



delivered by  correla

# Demand Estimation Sub Committee

## 5.1 Model Smoothing Review

19 December 23

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- Background, Timetable and Objectives
- Approach
- Analysis
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  - Predictive Ability Analysis
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- Conclusion

# Demand Estimation Cycle



- An overview of the Demand Estimation process and output can be found [here](#)
- Annual modelling cycle of activities are represented in diagram opposite
- This presentation relates to the Model Review phase of the Demand Model cycle

# Background

- Model Smoothing effectively means the averaging of [x] number of years of demand models to produce an overall 'Smoothed' demand model
- Model Smoothing is currently carried out over 3 years of input data for Demand Modelling, with the main aim of reducing any Volatility and providing greater stability to the models and subsequent gas demand profiles (i.e. ALPs, DAFs and PLFs)
- Volatility can be caused by either unusual behaviours due to abnormal events (such as a prolonged period of high temperatures) or EUC models that contain fewer sample points and can therefore be more susceptible to year-on-year movement
- It is currently a requirement of DESC to review the Model Smoothing approach every 2 to 3 years
- The last review was carried out as part of the 2020/21 ad hoc workplan

# CDSP / DESC Obligations and Timetable: October 2022 to September 2023

Milestone	UNC H Ref	2023			2024								
		Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
DESC Membership confirmed	1.12	✓		✓									
NDM Sampling: Data Collection and Validation	1.6	✓						✓					
NDM Algorithm Performance for Gas Year 2022/23	1.8			✓								✓	
DESC Adhoc Workplan	1.7	✓		✓			✓				✓		
DESC Modelling Approach – EUCs and Demand Models	1.7			✓			✓						
Single Year EUC Demand Modelling	1.7								✓				
Model Smoothing and Draft Gas Demand Profiles	1.7									✓			
Industry Consultation	1.8									✓	✓		
Gas Demand Profiles finalised and Core systems updated	1.9											✓	
Seasonal Normal Review 2025	1.4	✓		✓			✓		✓		✓		

# Objectives

- The primary objective is to assess whether the current model smoothing approach continues to reduce Volatility in the Demand Model and subsequent Gas Demand profiles year on year
- In addition, Predictability and Trend analysis will also be considered

Model Smoothing Review

# APPROACH

# Approach

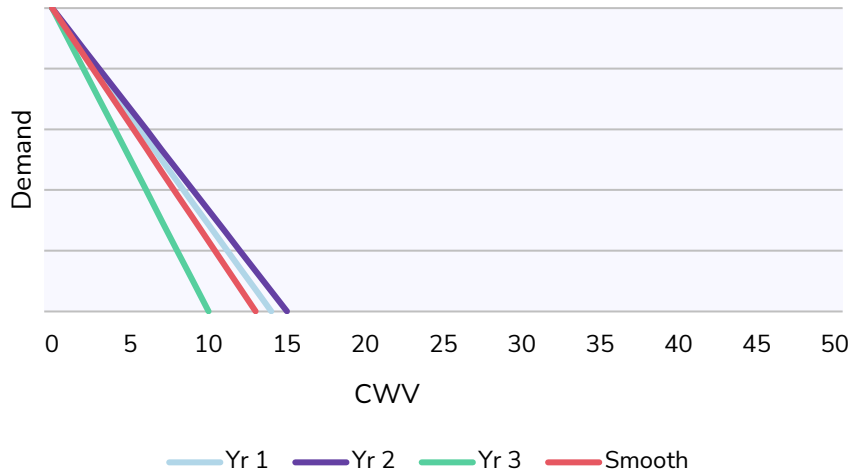
- CWV Intercepts give the weather sensitivity of the model and were compared for different Single Year and Smoothed models
- For assessing Volatility and Predictability, we observed the differences between CWV intercepts visually by comparing the spread of the data using bin ranges
- For assessing the magnitude of the differences, we compared the Root Mean Squared (RMS) of the intercepts
- For assessing Trends, we compared the movement in CWV intercepts between each single year



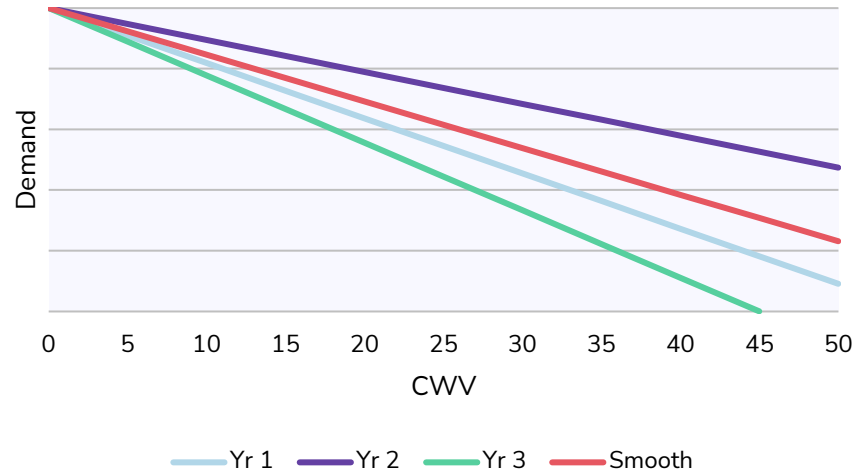
# Model Smoothing – CWV Intercepts

- The CWV Intercept is the value at which the demand line crosses the x axis
- Lower CWV Intercepts reflect higher weather sensitivity, higher CWV Intercepts reflect a less weather sensitive model
- Section 6 of the NDM Algorithms Booklet contains more information about CWV intercepts

Example of CWV Intercepts (Domestic - 01BND  
- High weather sensitivity)



