P304 – WORKGROUP PAR350 ANALYSIS

EXECUTIVE SUMMARY

BSC Modification P304 'Reduction in PAR from 500MWh to 250MWh' proposes to reduce the Price Average Reference (PAR) volume to 250MWh to make System Prices (cash-out prices) more marginal when they are calculated using the Main Price (see Appendix 1 for the effect of PAR in the Main Price calculation).

We assessed the impact of an alternative PAR volume of 350MWh on imbalance prices based on historical data starting from 2010 (post P217 implementation). We have also re-run the Settlement Trading Charge calculation using PAR350 imbalance prices to study the impacts to BSC Parties. Please note that this analysis does not take into account behavioural changes as a result of PAR350.

ELEXON's analysis shows that compared to PAR250, PAR350 will have a weaker effect on sharpening the Main Price when the period Net Imbalance Volume (NIV) is greater than 350MWh or less than -350MWh. Meaning an increase System Buy Price (SBP) when the System is short and decrease System Sell Price (SSP) when the System is long. The Main Price will not be affected for Settlement Periods with a NIV between +/- 350MWh inclusive. This supports the intention of Ofgem's EBSCR Policy; to make the Main Price a more accurate signal of scarcity on the system.

We have applied PAR350 imbalance prices to BSC Parties' historical Imbalance Volumes to assess the impacts of Imbalance Charges and Residual Cashflow Reallocation Cashflow (RCRC) on BSC Parties. The findings are similar to that of the PAR250 analysis as Parties with large Credited Energy Volumes will benefit from larger RCRC arising from PAR350 Main Price/Reverse Price spread. There is less impact to BSC Parties compared to PAR100 and PAR250. Independent Suppliers were more likely to be impacted by higher imbalance prices. However, the net daily impact is below £55 (about half of the impact of PAR250) for 97% of the Suppliers.

The full details of P304 can be found on the P304 page of the ELEXON website.

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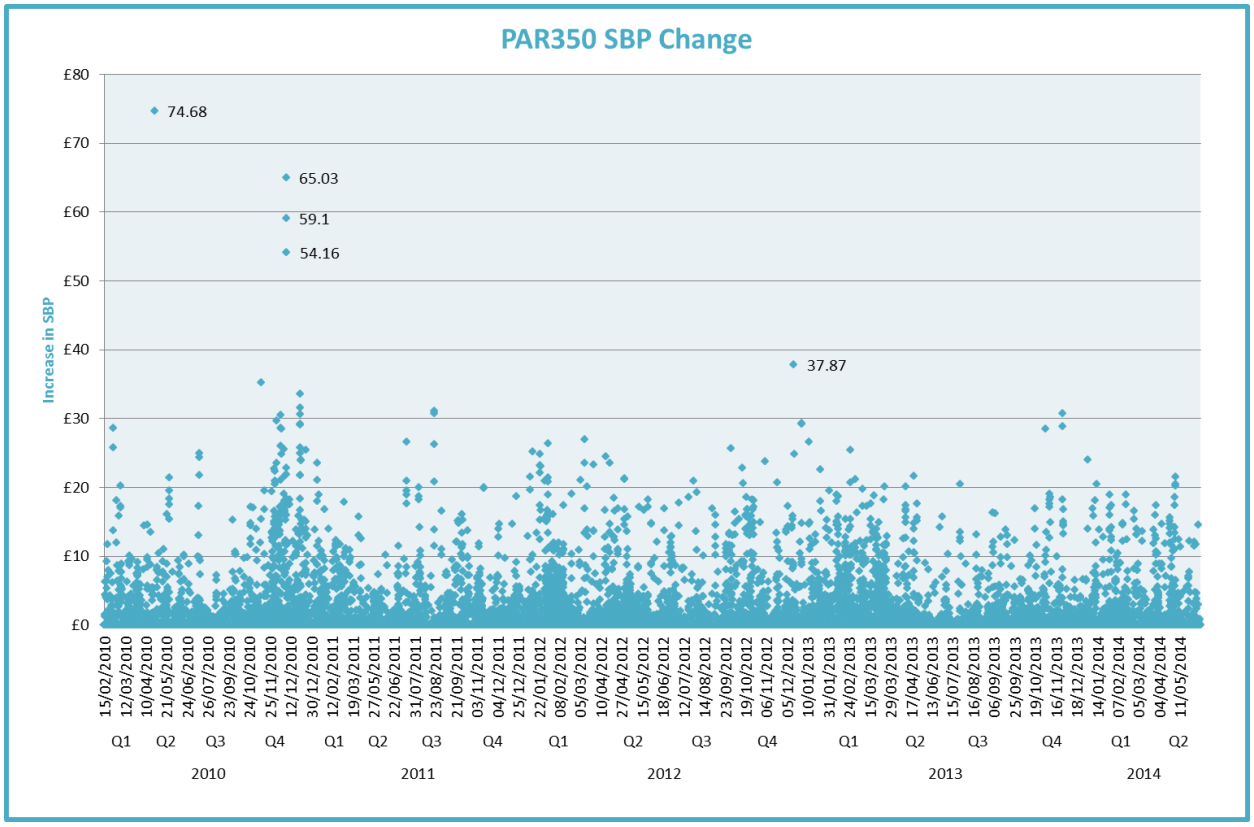
PAR350 MAIN PRICE IMPACT ANALYSIS

Graph 1 - Increase in System Buy Price (SBP) as a Result of PAR350



Graph 1 shows there were more Settlement Periods with large increases in SBP in 2010 especially during the winter period. SBP increased less compared to PAR100 and PAR250 with the maximum SBP increase being £74.68.

Throughout the analysis period, SBP remained unchanged in 75.10% of the total Settlement Periods where SBP was the Main Price (i.e. the system was short). This percentage has increased by 13.12 percentage points compared to PAR250, suggesting that less Settlement Periods were affected when increasing PAR from 250MWh to 350MWh.

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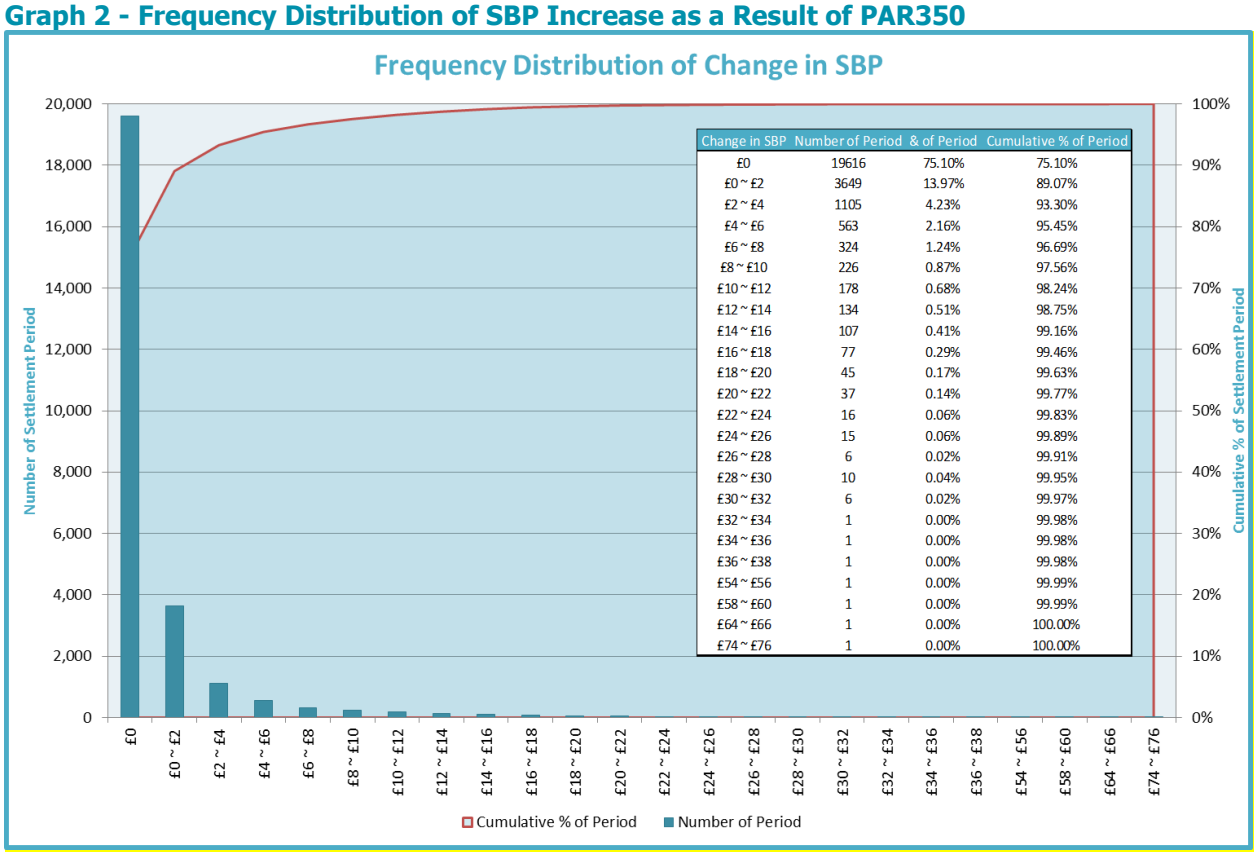
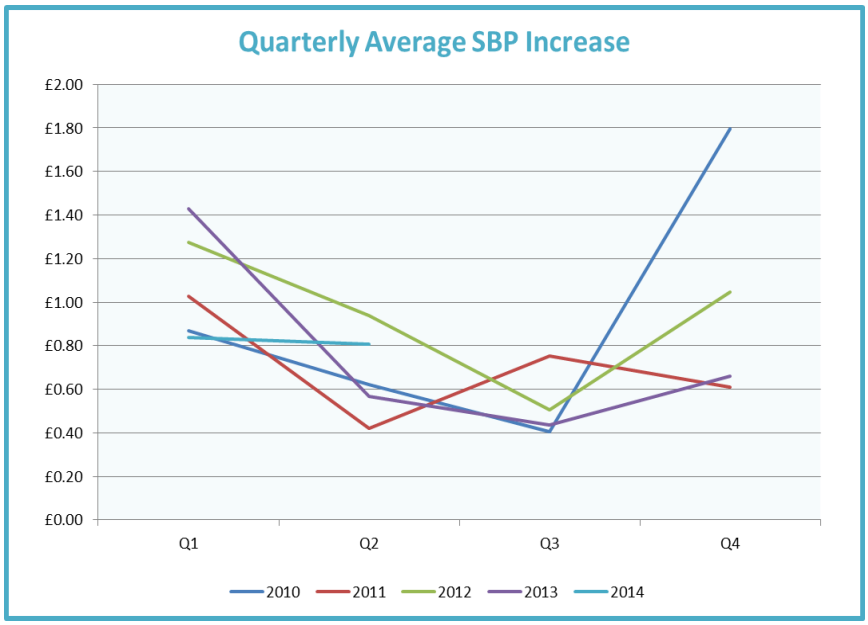
Graph 2 - Frequency Distribution of SBP Increase as a Result of PAR350



