, the SBP rose to a peak of £264/MWh in settlement period 21. However, this was well below the true value of scarcity in that period. In fact, under Package 3 and 5, prices peak at £6000/MWh in periods 21 and 22, reflecting the price of the voltage control actions taken in these periods. Further, the price rose in the preceding periods through the RSP which reflects the growing stress on the system and the value of STOR used in these periods.

1.3. Comparing the different packages, it can be seen that Packages 1, 2 and 4 move away from the prices under Packages 3 and 5. A PAR of 50MWh prevents Package 4 from representing the true value of scarcity in settlement period 21, curtailing the price from reaching VoLL. Further, not costing VoLL dampens the price under Packages 1 and 2 over settlement periods 21 to 23 when voltage control actions were taken to balance the system.

Appendix 4 – Single cash-out price and party imbalance cashflows

1.1. This appendix illustrates how a move to a single price could impact on different party's imbalance costs. In particular, it explores how a single price would remove a distortion from the balancing arrangements which has a redistributive affect from relatively poorer – most likely small and renewables parties – to stronger balancers.

1.2. The hypothetical scenario outlined in Table A2 is illustrative and simplifies the market to two party types: a relatively weaker and relatively stronger balancer. The stronger balancer has a lower level of imbalance relative to its credited energy relative to the weaker balancer.

Table A2: Hypothetical scenario – volumes by party type

Party type	Total volume (MWh)	Volume of imbalance in the same direction as system (MWh)	Volume of imbalance in the opposite direction as system ((MWh)
Weaker balancer	100	30	20
Stronger balancer	1000	40	10

1.3. Table A3 presents the imbalance charge and RCRC cash-flows by party types alongside the net pay-offs. To simplify, the scenario assumes the system is short hence parties pay (rather than receive) the main cash-out price (represented by £X) and RCRC is positive and flows back to parties. The scenario further assumes the reverse cash-out price under dual pricing is half the main cash-out price £X/2 for simplification.

Table A3: Pay-offs by party type under dual and single systems

<table>
<tr><th rowspan="2"></th><th rowspan="2">Party type</th><th colspan="4">Payments (-) or receipts (+) for imbalance</th><th rowspan="2">Net payoff</th></tr>
<tr><th>Imbalance charge for short imbalances</th><th>Imbalance charge for long imbalances</th><th>Net imbalance charges £</th><th>RCRC</th></tr>
<tr><td rowspan="2">Dual price</td><td>Weaker balancer</td><td>-£30 X</td><td>£20 (X/2) = £10 X</td><td>-£20 X</td><td>100/1100 x 55 X = 5 X</td><td>-£15 X</td></tr>
<tr><td>Stronger balancer</td><td>-£40 X</td><td>£10 (X/2) = £5 X</td><td>-£35 X</td><td>1000/1100 x 55 X = 50 X</td><td>£15 X</td></tr>
<tr><td rowspan="2">Single price</td><td>Weaker balancer</td><td>-£30 X</td><td>£20 X</td><td>-£10 X</td><td>100/1100 x 40 X = 3.6 X</td><td>-£6.4 X</td></tr>
<tr><td>Stronger balancer</td><td>-£40 X</td><td>£10 X</td><td>-£30 X</td><td>1000/1100 x 40 X = 36.4 X</td><td>£6.4 X</td></tr>
</table>

1.4. Table A4 shows that the net impact of moving from dual to single pricing. Both imbalance charges and RCRC are lower under a single price.

1.5. When moving from a dual to single price, the imbalance charges of weaker balancers decreases more than the reduction in RCRC for these parties, meaning these parties benefit more from a single price. However for stronger balancers, their reduction in imbalance charges is less than the reduction in RCRC so these parties are relatively worse off.

1.6. Dual price creates a distortion in the market that makes cash-out prices less reflective of the SO's balancing costs. This distortion has an impact on market participants and creates an inefficient re-distributive affect from weaker to stronger balancers. Implementing a single price would remove this distortive effect in the market, helping weaker balancers who currently face inefficiently high imbalance risk.

