MODEL SMOOTHING – INVESTIGATIVE ANALYSIS

1.0 Background

The application of model smoothing was first undertaken in formulating the NDM proposals for 1999/00. Model smoothing has since been applied to the NDM proposals for all subsequent years, and most recently for 2018/19.

It was agreed with the Demand Estimation Sub-Committee (DESC) and Ofgem shortly after the first application of model smoothing that the method applied would be subject each year to the scrutiny of DESC and that the results of successive years of demand modelling (feeding into model smoothing) would be examined for evidence of trends if any, so as to inform decisions on the approach to and mode of application of model smoothing in future years.

The first such investigative analysis was undertaken in autumn 1999 and in the light of those results it was decided to retain model smoothing without change for deriving the NDM proposals for 2000/01. Further investigations of model smoothing were undertaken during each autumn thereafter (in each of the years from 2000 to 2005) and following discussion of those results at DESC on each occasion, it was decided to continue to apply model smoothing in deriving the NDM proposals for the forthcoming year.

In January 2006, DESC agreed to move to a biennial assessment of the continued applicability of model smoothing. Accordingly, the last formal assessment of model smoothing undertaken was in autumn 2015. Following discussion of those results at DESC in November 2015, it was decided to continue to apply model smoothing in deriving the NDM proposals for 2016/17, 2017/18 and 2018/19.

The proposals for 2018/19 having been finalised, it is now appropriate to undertake a re-assessment so that informed decisions on the continued future application of model smoothing can be taken.

This note is a full formal assessment of model smoothing along the lines undertaken three years ago.

2.0 Principles of Model Smoothing

Model smoothing was introduced because EUC models were exhibiting some year on year volatility. It was therefore anticipated that averaging more than one year’s models would achieve greater stability.

A further obvious aspiration for the EUC models is that of improved accuracy. However, the two objectives of stability and accuracy are not necessarily consistent: if there is an underlying drift in customer behaviour which leads to changes in model characteristics then stability may be achieved at the expense of accuracy.

It is proposed here (as in the investigative analyses undertaken in all previous occasions) that accuracy is defined as the capability of a model (or a smoothed model) to predict the model that will be fitted to the following year’s data.

In order to attempt to illuminate this aspect it is possible to perform the following test on EUC models:

Compare the models fitted to the (single year) 2017/18 consumption data with:

- the 2016/17 (single year) models
- the smoothed models based on 2014/15, 2015/16 and 2016/17 data

The test has been applied to CWV intercepts, which give a simple indication of weather sensitivity - i.e. high CWV intercept implies low weather sensitivity. For each case root mean square (RMS) values of the CWV intercept differences have been computed.

For this year's investigation of model smoothing the CWV intercepts from the analyses of the data sets for 2014/15, 2015/16 and 2016/17 along with those for 2017/18, provide the necessary information. All of these CWV intercepts relate to models derived using the revised definitions of CWVs and the revised basis for SNCWVs that were used in the spring 2018 NDM analysis and which came into effect on 1st October 2015. In general, for EUCs in LDZs where a CWV definition has changed, the CWV intercepts presented here are not directly comparable with CWV intercepts published prior to the change of CWV definition. In addition the current definitions of holiday codes (implemented in the spring 2011 analysis) were applied in deriving the models for all the years.

3.0 Analysis

3.1 Predictive Ability Analysis – Consumption Bands (Figures 1 & 2)

The bar charts attached as Figures 1 and 2 shows, for the small and large NDM consumption band EUCs only, the difference between the respective CWV intercepts on the two bases.

For the small NDM consumption band EUCs (Figure 1) the bar chart for the smoothed model for 2017/18 (based on 2014/15, 2015/16 and 2016/17 data) is slightly better, in terms of the spread of CWV intercept differences, when compared with those for the single year (2016/17) model, and this is also reflected in the respective RMS values, which are marginally better for the smoothed model.

For large NDM consumption band EUCs (Figure 2) the spread of CWV intercept differences and RMS values are slightly better for the smoothed model. Note, results shown for large NDM exclude the contribution of band 09B.

Overall, for small and large NDM consumption band EUCs, the smoothed three-year model is marginally better at predicting 2017/18 than the single year (2016/17) model for both the small NDM "B" EUCs and large NDM "B" EUCs.

3.2 Predictive Ability Analysis – All EUCs incl. WAR bands (Figures 3 & 4)

This analysis has also been extended to include WAR band EUCs, the results from which are shown in Figures 3 and 4. The spread of CWV intercept differences, for all small NDM EUCs (Figure 3), for the single year model case and smoothed model case are quite similar, however the RMS value (indicating the spread of CWV intercept differences around zero) is slightly lower for the smoothed model.

For all large NDM EUCs (Figure 4) the spread of CWV intercept differences for the smoothed model case is similar to the single year model case, however the relevant RMS values (excluding band 09B) are better for the smoothed model.

This analysis of "predictive ability", undertaken on the same basis as previous years, has shown overall that the smoothed model for small NDM EUCs was marginally better than the single year model. It has also shown the smoothed model for large NDM EUCs was better than the single year model.

The main driver for using a smoothed model is the mitigation of year of year volatility rather than predictive capability.

3.3 Year on Year Volatility Analysis (Figures 5, 6, 7 & 8)

In order to assess this a similar test has been applied to observe the year-on-year volatility of smoothed models as against individual years' models. The bar charts in Figures 5 & 7 (small NDM) and Figures 6 & 8 (large NDM) show:

- Difference in CWV intercepts between the smoothed models applicable to gas year 2017/18 (based on 2014/15, 2015/16 and 2016/17) and the smoothed models applicable to gas year 2018/19 (based on 2015/16, 2016/17 and 2017/18).

- Difference in CWV intercepts between individual year models for 2016/17 and 2017/18 that would have been applied to gas years 2017/18 and 2018/19 respectively if model smoothing had not been implemented.

The results in Figures 5 and 6 relate to both consumption band and WAR band EUCs, while the results in Figures 7 and 8 relate to just the consumption band EUCs.

As expected, the smoothed models are associated with notably lower year-on-year volatility for both small and large NDM EUCs. This is evident in the generally narrower distribution of CWV intercept differences and the notable reductions in corresponding RMS values, visible in all 4 charts.

4.0 Model Smoothing – Average or Trend (Figure 9, Table 1, 2 & 3)

On each occasion when this investigation of model smoothing has been carried out, there has been some discussion as to whether model averaging or model extrapolation is more appropriate. Extrapolation would only be worthy of consideration if a clear trend could be detected. There has also been some discussion in previous years about whether a trend based on a limited number of years' data should be regarded as a reliable basis for extrapolation.

An analysis of CWV intercepts (all of which are on the current weather basis) is attached which attempts to shed some light on whether trends exist. This analysis is usually presented to DESC every two years (last presented to DESC in autumn 2015). However, for a complete view of CWV intercepts from one year to another, the summary results of this CWV intercept analysis undertaken on an annual basis must be included and this has been done in the results presented here.

The CWV intercept analysis has been applied to all EUCs, small and large NDM, including both consumption band and WAR band EUCs. Figure 9 shows the classification scheme that has been applied to the individual years comprising the smoothed models for gas year 2018/19 - essentially there are five possible patterns for a series of three CWV intercepts to follow:

- UP/ UP (UU)
- UP / DOWN (UD)
- DOWN / UP (DU)
- DOWN / DOWN (DD)
- FLAT (F)

A code has been associated with each of the patterns, and Table 1 shows how each EUC is classified. In Table 2, the counts of each type are shown, firstly a count by EUC across the LDZs, and secondly a count by LDZ across the EUCs.

For the analysis years 2015/16, 2016/17 and 2017/18, the overall count of the different pattern types indicates that:

- The "up/up", pattern shows 168 occurrences out of 429 (there were 121 in 2017, 78 in 2016, 11 in 2015 and 75 in 2014).
- The “down/down” pattern shows 3 occurrences (there were 31 in 2017, 57 in 2016, 109 in 2015 and 58 in 2014).
- The majority of instances show no increasing or decreasing pattern over the 3 years i.e. either “up/down” or “down/up”, with 216 occurrences out of 429 (there were 235 in 2017, 256 in 2016, 271 in 2015 and 262 in 2014).
- This year also shows 42 flat or nearly flat models (similar numbers to 2017, 2016, 2015 and 2014).

The prevalence of “down/up” and “up/down” patterns (216) only just remains greater than half of the number of cases (429), Since there are 42 cases of flat or nearly flat models (almost all of which are EUCs applicable to WAR band 1) 216 of 387 remaining cases show no consistent pattern over three years. Instances with a decreasing pattern number 3 (31 in 2017, 57 in 2016, 109 in 2015 and 58 in 2014) and instances of an increasing pattern over three years amount to 168 (121 in 2017, 78 in 2016, 11 in 2015 and 75 in 2014).

There were 10 instances of EUCs where there is an increasing pattern over three years in a majority of LDZs (i.e. 7 or more of 13), of which 8 were in the WAR band EUCs. There were 0 instances of EUCs where there is a decreasing pattern in a majority of LDZs. There were 4 LDZs that showed an increasing pattern in the majority of EUCs (17 or more), however there was a notable decrease generally in the number of EUCs that displayed a downward trend across all LDZs. There was also a notable increase in the number of EUCs that displayed a “down/up” trend this year. For the higher consumption bands and most WAR band analyses, demand modelling is done with data sets grouped across LDZs. In these circumstances instances of multiple EUCs with increasing or decreasing patterns are down to the same underlying demand model and not due to multiple models showing a trend.

To reiterate, there are some instances of specific EUCs and specific LDZs, where a “down/down” pattern or an “up/up” pattern occurs to a notable extent over the three years. However, three data points do not necessarily point to a trend and examination of a fourth year of CWV intercept data reveals that these possible instances are not sustained. For the four most recent analysis years (2014/15, 2015/16, 2016/17 and 2017/18) CWV intercepts are available on a consistent basis. These may be categorised into four groups, namely: no consistent trend, increasing values, decreasing values and flat (or nearly flat) models. Summary results are presented as Table 3.

These show that 297 out of 429 occurrences (there were 350 in 2017, 378 in 2016, 372 in 2015 and 346 in 2014) indicate no consistent trend while the numbers of consistently decreasing occurrences have reduced from previous years (1 this year – 7 in 2017, 13 in 2016, 13 in 2015 and 14 in 2014). The numbers for consistently increasing occurrences have significantly increased this year when compared to previous years (90 this year – 33 in 2017, 0 in 2016, 6 in 2015 and 35 in 2014). Although a full model smoothing investigation was not undertaken in 2017 and 2016, these relevant counts were derived for use in this assessment.

The count of EUCs of no consistent pattern (297) is lower than all previous assessments – the next lowest observed was 308 in 2013. As Table 3 shows, the results for all previous model smoothing investigations up to and including Autumn 2018 have been very similar with the vast majority of cases always that of no consistent trend.

For every LDZ over four years, the predominant effect is of no consistent pattern. In each LDZ 18 or more (of 33) EUCs show no consistent pattern over the four years. The number of EUCs with a consistent pattern (upwards or downwards) in any LDZ does not exceed 12 (of 33).

