Demand Estimation Sub Committee

Evaluation of Model Smoothing Methodology

24th February 2021

Objective

- To assess whether Model Smoothing approach continues to reduce volatility in the Demand Model characteristics and subsequent Gas Demand profiles, from one year to the next

Background

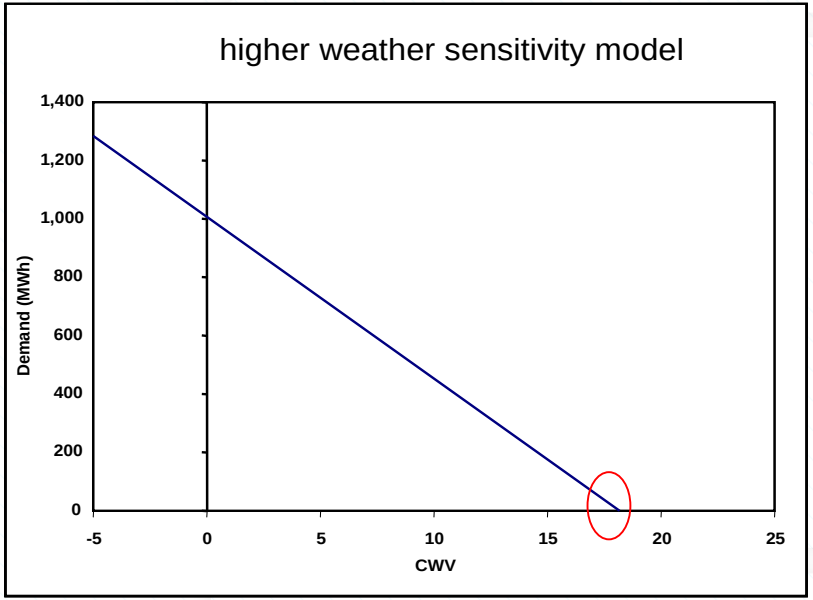
- The principle of ‘Model Smoothing’ has been applied for many years, with the methodology detailed in the Modelling Approach document
- In January 2006, DESC agreed to move to a biennial assessment of the continued applicability of Model Smoothing
- The analysis presented today is the first full assessment of model smoothing since Autumn 2018 and has been carried out along the same lines
- This is the first time this analysis has been performed since the new CWV formula and Seasonal Normal values were implemented, as such all data used in this assessment is comparable and reflects the ‘new basis’
- The following presentation summarises the results and conclusions, however there is a supporting document also available which provides further detailed commentary and analysis – Document name: *DESC_Model Smoothing Review_Winter20.pdf*

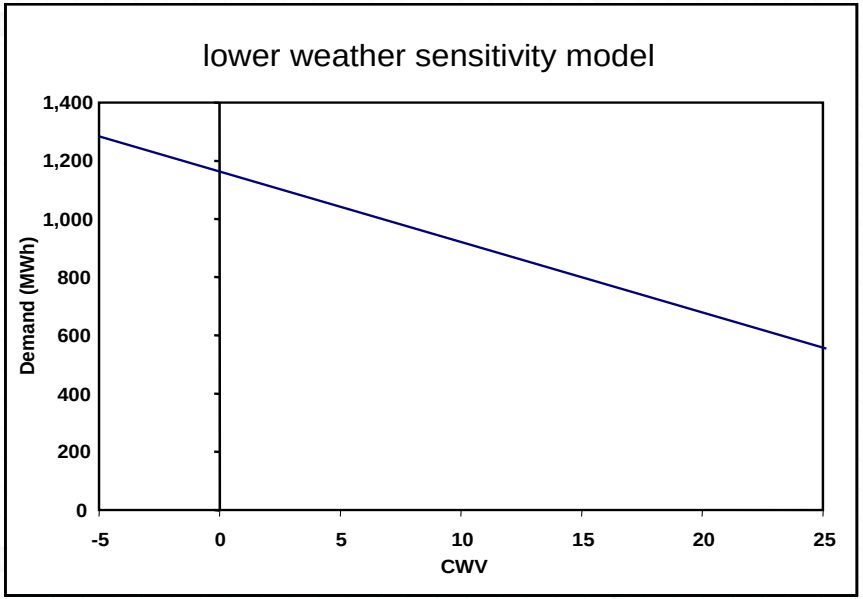
Model Smoothing Principles

- Model Smoothing is the averaging of 3 years of models (including the current and most recent data sets) to derive new parameters
- Introduced to address year on year volatility and provide greater stability in EUC Demand Models and subsequent Gas Demand Profiles (i.e. ALPs, DAFs, and PLFs)
- Model Smoothing will not necessarily improve model predictability, however it may be more effective than single year models
- Analysis performed considers: i) Volatility, ii) Predictability, and iii) Trend Analysis
- Model Smoothing assessments are undertaken using the CWV intercept differences from relevant single year or smoothed models

Model Smoothing: CWV Intercepts

- Section 6 of the Annual NDM Algorithms booklet contains individual year and smoothed model CWV Intercepts





Model Smoothing: Assessment of Volatility

Single Year Data Sets	Smoothed Model (Sm)
2017/18 (Yr.1) 2018/19 (Yr.2) 2019/20 (Yr.3)	**for Gas Year 2020/21**
2016/17 (Yr.1) 2017/18 (Yr.2) 2018/19 (Yr.3)	**for Gas Year 2019/20**

Most recent data set available is 2019/20

Single Year Test

Examines **2019/20 (Yr.3)** against **2018/19 (Yr.2)** indicating extent of year on year change

Smoothed Model Test

Examines **2020/21 (Sm)** against **2019/20 (Sm)** indicating extent of year on year change

Tests used for assessing Volatility and Predictability

- The following explains the tests used to complete the review of Model Smoothing:

- Observe the differences between CWV intercepts visually by comparing the spread of the data using bin ranges

- Root Mean Squared (RMS); This is used to give the average value of the magnitude of differences in intercepts i.e. if the average was taken for:

  Single Year models = (2, -2, 2, -2) and

  Smoothed Models = (1, -1, 1, -1)

  The average for both sets of results would be 0, even though the single year model values are twice as big as the smoothed model values.

- The RMS allows us to appreciate that on average, the difference in intercepts for the single year models are twice as big as the smoothed models

Notes on Analysis

- All analysis throughout this presentation and accompanying document has been performed on the new CWV formula and Seasonal Normal basis implemented on 1st October 2020, as such, retrospective data is only available for gas year 2016/17 onwards.

