

## **Summary of Sensitivities Analysis on the LRMCM modelling**

Key terms:

<b>Term</b>	<b>Detail</b>
LRMC	Long Run Marginal Cost (LRMC), or Virtual Point. This is the current underlying Reference Price Methodology (RPM) used in the calculation of Entry and Exit Capacity prices. Whilst there are different approaches in Entry and Exit as to how secondary adjustments are applied, the underlying LRMCM principles are there in both. The LRMCM approach is an investment focused methodology where the intention is to have strong locational signals to facilitate decision making.

### **Background to sensitivity analysis on the LRMCM modelling**

The current LRMCM Model is designed based on a Long Run marginal cost model that is linked to cost of investment. As part of the model the overall distance gas is presumed to travel to match supplies to demand is optimised. Based on the distance, using cost components a price is produced.

There are some input items that go into the LRMCM model that have a greater influence on the predictability and volatility of prices than other input items. Over the course of the analysis of the current model these have been presented at NTSCMF and at the Sub Groups. The inputs which have previously been discussed as having more of an influence on the capacity prices produced from the LRMCM model have been modelled to show the sensitivities of the associated inputs. For the inputs discussed, at the November NTSCMF sub-group, it was suggested that a 10% increase and a 10% decrease on the input into the base model was modelled, to show the influence of these changes on the prices.

The sensitivity analysis has been completed on the Supply and Demand (increase and decrease of 10%), Merit Order (all supply values pro-rated together as one group), Revenue (increase and decrease of 10%), and Capacity Values (Exit (TO Baseline) and Entry (Obligated Level)) (increase and decrease of 10%), which were items discussed at the November NTSCMF sub-group.

This note brings together the analysis that has been completed for both Entry and Exit using the LRMCM, or Virtual Point, model completed for 2015/16 and 2016/17. There are different starting base models for 2015/16 and 2016/17 which start with the applicable data for the year of modelling.

### **Summary of Analysis**

In each of the different input changes there is a range of increases and decreases in the capacity prices, the exact range in each input change and the base model input values can be seen in Appendix 1.

Largest Ranges:

- Exit for the 2015/16 model the largest range in the capacity prices produced was the change in the Merit Order, followed by a 10% decrease in Supply and Demand.
- Entry for the 2015/16 model the largest range in the capacity prices produced was the change in the Merit Order, followed by a 10% decrease in Supply and Demand.
- Exit for the 2016/17 model the largest range in the capacity prices produced was the 10% decrease in Supply and Demand.
- Entry for the 2016/17 model the largest range in the capacity prices produced was the change in the Merit Order, closely followed by a 10% increase in Supply and Demand.

Smallest Ranges:

- Exit for the 2015/16 model the smallest range in the capacity prices produced was the 10% increase in capacity values and the 10% decrease in the revenue.
- Entry for the 2015/16 model the smallest range in the capacity prices produced was any change in revenue, as the LRMC model for Entry does not use revenue in the calculation of prices.
- Exit for the 2016/17 model the smallest range in the capacity prices produced was the 10% increase in capacity values and the 10% decrease in the revenue.
- Entry for the 2016/17 model the smallest range in the capacity prices produced was any change in revenue, as the LRMC model for Entry does not use revenue in the calculation of prices.

As the secondary adjustment for Exit and Entry in the models are different, the changes in the inputs have different effects on the Exit and Entry prices.

The 10% change in the inputs does not have proportionally the same effect on the price year on year as it also depends on any changes in the base model for the applicable year. This can be seen in the differences between the sensitivity of the 2015/16 prices and the 2016/17 prices.

The inputs that have been amended in this sensitivity analysis are the main variable inputs into the LRMC modelling. Not all the same inputs are required under a methodology under the TAR NC. Some will be linked to how other areas are addressed (e.g. the use of a forecasted contracted capacity).

### **Supporting Data on Analysis**

More detail on the analysis can be found in Appendix 1 (Ranges of outputs), Appendix 2 (Graphical representation of analysis) and Appendix 3 (analysis spreadsheet) at the end of this document.

### **Conclusion**

There is a wide range of prices in each of the different sensitivity analysis, which can cause some large changes in prices produced and on the stability of these prices as they change year on year as there is a large amount of sensitivity on the inputs into the overall charging framework.

The outcomes of changing the variables by the ranges seen in this summary highlight:

- Results of changes not intuitive;
- Changes to the inputs of these sorts of levels are not uncommon;
- Unpredictable results.