For the 10 EUCs that showed a majority of occurrences of an upward pattern in CWV intercepts over three years, the four year picture for these EUCs is one of no consistent trend (only 2 of those EUCs showed a majority of an upward pattern). Over four years 90 EUCs of 429 (21% of EUCs) showed a consistently upward pattern.

5.0 Load Factor Trends (Figure 10 to 18)

The final set of information to be considered as part of this analysis is presented in Figures 10 to 18. These show the load factors for the individual years' models of the consumption band EUCs, over the four years available on a consistent basis.

These graphs of load factors (Figures 10 to 18) show that there are zero instances of a year on year increase in load factors in any of the consumption band EUCs that is consistently expressed across all of the LDZs. The graphs do show, however, instances of a small year on year increase in load factors for 22 of the 117 consumption bands EUCs. 9 of which relate to Small NDM EUCs – EA:E1802B, NT:E1802B, EM:E1803B, NT:E1803B, SO:E1803B, SW:E1803B, EA:E1804B, SO:E1804B, SW:E1804B and 13 which relate to Large NDM EUCs - NW:E1805B, NE:E1805B, WN:E1805B, WS:E1805B, NE:E1806B, EM:E1806B, EA:E1806B, SE:E1806B, SO:E1806B, SE:E1807B, SO:E1807B, SE:E1808B and SO:E1808B.

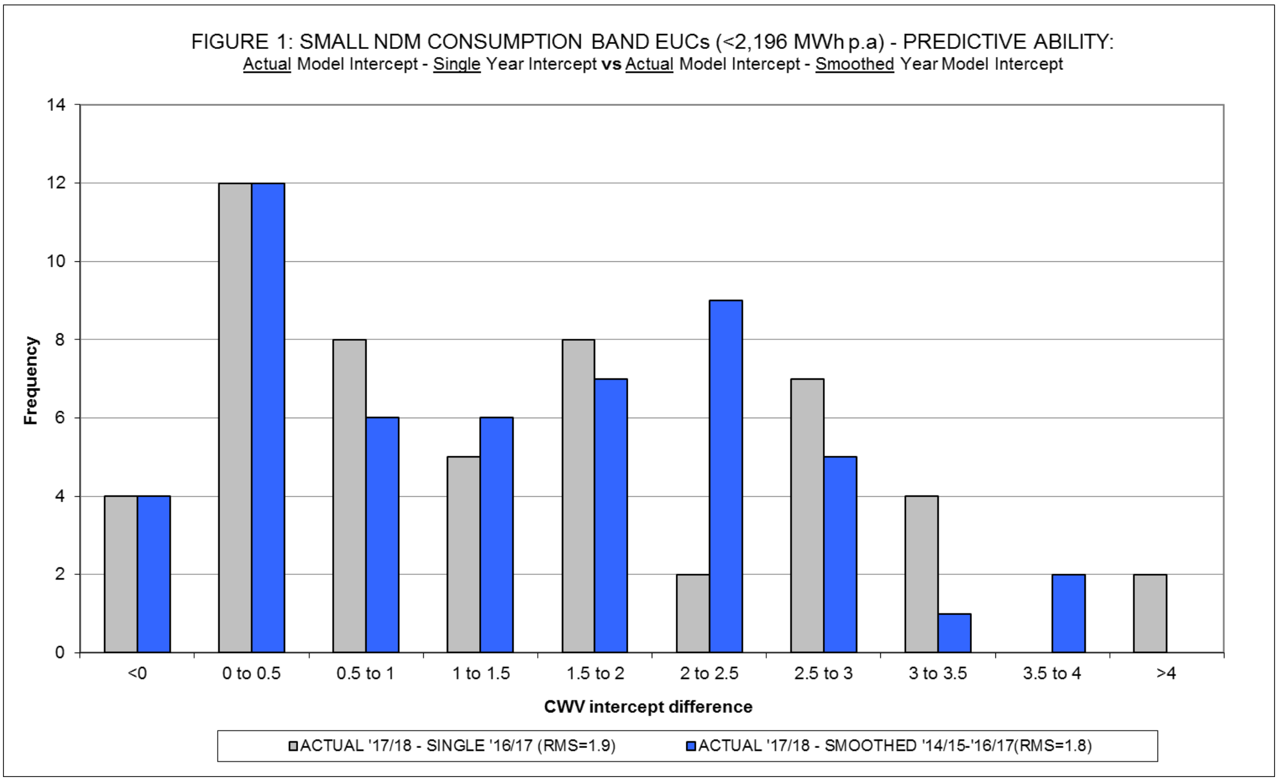
Overall the graphs confirm the evidence of the CWV intercept information previously presented, that the predominant effect is one of no consistent trend.

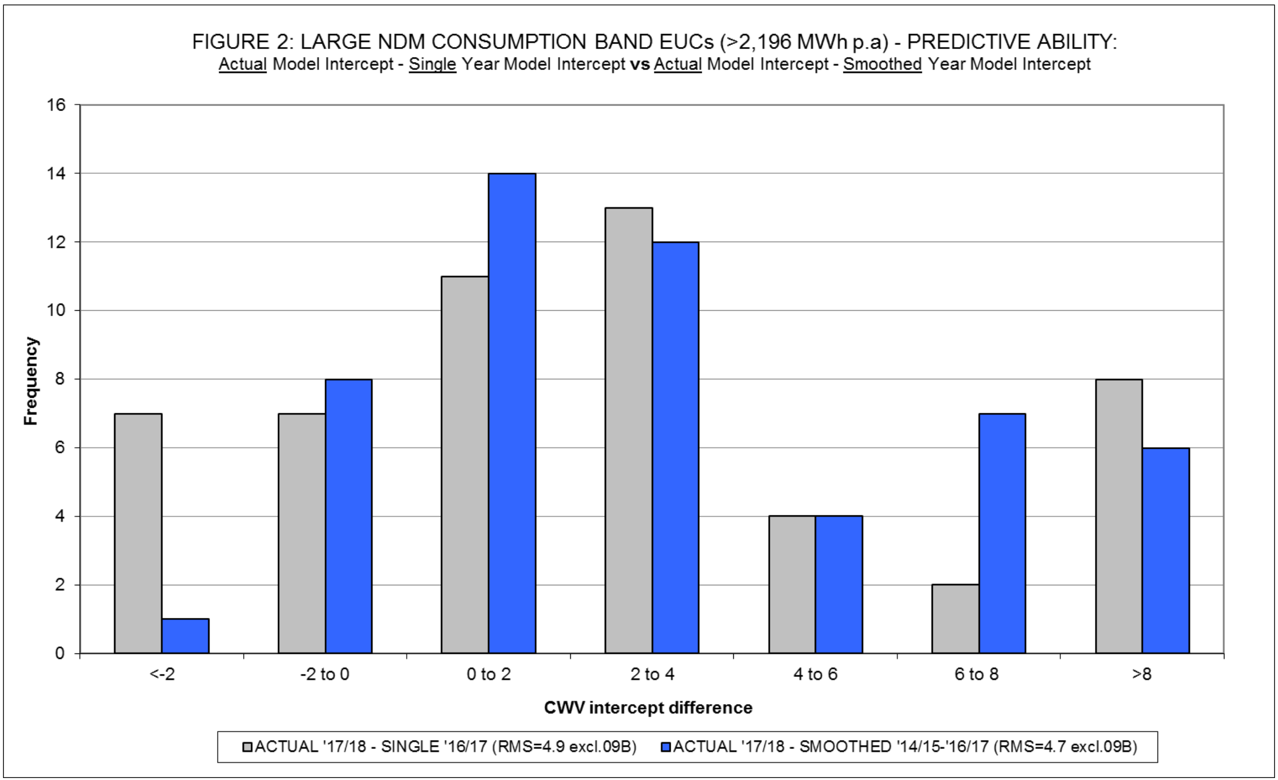
6.0 Conclusion

On the basis of this material, supported by the results of similar analysis undertaken in previous years and there being no signs of trends in the EUC demand models of sufficient clarity, Xoserve believe that the current averaging approach to model smoothing applied over three years continues to be appropriate and fit for purpose.

DESC will be consulted on this topic at a meeting on 8th October to seek their views.

FIGURES 1 TO 4: CWV INTERCEPT DIFFERENCES – PREDICTIVE ABILITY ANALYSIS





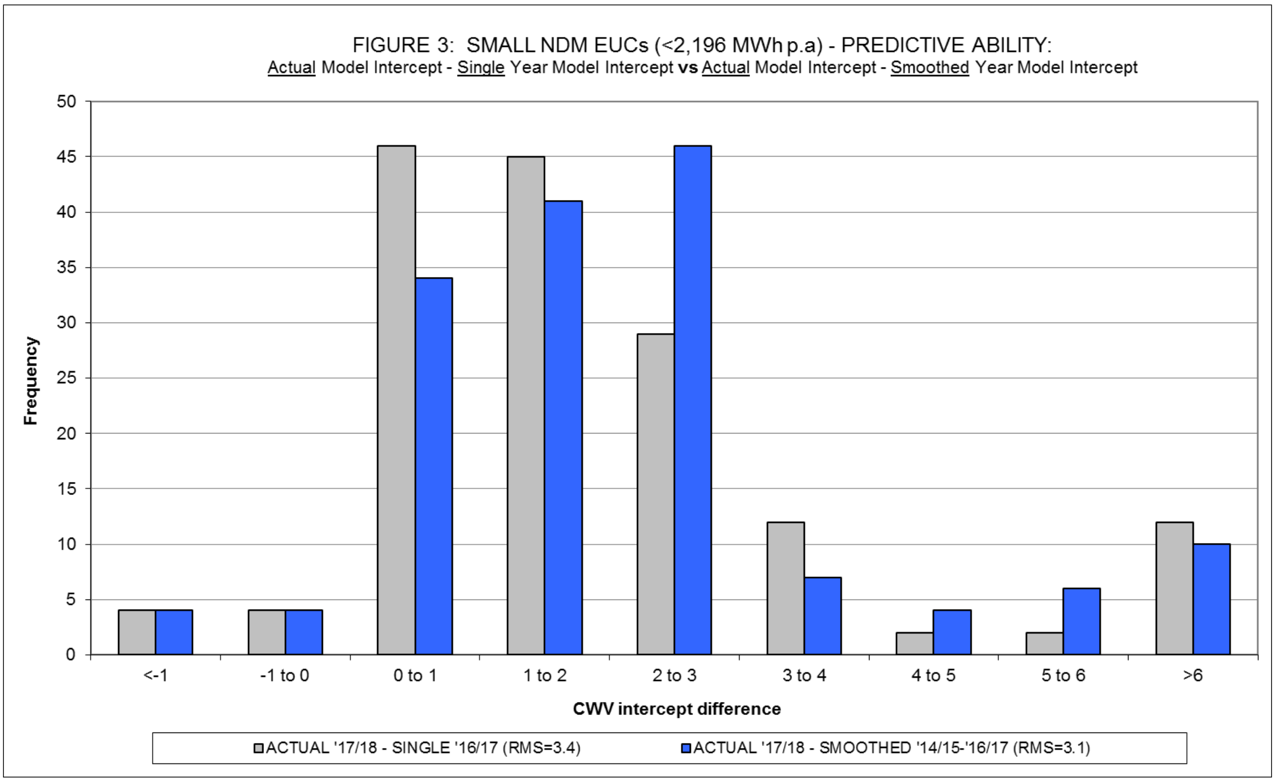


FIGURE 3: SMALL NDM EUCs (<2,196 MWh p.a) - PREDICTIVE ABILITY:
Actual Model Intercept - Single Year Model Intercept vs Actual Model Intercept - Smoothed Year Model Intercept
Frequency
50
45
40
35
30
25
20
15
10
5
0
<-1
-1 to 0
0 to 1
1 to 2
2 to 3
3 to 4
4 to 5
5 to 6
>6
CWV intercept difference
ACTUAL '17/18 - SINGLE '16/17 (RMS=3.4)
ACTUAL '17/18 - SMOOTHED '14/15-'16/17 (RMS=3.1)