Change in SBP	Number of Period	& of Period	Cumulative % of Period
£0	19616	75.10%	75.10%
£0 ~ £2	3649	13.97%	89.07%
£2 ~ £4	1105	4.23%	93.30%
£4 ~ £6	563	2.16%	95.45%
£6 ~ £8	324	1.24%	96.69%
£8 ~ £10	226	0.87%	97.56%
£10 ~ £12	178	0.68%	98.24%
£12 ~ £14	134	0.51%	98.75%
£14 ~ £16	107	0.41%	99.16%
£16 ~ £18	77	0.29%	99.46%
£18 ~ £20	45	0.17%	99.63%
£20 ~ £22	37	0.14%	99.77%
£22 ~ £24	16	0.06%	99.83%
£24 ~ £26	15	0.06%	99.89%
£26 ~ £28	6	0.02%	99.91%
£28 ~ £30	10	0.04%	99.95%
£30 ~ £32	6	0.02%	99.97%
£32 ~ £34	1	0.00%	99.98%
£34 ~ £36	1	0.00%	99.98%
£36 ~ £38	1	0.00%	99.98%
£54 ~ £56	1	0.00%	99.99%
£58 ~ £60	1	0.00%	99.99%
£64 ~ £66	1	0.00%	100.00%
£74 ~ £76	1	0.00%	100.00%

Graph 2 shows the cumulative frequency distribution. Around 89% of the Periods were impacted by less than £2 and around 95% of the Periods were impacted by less than £6.

Graph 3 – Quarterly Average Increase in SBP



As shown in Graph 3, the average SBP increases in Q1 and Q4 (Calendar Year) were higher than those of other quarters in most of the years. The largest average SBP increase occurred in Q4 of 2010.

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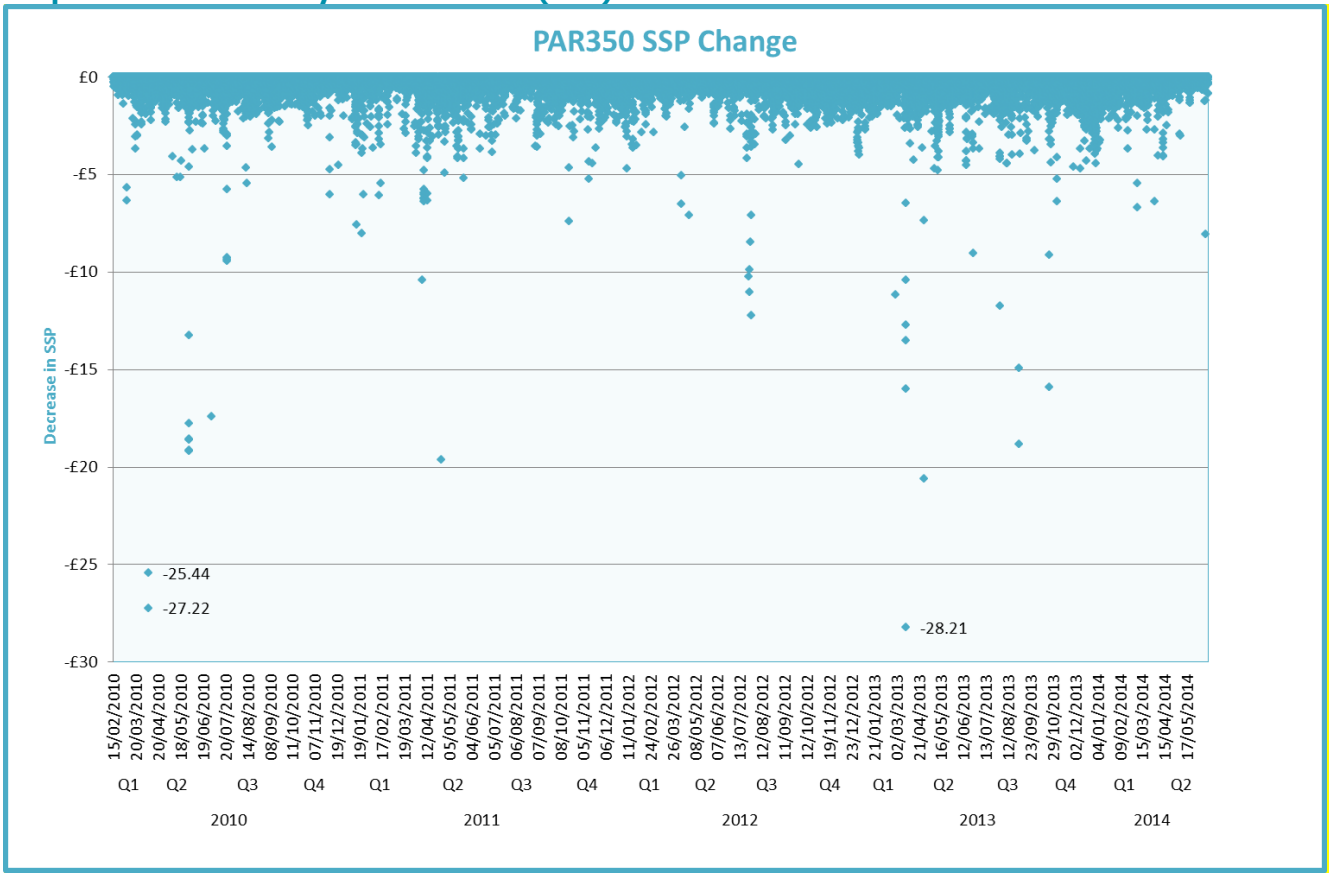
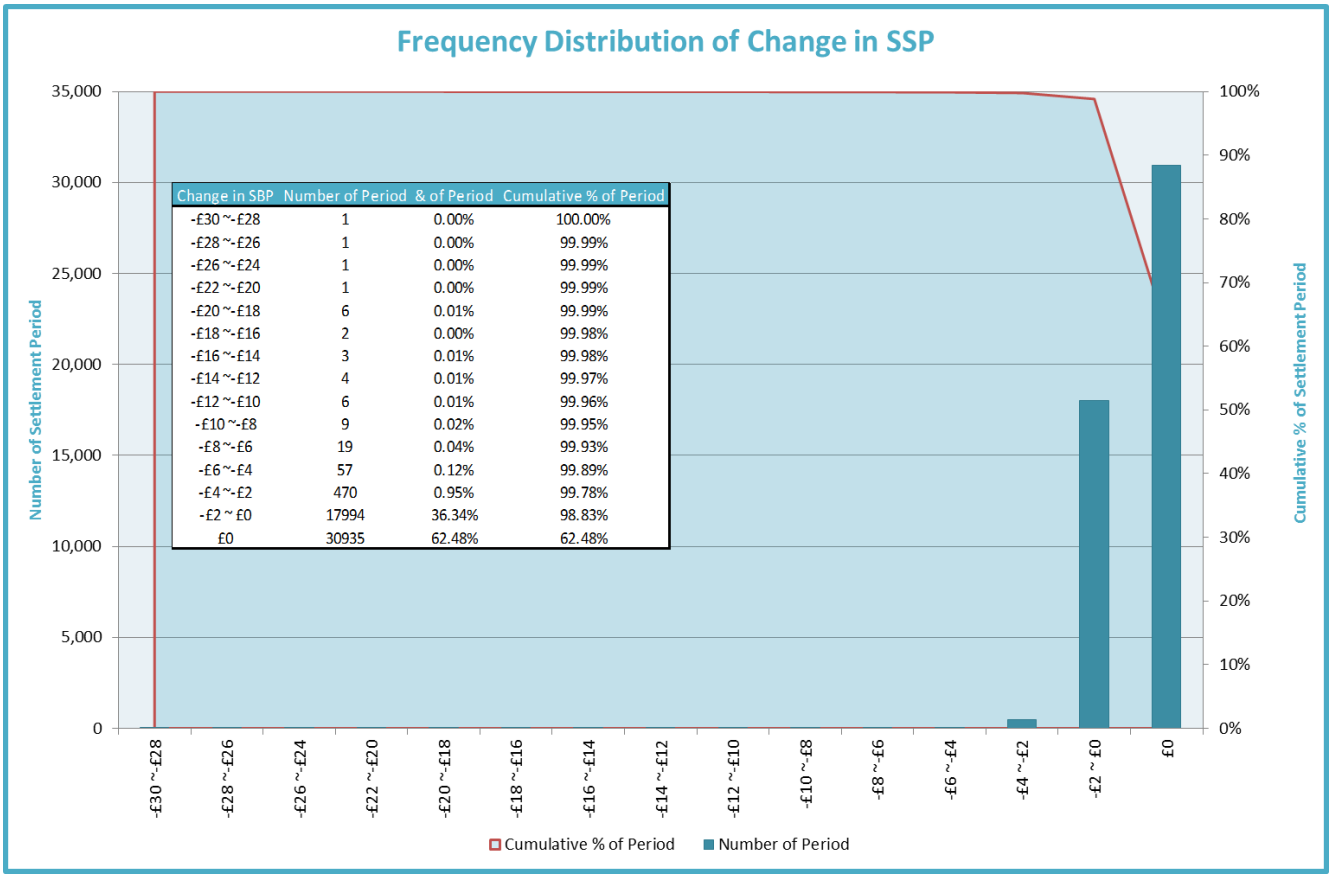
Graph 4 - Decrease in System Sell Price (SSP) as a Result of PAR350