- Due to insufficient data, new EUCs added to Bands 1 and 2 since Gas Year 2019/20 have not been included in the assessment. The traditional Band 1 Domestic EUC ("01BND") and Band 2 Non Domestic EUC ("02BNI") have been included

Volatility Analysis

Aim:

- To assess the level of year on year volatility of each model type (smoothed and single year) by comparing the differences between each year. This is achieved by using variations in the CWV intercepts and calculating the overall RMS values

Analysis:

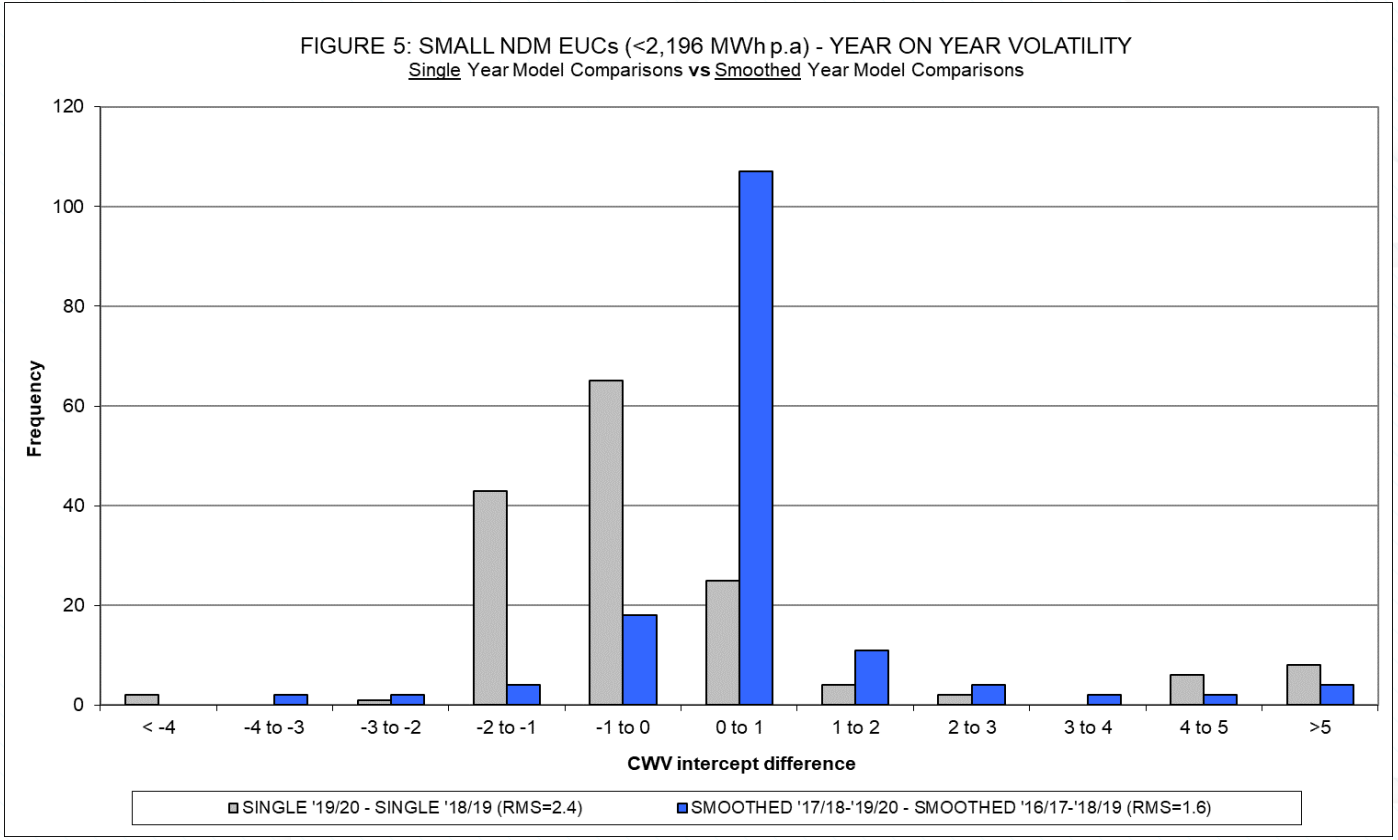
Smoothed model comparisons

Applicable smoothed model for **'20/21** (*based on '17/18, '18/19, '19/20*) compared to the applied smoothed model for **'19/20** (*based on* '16*/17, '17/18, '18/19*)

Single year model comparisons

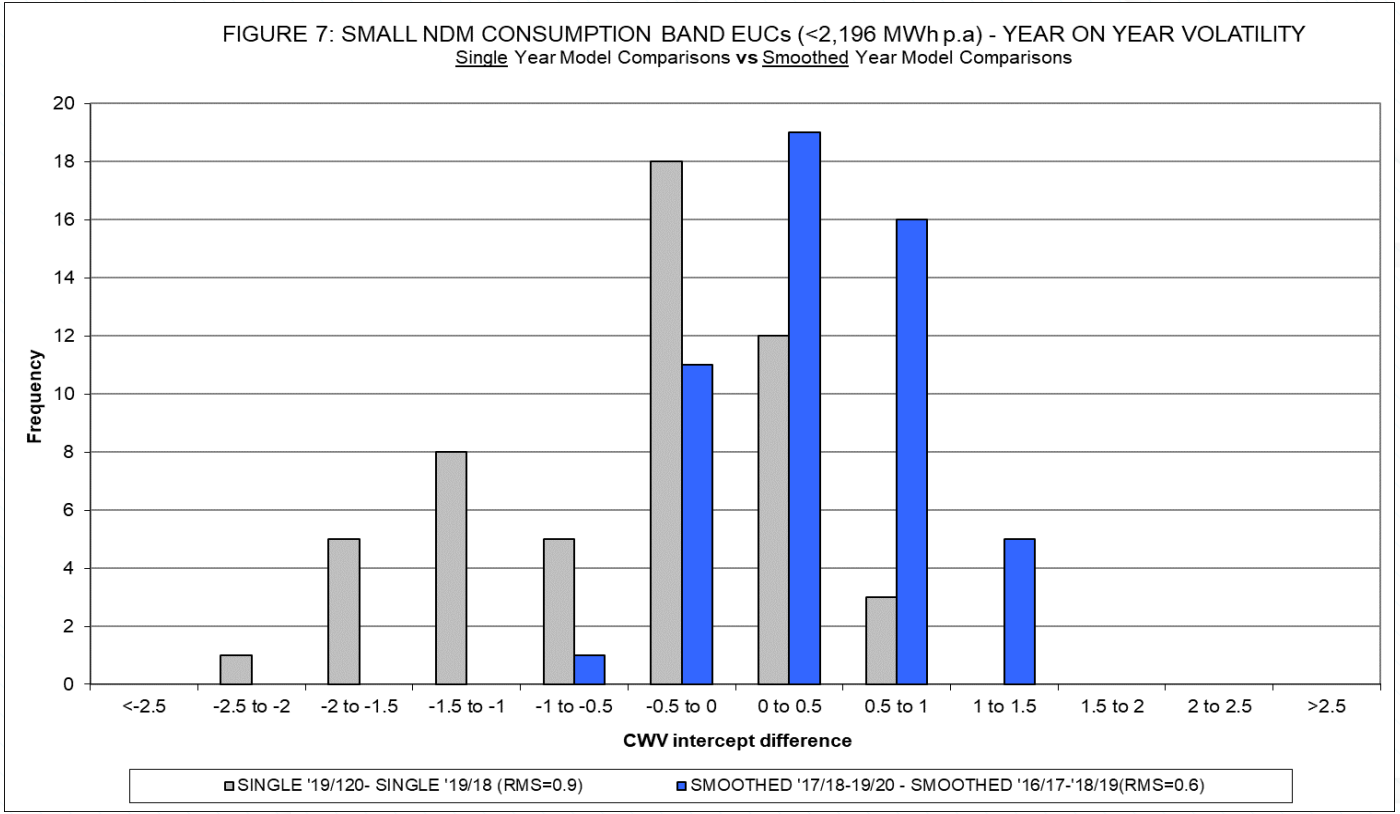
Single year model for **'19/20** (*that would have been applied to '20/21*) compared to the single year model for **'18/19** (*that would have been applied to '19/20*)