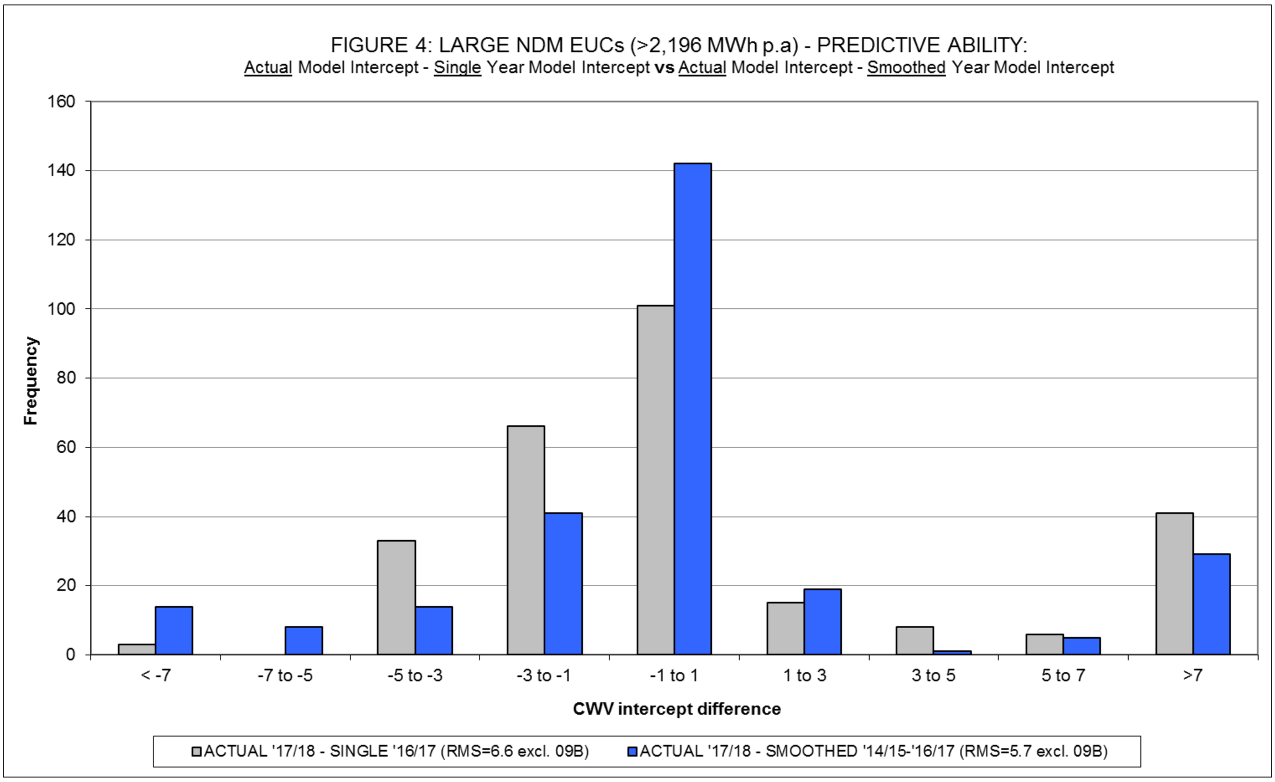
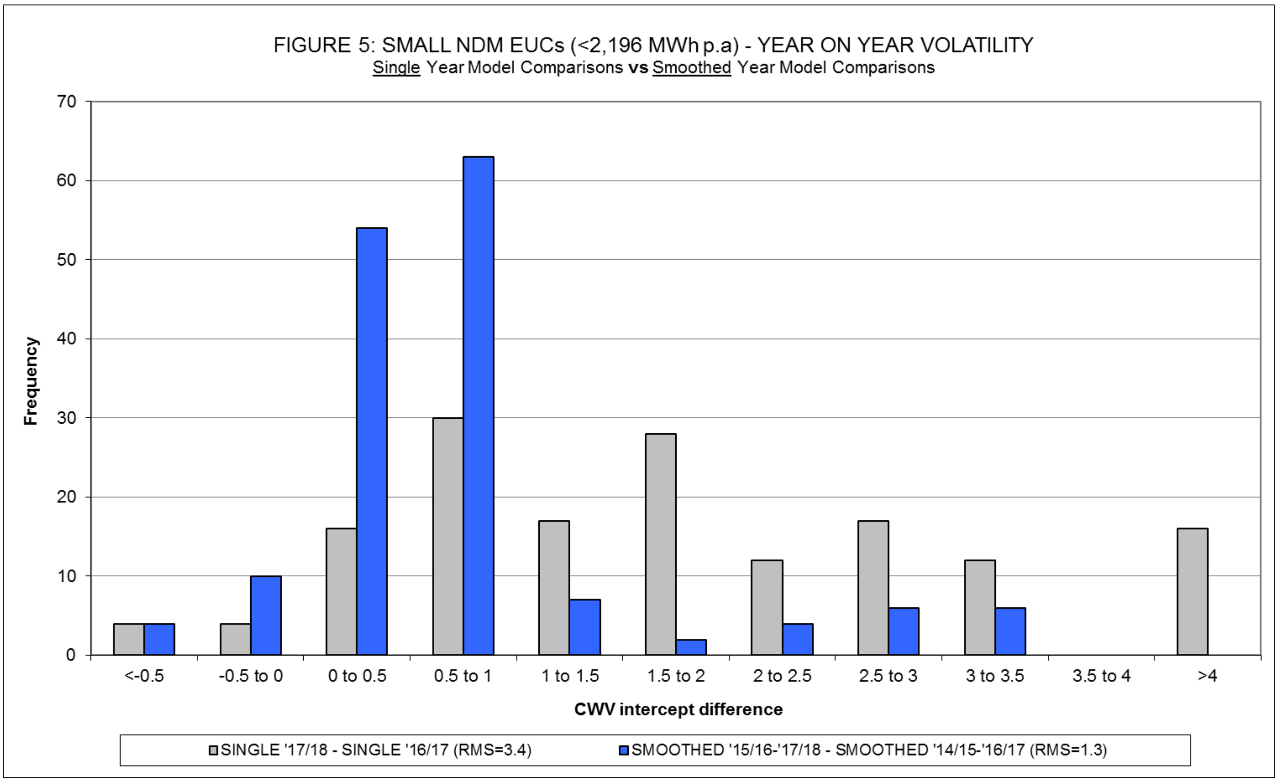
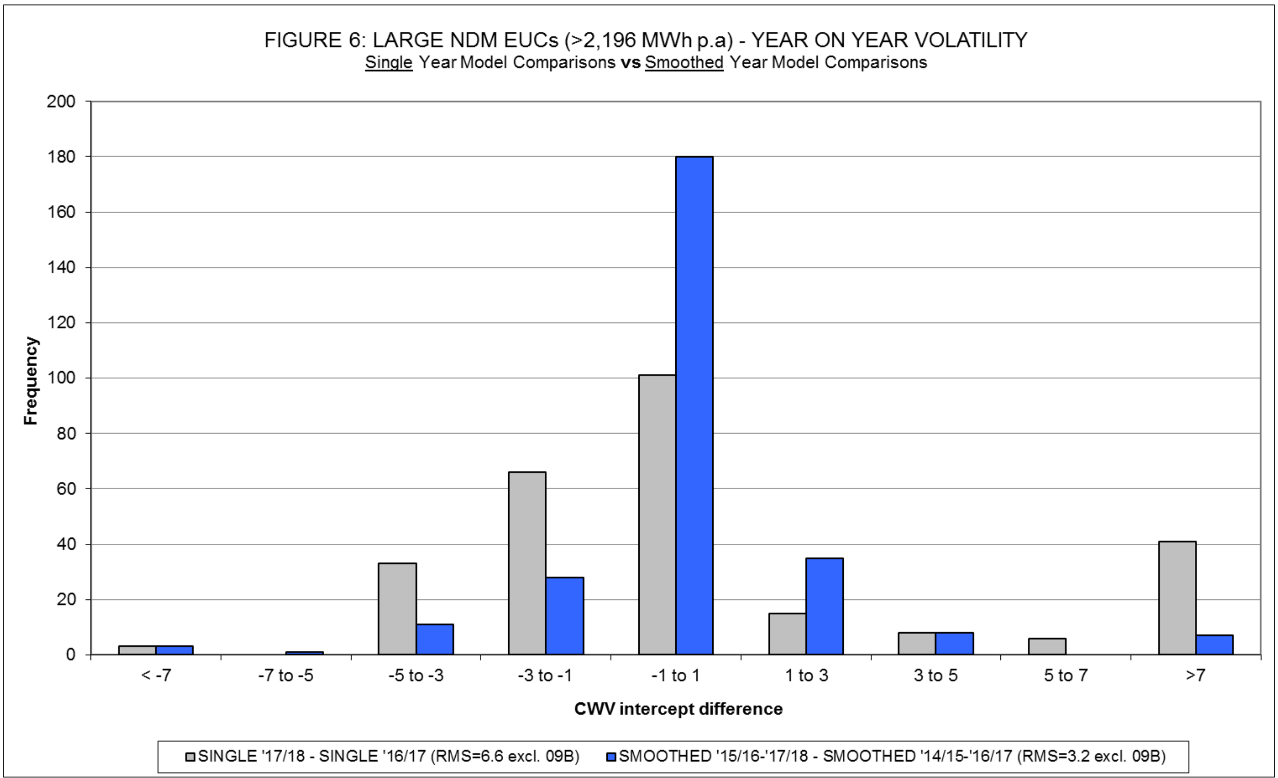


FIGURE 4: LARGE NDM EUCs (>2,196 MWh p.a) - PREDICTIVE ABILITY:
Actual Model Intercept - Single Year Model Intercept vs Actual Model Intercept - Smoothed Year Model Intercept
Frequency
160
140
120
100
80
60
40
20
0
< -7
-7 to -5
-5 to -3
-3 to -1
-1 to 1
1 to 3
3 to 5
5 to 7
>7
CWV intercept difference
ACTUAL '17/18 - SINGLE '16/17 (RMS=6.6 excl. 09B)
ACTUAL '17/18 - SMOOTHED '14/15-'16/17 (RMS=5.7 excl. 09B)