Graph 5 - Frequency Distribution of SSP Decrease as a Result of PAR350



Change in SBP	Number of Period	& of Period	Cumulative % of Period
-£30 ~-£28	1	0.00%	100.00%
-£28 ~-£26	1	0.00%	99.99%
-£26 ~-£24	1	0.00%	99.99%
-£22 ~-£20	1	0.00%	99.99%
-£20 ~-£18	6	0.01%	99.99%
-£18 ~-£16	2	0.00%	99.98%
-£16 ~-£14	3	0.01%	99.98%
-£14 ~-£12	4	0.01%	99.97%
-£12 ~-£10	6	0.01%	99.96%
-£10 ~-£8	9	0.02%	99.95%
-£8 ~-£6	19	0.04%	99.93%
-£6 ~-£4	57	0.12%	99.89%
-£4 ~-£2	470	0.95%	99.78%
-£2 ~ £0	17994	36.34%	98.83%
£0	30935	62.48%	62.48%

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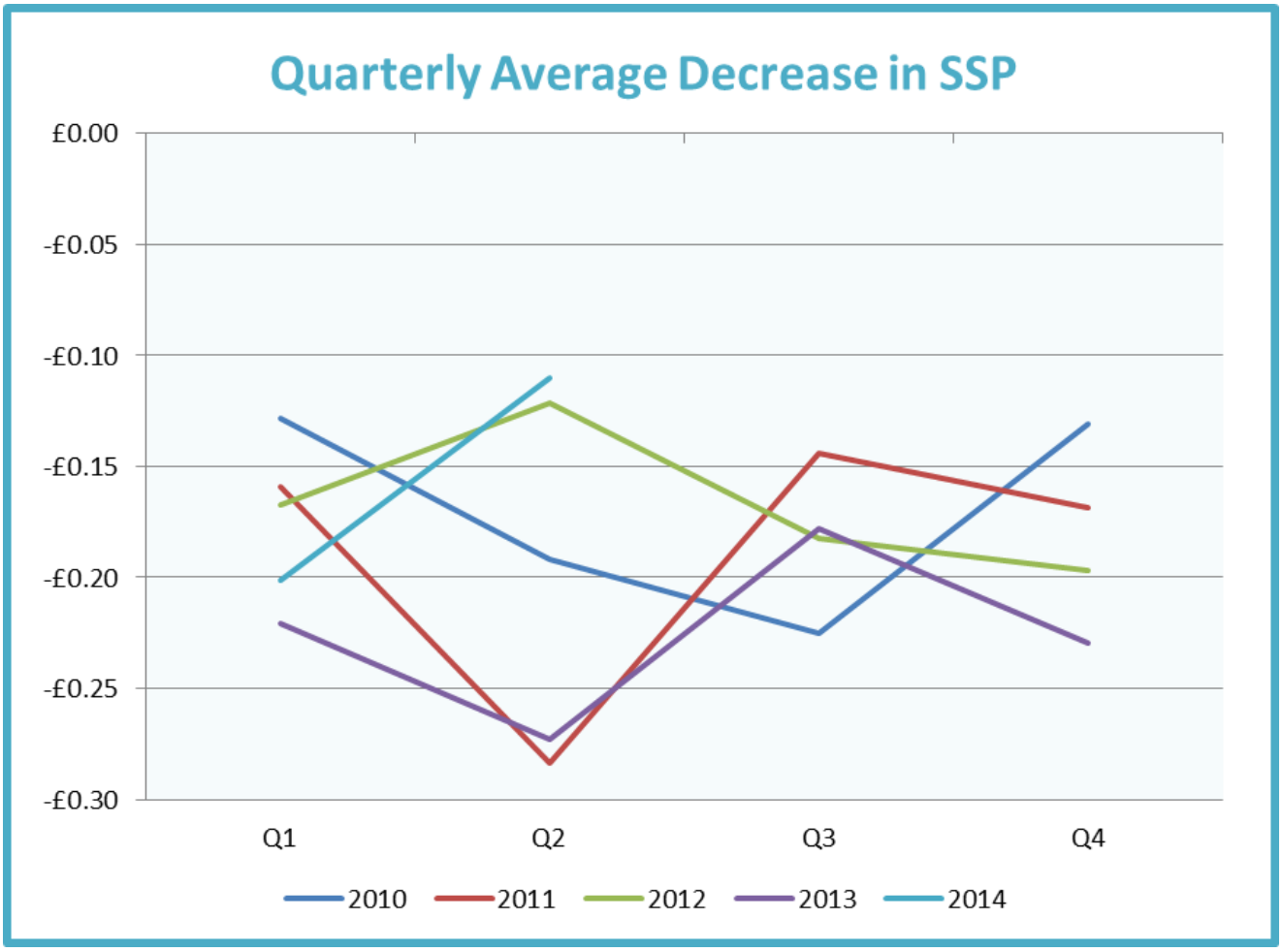
Graph 6 – Quarterly Average Decrease in SSP



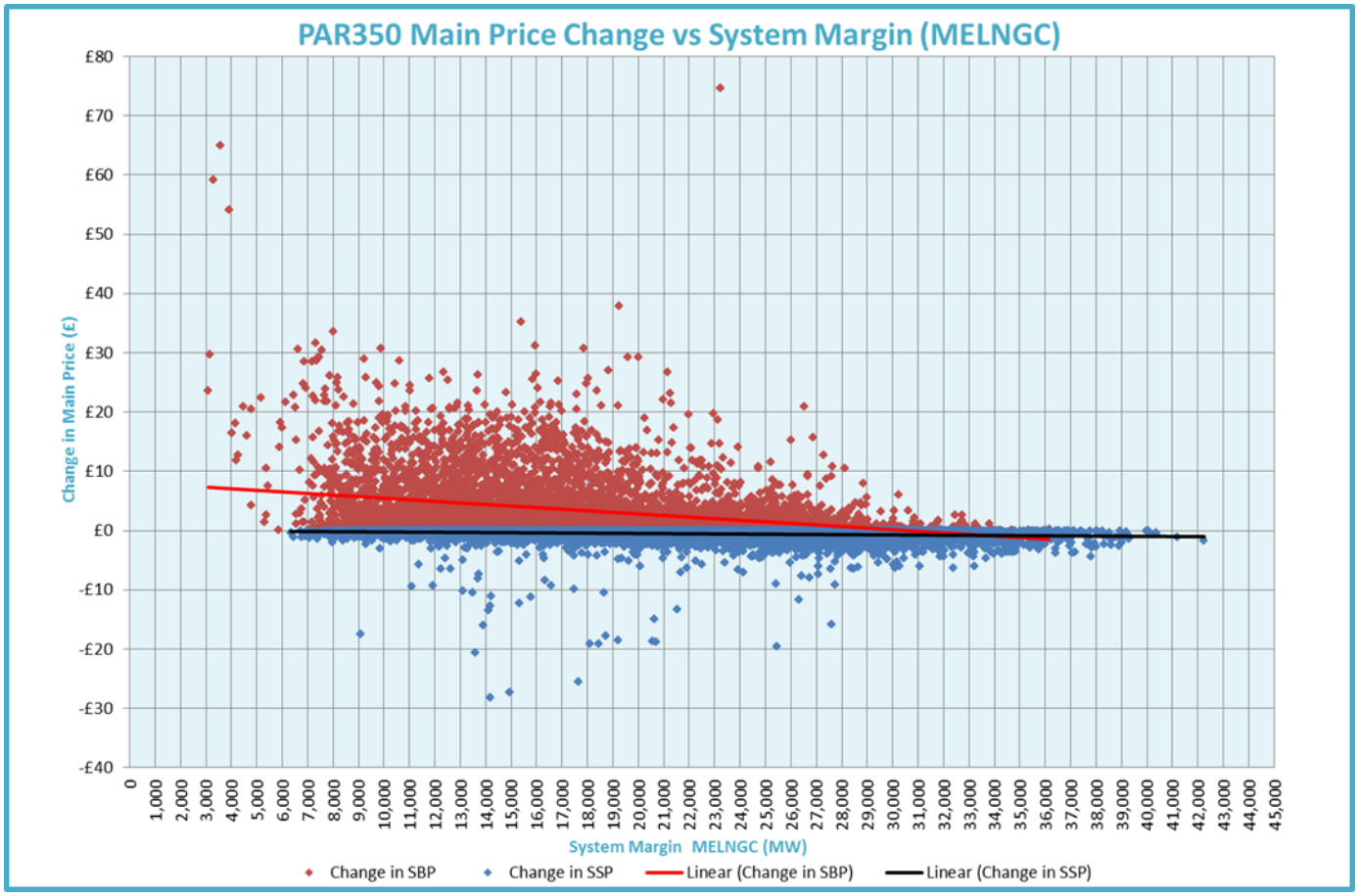
Throughout the analysis period, SSP remained unchanged in 62.48% of the Settlement Periods where SSP was the Main Price (i.e. the system was long). This percentage has decreased by 15.4 percentage points compared to PAR250, showing that less Settlement Periods were affected when increasing PAR from 250MWh to 350MWh.