Volatility Analysis: Small NDM – All EUC Bands



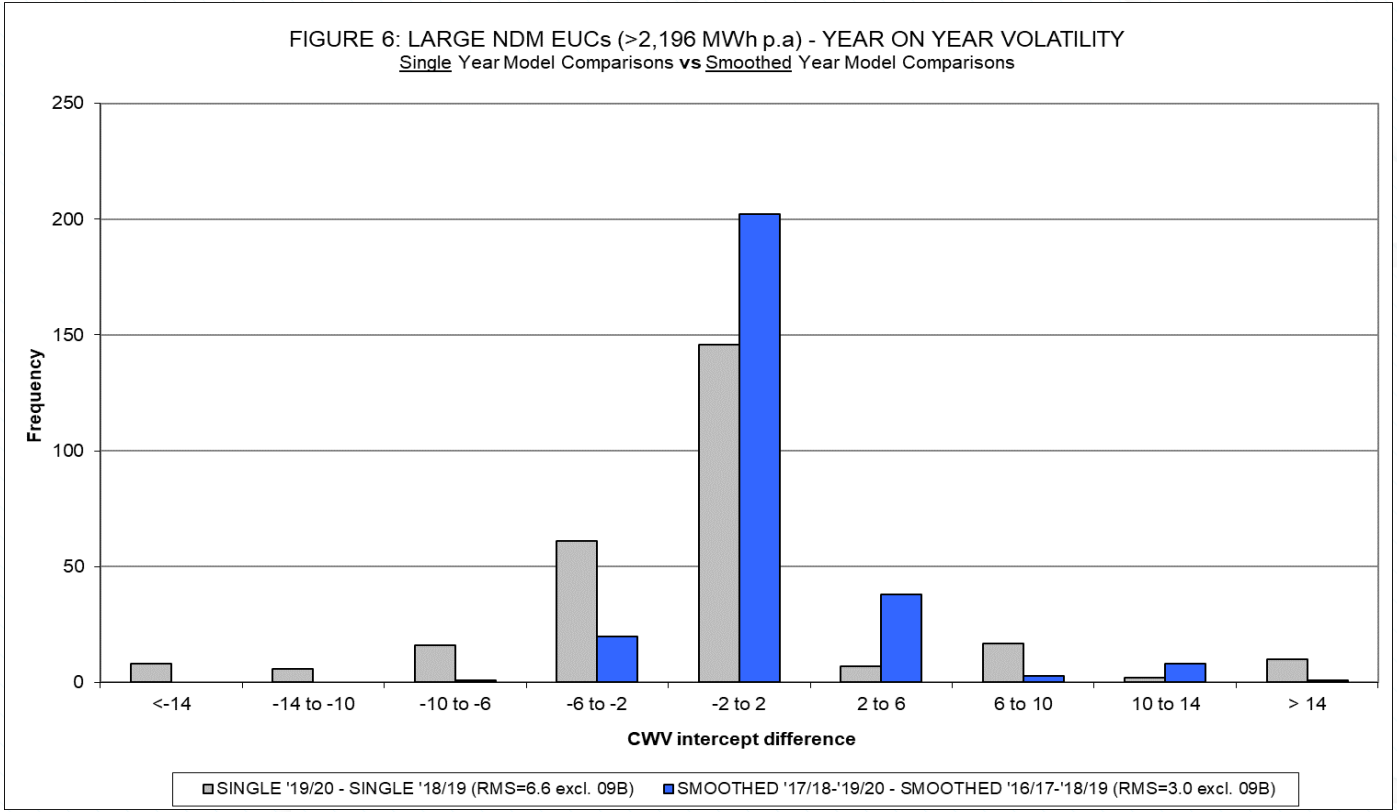
- 156 Small NDM EUCs assessed
- Smoothed model has smaller CWV intercept differences and a lower RMS value (2.4 vs 1.6) and so overall less volatility