Table A4: Impact of net pay-offs by party type of reform from dual to single

Party type	Dual Price	Single Price	Change to single Price
Weaker balancer	-£15 X	-£6.4 X	£8.6 X
Stronger balancer	£15 X	£6.4 X	-£8.6 X

Appendix 5 – Cost-benefit analysis: methodology and results

1.1. As part of the evidence base to support our Draft Policy Decision, we have developed a CBA of each of the packages. This analysis seeks to illustrate and monetise the key costs, benefits and resulting NPV for each package. This Appendix sets out in greater detail our approach to constructing the CBA, key caveats and the detailed results of this analysis.

Methodology and assumptions of CBA

1.2. There is significant uncertainty around investment impacts in response to cash-out reform. The model developed to support this IA attempts to assess whether investment could be economically rational in response to the signals that cash-out reform could create. In the CBA, we assume that parties respond to these investment signals. However, the model does not suggest if, when or what investment could respond to reform.

1.3. As the model does not depict when investment may come forward, the CBA presents annualised costs and benefits[64] in two example years of 2020 and 2030 rather than presenting a full NPV over the time period assessed. Hence rather than attempting to allocate the costs of investment into one modelled year, these upfront costs are spread over the likely lifetime of the asset to present a fairer comparison of the balance of costs and benefits. The two sample years were chosen to provide a illustration of the CBA over the whole assessment period. There are likely to be costs and benefits before, in between and after these years however we expect these to follow a similar pattern to those in the years assessed.

1.4. Given the uncertainty around the response of investment to market signals, we present two different CBAs exploring two options. The market is assumed to respond to investment signals either through investment in new CCGT plant[65] or bringing forward additional industrial and commercial DSR. Under each it is assumed that the additional capacity signalled is fully met by that investment opportunity. In practice, it is likely that a range of different options could respond to changes in balancing incentives, depending on the relative economic merits of each option. In the absence of a model which compares all possible investment options, we have selected these two to illustrate a range of possible impacts.

[64] Annualised costs and benefits compare typical costs and benefits of a policy reform in a given year, producing an NPV for that year. This includes benefits that are attained in that year but where there is a cost incurred in one year that will be recouped over the lifetime of an asset (eg investment), the fixed cost is divided by the asset's lifetime and only an average (or annualised) fixed cost is included in the annualised NPV.

[65] CCGT was chosen as it is a typical flexible generator which would offer balancing services into the BM and could continue to operate going forward to 2030.

1.5. The CBA is split into two groups of costs and benefits: those accruing to producers (producer surplus) and consumers (consumer surplus). Some of the impacts assessed are direct outputs of the model whereas some are impacts that are layered onto the model outputs ex-post, where these impacts are not directly captured by the model. The costs and benefits included in the producer surplus category are:

- Net imbalance charges (NIC) and RCRC: these are direct outputs of the model and represent the costs of imbalance charges to parties and the redistribution of these charges through RCRC;

- SO balancing and party hedging cost: This represents the net change in the total costs of balancing the system. 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 prices and reliability or forecasting improvements made by parties;

- Payments for involuntary and voluntary disconnection: This captures payments to consumers who are involuntarily disconnected and payments to industrial and commercial DSR where appropriate. These would in practice form part of the SO's costs of balancing but are split out here for transparency;

- Investment in new capacity: This captures the investment costs of parties' response to the investment signal in the market. DSR is assumed to have no up-front investment costs but does have a utilisation cost captured in the SO balancing costs above. We also include the 'infra-marginal' benefit of investment in CCGT: this is the benefit which is captured by parties through operating in forward markets to recoup some of the cost of investment. As not all costs associated with the asset are likely to be recouped through cash-out, it is was considered inappropriate to assign all these costs to the packages;

- Investment in reliability and forecasting: Reliability and forecasting improvements are not endogenously captured as part of the model. However, changing cash-out incentives is likely to have a significant impact on the incentives to invest in these opportunities. We have undertaken analysis to assess the likely difference in investment incentives for reliability or forecasting improvements under the different packages[66]. This presents the difference in investment cost compared to the Do Nothing scenario, where benefits represent a reduction in investment cost under a given package; and

- Price revenue benefit: It is assumed that market participants pass all costs onto consumers through market prices. As such, this revenue benefit for producers offsets all the costs incurred by market participants.