The cumulative percentage suggests that around 98.83% of the Periods were impacted for less than -£2. The maximum decrease in SSP of -£28.21 occurred in Q1 of 2013. Graph 6 suggests that the average changes in SSP are more volatile in Q2.

P304 – WORKGROUP PAR350 ANALYSIS

PAR350 AGAINST SYSTEM MARGIN ANALYSIS

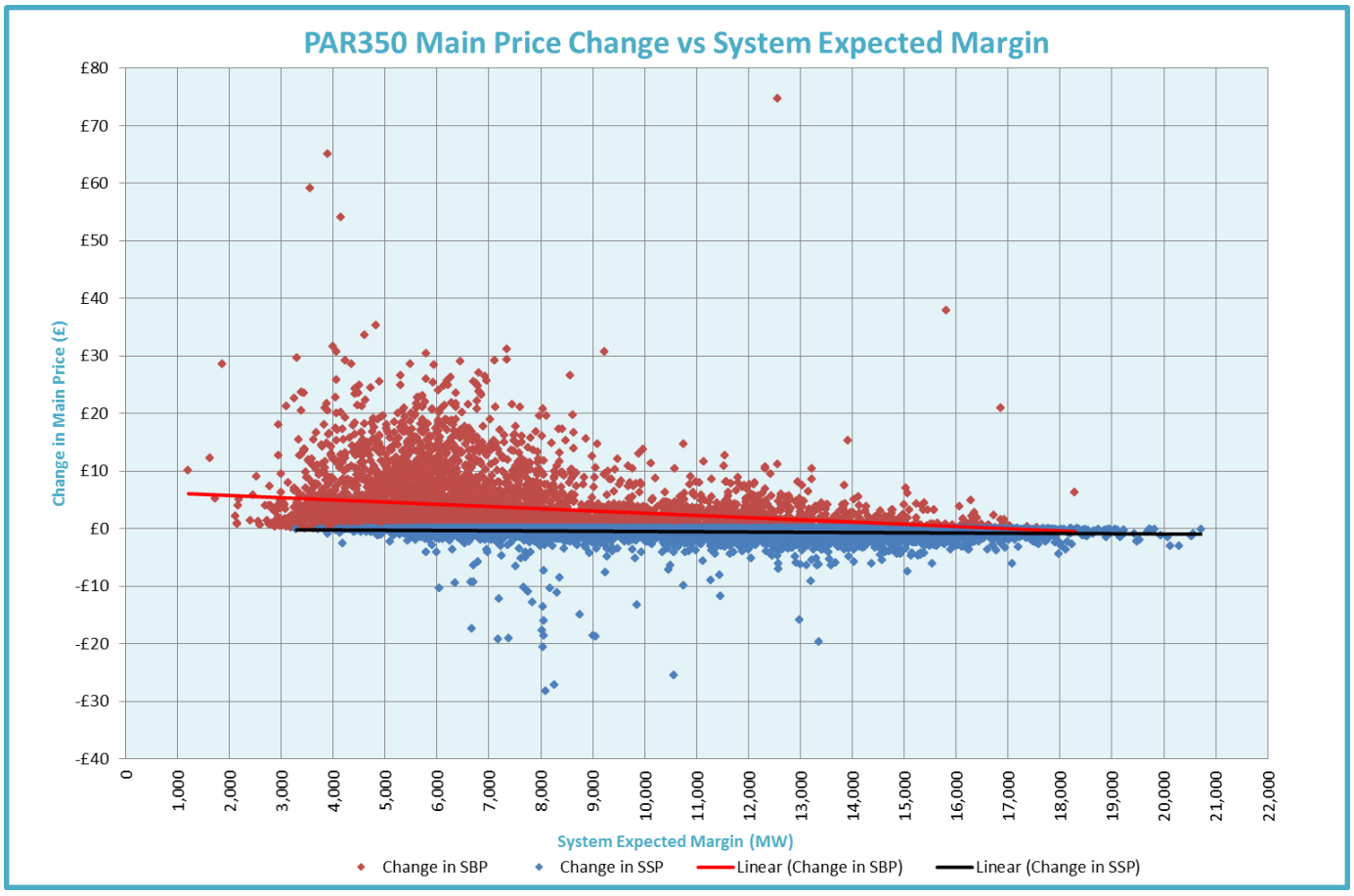
Graph 7 – Change in Main Price vs Transmission System Margin (MELNGC)



The objective of P304 is to calculate more marginal imbalance prices when System margins are tight. MELNGC is the indicated margin forecast for each Settlement Period and is the difference between the sums of the MELs submitted for that period and the National Demand Forecast made by the System Operator. This means that the greater the value the higher the margin between available generation capacity and forecast demand.

P304 – WORKGROUP PAR350 ANALYSIS

Graph 8 – Change in Main Price vs Transmission System Expected Margin



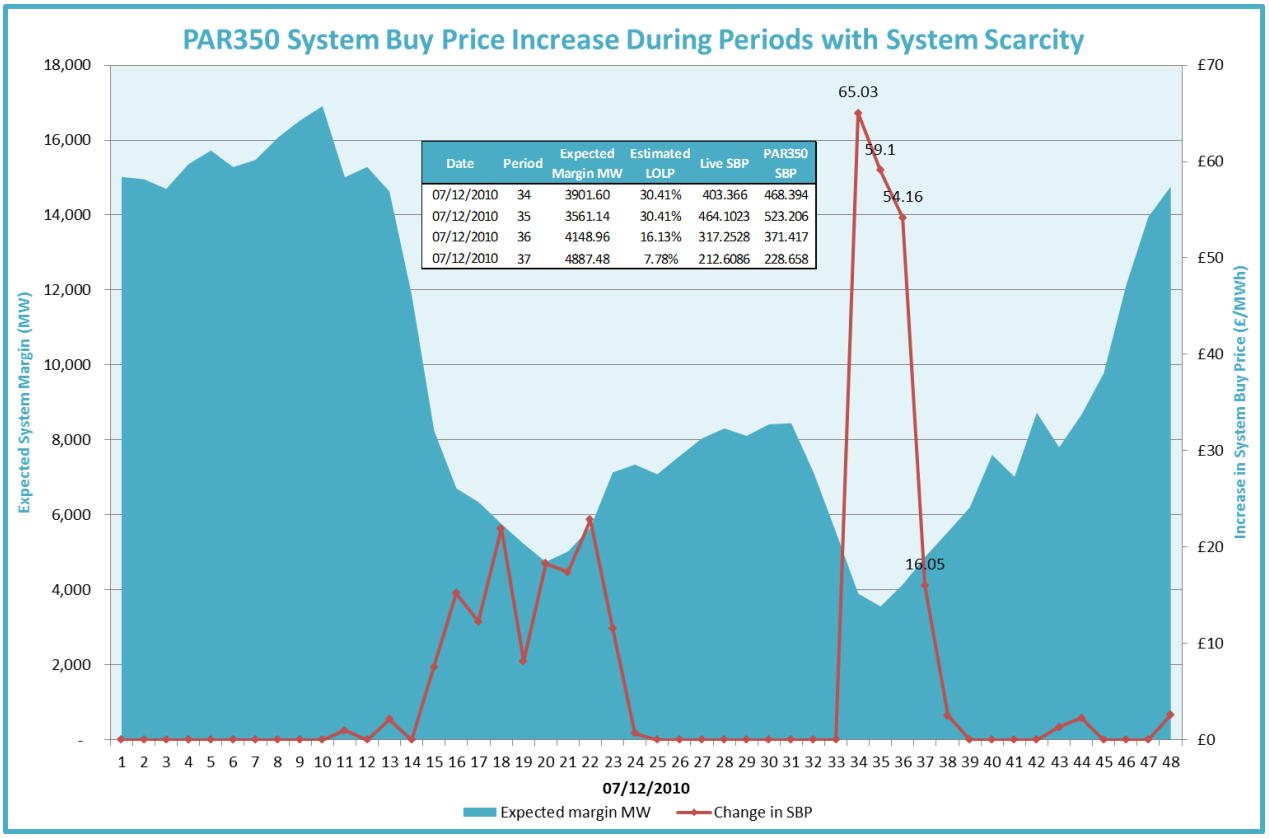
Another measure of System margin is its expected margin which is used by Ofgem to model Loss of Load Probability (LOLP). System expected margin is defined as:

- Available capacity - Demand + Interconnector flow + 900 (Non BM reserve)

Graphs 7 & 8 provide the assessment of the effectiveness of PAR350 when the system margin is tight based on MELNGC and expected margin respectively. The best fit line of SBP suggests that SBP increases when the system margin is low.

P304 – WORKGROUP PAR350 ANALYSIS

Graph 9 – PAR350 Largest System Buy Price Increase vs System margin on 7/12/2010



Date	Period	Expected Margin MW	Estimated LOLP	Live SBP	PAR350 SBP
07/12/2010	34	3901.60	30.41%	403.366	468.394
07/12/2010	35	3561.14	30.41%	464.1023	523.206
07/12/2010	36	4148.96	16.13%	317.2528	371.417
07/12/2010	37	4887.48	7.78%	212.6086	228.658

Graph 9 picks up the Periods with the largest increase in SBP and determines whether such Periods reflect tight system margins.