Volatility Analysis: Small NDM – Consumption Bands



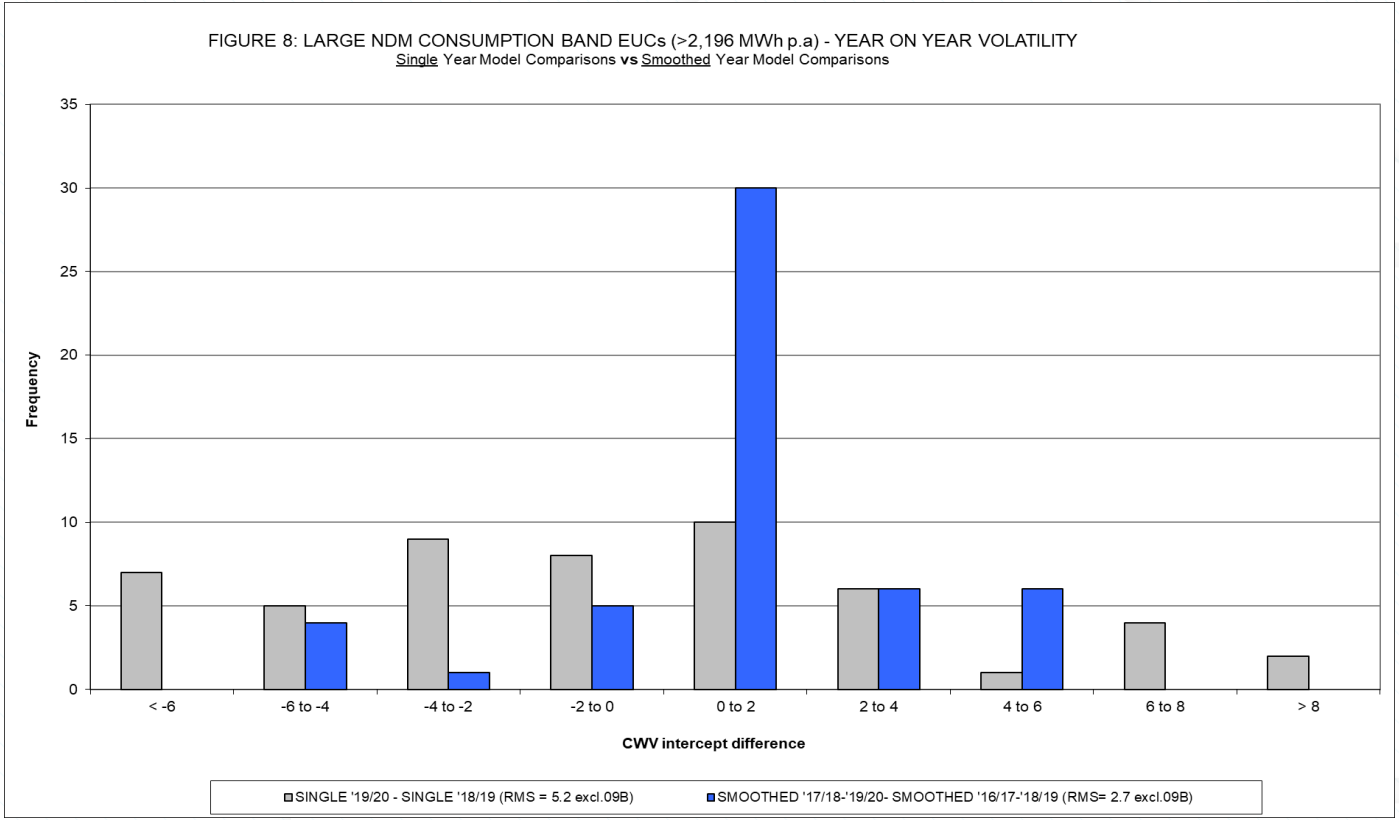
- 52 Small NDM Consumption bands assessed
- Smoothed model has smaller spread of CWV intercept differences and a slightly lower RMS value (0.9 vs 0.6)

Volatility Analysis: Large NDM – All EUC Bands



- 273 Large NDM EUCs assessed
- Smoother model clearly has smaller differences in CWV intercepts, and a lower RSM value (6.6 vs 3.0) and so overall less volatility

Volatility Analysis: Large NDM – Consumption Bands



- 52 Large NDM consumption bands assessed
- Smoothed model clearly has smaller CWV intercepts and lower RMS (5.2 vs 2.7) values and so overall less volatility

Model Smoothing Results: Volatility Assessment

- Analysis shows that the smoothed models for Large and Small NDM EUCs are associated with significantly lower year on year volatility, this is demonstrated by:
  - Generally narrower distribution of CWV intercept differences
  - Notably smaller values in the corresponding RMS values
- Further analysis has been performed to assess predictive ability

Model Smoothing: Assessment of Predictability

Single year data Sets

Smoothed model (Sm)

2017/18 (Yr.1)
2018/19 (Yr.2)
2019/20 (Yr.3)

for Gas Year 2020/21

Most Recent data set available is 2019/20

2016/17 (Yr.1)
2017/18 (Yr.2)
2018/19 (Yr.3)

for Gas Year 2019/20

Single Year Test

Examines **2019/20 (Yr.3)** against **2018/19 (Yr.2)** indicating year on year change

Smoothed Model Test

Examines **2019/20 (Yr.3)** against **2019/20 (Sm)** indicating year on year change

Analysis

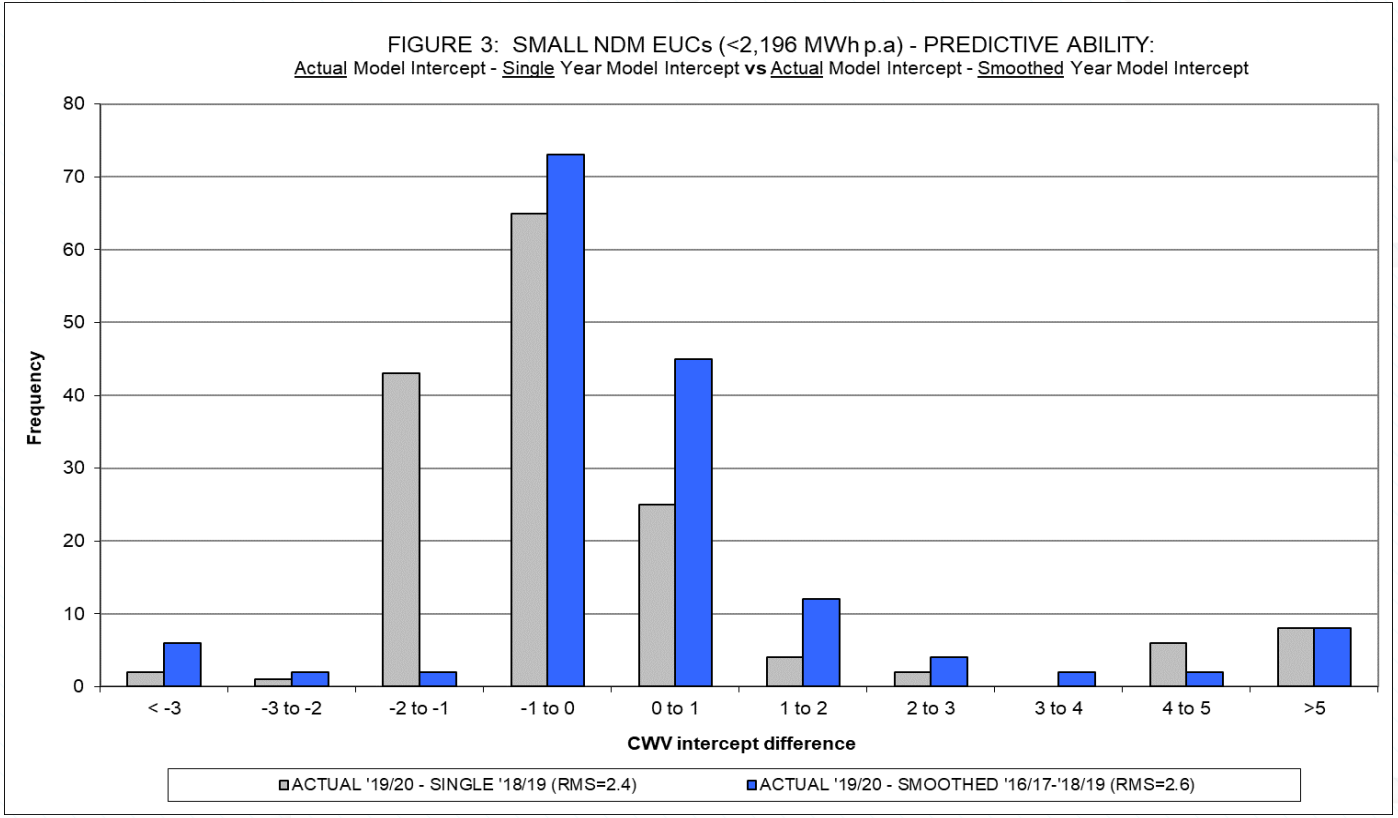
- Aim: To assess the predictive ability of each model type (smoothed and single year) by comparing the difference of the actual CWV intercept from the most recent data set (i.e. 2019/20) to the single year model and the smoothed model. This is achieved by using variations in the CWV intercepts and calculating the overall RMS values.