[66] See 'Long-term Balancing Incentives' in Section 4 of Baringa's report.

1.6. Consumer surplus costs and benefits include:

- Price revenue cost: represents the costs passed through by market participants to consumers and directly offsets the price revenue benefit under producer surplus above;

- Value of reduced lost load: The packages are likely to improve security of supply for consumers and reduce lost load. Consumers place a value on lost load hence any reduction implies a benefit for consumers. The benefit to consumers of avoided voltage control and disconnection are valued at £6,000/MWh and £17,000/MWh respectively[67]. Lost load is reduced through new capacity added in the model and improved interconnector response. Although interconnector flows are not captured endogenously within the model, it is assumed that given the spikiness of prices at times of system stress under the packages, these prices could be sufficiently high to incentivise interconnectors to flow into GB averting some of the remaining lost load as a consequence. As this is not directly captured in the model, this benefit is capped across scenarios and the likely further impact on cash-out prices is not included in the analysis in the rest of this document;

- Payment for involuntary and voluntary disconnection: this captures the payments to consumers from the SO for disconnection services, netting off the cost under producer surplus above. These are payments for involuntary services in the case where consumers are cut-off in an emergency, and voluntary where I&C consumers offer DSR services to the SO; and

- Value of voluntary disconnections: Where I&C DSR is disconnected, even if they receive payment for this, they still place an inherent value on lost load[68]. This is captured here and is equal to the payment that they receive for this service.

[67] The VoLL study found a wide degree of uncertainty regarding the costs of SO-directed voltage control. The study suggested that this is an area where further research is required in order to provide robust estimates of the impacts or costs of voltage reduction on consumers. However, it is likely that consumers place inherent value on maintaining certain levels of voltage. Evidence for this can be found in the fact that some consumers invest in devices or appliances that overcome voltage fluctuations. In addition, the SO uses voltage control only as an emergency action and we are not aware of any SOs that frequently use voltage reduction as a standard practice. We have chosen to value voltage control actions at £6,000 is this analysis to be consistent with the price these actions would be attached in the price calculation.

[68] Note that this does not capture all DSR payments to voluntary providers as this could not be fully split out in the modelling. All costs and benefits are captured in the NPV but this line item in the CBA slightly underestimates the consumer surplus cost of these actions.

Illustrative CBA and modelling limitations

1.7. 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. However, the response of parties to changes in cash-out 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 a small element of the overall wholesale market and is only one of a number of different influences on party behaviour. As such, the CBA is likely to have a wide range of uncertainty that is not captured in our analysis.

1.8. To support the analysis in this IA, we developed a model to help us look in detail at how specific changes to the cash-out regime could impact on participant behaviour. This has also allowed us to understand how some of the key cash-out parameters may respond to proposed reforms and underlying market trends going forward (for example changes in capacity mix). It is possible to draw conclusions from the model developed to illustrate the costs and benefits of reform as we have done in this analysis. 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:

- Rigorously model investment decisions of parties, it only assesses the signal to invest in new capacity through the impact on near-term market prices. The model does not factor in other influences on investment decisions and does not forecast if, when and what new capacity may be added to the system;

- Undertake a probabilistic estimation of EEU. The model is calibrated to an underlying capacity scenario which implies a given level of security of supply. When new capacity is added under the long-term sensitivity, a full probabilistic estimate of EEU is not undertaken. Instead, the likely change in EEU is assessed using the static relationship between margin and EEU assumed from the Capacity Assessment work;

- Consider in detail parties’ strategies around bidding and offering going forward and how these could change. The parameters of bids and offers are based on historic experience and do not reflect changes in the amount of or competition between sources of flexible capacity in the BM, which could underestimate the cost of the Do Nothing scenario relative to the packages;