FIGURES 5 TO 8: CWV INTERCEPT DIFFERENCES – VOLATIITY ANALYSIS





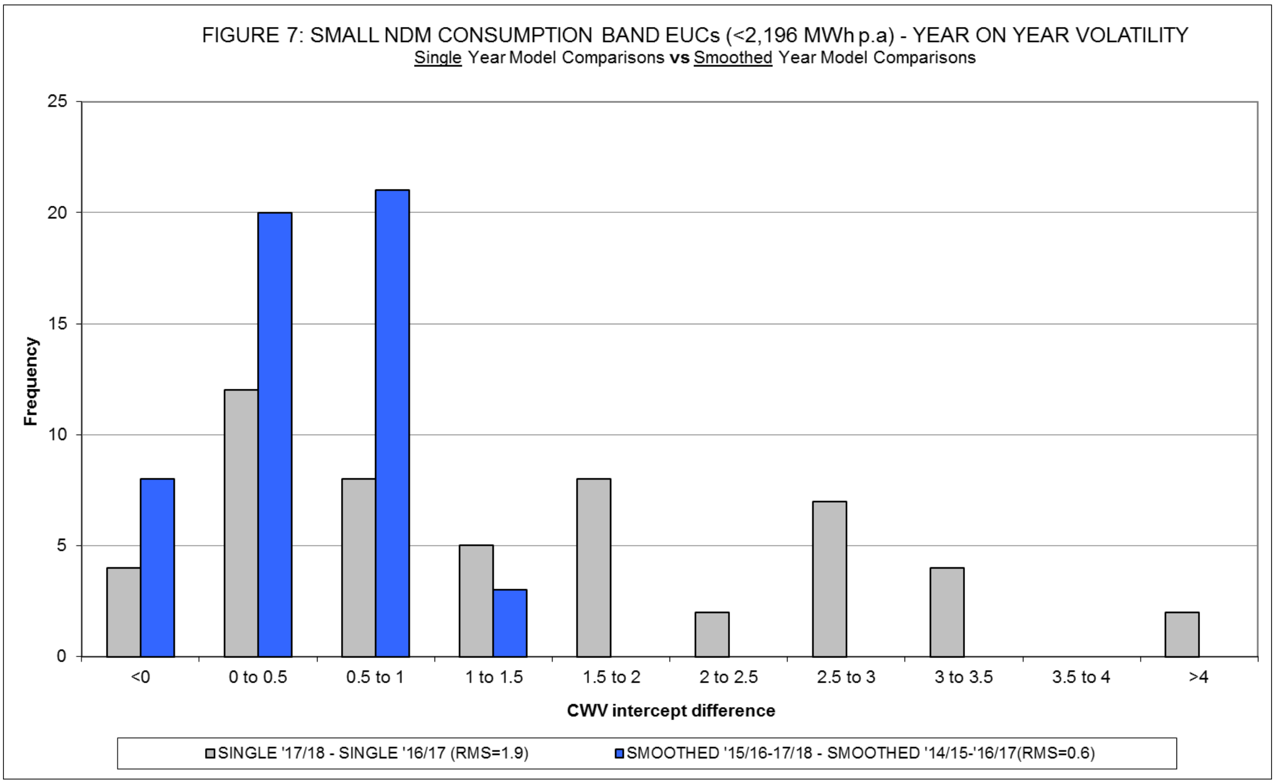


FIGURE 7: SMALL NDM CONSUMPTION BAND EUCs (<2,196 MWh p.a) - YEAR ON YEAR VOLATILITY
Single Year Model Comparisons vs Smoothed Year Model Comparisons
Frequency
25
20
15
10
5
0
<0
0 to 0.5
0.5 to 1
1 to 1.5
1.5 to 2
2 to 2.5
2.5 to 3
3 to 3.5
3.5 to 4
>4
CWV intercept difference
SINGLE '17/18 - SINGLE '16/17 (RMS=1.9)
SMOOTHED '15/16-17/18 - SMOOTHED '14/15-'16/17(RMS=0.6)

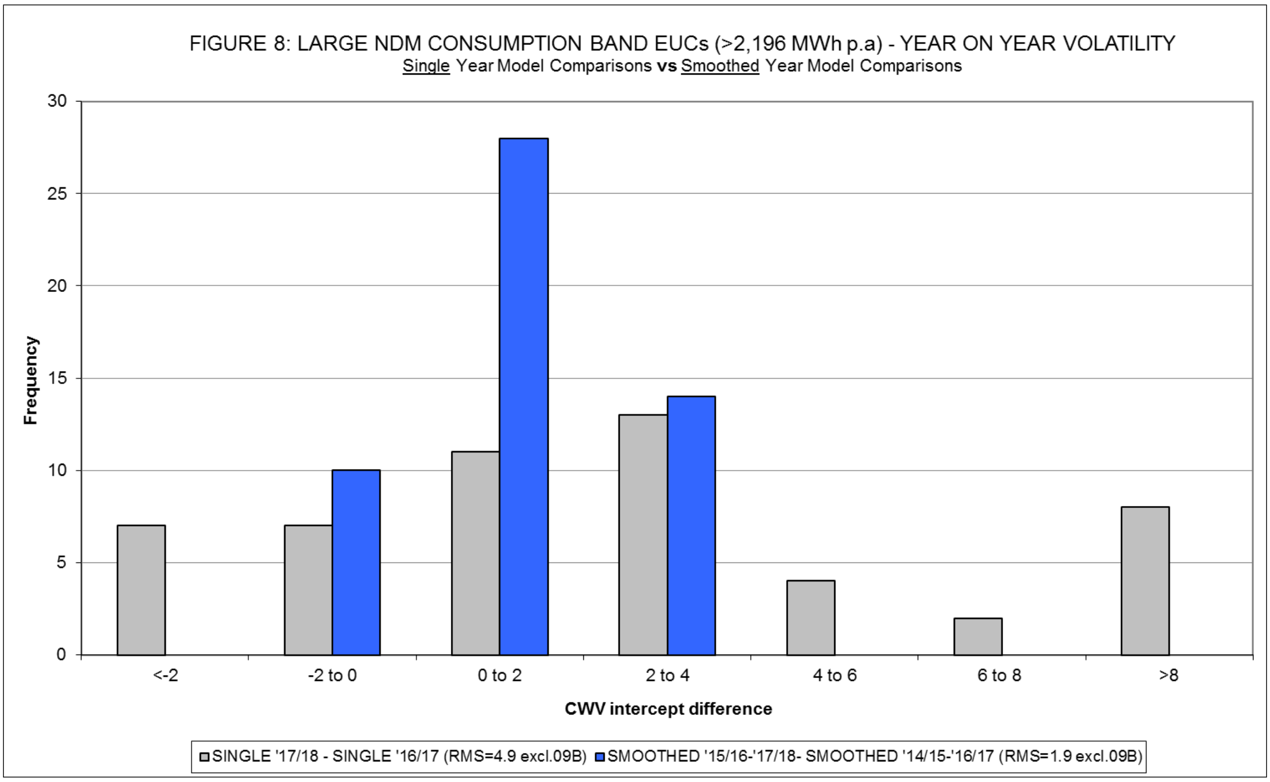


FIGURE 8: LARGE NDM CONSUMPTION BAND EUCs (>2,196 MWh p.a) - YEAR ON YEAR VOLATILITY
Single Year Model Comparisons vs Smoothed Year Model Comparisons
Frequency
30
25
20
15
10
5
0
<-2
-2 to 0
0 to 2
2 to 4
4 to 6
6 to 8
>8
CWV intercept difference
SINGLE '17/18 - SINGLE '16/17 (RMS=4.9 excl.09B)
SMOOTHED '15/16-'17/18- SMOOTHED '14/15-'16/17 (RMS=1.9 excl.09B)

FIGURE 9: KEY FOR CWV INTERCEPT PATTERN TYPES: 3 YEARS OF NDM DEMAND MODELS

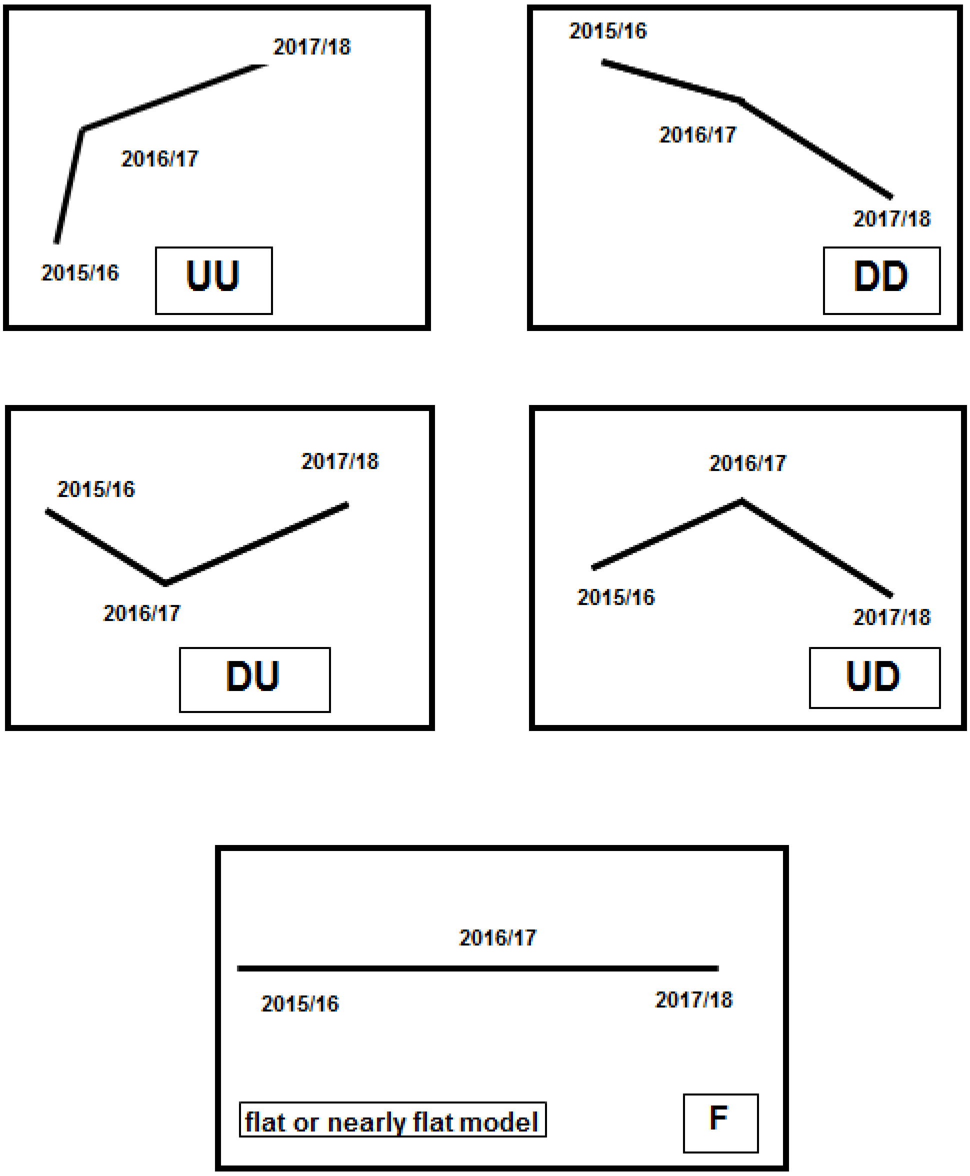


TABLE 1: CWV INTERCEPT PATTERNS
NDM DEMAND MODELS FOR 2015/16, 2016/17, 2017/18

Consumption Band EUCs

xx=LDZ =	SC	NO	NW	NE	EM	WM	WN	WS	EA	NT	SE	SO	SW
xx:E1801B	UD	DU	UU	UU	UU	DU	UU	UD	DU	DU	DU	F	UU
xx:E1802B	UU	DU	DU	DU	UU	DU	DU	UU	DU	UU	DU	DU	DU
xx:E1803B	UU	UU	DU	DU	DU	DU	DU	DU	DU	UU	DU	UU	UU
xx:E1804B	DU	UU	DU	UU	DU	DU	DU	UD	UU	DU	DU	UU	UU
xx:E1805B	UU	UD	UU	UU	DD	UD	UU	UU	DU	UU	DU	DU	UU
xx:E1806B	DU	UU	DU	UU	UU	DU	DU	UD	UU	UU	UU	UU	UU
xx:E1807B	UU	UD	DU	UD	DU	UD	DU	UD	DU	DU	DU	DU	UD
xx:E1808B	UU	UD	DU	UD	DU	UD	DU	UD	DU	DU	DU	DU	UD
xx:E1809B	DU	DU	DU	DU	DU	DU	DU	DU	DU	DU	DU	DU	DU