- Analysis:

- Smoothed model comparisons
  - Applicable smoothed model for **‘19/20** (based on ‘16/17, ‘17/18, and ’18/19) compared to the most recent data set for **’19/20**

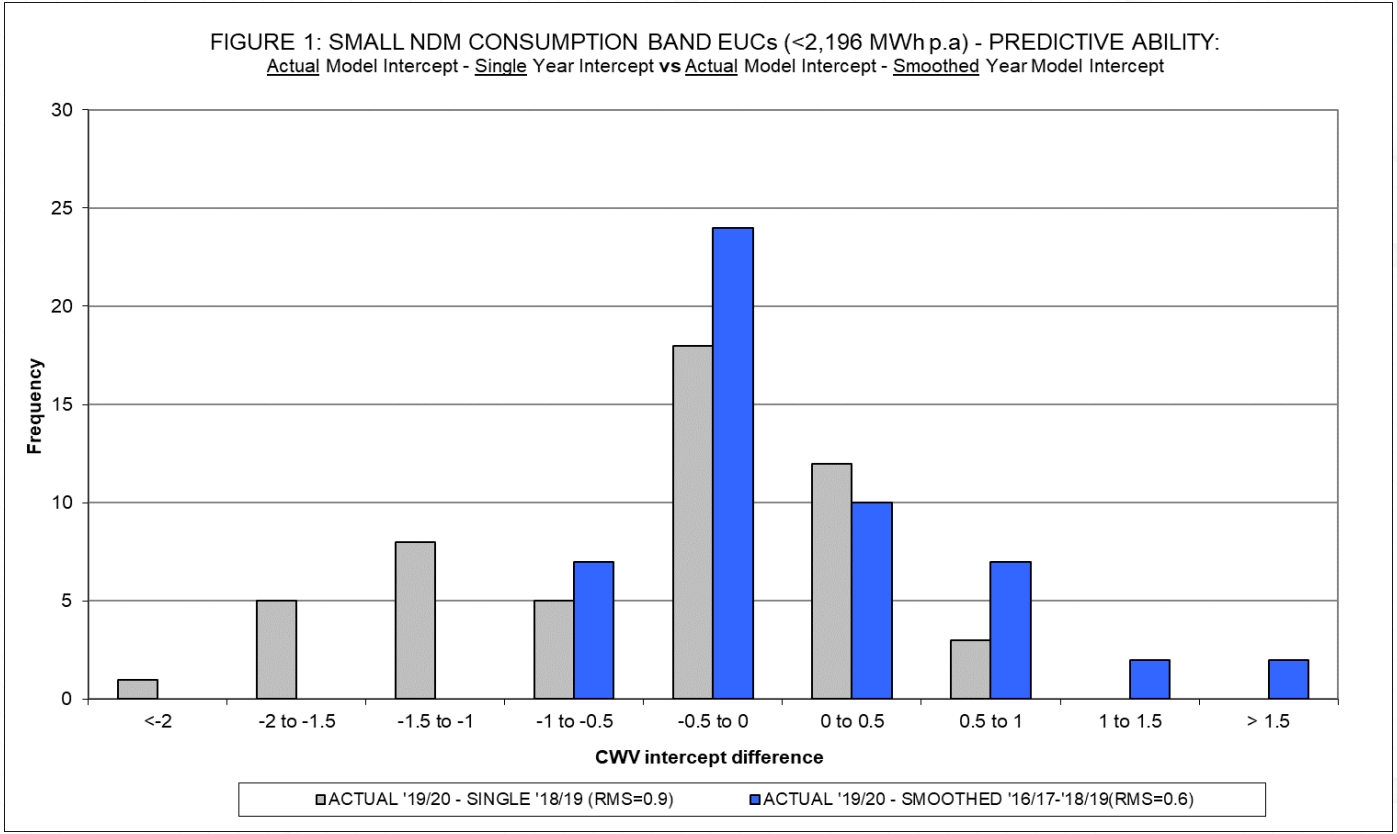
- Single year model comparisons
  - Single year model for **‘19/20** (That would have been applied to ‘20/21) compared to the most recent data set for **‘18/19**