- Incorporate the wider impact that distributional effects could have on competition in the market, which could understate the benefits of packages 2, 4 and 5 which include a single price;

- Contain detailed information regarding opportunities to invest in reliability and forecasting improvements. As such, the modelled impacts could overstate the impacts of investment in reliability, increasing the costs of the Do Nothing, Package 1 and 3 relative to the other packages;

- Model directly interconnector flows, including all influences on the size and direction of flow and how these could react to changes in cash-out reform, which could underestimate the benefit of all packages, in particular Packages 3 and 5 which create the sharpest prices; and

- Consider new alternative technologies which could be introduced, for example storage, including potential opportunities and costs of bringing these technologies forward, which again could underestimate the benefit of all packages.

1.9. As such, the CBA presented does not include all costs and benefits associated with cash-out reform. In particular, it is likely to understate some benefits, for example, through improved competition in the market, and understate some costs, for example, any additional costs associated with increased volatility of cash-out prices. However, this CBA does represent a best-attempt to capture and illustrate the key costs and benefits associated with cash-out reform.

1.10. Given the significant interaction between cash-out reform and a CM, we also present an illustrative CBA of cash-out reform in the context where a CM is introduced. However, it should be noted that the model is limited in how it captures the impact of a CM: only the additional capacity anticipated to be delivered is added to the model. The model does not capture how the CM could impact on balancing behaviour or the interaction between the investment incentives from cash-out reform and a CM.

1.11. To be able to produce this illustration we have had to make an exogenous assumption on how a CM would interact with the incentives from cash-out reform to feed into parties investment decisions. For this analysis we assumed that a CM would overwhelm any additional investment signal from cash-out for new capacity. Hence a CM would significantly reduce the potential benefits associated with cash-out from reducing lost load, but also the costs of additional investment.

Results of CBA

1.12. The annualised estimates of the costs and benefits are included in the tables below for 2020 and 2030 for both the CCGT and DSR sensitivity. Results are also presented for the 'with CM' sensitivity. All impacts are expressed relative to Do Nothing option and a positive value represents a net cost. Further, all costs and benefits are in 2012 prices.

Table A6 – CBA assuming CCGT investment

£m/year		2020					2030				
		P1	**P2**	**P3**	**P4**	**P5**	**P1**	**P2**	**P3**	**P4**	**P5**
Producer Surplus	NIC	-107	144	-129	156	145	-233	461	-323	451	434
	RCRC	107	-144	129	-156	-145	233	-461	323	-451	-434
	SO balancing and party hedging costs	2	1	3	0	1	13	2	18	-5	17
	Payments for involuntary disconnections	0	0	0	0	0	0	0	0	0	0
	Payments for voluntary disconnections	0	0	0	0	0	0	0	0	0	0
	Investment in new capacity	-8	-9	-9	-8	-9	-66	-70	-84	-79	-84
	Investment in reliability	-8	13	-9	13	13	-33	66	-40	73	54
	Price revenue benefit	14	-5	15	-5	-5	87	2	106	12	13
Consumer surplus	Price revenue cost	-14	5	-15	5	5	-87	-2	-106	-12	-13
	Reduction in disconnection (new capacity)	0	0	0	0	0	7	7	7	7	7
	Reduction in voltage control (new capacity)	0	0	0	0	0	60	62	63	61	63
	Reduction in disconnection (Interconnector)	0	0	0	0	0	1	1	1	1	1
	Reduction in voltage control (Interconnector)	0	0	0	0	0	31	31	31	31	31
	Payment for involuntary disconnection	0	0	0	0	0	0	0	0	0	0
	Payment for voluntary disconnection	0	0	0	0	0	0	0	0	0	0
	Value of voluntary disconnection	0	0	0	0	0	0	0	0	0	0
Total		-14	5	-15	5	5	13	99	-4	89	89
Change in average domestic bill £/year		0.15	-0.06	0.16	-0.06	-0.06	0.83	0.02	1.01	0.11	0.12