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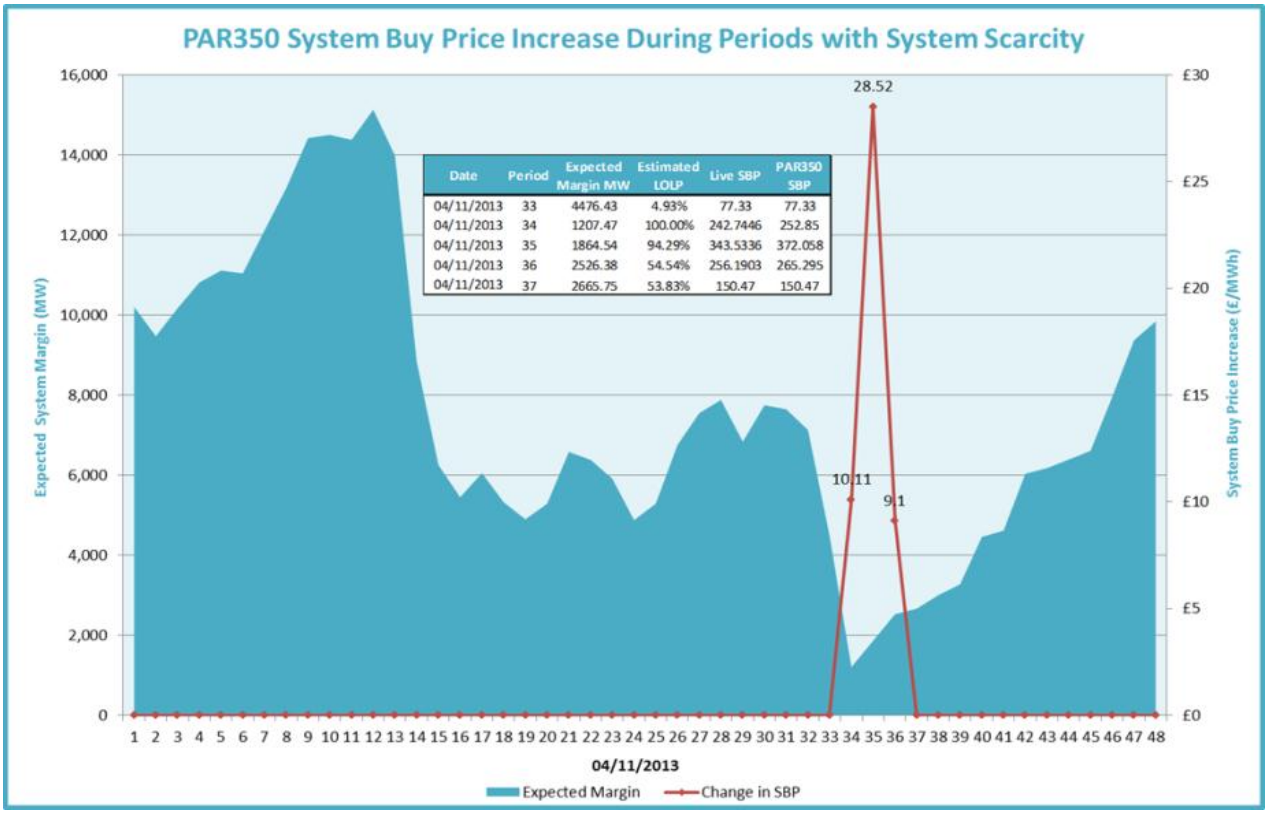
Graph 10 – PAR350 System Buy Price Increase vs Highest System Scarcity on 4/11/2013



Date	Period	Expected Margin MW	Estimated LOLP	Live SBP	PAR350 SBP
04/11/2013	33	4476.43	4.93%	77.33	77.33
04/11/2013	34	1207.47	100.00%	242.7446	252.85
04/11/2013	35	1864.54	94.29%	343.5336	372.058
04/11/2013	36	2526.38	54.54%	256.1903	265.295
04/11/2013	37	2665.75	53.83%	150.47	150.47

Graph 10 picks up the Periods where the level of system scarcity is high (high LOLP) and determines whether PAR350 would sharpen the SBP in these Periods. Both Graphs 9 and 10 show a good relationship between a SBP increase and a high level of system scarcity such that that PAR350 would increase SBP when the system margin is exceptionally tight. This supports the intention Ofgem's EBSCR Policy.

P304 – WORKGROUP PAR350 ANALYSIS

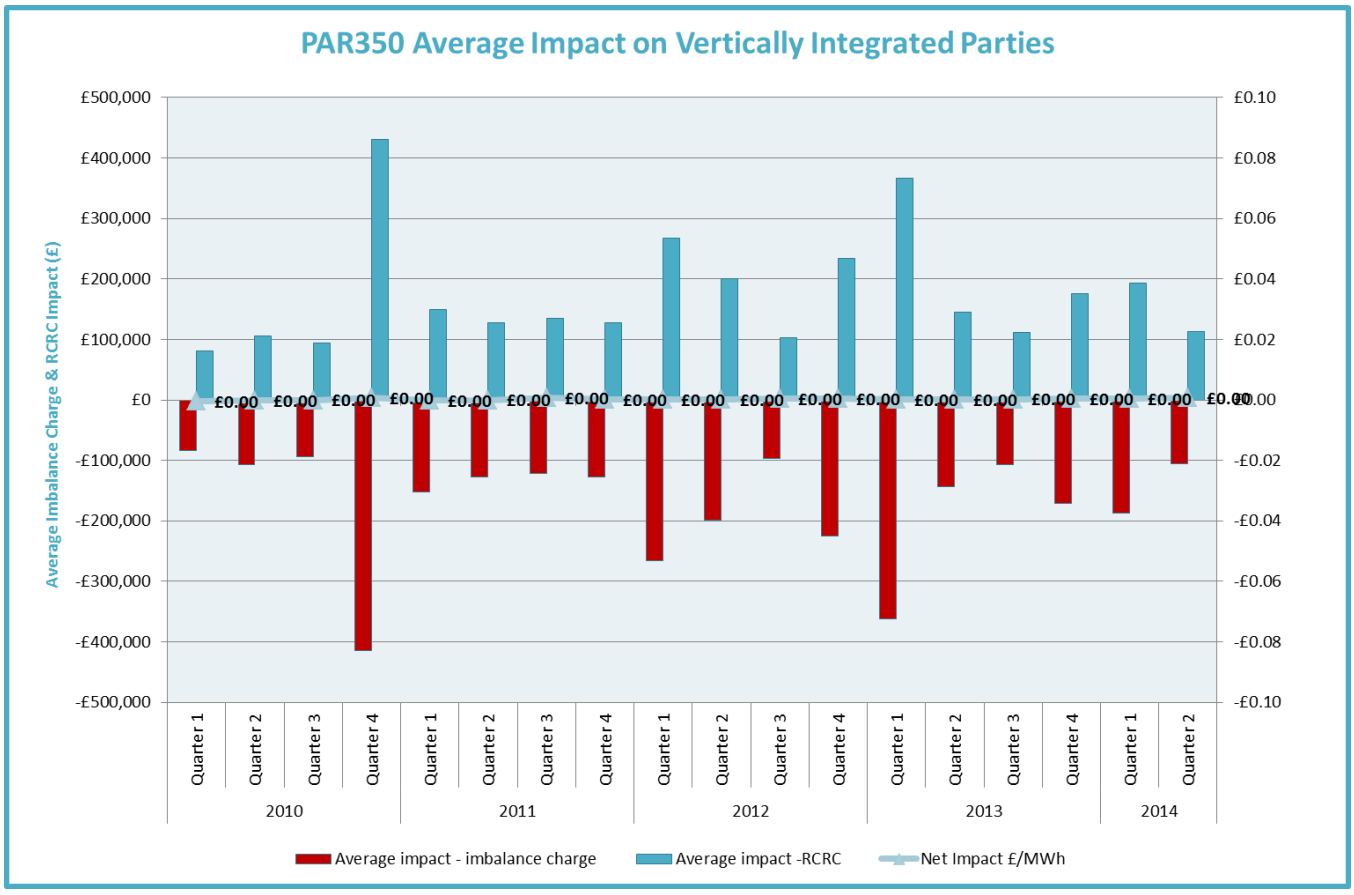
PAR350 PARTY TRADING CHARGE IMPACT ANALYSIS

We have re-run the Imbalance Charge and RCRC calculations using PAR350 imbalance prices to assess the impact to different types of Trading Parties and study whether any particular types of Trading Party would be more heavily affected by sharpened imbalance prices. We note that PAR350 has resulted in higher Imbalance Charge payments for all BSC Parties, especially during Q4 of 2010 and Q1 of 2013 when SBP increased more significantly (see graph 3). This would effectively increase the total RCRC given if the Reverse Price remains unchanged and would benefit the Parties with large Credited Energy Volumes[1]. Under the current dual pricing system, reducing PAR would have more impact to Parties with small Credited Energy Volumes as their receivable RCRC does not sufficiently cover the additional imbalance cost arising from sharpened imbalance prices.

Table 3 – BSC Party Grouping

Group
Vertically Integrated
Independent Generator - Thermal
Independent Generator - Wind
Independent Suppliers

Graph 11 – Average PAR350 Impact on Vertically Integrated Parties



Graph 11 shows the quarterly average impact on Trading Charges for **vertically integrated Parties** as a result of PAR350. Each individual vertically integrated Party includes both their Supplier and generator businesses. There were negative impacts in Q1 to Q3 of 2010 and Q1 of 2011. The higher Imbalance Charge (due to sharpened imbalance prices paid by vertically integrated Parties) was netted off by higher RCRC payments in the majority of quarters which results in net gain for vertically integrated Parties in these Periods. In comparison to PAR250, the overall net gain was less due to lower RCRC payments arising from smaller PAR350 Main

[1] RCRC is net Imbalance Charge payment to be redistributed back to Parties which amount is proportional to the amount of Credited Energy in BSC Parties' trading accounts. Large Trading Parties would therefore receive more money from RCRC because they have more Credited Energy Volumes.