First (i.e. Flattest, W01) WAR Bands in each Consumption Range

xx=LDZ =	SC	NO	NW	NE	EM	WM	WN	WS	EA	NT	SE	SO	SW
xx:E1803W01	DU	DU	UU	DU	DU	DU	UU	UD	UU	UU	UD	UU	UU
xx:E1804W01	DU	DU	UU	DU	DU	DU	UU	UD	UU	UU	UD	UU	UU
xx:E1805W01	DU	DU	F	DU	DU	DU	F	UD	UD	UD	UD	DD	DD
xx:E1806W01	F	F	F	F	F	F	F	F	F	F	F	F	F
xx:E1807W01	F	F	F	F	F	F	F	F	F	F	F	F	F
xx:E1808W01	F	F	F	F	F	F	F	F	F	F	F	F	F

Second (ie. W02) ,WAR Bands in Each Consumption Range

xx=LDZ =	SC	NO	NW	NE	EM	WM	WN	WS	EA	NT	SE	SO	SW
xx:E1803W02	DU	DU	DU	DU	DU	DU	DU	UU	UU	UU	UU	UU	DU
xx:E1804W02	DU	DU	DU	DU	DU	DU	DU	UU	UU	UU	UU	UU	DU
xx:E1805W02	DU	DU	DU	UD	UD	UD	DU	UD	UD	UD	UD	UD	UD
xx:E1806W02	DU	DU	DU	UU	UU	UU	DU	UU	UU	UU	UU	UU	UU
xx:E1807W02	DU	DU	DU	UU	UU	UU	DU	UD	UD	UD	UD	UD	UD
xx:E1808W02	DU	DU	DU	UU	UU	UU	DU	UD	UD	UD	UD	UD	UD

Third (ie. W03) ,WAR Bands in Each Consumption Range

xx=LDZ =	SC	NO	NW	NE	EM	WM	WN	WS	EA	NT	SE	SO	SW
xx:E1803W03	DU	DU	DU	DU	DU	DU	DU	UU	UU	UU	UU	UU	UU
xx:E1804W03	DU	DU	DU	DU	DU	DU	DU	UU	UU	UU	UU	UU	UU
xx:E1805W03	DU	DU	DU	DU	UU	DU	DU	UU	UU	UU	UU	UD	UU
xx:E1806W03	DU	DU	DU	UU	UU	DU	DU	UD	UD	UD	UD	UD	UD
xx:E1807W03	DU	DU	DU	UU	UU	UU	DU	UU	UU	UU	UU	UU	UU
xx:E1808W03	DU	DU	DU	UU	UU	UU	DU	UU	UU	UU	UU	UU	UU

Fourth (ie. peakiest, W04) ,WAR Bands in Each Consumption Range

xx=LDZ =	SC	NO	NW	NE	EM	WM	WN	WS	EA	NT	SE	SO	SW
xx:E1803W04	DU	DU	DU	DU	UU	UU	DU	UU	UU	UU	UU	UU	UU
xx:E1804W04	DU	DU	DU	DU	UU	UU	DU	UU	UU	UU	UU	UU	UU
xx:E1805W04	DU	DU	DU	UU	UU	UU	DU	UU	UD	UD	UD	UD	UU
xx:E1806W04	UU	DU	DU	UU	UU	UU	DU	UU	UU	UU	UU	UU	UU
xx:E1807W04	UU	UU	UU	UU	UU	UU	UU	UU	UU	UU	UU	UU	UU
xx:E1808W04	UU	UU	UU	UU	UU	UU	UU	UU	UU	UU	UU	UU	UU

KEY

UU	UP UP 2015/16 < 2016/17 < 2017/18
UD	UP DOWN 2015/16 < 2016/17 >= 2017/18
DU	DOWN UP 2015/16 >= 2016/17 < 2017/18
DD	DOWN DOWN 2015/16 > 2016/17 > 2017/18
F	FLAT OR NEARLY FLAT MODELS

TABLE 2: CWV INTERCEPT PATTERNS: NDM DEMAND MODELS FOR 2015/16, 2016/17 AND 2017/18
COUNTS OF CWV INTERCEPT PATTERN TYPES BY END USER CATEGORY AND BY LDZ

EUC	Type					Total	
	UU	UD	DU	DD	F		
xx:E1801B	5	2	5	0	1	13	
xx:E1802B	4	0	9	0	0	13	
xx:E1803B	5	0	8	0	0	13	
xx:E1803W01	6	2	5	0	0	13	
xx:E1803W02	5	0	8	0	0	13	
xx:E1803W03	6	0	7	0	0	13	
xx:E1803W04	8	0	5	0	0	13	
xx:E1804B	5	1	7	0	0	13	
xx:E1804W01	6	2	5	0	0	13	
xx:E1804W02	5	0	8	0	0	13	
xx:E1804W03	6	0	7	0	0	13	
xx:E1804W04	8	0	5	0	0	13	
xx:E1805B	7	2	3	1	0	13	
xx:E1805W01	0	4	5	2	2	13	
xx:E1805W02	0	9	4	0	0	13	
xx:E1805W03	6	1	6	0	0	13	
xx:E1805W04	5	4	4	0	0	13	
xx:E1806B	8	1	4	0	0	13	
xx:E1806W01	0	0	0	0	13	13	
xx:E1806W02	9	0	4	0	0	13	
xx:E1806W03	2	6	5	0	0	13	
xx:E1806W04	10	0	3	0	0	13	
xx:E1807B	1	5	7	0	0	13	
xx:E1807W01	0	0	0	0	13	13	
xx:E1807W02	3	6	4	0	0	13	
xx:E1807W03	9	0	4	0	0	13	
xx:E1807W04	13	0	0	0	0	13	
xx:E1808B	1	5	7	0	0	13	
xx:E1808W01	0	0	0	0	13	13	
xx:E1808W02	3	6	4	0	0	13	
xx:E1808W03	9	0	4	0	0	13	
xx:E1808W04	13	0	0	0	0	13	
xx:E1809B	0	0	13	0	0	13	
Total by Type	168	56	160	3	42	429	Autumn 2018
2014/15, 2015/16 and 2016/17 Analysis Years	121	132	103	31	42	429	Autumn 2017
2013/14, 2014/15 and 2015/16 Analysis Years	78	96	160	57	38	429	Autumn 2016
2012/13, 2013/14 and 2014/15 Analysis Years	11	135	136	109	38	429	Autumn 2015
2011/12, 2012/13 and 2013/14 Analysis Years	75	194	68	58	34	429	Autumn 2014
2010/11, 2011/12 and 2012/13 Analysis Years	132	117	115	26	39	429	Autumn 2013
2009/10, 2010/11 and 2011/12 Analysis Years	135	150	74	31	39	429	Autumn 2012
2008/09, 2009/10 and 2010/11 Analysis Years	90	85	161	54	39	429	Autumn 2011
2007/08, 2008/09 and 2009/10 Analysis Years	52	214	91	33	39	429	Autumn 2010
2006/07, 2007/08 and 2008/09 Analysis Years	129	123	101	37	39	429	Autumn 2009
2005/06, 2008/09 and 2009/10 Analysis Years	46	81	173	90	39	429	Autumn 2008
2004/05, 2005/06 and 2008/09 Analysis Years	28	195	68	99	39	429	Autumn 2007
2003/04, 2004/05 and 2005/06 Analysis Years	109	169	65	48	38	429	Autumn 2006
2002/03, 2003/04 and 2004/05 Analysis Years	99	111	151	33	35	429	Autumn 2005
2001/02, 2002/03 and 2003/04 Analysis Years	62	95	182	57	33	429	Autumn 2004
2000/01, 2001/02 and 2002/03 Analysis Years	21	145	130	94	39	429	Autumn 2003
1999/00, 2000/01 and 2001/02 Analysis Years	66	194	80	50	39	429	Autumn 2002

LDZ	Type					Total
	UU	UD	DU	DD	F	
SC	8	1	21	0	3	33
NO	5	3	22	0	3	33
NW	6	0	23	0	4	33
NE	14	3	13	0	3	33
EM	16	1	12	1	3	33
WM	11	4	15	0	3	33
WN	6	0	23	0	4	33
WS	16	12	2	0	3	33
EA	17	6	7	0	3	33
NT	19	6	5	0	3	33
SE	14	8	8	0	3	33
SO	17	6	5	1	4	33
SW	19	6	4	1	3	33
Totals	168	56	160	3	42	429

KEY	
UU	Increasing Trend
UD	Increasing then decreasing Trend
DU	Decreasing then increasing Trend
DD	Decreasing Trend
F	Flat model

TABLE 3: CWV INTERCEPT PATTERNS: NDM DEMAND MODELS FOR 2014/15, 2015/16, 2016/17 AND 2017/18
COUNTS OF CWV INTERCEPT PATTERN TYPES BY END USER CATEGORY AND BY LDZ

EUC	Type				Total
	N	D	U	F	
xx:E1801B	13	0	0	0	13
xx:E1802B	11	0	2	0	13
xx:E1803B	9	0	4	0	13
xx:E1803W01	10	0	3	0	13
xx:E1803W02	9	0	4	0	13
xx:E1803W03	9	0	4	0	13
xx:E1803W04	11	0	2	0	13
xx:E1804B	10	0	3	0	13
xx:E1804W01	10	0	3	0	13
xx:E1804W02	9	0	4	0	13
xx:E1804W03	9	0	4	0	13
xx:E1804W04	11	0	2	0	13
xx:E1805B	8	0	5	0	13
xx:E1805W01	10	1	0	2	13
xx:E1805W02	13	0	0	0	13
xx:E1805W03	10	0	3	0	13
xx:E1805W04	12	0	1	0	13
xx:E1806B	7	0	6	0	13
xx:E1806W01	0	0	0	13	13
xx:E1806W02	5	0	8	0	13
xx:E1806W03	11	0	2	0	13
xx:E1806W04	5	0	8	0	13
xx:E1807B	13	0	0	0	13
xx:E1807W01	0	0	0	13	13
xx:E1807W02	10	0	3	0	13
xx:E1807W03	10	0	3	0	13
xx:E1807W04	8	0	5	0	13
xx:E1808B	13	0	0	0	13
xx:E1808W01	0	0	0	13	13
xx:E1808W02	10	0	3	0	13
xx:E1808W03	10	0	3	0	13
xx:E1808W04	8	0	5	0	13
xx:E1809B	13	0	0	0	13