Table A7 – CBA assuming DSR investment

£m/year		2020					2030				
		P1	**P2**	**P3**	**P4**	**P5**	**P1**	**P2**	**P3**	**P4**	**P5**
Producer Surplus	NIC	-107	144	-129	156	145	-233	461	-323	451	434
	RCRC	107	-144	129	-156	-145	233	-461	323	-451	-434
	SO balancing and party hedging costs	1	0	2	-1	1	9	-3	14	-9	13
	Payments for involuntary disconnections	0	0	0	0	0	0	0	0	0	0
	Payments for voluntary disconnections	0	0	0	0	0	-16	-16	-16	-16	-16
	Investment in new capacity	0	0	0	0	0	0	0	0	0	0
	Investment in reliability	-8	13	-9	13	13	-33	66	-40	73	54
	Price revenue benefit	7	-14	7	-13	-13	41	-47	43	-47	-50
Consumer surplus	Price revenue cost	-7	14	-7	13	13	-41	47	-43	47	50
	Reduction in disconnection (new capacity)	0	0	0	0	0	7	7	7	7	7
	Reduction in voltage control (new capacity)	0	0	0	0	0	60	62	63	61	63
	Reduction in disconnection (Interconnector)	0	0	0	0	0	1	1	1	1	1
	Reduction in voltage control (Interconnector)	0	0	0	0	0	31	31	31	31	31
	Payment for involuntary disconnection	0	0	0	0	0	0	0	0	0	0
	Payment for voluntary disconnection	0	0	0	0	0	0	0	0	0	0
	Value of voluntary disconnection	0	0	0	0	0	16	16	16	16	16
Total		-7	14	-7	13	13	59	148	59	148	152
Change in average domestic bill £/year		0.07	-0.15	0.07	-0.14	-0.14	0.24	-0.61	0.25	-0.61	-0.64

Table A8 – CBA assuming CM

£m/year		2020					2030				
		P1	**P2**	**P3**	**P4**	**P5**	**P1**	**P2**	**P3**	**P4**	**P5**
Producer Surplus	NIC	-113	139	-139	152	138	-195	488	-242	510	486
	RCRC	113	-139	139	-152	-138	195	-488	242	-510	-486
	SO balancing and party hedging costs	1	0	2	1	0	2	-10	1	-29	-11
	Payments for involuntary disconnections	0	0	0	0	0	0	0	0	0	0
	Payments for voluntary disconnections	0	0	0	0	0	0	0	0	0	0
	Investment in new capacity	0	0	0	0	0	0	0	0	0	0
	Investment in reliability	-7	12	-9	11	12	-28	64	-33	84	64
	Price revenue benefit	7	-12	7	-12	-13	25	-54	32	-56	-52
Consumer surplus	Price revenue cost	-7	12	-7	12	13	-25	54	-32	56	52
	Reduction in disconnection (new capacity)	0	0	0	0	0	0	0	0	0	0
	Reduction in voltage control (new capacity)	0	0	0	0	0	0	0	0	0	0
	Reduction in disconnection (Interconnector)	0	0	0	0	0	0	0	0	0	0
	Reduction in voltage control (Interconnector)	0	0	0	0	0	1	1	1	1	1
	Payment for involuntary disconnection	0	0	0	0	0	0	0	0	0	0
	Payment for voluntary disconnection	0	0	0	0	0	0	0	0	0	0
	Value of voluntary disconnection	0	0	0	0	0	0	0	0	0	0
Total		-7	12	-7	12	13	-24	55	-31	57	53
Change in average domestic bill £/year		0.08	-0.13	0.08	-0.13	-0.14	0.24	-0.52	0.31	-0.53	-0.50

Appendix 6 - Glossary

B

Balancing and Settlement Code (BSC)

The Balancing and Settlement Code contains the governance arrangements for electricity balancing and settlement in Great Britain. The energy balancing aspect relates to parties' submissions to the System Operator to either buy or sell electricity from/to the market at close to real time through the Balancing Mechanism in order to keep the system from moving too far out of balance. The settlement aspect relates to monitoring and metering the actual positions of generators and suppliers (and interconnectors) against their contracted positions and settling imbalances when actual delivery or offtake does not match contractual positions.