Predictive ability: Small NDM – All EUC Bands



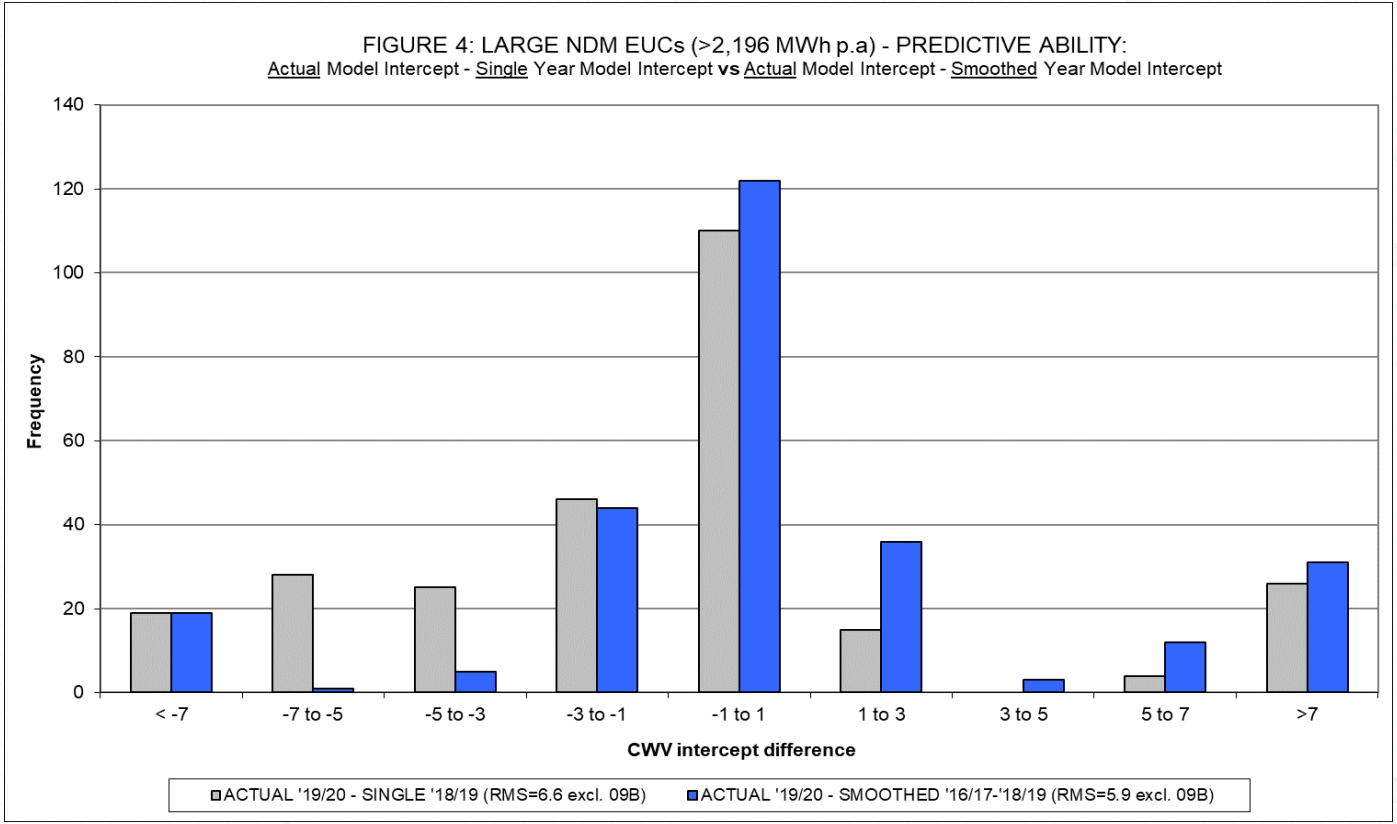
- 156 Small NDM EUCs assessed
- Smoothed model and single year models have a similar spread of CWV intercept differences.
- Smoothed model has a slightly higher RMS value (2.4 vs 2.6)

Predictive Ability: Small NDM – Consumption Bands



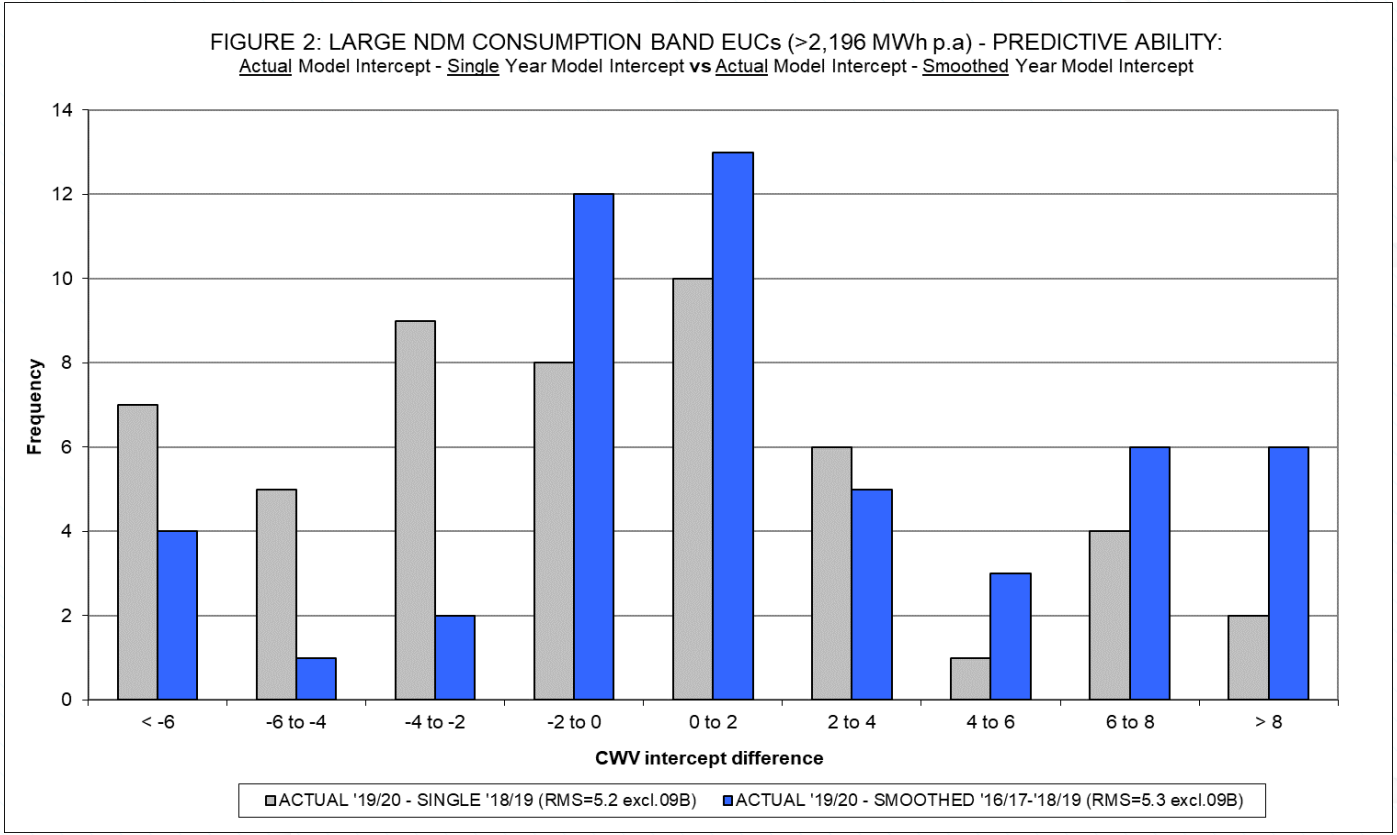
- 52 Small NDM consumption bands assessed
- Smoothed model and single year models have similar spreads, with the smoothed model being slightly more concentrated around 0
- Smoothed model has a slightly lower RMS (0.9 vs 0.6)