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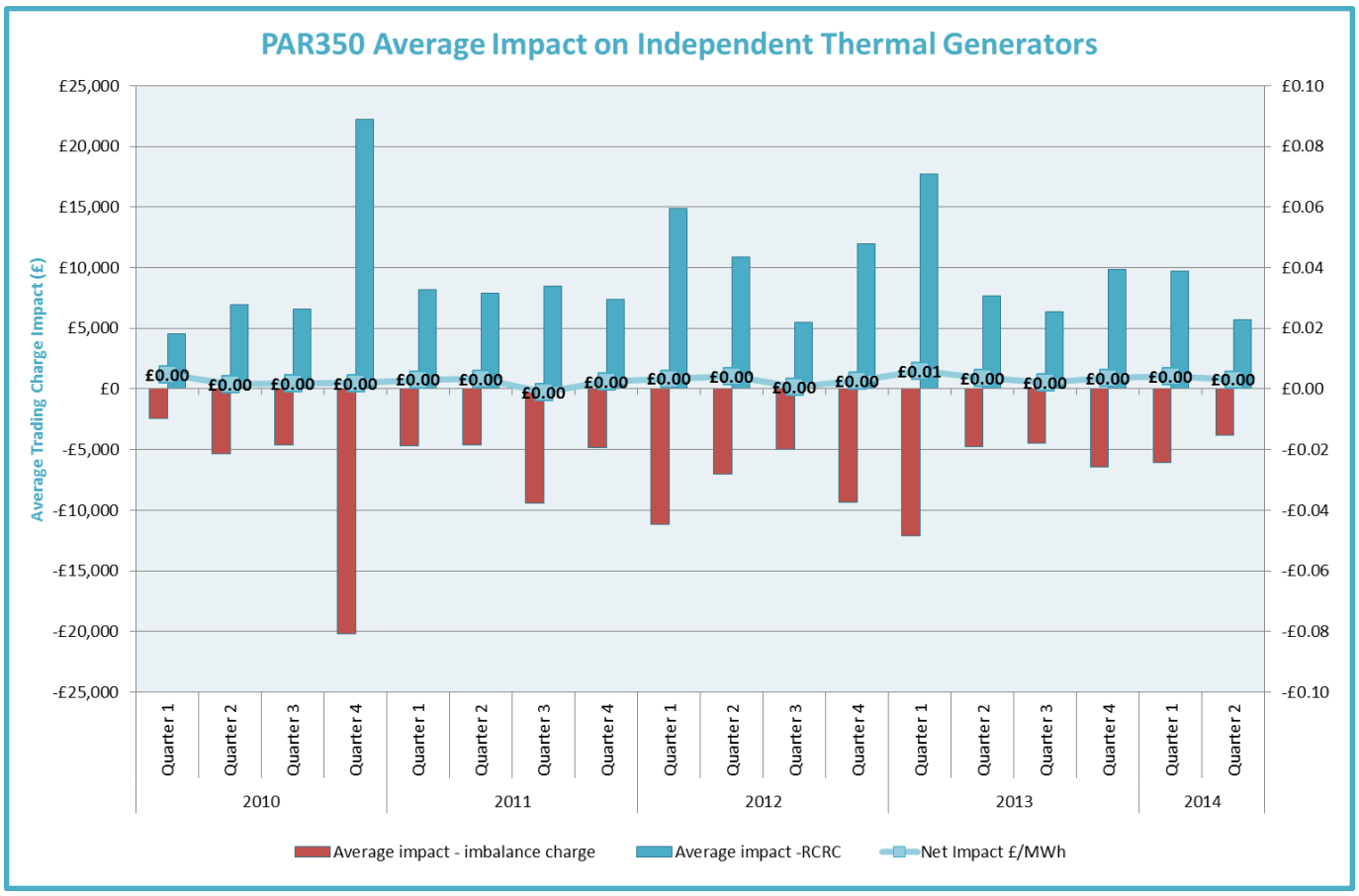
Price/Reverse Price spread. The average net impact per MWh of Credited Energy is £0.00/MWh for vertically integrated Parties due to the large amount of energy that is traded by them.

Graph 12 – Average PAR350 Impact on Independent Thermal Generators



Graph 12 shows the quarterly average impact on Trading Charges for **independent thermal generators** as a result of PAR350. Overall, independent thermal generators would gain in the majority of periods, which is due to a combination of better energy balancing from more predictable station exports and higher receivable RCRC based on large Credited Energy Volumes however the gain would be less compared to PAR250. The average net impact per MWh of Credited Energy was £0.00/MWh for the majority of period for thermal generators.

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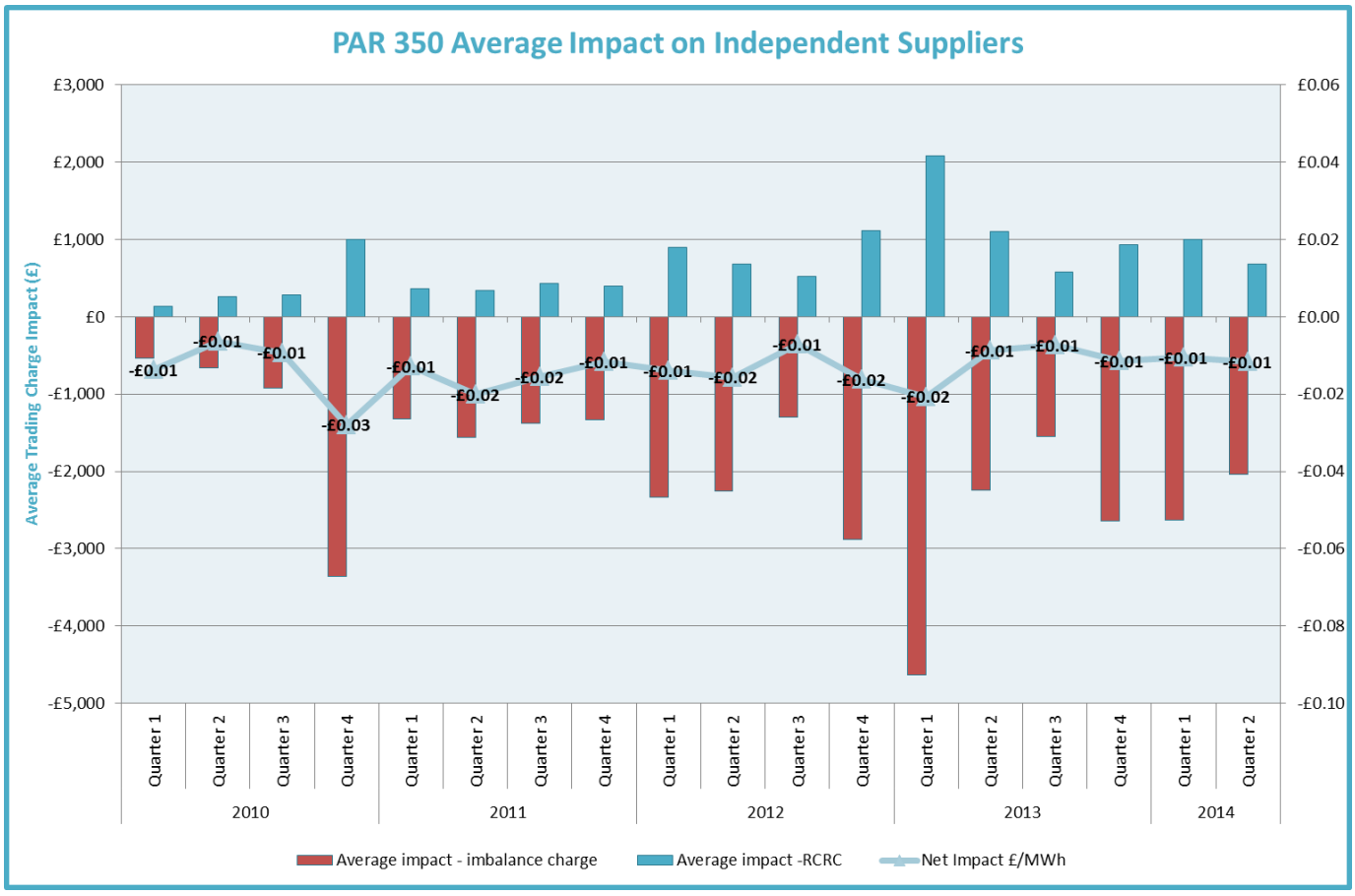
Graph 13 – Average PAR350 Impact on Independent Suppliers



Graph 13 shows the quarterly average impact on Trading Charges for **independent Suppliers** as a result of PAR350. Unlike the other types of Parties, the receivable RCRC for independent Suppliers does not outweigh the additional Imbalance Charges incurred due to sharpened imbalance prices. Independent Suppliers are more likely to be exposed to Imbalance Charges than generators as it is harder for them to predict the consumption of customers. Independent Suppliers also had less Credited Energy Volumes in their trading accounts compared to vertically integrated players and big generators and hence would receive less RCRC. In comparison to PAR250, PAR350 would reduce this impact on independent Suppliers due to smaller imbalance price spread. The net impact per MWh of Credit Energy for independent Suppliers is more volatile and ranges from -£0.01/MWh to -£0.03/MWh.

Please note that the impact on independent wind generators is not shown in this analysis as the impact is minimal, except for quarter 3 of 2013 which was due to the abnormal charge of a particular Party (see PAR250 analysis for information).