Balancing Mechanism (BM)

The Balancing Mechanism (BM) is the principal tool used by the System Operator (SO) to balance the electricity system on a second-by-second basis. Generators and consumers with spare flexibility in their portfolios submit offers (to increase generation or decrease demand) and bids (to decrease generation or increase demand) to the SO via the BM. The SO uses the BM for energy balancing and system balancing actions.

Balancing Mechanism Unit

The basic unit of participation in the Balancing Mechanism, describing one or more generation or demand units which import or export electricity from or to the electricity system.

Balancing Services

The System Operator (SO) supplements the Balancing Mechanism (BM) with forward contracts for a range of Balancing Services. The SO will enter into these agreements where it believes that it cannot source the service through the BM, or it wishes to reduce the costs of BM actions by guaranteeing the availability of certain units.

Balancing Services Use of System (BSUoS) charges

Balancing Services Use of System charges recover the costs that the System Operator incurs in the Balancing Mechanism and in procuring Balancing Services from parties. They are charged on a half-hourly basis to market participants based on energy volumes.

Bid/Offer Acceptances (BOAs)

Acceptances by the System Operator of Balancing Mechanism offers to increase electricity on the system, or bids to reduce electricity on the system. The prices of BOAs form the basis for the calculation of cash-out prices.

Buy Price Adjuster (BPA)

The Buy Price Adjuster is added to the System Buy Price in short periods to reflect the costs of the long-term contracts that the System Oprator enters into to provide Short Term Operating Reserve (STOR) and Balancing Mechanism start-up. The STOR component is calculated and allocated using historical data. It is added when the net imbalance volume is positive.

C

Constraints

There are various parts of the transmission network where import or export capacity is limited. Constraints can become active when this capacity limit is reached. This may require the System Operator (SO) to take balancing actions to reduce generation behind the constraint, and increase generation or reduce demand elsewhere on the network to maintain the balance of energy on the system.

D

Demand Control

Demand Control actions are instructions from the SO – when it considers there to be insufficient supply to meet demand – to Distribution Network Operators to reduce demand, through either voltage reduction ('brownouts'), or firm load disconnection ('blackouts'). These 'Demand Control' actions are balancing actions, but unlike other balancing actions they are not included in the calculation of cash-out prices, or in the determination of participants' imbalance positions.

Demand Side Response (DSR)

Demand side response involves electricity consumers actively varying their level of demand, usually in response to market prices or to offer balancing services.

E

Elexon

Elexon is the Balancing and Settlement Code (BSC) company which manages the BSC on National Grid Electricity Transmission Plc's behalf.

Energy Imbalance Prices (or Cash-out Prices)

Energy Imbalance Prices are applied to parties for their imbalances in each half-hour period. The System Buy Price is charged for short contracted positions, while the System Sell Price is paid for long contracted positions.

Energy Imbalance

An energy imbalance in a given settlement period is the difference between the total level of demand and the total level of generation on the system within the half hour balancing period. This ignores any actions that the System Operator might have to take to resolve constraints on the system and purely refers to the difference on market participants between their contracted and outturn positions.

F

Feed-in Tariffs with a Contract for Difference (FiT CfDs)

Long term contracts to be introduced by Government as part of the Electricity Market Reform Project to encourage investment in low-carbon generation. Feed-in Tariffs with a Contract for Difference are intended to provide greater long-term revenue certainty to low carbon investors.

Final Physical Notification

The Final Physical Notification is the level of generation or demand that the Balancing Mechanism Unit expects to produce or consume. This information is submitted to the System Operator at Gate Closure.

Flagging

Certain balancing actions are assigned a flag in the cash-out price calculation to consider whether these actions should be repriced. This includes System Operator identification of balancing actions deemed as potentially being impacted by a transmission constraint.