Predictive Ability: Large NDM – All EUC Bands



- 273 Large NDM EUCs assessed
- Smoothed model and single year models show a similar spread of CWV intercept differences.
- Smoothed model has a slightly lower RMS (6.6 vs 5.9)

Predictive Ability: Large NDM – Consumption Bands



- 52 Large NDM Consumption bands assessed
- Smoothed model and single year models have a similar spread of CWV intercept differences.
- Smoothed model has a slightly higher RMS (5.2 vs 5.3)

Model Smoothing results: Predictive Ability

- For Small NDM - whether analysing all EUCs or the consumption band EUCs – the smoothed model for 2019/20 showed a similar spread of CWV intercepts when compared to the single year model, which is also reflected in the respective RMS values, which have seen little movement either up or down between the compared models

- For Large NDM, the conclusion is similar to the Small NDM EUCs and consumption bands. The spread between the two data sets are similar. Despite the smoothed model for large consumption bands having a fractionally higher RMS value, when assessing all EUCs and consumption bands the smoothed model for 2019/20 shows a slightly better performance, which is reflected in the RMS value

- Overall, there is no strong evidence that either smoothed models or single year models are consistently better in terms of predictive ability

- The main driver for using a smoothed model is the mitigation of year on year volatility rather than predictive ability

Model Smoothing Results: CWV Intercept Trends (3Yr)

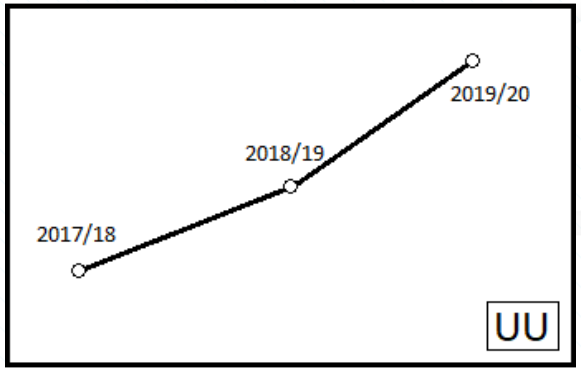
- Aim: To identify any trends occurring in CWV intercepts between each year. This is achieved by comparing trends in the CWV intercept year models constituting the ‘20/21 smoothed model

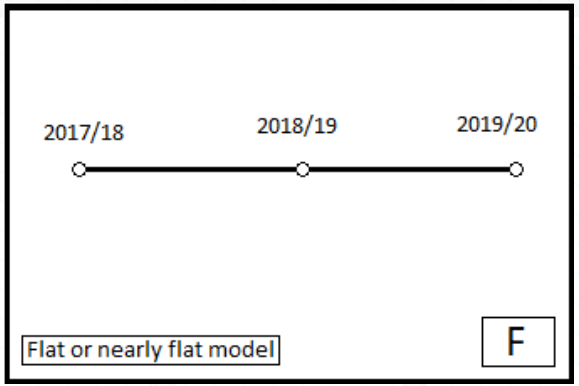
- Argument for single year models rather than smoothed models could be strengthened if there is evidence of any underlying trends

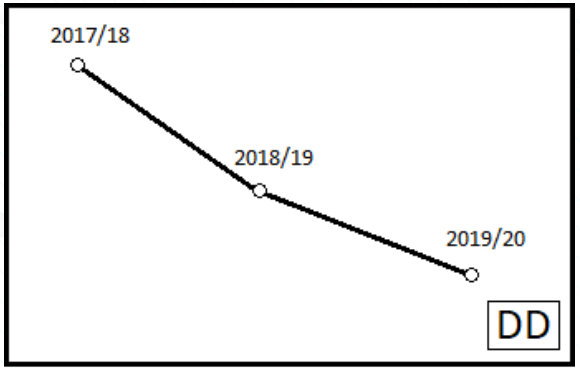
- Analysis:
  - CWV Intercepts for **‘17/18** Single Year Models
  - CWV Intercepts for **‘18/19** Single Year Models
  - CWV Intercepts for **‘19/20** Single Year Models

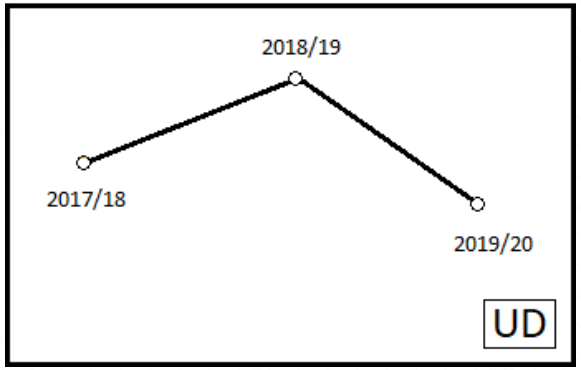
- 5 Possible outcomes when completing the analysis, summarised on next slide

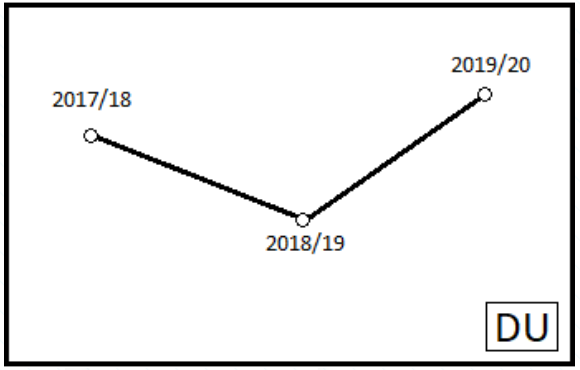
CWV Intercept Trends: 3-Year Possible Outcomes











CWV Intercept Trends: Results of Analysis – 3 Years

- Table summarises the Results for all EUCs for 3 years CWV Intercept patterns
- Results are performed on the new CWV Formula which includes Solar Radiation, as such the earliest modelled single year model available is 2016/17

Analysis Years	Type					Total	
	UU	UD	DU	DD	F		
2017/18, 2018/19, and 2019/20	35	193	87	75	39	429	Autumn 2020
2016/17, 2017/18, and 2018/19	163	155	59	13	39	429	Autumn 2019