The underlying principles for the LRMC model were thought to be less relevant today than they were when the model was originally developed. At the moment there is no new investment and also falling demand and on this basis the LRMC model

### **Version Control**

V1.0	Updated and agreed post 14.12.16 and 19.12.16 sub-group meeting
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## Appendix 1: Ranges of inputs and outputs

2015/16

<b>Input Amendments</b>	<b>Current values</b>	<b>Updated values</b>	<b>Range – Impact on Entry Prices</b>	<b>Range – Impact on Exit Prices</b>
Base Model	Supply and Demand: 6166.14 GWh Revenue: £287.9m Capacity Values: Exit - 8794.40 Gwh (TO Baseline) and Entry - 10956.13 Gwh (Obligated Level) Expansion Constant: 2756 Annuitisation Factor: 0.1272 Pipelines – 2015/16 values from January 2015 pipeline databook	N/A	N/A	N/A
Merit Order Updated	As today	All supply pro-rated together	Between -98% to 6900% – excluding the most extreme the range would be from -27% to 600%	Between -95% to 10300%
10% increase in supply and demand	6166.14 Gwh	6782.76 Gwh	Between -95% to 29%	Between -95% to 1700%
10% decrease in supply and demand	6166.14 Gwh	5549.53 Gwh	Between -99% to 2100%	Between -96% to 8200% – excluding the most extreme the range would be from -90% to 2514%
10% increase in revenue	£287.9m	£316.6m	Zero percent change. Currently no revenue input to Entry Capacity.	Between 0% to 1000%
10% decrease in revenue	£287.9m	£259.1m	Zero percent change. Currently no revenue input to Entry Capacity.	Between -93 to 0%
10% increase in capacity values	Exit - 8794.40 Gwh (TO Baseline) Entry - 10956.13 Gwh (Obligated Level)	Exit - 9673.84Gwh Entry - 12051.74 Gwh	Between 0% to 150%	Between -91 to 0%
10% decrease in capacity	Exit - 8794.40 Gwh (TO Baseline)	Exit - 7914.96 Gwh	Between -94% to 0%	Between 0% to 1200%

values	Entry - 10956.13 Gwh (Obligated Level)	Entry - 9860.52 Gwh		
Combined: 10% increase in supply and demand, revenue and capacity values all combined together	Supply and Demand - 6166.14 Gwh Revenue - £287.9m Capacity Values: Exit - 8794.40 Gwh (TO Baseline) Entry - 10956.13 Gwh (Obligated Level)	Supply and Demand - 6782.76 Gwh Revenue - £316.6m Capacity Values: Exit - 9673.84Gwh Entry - 12051.74 Gwh	Between -95% to 450%	Between -95% to 1700%
Combined: 10% decrease in supply and demand, revenue and capacity values all combined together	Supply and Demand - 6166.14 Gwh Revenue - £287.9m Capacity Values: Exit - 8794.40 Gwh (TO Baseline) Entry - 10956.13 Gwh (Obligated Level)	Supply and Demand - 5549.53 Gwh Revenue - £259.1m Capacity Values: Exit - 7914.96 Gwh Entry - 9860.52 Gwh	Between -99% to 1600%	Between -96% to 8200%
Combined: 10% increase in supply and demand with updated Merit order of supply all together	Supply and Demand - 6166.14 Gwh Merit Order – as today	Supply and Demand - 6782.76 Gwh Merit Order - All supply pro-rated together	Between -98% to 5700% – excluding the most extreme the range would be from -98% to 494%	Between -95% to 10300%
Combined: 10% decrease in supply and demand with updated Merit order of supply all together	Supply and Demand - 6166.14 Gwh Merit Order – as today	Supply and Demand - 5549.53 Gwh Merit Order - All supply pro-rated together	Between -98% to 6900% – excluding the most extreme the range would be from -98% to 800%	Between -95% to 10300%

**2016/17**

<u>Input Amendments</u>	<u>Current values</u>	<u>Updated values</u>	<u>Range - Entry</u>	<u>Range - Exit</u>
Base Model	Supply and Demand: 5423.34 GWh Revenue: £431.5m Capacity Values: Exit - 8895.85Gwh (TO Baseline) and Entry 10956.13 Gwh (Obligated Level)Expansion Constant: 2830	N/A	N/A	N/A