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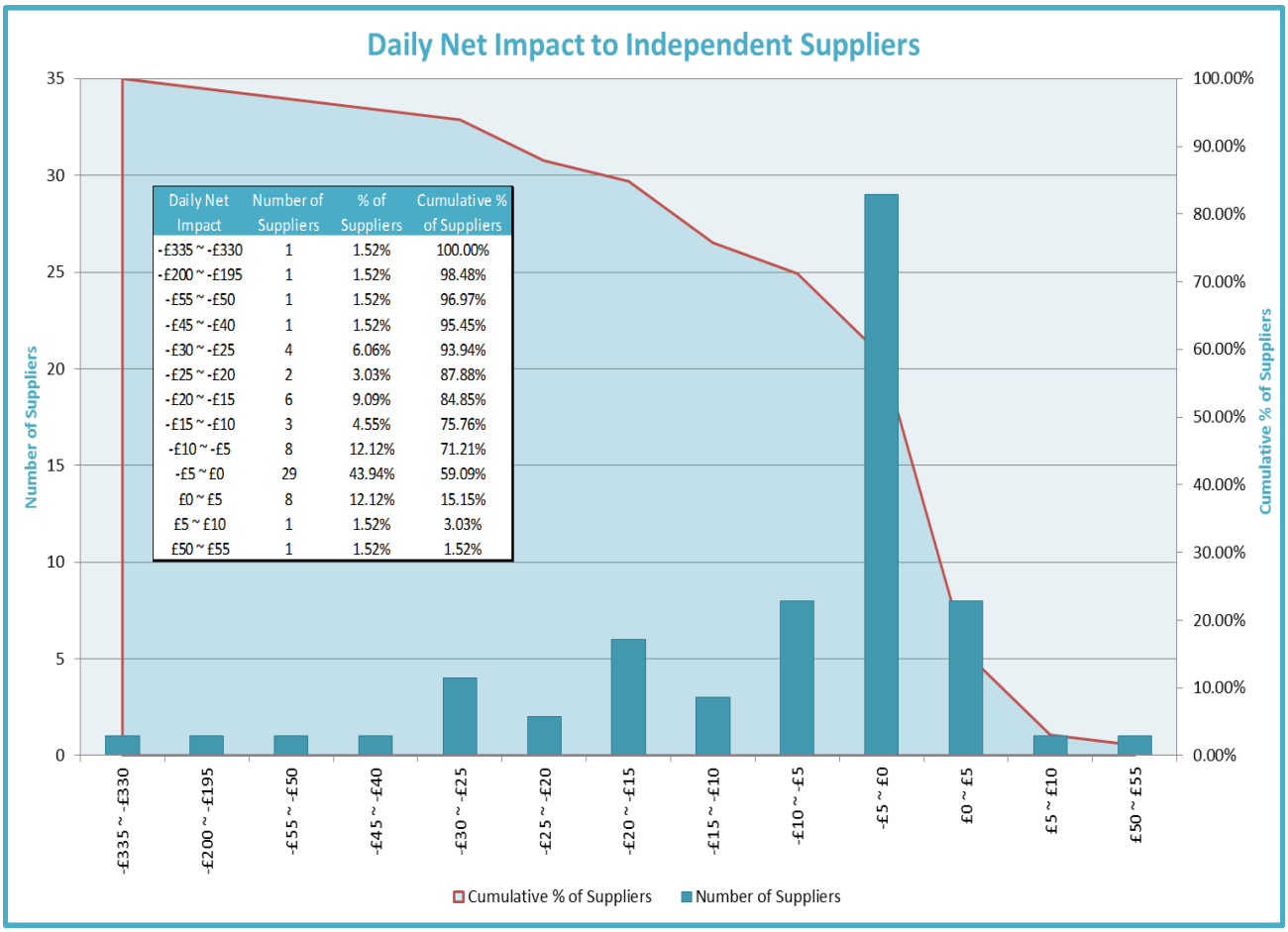
Graph 14 – Daily Net Impact on Independent Suppliers (£/MWh)



Daily Net Impact	Number of Suppliers	% of Suppliers	Cumulative % of Suppliers
-£335 ~ -£330	1	1.52%	100.00%
-£200 ~ -£195	1	1.52%	98.48%
-£55 ~ -£50	1	1.52%	96.97%
-£45 ~ -£40	1	1.52%	95.45%
-£30 ~ -£25	4	6.06%	93.94%
-£25 ~ -£20	2	3.03%	87.88%
-£20 ~ -£15	6	9.09%	84.85%
-£15 ~ -£10	3	4.55%	75.76%
-£10 ~ -£5	8	12.12%	71.21%
-£5 ~ £0	29	43.94%	59.09%
£0 ~ £5	8	12.12%	15.15%
£5 ~ £10	1	1.52%	3.03%
£50 ~ £55	1	1.52%	1.52%

We have looked into the daily net impact for independent Suppliers as shown in Graph 14. Among all the active independent Suppliers (some BSC Parties are registered as Suppliers but had no energy consumption in the past four years, they are excluded from the impact analysis), around 97% of the Suppliers had a daily net impact of less than £55. Two Parties had a daily impact of £196 and £322 respectively, however this was due to the Parties having large Imbalance Volumes during a few specific days/Settlement Periods when the imbalance prices were sharpened by PAR350.

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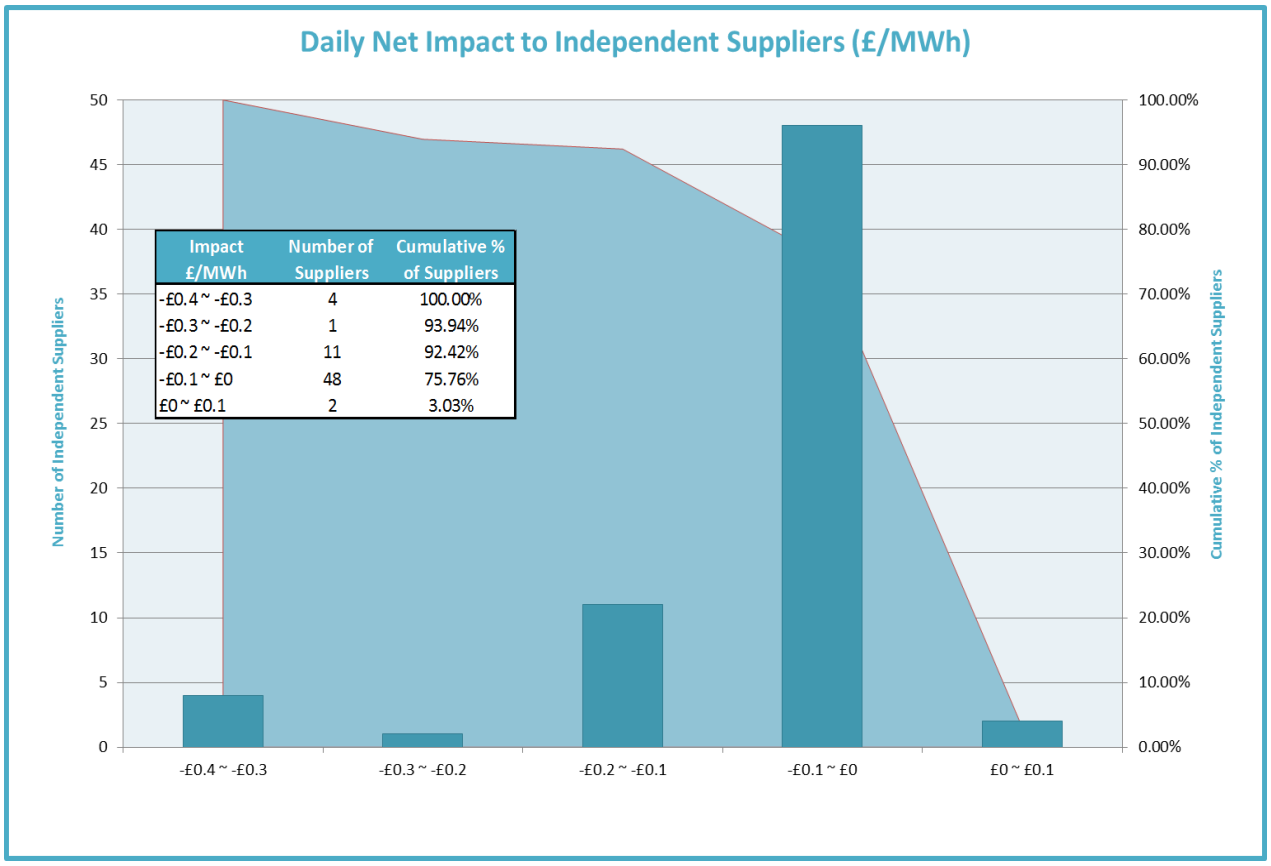
Graph 15 – Daily Net Impact on Independent Suppliers (£/MWh)



Impact £/MWh	Number of Suppliers	Cumulative % of Suppliers
-£0.4 ~ -£0.3	4	100.00%
-£0.3 ~ -£0.2	1	93.94%
-£0.2 ~ -£0.1	11	92.42%
-£0.1 ~ £0	48	75.76%
£0 ~ £0.1	2	3.03%

We also looked at the net daily impact using £/MWh to factor the sizes of independent Suppliers, this is shown in Graph 15. 75.76% of independent Suppliers would be impacted by less than -£0.1/MWh and the maximum daily average impact to independent Suppliers would be limited to -£0.4/MWh as a result of PAR350