	N	D	U	F	Total	
Total by Type	297	1	90	41	429	Autumn 2018
2013/14, 2014/15, 2015/16 and 2016/17 Analysis Years	350	7	33	39	429	Autumn 2017
2012/13, 2013/14, 2014/15 and 2015/16 Analysis Years	378	13	0	38	429	Autumn 2016
2011/12, 2012/13, 2013/14 and 2014/15 Analysis Years	372	13	6	38	429	Autumn 2015
2010/11, 2011/12, 2012/13 and 2013/14 Analysis Years	346	14	35	34	429	Autumn 2014
2009/10, 2010/11, 2011/12 and 2012/13 Analysis Years	308	7	75	39	429	Autumn 2013
2008/09, 2009/10, 2010/11 and 2011/12 Analysis Years	335	16	39	39	429	Autumn 2012
2007/08, 2008/09, 2009/10 and 2010/11 Analysis Years	363	5	22	39	429	Autumn 2011
2006/07, 2007/08, 2008/09 and 2009/10 Analysis Years	364	6	20	39	429	Autumn 2010
2005/06, 2006/07, 2007/08 and 2008/09 Analysis Years	356	18	16	39	429	Autumn 2009
2004/05, 2005/06, 2006/07 and 2007/08 Analysis Years	352	25	13	39	429	Autumn 2008
2003/04, 2004/05, 2005/06 and 2006/07 Analysis Years	353	19	19	38	429	Autumn 2007
2002/03, 2003/04, 2004/05 and 2005/06 Analysis Years	355	10	29	35	429	Autumn 2006
2001/02, 2002/03, 2003/04 and 2004/05 Analysis Years	360	9	25	35	429	Autumn 2005
2000/01, 2001/02, 2002/03 and 2003/04 Analysis Years	364	23	9	33	429	Autumn 2004
1999/00, 2000/01, 2001/02 and 2002/03 Analysis Years	353	32	5	39	429	Autumn 2003

LDZ	Type				Total
	N	D	U	F	
SC	27	0	3	3	33
NO	29	0	1	3	33
NW	26	0	3	4	33
NE	20	0	10	3	33
EM	20	0	10	3	33
WM	22	0	8	3	33
WN	26	0	3	4	33
WS	26	0	4	3	33
EA	19	0	11	3	33
NT	18	0	12	3	33
SE	21	0	9	3	33
SO	20	1	9	3	33
SW	23	0	7	3	33
Totals	297	1	90	41	429

KEY	
N	No consistent trend over 4 years
D	Decreasing values over 4 years
U	Increasing values over 4 years
F	Flat or nearly flat models