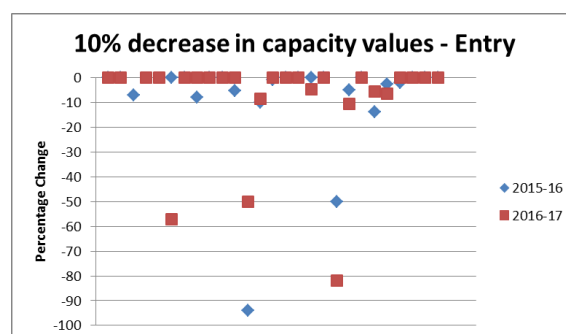
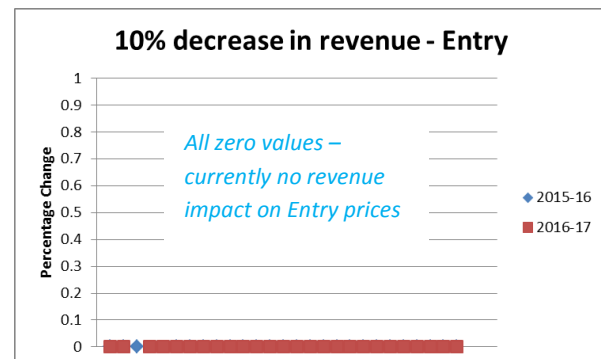
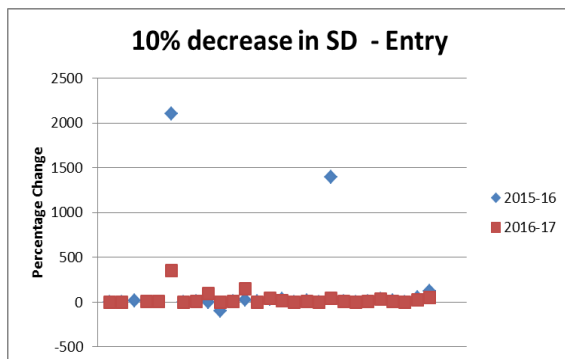
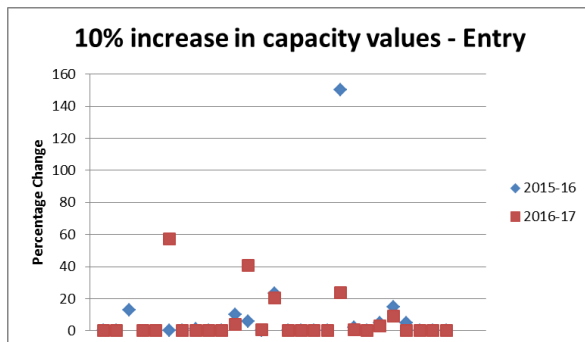
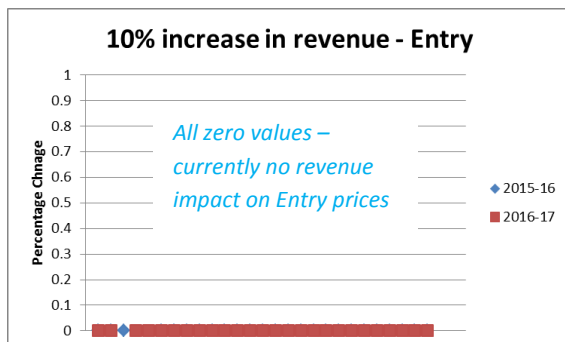
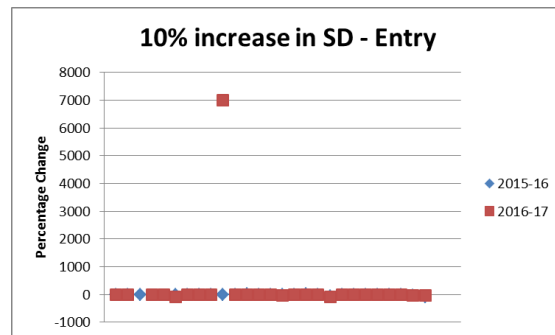
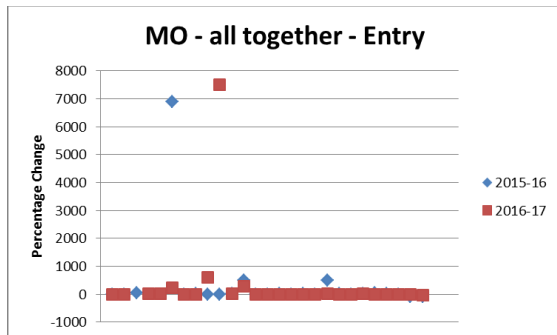
	Annuitisation Factor: 0.1272 Pipelines – 2016/17 values from January 2016 pipeline databook			
Merit Order Updated	As today	All supply pro-rated together	Between -27% to 7500% – excluding the most extreme the range would be between -27% to 600%	Between -94% to 600%
10% increase in supply and demand	5423.34 Gwh	5965.68 Gwh	Between -98% to 7000% – excluding the most extreme the range would be from -98% to 0%	Between -86% to 1200%
10% decrease in supply and demand	5423.34 Gwh	4881.01 Gwh	Between -2% to 350%	Between -90% to 17600% – excluding the most extreme the range would be from - 90% to 2514%
10% increase in revenue	£431.5m	£474.7m	Zero percent change	Between 0% to 1400%
10% decrease in revenue	£431.5m	£388.4m	Zero percent change	Between -94 to 0%
10% increase in capacity values	Exit - 8895.85Gwh (TO Baseline) Entry 10956.13 Gwh (Obligated Level)	Exit - 9785.43 Gwh Entry - 12051.74 Gwh	Between 0% to 57%	Between -94 to 0%