- Predominant effect is that of no consistent pattern (“UD” and “DU”) – 214 in 2019, and 280 in 2020
- The number of “UU” results has fallen sharply from 163 in 2019 to 35 in 2020, whilst the number of “DD” results have risen from 13 to 75 respectively. The number of “F” results has remained constant
- For Individual EUC and LDZ details see Table 2 in accompanying document

Model Smoothing Results: CWV Intercept Trends (4Yr)

- Aim: To identify any trends occurring in CWV intercepts between each year. This is achieved by comparing trends in the CWV intercept values for the 4 single year models

- Analysis:
  - CWV Intercepts for **‘16/17** Single Year Model
  - CWV Intercepts for **‘17/18** Single Year Model
  - CWV Intercepts for **‘18/19** Single Year Model
  - CWV Intercepts for **‘19/20** Single Year Model

- Summarised possible outcomes as:
  - N - No consistent trend
  - D – Decreasing values
  - U – Increasing values
  - F – Flat or nearly flat models

CWV Intercept Trends: Results of Analysis - 4 Years

- Table summarises the results for all EUCs for 4 year CWV Intercept patterns
- Results are performed on the new CWV Formula which includes Solar Radiation, as such the earliest single year model available is 2016/17

Analysis Years	Type				Total
	N	D	U	F	
'16/17, '17/18, 18/19, and '19/20	362	6	22	39	429

- Examined over 4 years, the predominant effect is one of no consistent pattern across each LDZ and EUC Band/ WAR Band
- Over 4 years, only 6 EUCs showed a consistent downward trend, and only 22 showed a consistent upward trend, and 39 EUCs displayed a flat trend.
- For individual EUC and LDZ details see Table 3 in accompanying document

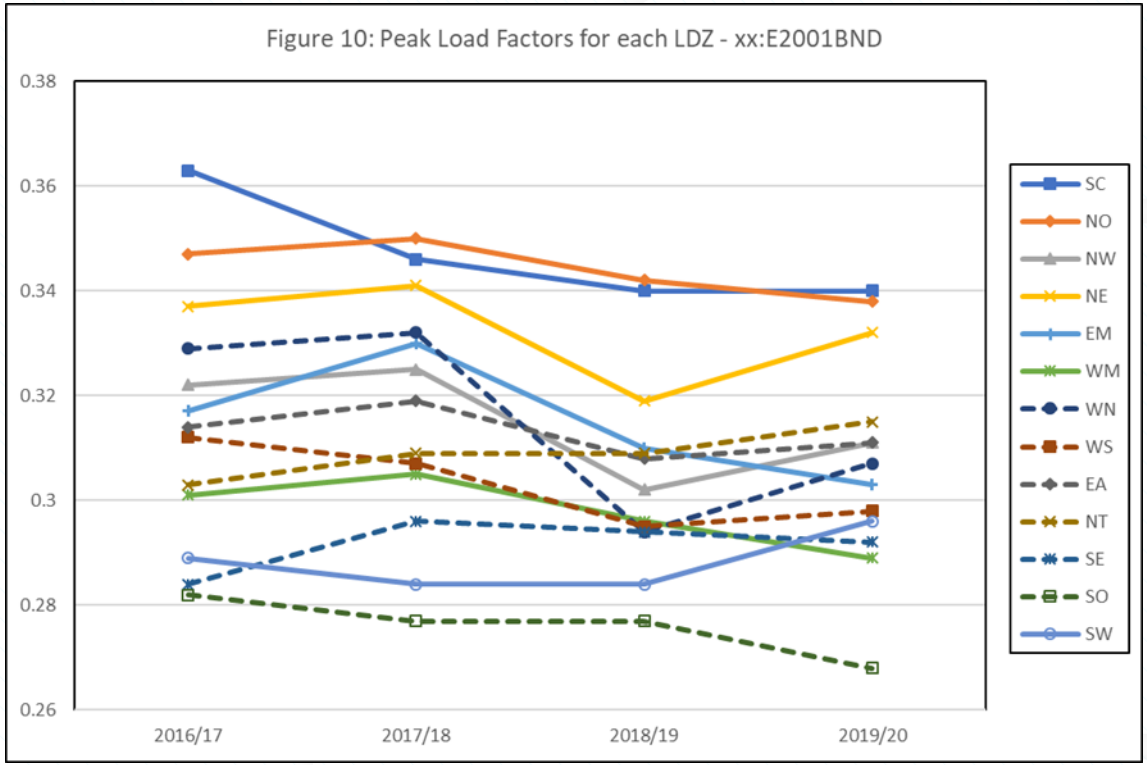
Model Smoothing Results: Peak Load Factor Trends

- Aim: To identify any trends occurring in the Peak Load Factors for the individual years models

- This is achieved by comparing the Peak Load Factor values for the 4 single year models (constituting the ‘20/21 smoothed model and the year prior to this) in graphical format

- Analysis:
  - Peak Load Factors for **‘16/17** based on Single Year Model
  - Peak Load Factors for **‘17/18** based on Single Year Model
  - Peak Load Factors for **‘18/19** based on Single Year Model
  - Peak Load Factors for **‘19/20** based on Single Year Model

Peak Load Factor Trends: Results of Analysis - 4 Years



- Graph shows the Peak Load Factors for the single year models for 01BND
- Examined over 4 years there is no obvious pattern across all LDZs. Generally movement in Peak Load Factors is mixed
- Over 4 years, 18 of 117 consumption bands EUCs showed an upwards trend in each of the 4 years, while there were 2 that showed a downward trend across the same 4 year period
- Figures 10 to 18 in the accompanying document provide Peak Load Factor values for all Consumption Band EUCs

Model Smoothing Review Conclusions

- Principles of Model Smoothing:
  - Reduce Year on Year Volatility
  - Not necessarily to improve model prediction
  - Necessary to review and assess if emerging trends are identified
- Current analysis consistent with results from previous analysis
  - Model Smoothing does reduce year on year volatility overall
  - No strong evidence that the predictive ability is consistently better
  - No strong evidence of consistent trends across CWV intercepts or Peak Load Factors
- The continued use of a Model Smoothing methodology provides DESC with flexibility in terms of (i) how many years to use and (ii) weightings to associate to them in the production of Demand Models, particularly useful when reviewing an analysis year which contains untypical demand reactions/levels - such as this year with the expected COVID-19 pandemic impacts

Recommendations

- Results indicate current methodology of using model smoothing over 3 years is appropriate and fit for purpose

- Are DESC happy to continue with 3 year model smoothing for the Spring 2021* and Spring 2022 analysis? Next review Autumn 2022?

    - Pending DESC TWG's review of the modelling results from this year's sample data for the period April 2020 to March 2021, there may be a decision to be made about the use of the latest year in Model Smoothing - this is discussed further in the Modelling Approach agenda item