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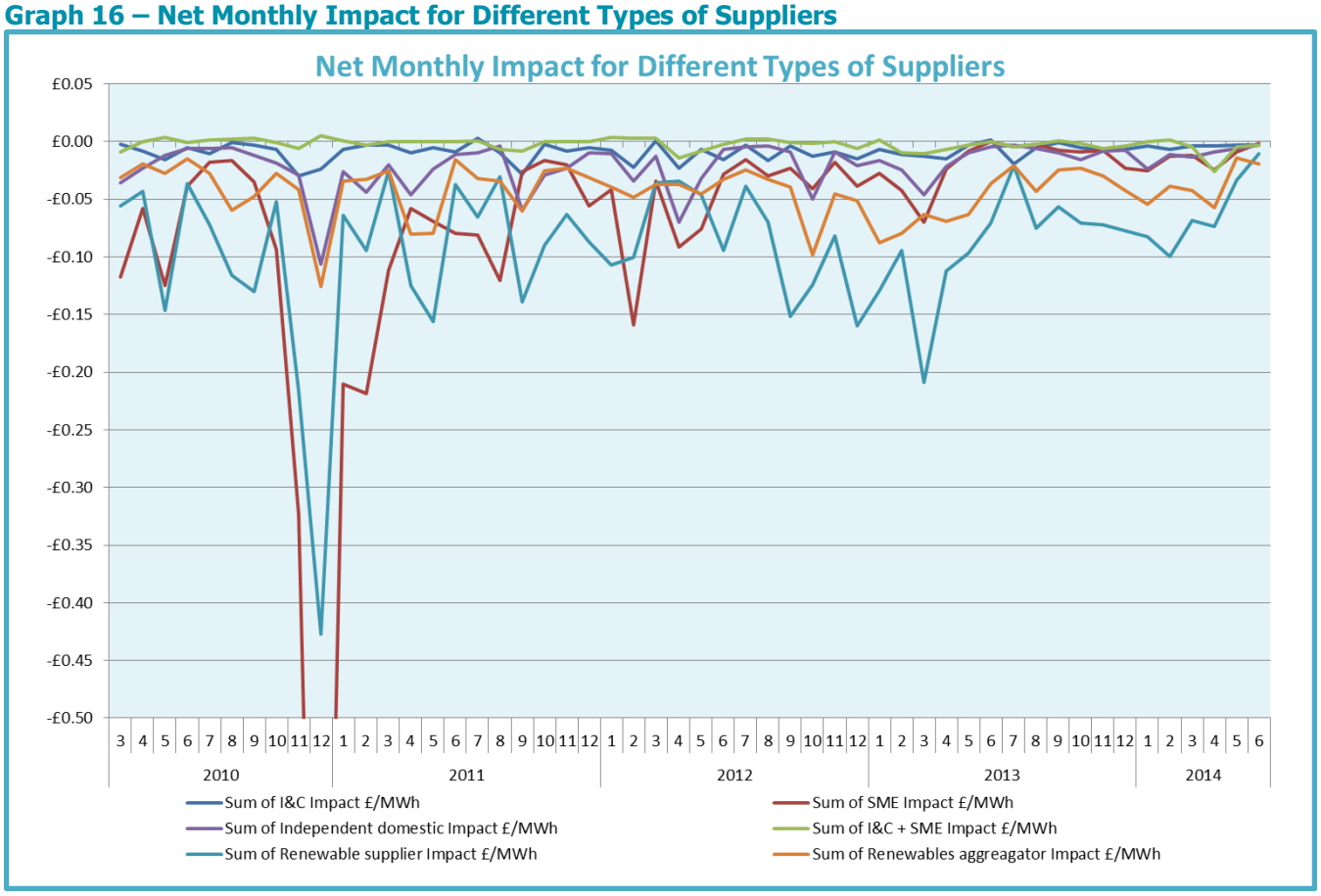
Graph 16 – Net Monthly Impact for Different Types of Suppliers



Graph 16 shows that, despite the spike in December 2010 (-£1.09/MWh) for SME Suppliers which was due to one particular Party having an abnormal imbalance in that month, renewable Suppliers would have experienced the largest impact as a result of PAR350 with a maximum net impact of -£0.43/MWh in December 2010 when the System Price increased most significantly. All other types of Suppliers would have an average monthly impact limited to -£0.13/MWh in a worst case scenario.

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Appendix 1: The Main Price Calculation with Different PAR Values

This is an example of the System Sell Price (Main Price) calculation for Period 30 on 31/08/2013, and here we demonstrate how different PAR values would impact the final price calculation. PAR is a imbalance pricing parameter which determines the maximum volume of most expensive priced energy balancing actions to be volume averaged to calculate the Main Price. The smaller the PAR values, the more marginal the price will be (hence we will take less cheap balancing actions when calculating the Main Price).

The below table shows all the PAR500 adjusted balancing actions that the live SSP of -£11.48/MWh was calculated based on. When PAR decreases to 350MWh, we exclude more cheap balancing actions (i.e. tightening our selection box in the below table) to calculate the SSP, this effectively sharpens the SSP to -£30.48. As PAR decreases further to 250MWh, the SSP drops to -£53.29/MWh and eventually to -£78/MWh when PAR equals 100MWh.

BOA	Date	Period	BMU	PAR Adjusted Volume	Price	TLM	TLM Adjusted Volume	BOA Final Cost	PAR
BID	20130831	30	T_WHILW-1	-15.476	-78	0.9909	-15.335	1196.12	PAR500 / PAR350 / PAR250 / PAR100
BID	20130831	30	T_CLDSW-1	-13.687	-78	0.9909	-13.562	1057.84	
BID	20130831	30	T_GRIFW-1	-13.437	-78	0.9909	-13.314	1038.48	
BID	20130831	30	T_GRIFW-2	-13.437	-78	0.9909	-13.314	1038.48	
BID	20130831	30	T_WHILW-1	-13.15	-78	0.9909	-13.03	1016.36	
BID	20130831	30	T_BLLA-1	-13.15	-78	0.9909	-13.03	1016.36	
BID	20130831	30	T_WHILW-1	-12.3	-78	0.9909	-12.188	950.68	
BID	20130831	30	T_WHILW-2	-12.3	-78	0.9909	-12.188	950.68	
BID	20130831	30	T_GORDW-1	-11.853	-78	0.9909	-11.745	916.1	
BID	20130831	30	T_CLDNW-1	-10.265	-78	0.9909	-10.172	793.38	
BID	20130831	30	T_WHILW-2	-8.856	-78	0.9909	-8.775	684.49	
BID	20130831	30	T_WHILW-1	-8.834	-78	0.9909	-8.753	682.76	
BID	20130831	30	T_CLDCW-1	-7.626	-78	0.9909	-7.557	589.42	
BID	20130831	30	T_WHILW-2	-7.246	-78	0.9909	-7.18	560.03	
BID	20130831	30	T_GORDW-1	-4.249	-78	0.9909	-4.21	328.42	
BID	20130831	30	T_HADHW-1	-2.657	-78	0.9909	-2.633	205.35	
BID	20130831	30	T_CLDCW-1	-2.371	-78	0.9909	-2.349	183.22	
BID	20130831	30	T_TDBNW-1	-2.201	-78	0.9909	-2.181	170.08	
BID	20130831	30	T_HADHW-1	-2.174	-78	0.9909	-2.154	168.01	
BID	20130831	30	T_TDBNW-1	-1.02	-78	0.9909	-1.011	78.82	
BID	20130831	30	T_CLDCW-1	-0.693	-78	0.9909	-0.687	53.58	
BID	20130831	30	E_BETHW-1	-3.042	-76	0.9909	-3.014	229.06	
BID	20130831	30	M_CAS-GAR01	-5.1	-50	0.9909	-5.053	252.67	
BID	20130831	30	M_CAS-GAR01	-3.9	-50	0.9909	-3.864	193.22	
BID	20130831	30	M_CAS-BEU01	-0.908	-50	0.9909	-0.9	45	
BID	20130831	30	M_CAS-BEU01	-0.483	-50	0.9909	-0.479	23.94	
BID	20130831	30	T_DRAXX-1	-18.375	20	0.9909	-18.207	-364.14	
BID	20130831	30	T_DRAXX-4	-17.625	20.1	0.9909	-17.464	-351.03	
BID	20130831	30	T_DRAXX-3	-17.625	20.5	0.9909	-17.464	-358.01	
BID	20130831	30	T_LOAN-2	-52.125	26.5	0.9909	-51.649	-1368.7	
BID	20130831	30	T_LOAN-2	-37.5	26.5	0.9909	-37.158	-984.68	
BID	20130831	30	T_LOAN-4	-64.764	27.5	0.9909	-64.172	-1764.74	
BID	20130831	30	T_RUGPS-7	-7.708	30	0.9909	-7.638	-229.14	
BID	20130831	30	T_RUGPS-6	-7.708	30	0.9909	-7.638	-229.14	
BID	20130831	30	T_RUGPS-7	-1.581	30	0.9909	-1.566	-46.99	
BID	20130831	30	T_RUGPS-6	-1.581	30	0.9909	-1.566	-46.99	
BID	20130831	30	T_RATS-3	-9.208	31	0.9909	-9.124	-282.85	
BID	20130831	30	T_RATS-2	-7.75	31.1	0.9909	-7.679	-238.82	
BID	20130831	30	T_RATS-2	-3.333	31.1	0.9909	-3.303	-102.72	
BID	20130831	30	T_ABTH8	-12.5	34.01	0.9909	-12.386	-421.24	
BID	20130831	30	T_PEHE-1	-19.816	37	0.9909	-19.635	-726.5	
BID	20130831	30	T_PEHE-1	-17.174	37	0.9909	-17.017	-629.63	
BID	20130831	30	T_PEHE-1	-13.211	37	0.9909	-13.09	-484.33	
PAR500				**-500**		**0.9909**	**-495.43**	**5687.58**	**-11.48**
PAR350				**-350**		**0.9909**	**-346.80**	**10570.95**	**-30.48**
PAR250				**-250**		**0.9909**	**-247.72**	**13200.87**	**-53.29**
PAR100				**-100**		**0.9909**	**-99.09**	**7728.79**	**-78.00**