G

Gate Closure

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

I

Imbalance

The difference between a party’s contracted position and metered position measured on a half-hourly basis.

Information Imbalance Charge

This is a provision in the market rules to levy a charge on participants who deviate from their Final Physical Notification after Gate Closure. It is currently set to zero.

Interconnectors

Interconnectors link the electricity transmission networks of different countries. The GB electricity market has interconnection to France, Northern Ireland, the Netherlands and Ireland.

M

Main Price

There are two Energy Imbalance Prices: 'Main' and 'Reverse'. The Main Price is charged to parties out of balance in the same direction as the system. When the system is long, long parties receive the Main Price (System Sell Price), and when it is short, short parties pay the Main Price (System Buy Price).

Market Index Price (MIP)

The Market Index Price (MIP) is used to set the reverse Energy Imbalance Price. It is calculated based on short term trading activity on exchanges. Currently the MIP is set based on selected trades undertaken on the APX and N2EX exchanges over a period of 20 hours before gate closure.

Metered Position

The actual volume of electricity generated or consumed by a participant. It is the sum of the actual volume of electricity imported or exported at each Balancing Mechanism Unit.

N

Net Imbalance Volume (NIV)

The overall energy imbalance on the system as determined by the net volume of actions taken by the SO in the Balancing Mechanism and under Balancing Services contracts.

P

Price Average Reference (PAR)

The volume of electricity from the energy stack (taken in descending price order) included in the calculation of the Main Price. PAR is currently set to 500 MWh. The PAR volume is always the most expensive 500 MWh of available electricity in the main stack.

R

Reserve

Additional capacity available to the System Operator in order to manage uncertainty in the supply/demand balance.

Reserve Creation

The use of Bid/Offer Acceptances in order to create sufficient flexibility and responsiveness to meet variations in the supply/demand balance.

Reserve Scarcity Pricing (RSP) Function

The Reserve Scarcity Pricing function derives pricing for reserve actions with reference to a measure of loss of load probability and the margin on the system for a given settlement period. The aim is to ensure that the reserve actions are reflected in the cash-out price according to the value that those actions deliver to the system. The RSP would be used to in place of the Buy Price Adjuster.

Residual Cashflow Reallocation Cashflow (RCRC)

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

Reverse Price

There are two Energy Imbalance Prices, 'Main' and 'Reverse'. The Reverse Price is charged to parties out of balance in the opposite direction to the system. When the system is long, short parties pay the Reverse Price (System Buy Price)and when it is short, long parties receive the Reverse Price (System Sell Price) The Reverse Price is currently set to the Market Index Price.

S

Sell Price Adjuster (SPA)

The Sell Price Adjuster is added to the System Sell Price in long periods to reflect the costs of the long-term contracts that the System Oprator enters into to provide Short Term Operating Reserve (STOR) and Balancing Mechanism start-up. The STOR component is calculated and allocated using historical data. It is added when the net imbalance volume is negative.

Short Term Operating Reserve (STOR)

A contracted Balancing Service, whereby the service provider delivers a contracted level of power when instructed by the System Operator (SO), within pre-agreed parameters. The SO makes two kinds of payments for use of Short Term Operating Reserve, availability payments and utilisation payments.

System Operator (SO)

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

System Buy Price (SBP)

The price that parties face for a negative energy imbalance (short positions).

System Pollution

Cash-out prices are polluted when they are calculated based on the cost of actions taken by the System Operator for non-energy related reasons, for example, to resolve constraints. There exist a number of mechanisms in the cash-out price calculation to remove pollution from prices. These processes are known as flagging and tagging.

System Sell Price (SSP)

The price that parties face for a positive energy imbalance (long positions).

T

Tagging

The process by which bids and offers are removed from the energy stack so that remaining actions determine energy imbalance prices.

Transmission System

The national high voltage electricity network, operated by the System Operator.

V

Value of Lost Load (VoLL)

The value that a consumer places on maintaining voltage or supply in the face of voltage control or disconnection.