FIGURES 10 to 18: LOAD FACTORS FROM INDIVIDUAL YEAR MODELS OVER 4 YEARS AVAILABLE 2014/15, 2015/16, 2016/17 AND 2017/18

Figure 10: Load Factors for each LDZ - xx:E1801B

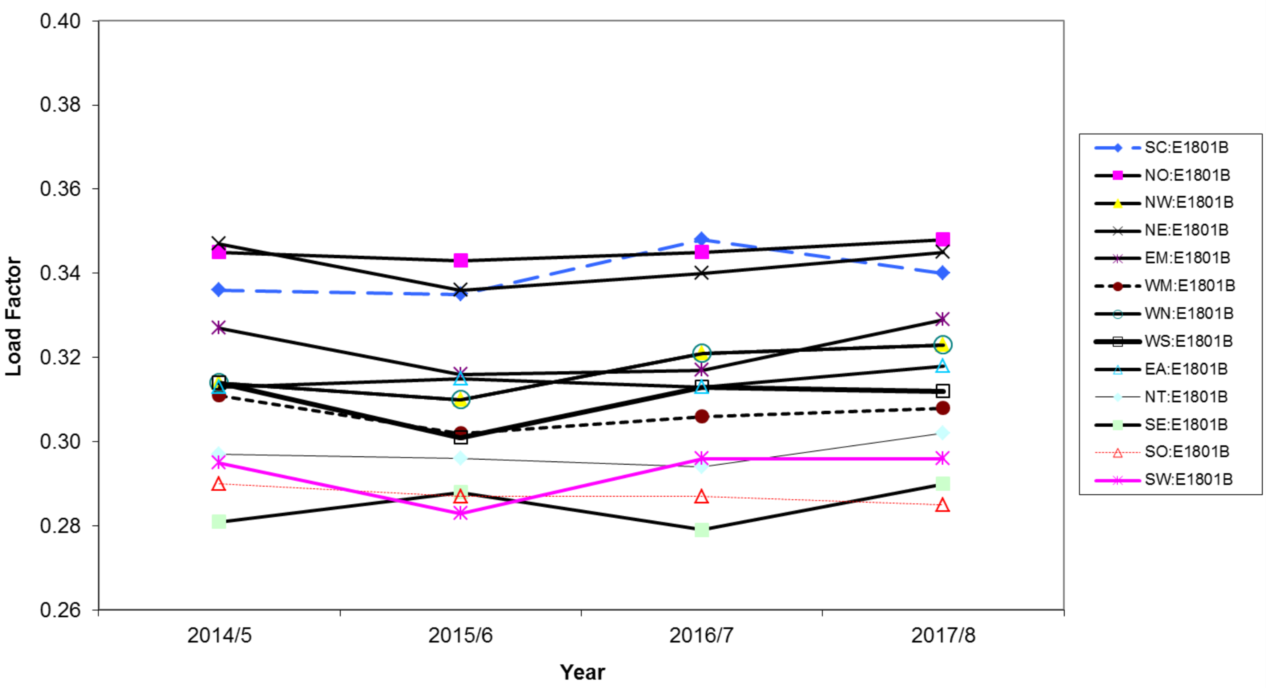


Figure 11: Load Factors for each LDZ - xx:E1802B

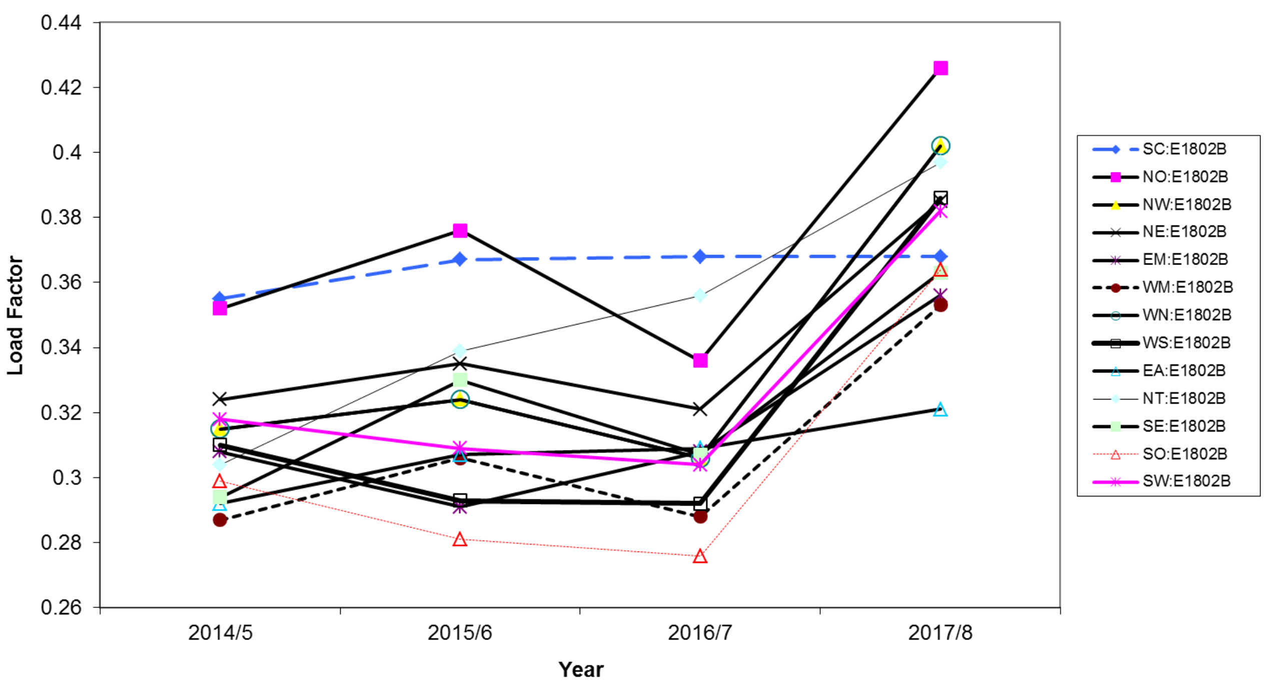


Figure 12: Load Factors for each LDZ - xx:E1803B

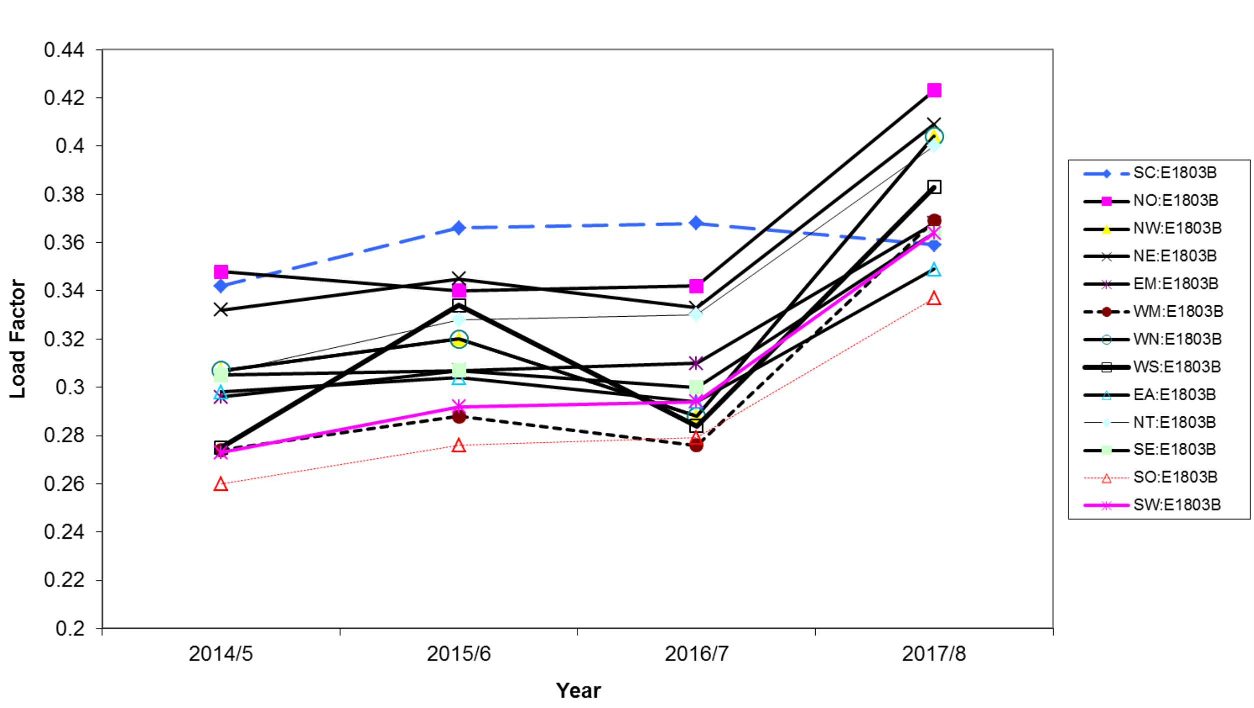
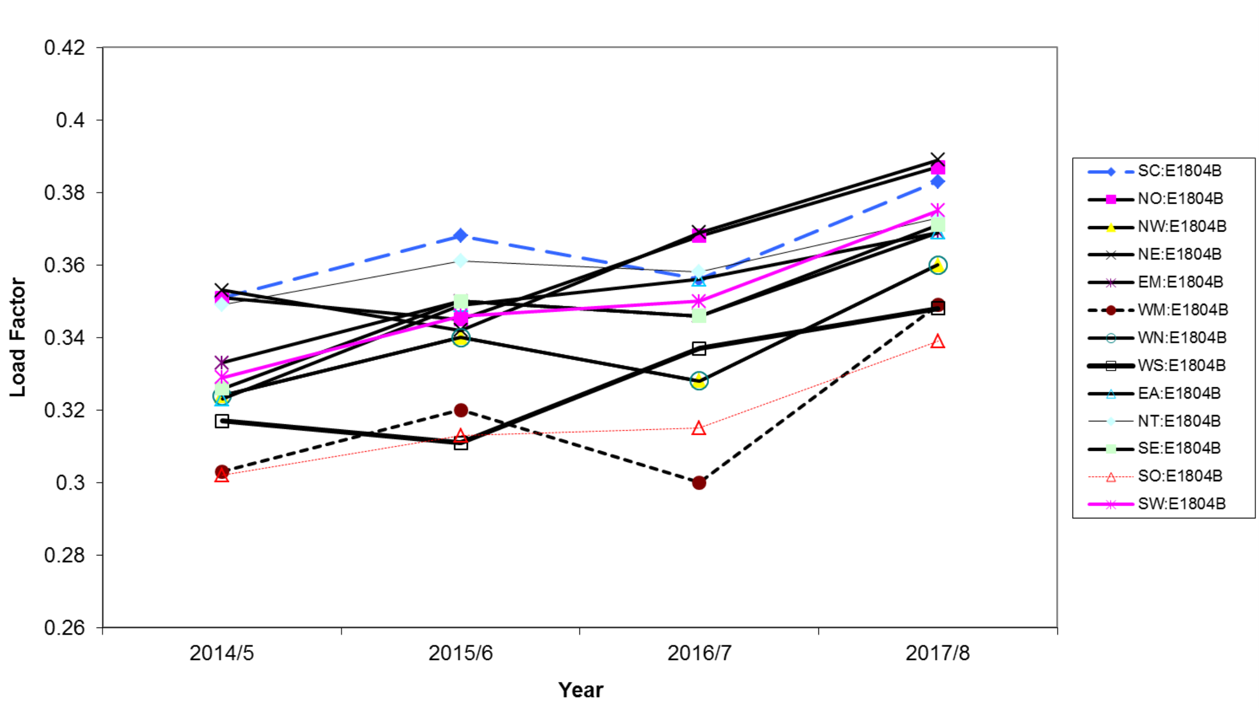


Figure 13: Load Factors for each LDZ - xx:E1804B



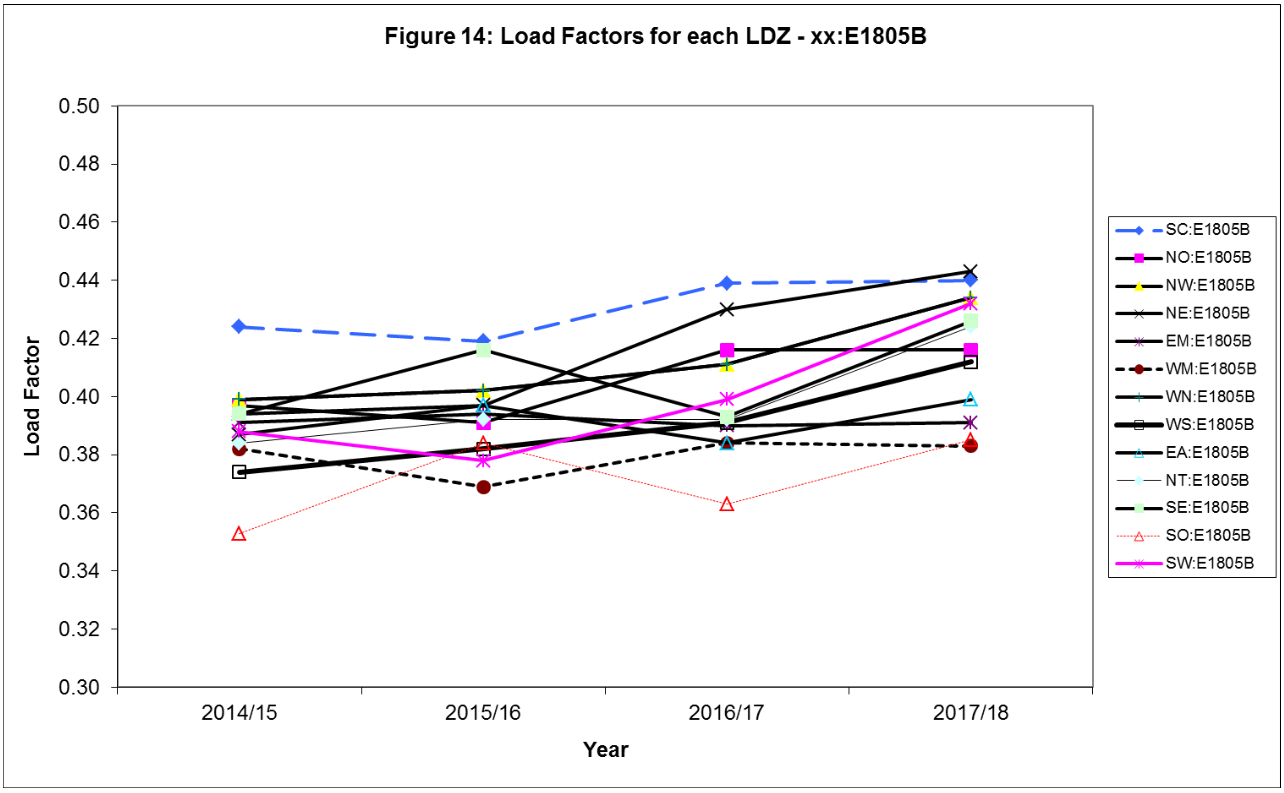


Figure 14: Load Factors for each LDZ - xx:E1805B
Load Factor
0.50
0.48
0.46
0.44
0.42
0.40
0.38
0.36
0.34
0.32
0.30
2014/15
2015/16
2016/17
2017/18
Year
SC:E1805B
NO:E1805B
NW:E1805B
NE:E1805B
EM:E1805B
WM:E1805B
WN:E1805B
WS:E1805B
EA:E1805B
NT:E1805B
SE:E1805B
SO:E1805B
SW:E1805B

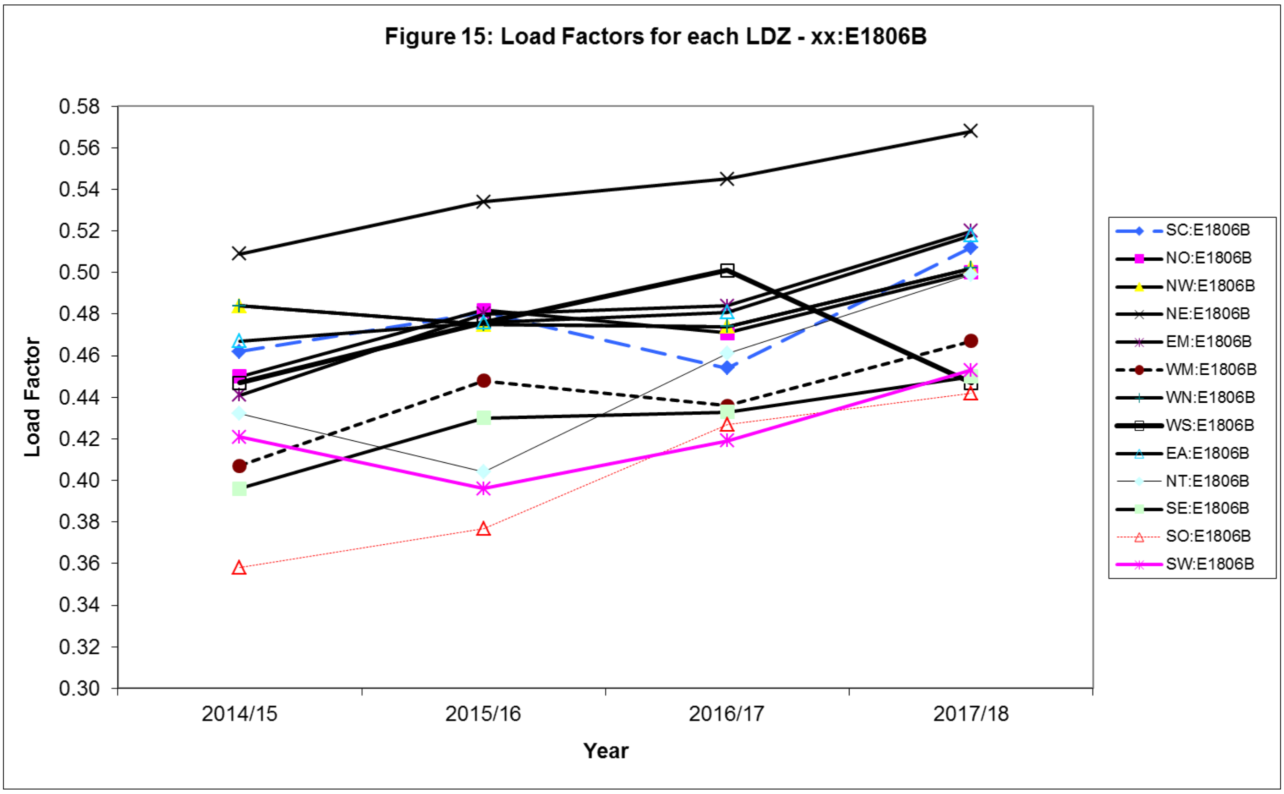


Figure 15: Load Factors for each LDZ - xx:E1806B
Load Factor
0.58
0.56
0.54
0.52
0.50
0.48
0.46
0.44
0.42
0.40
0.38
0.36
0.34
0.32
0.30
2014/15
2015/16
2016/17
2017/18
Year
SC:E1806B
NO:E1806B
NW:E1806B
NE:E1806B
EM:E1806B
WM:E1806B
WN:E1806B
WS:E1806B
EA:E1806B
NT:E1806B
SE:E1806B
SO:E1806B
SW:E1806B