10% decrease in capacity values	Exit 8895.85 Gwh (TO Baseline) Entry 10956.13 Gwh (Obligated Level)	Exit - 8006.26 Gwh Entry - 9860.52 Gwh	Between -82% to 0%	Between 0% to 1600%
Combined: 10% increase in supply and demand, revenue and capacity values all combined together	Supply and Demand - 5423.34 Gwh Revenue - £431.5m Capacity Values: Exit 8895.85 Gwh (TO Baseline Entry 10956.13 Gwh (Obligated Level)	Supply and Demand - 5965.68 Gwh Revenue - £474.7m Capacity Values: Exit 9785.43 Gwh Entry 12051.74 Gwh	Between -93% to 7000% – excluding the most extreme the range would be from -93% to 0%	Between -86% to 1200%
Combined: 10% decrease in supply and demand, revenue and capacity values all combined together	Supply and Demand - 5423.34 Gwh Revenue - £431.5m Capacity Values: Exit 8895.85 Gwh (TO Baseline Entry 10956.13 Gwh (Obligated Level)	Supply and Demand - 4881.01 Gwh Revenue - £388.4m Capacity Values: Exit 8006.26 Gwh Entry 9860.52 Gwh	Between -32% to 271%	Between -90% to 17600% – excluding the most extreme the range would be from - 90% to 2514%

Combined: 10% increase in supply and demand with updated Merit order of supply all together	Supply and Demand - 5423.34 Gwh Merit Order – as today	Supply and Demand - 5965.68 Gwh Merit Order - All supply pro-rated together	Between -66% to 7300% – excluding the most extreme the range would be from -66% to 286%	Between -94% to 600%
Combined: 10% decrease in supply and demand with updated Merit order of supply all together	Supply and Demand - 5423.34 Gwh Merit Order – as today	Supply and Demand - 4881.01 Gwh Merit Order - All supply pro-rated together	Between -27% to 7800% – excluding the most extreme the range would be from -27% to 5100%	Between -94% to 600%

## Appendix 2: Graphical representation of analysis

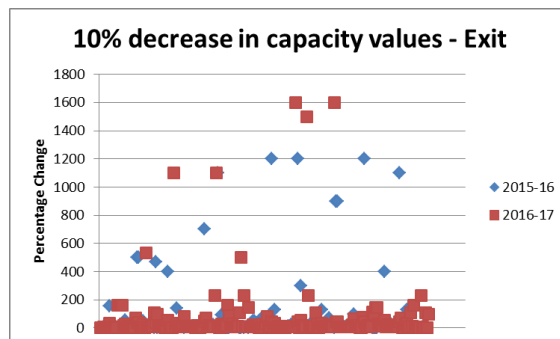
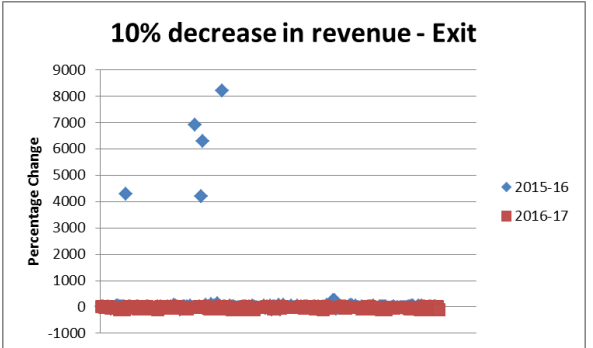
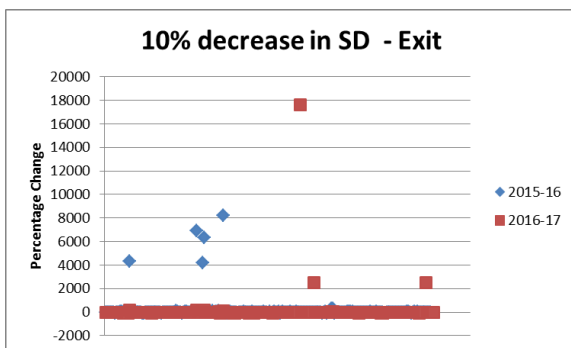
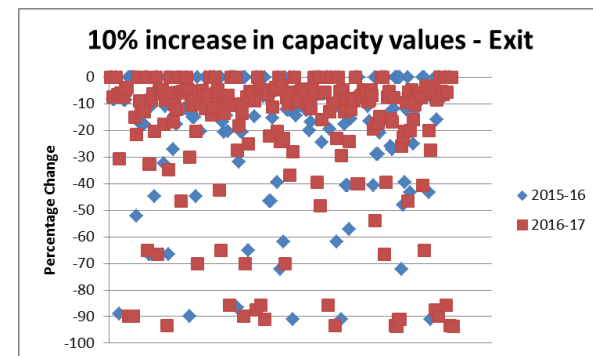
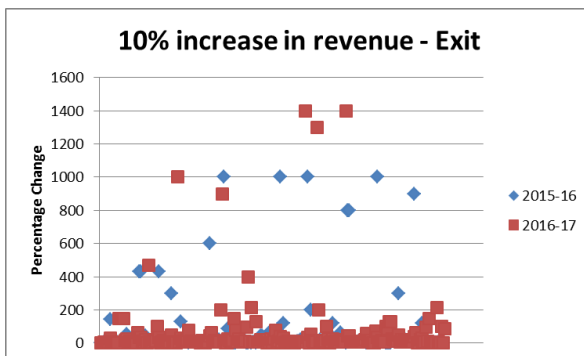
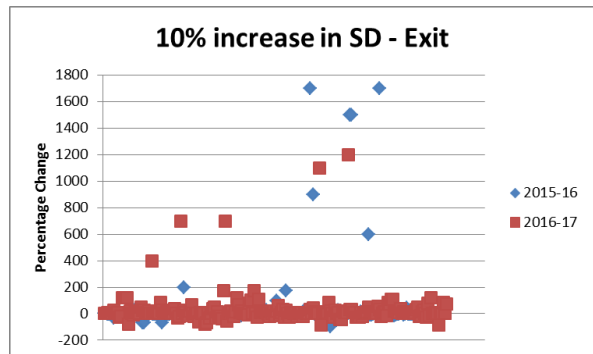
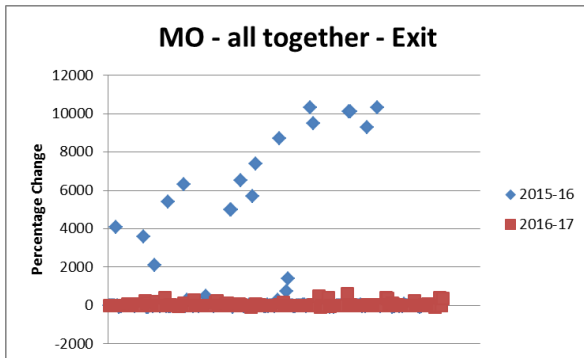
### Graphical Representation – Entry

N.B. due to the size of some of the changes the ranges on the charts are different. Therefore the changes shown on the graphs can hide some broad ranges of impacts to the prices. The changes can be seen on the associated spreadsheet and the summary tables in Appendix 1.



**Graphical Representation – Exit**

N.B. due to the size of some of the changes the ranges on the charts are different. Therefore the changes shown on the graphs can hide some broad ranges of impacts to the prices. The changes can be seen on the associated spreadsheet and the summary tables in Appendix 1.





### **Appendix 3: Analysis Spreadsheet**

The attached spreadsheet shows the individual prices and the applicable sensitivity in each of the inputs, when amending the original values by 10%.



Summary Analysis of  
Sensitivities v0.1.xlsx