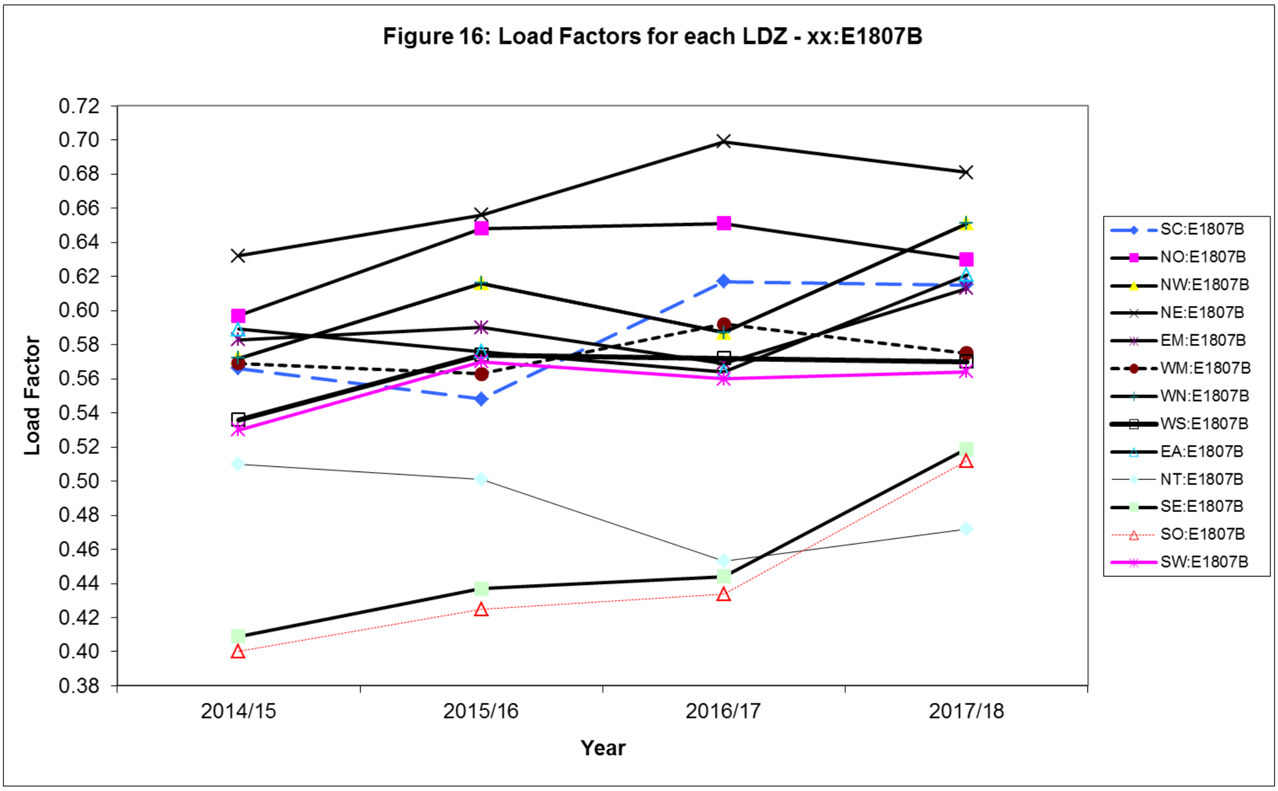


Figure 16: Load Factors for each LDZ - xx:E1807B
Load Factor
0.72
0.70
0.68
0.66
0.64
0.62
0.60
0.58
0.56
0.54
0.52
0.50
0.48
0.46
0.44
0.42
0.40
0.38
2014/15
2015/16
2016/17
2017/18
Year
SC:E1807B
NO:E1807B
NW:E1807B
NE:E1807B
EM:E1807B
WM:E1807B
WN:E1807B
WS:E1807B
EA:E1807B
NT:E1807B
SE:E1807B
SO:E1807B
SW:E1807B

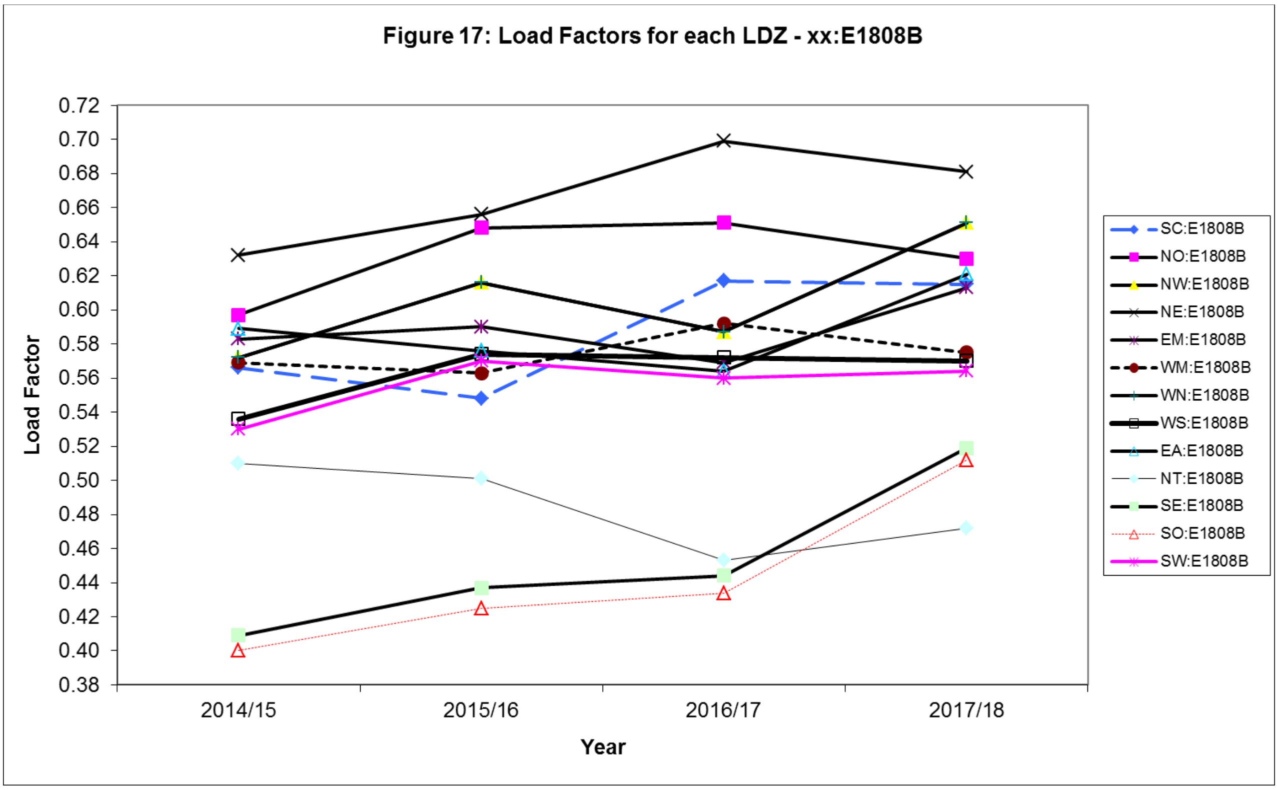
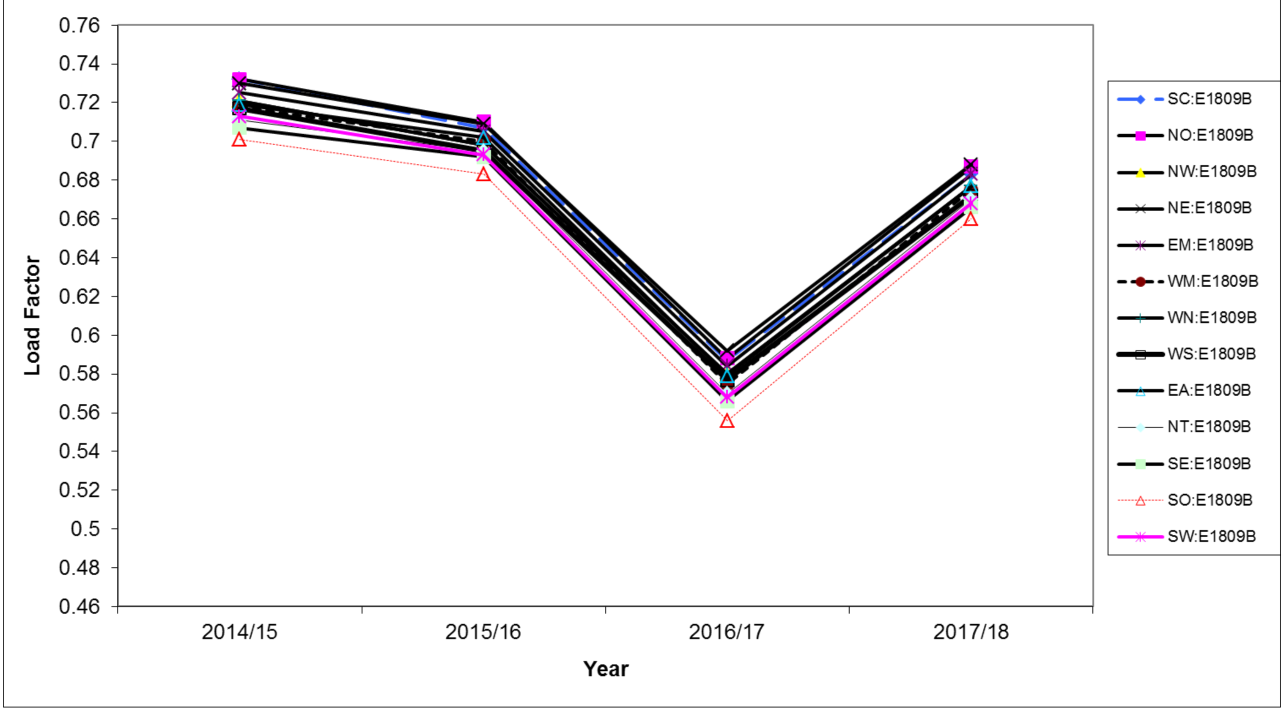


Figure 17: Load Factors for each LDZ - xx:E1808B
Load Factor
0.72
0.70
0.68
0.66
0.64
0.62
0.60
0.58
0.56
0.54
0.52
0.50
0.48
0.46
0.44
0.42
0.40
0.38
2014/15
2015/16
2016/17
2017/18
Year
SC:E1808B
NO:E1808B
NW:E1808B
NE:E1808B
EM:E1808B
WM:E1808B
WN:E1808B
WS:E1808B
EA:E1808B
NT:E1808B
SE:E1808B
SO:E1808B
SW:E1808B

Figure 18: Load Factors for each LDZ - xx:E1809B



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