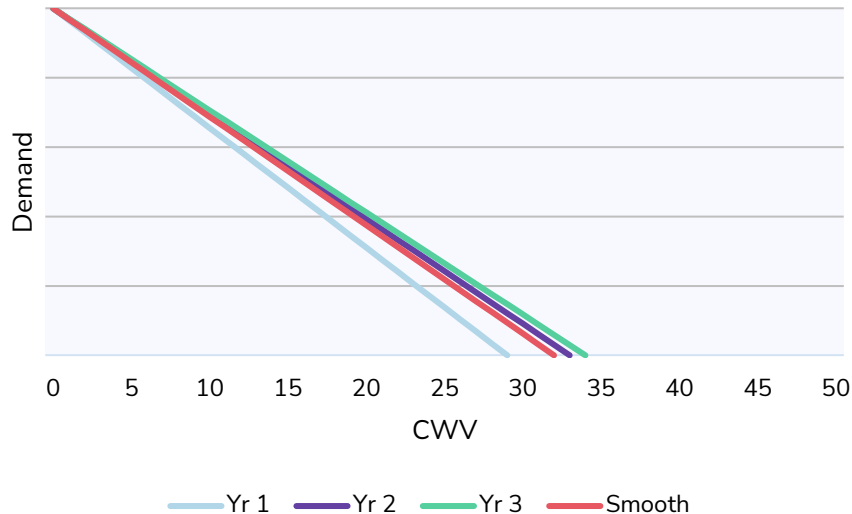
Example of CWV Intercepts (I&C - EUC 08W02 -  
Low weather sensitivity)



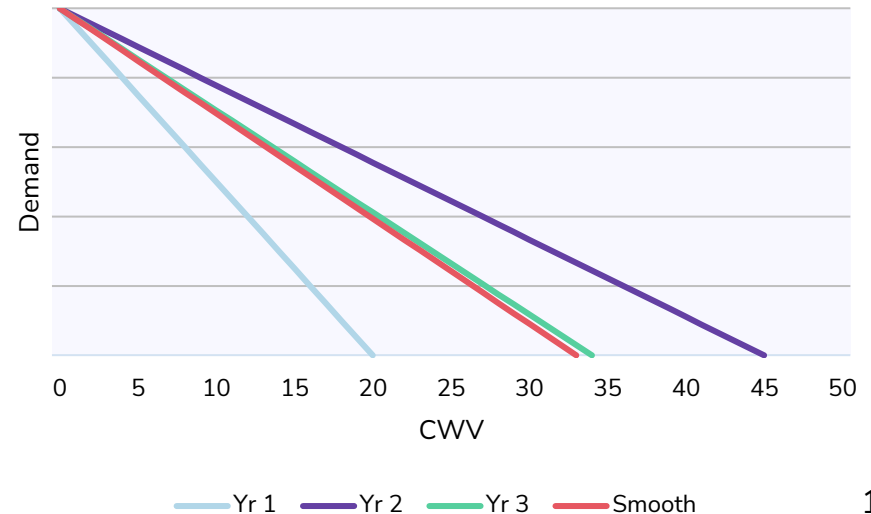
# Model Smoothing – CWV Intercepts

- The two sets of CWV Intercepts below show a similar Smoothed CWV Intercept
- The one on the left has a similar intercept for the Smoothed Model and the individual years, indicating low Volatility
- The chart on the right has a much wider range of CWV Intercepts, indicating more Volatility across the 3 individual years

Example of CWV Intercepts (Low Volatility)



Example of CWV Intercepts (High Volatility)



Model Smoothing Review

# ANALYSIS

# Analysis

- Summary of EUCs Used
  - Small NDM EUCs
  - Large NDM EUCs
- CWV Intercept Analysis
  - Volatility Analysis
  - Predictability Analysis
- Trend Analysis
  - CWV Intercept Trend Analysis
  - Peak Load Factors Trend Analysis

# Analysis – Small NDM EUCs

- There are 78 EUCs in the Small NDM analysis, 13 LDZs for each of 01BND, 01BNI, 02BND, 02BNI, 03B and 04B
- Analysis is not possible at present for the Prepayment EUCs (01BPD, 01BPI, 02BPD and 02BPI)
  - 01BPD modelling used MOD451AV data (from 2012/13), until Gas Year 2021/22 when Class 3 data was introduced, Model Smoothing for 3 years of class 3 data will be from 2023/24
  - The meter count is insufficient for modelling 01BPI, 02BPD and 02BPI
- Due to changes in the modelling grouping for WAR Bands, these have not been included in the slide pack, a summary is in the accompanying document

# Analysis – Large NDM EUCs

- There are 52 EUCs in the Large NDM analysis, 13s LDZ for each of 05B, 06B, 07B and 08B
- Due to changes in the modelling grouping for WAR Bands, these have not been included in the slide pack, a summary is in the accompanying document
- Band 9 EUCs have been excluded as they are not modelled

Model Smoothing Review

# **VOLATILITY ANALYSIS**

# Volatility Analysis - Datasets

Single Year Datasets			Smoothed Model
Year	01BND*	All other EUCs	
Year 1	2020/21	2019/20	} For Gas Year 2023/24
<b>Year 2</b>	2021/22	2021/22	
<b>Year 3</b>	2022/23	2022/23	
Year 1	2019/20	2018/19	} For Gas Year 2022/23
Year 2	2020/21	2019/20	
Year 3	2021/22	2021/22	

\*DESC agreed in 2021 that due to the impact of COVID-19 lockdowns on the sample, only 01BND would use the data for 2020/21

## Single Year Test

Examines Year 3 (2022/23) against Year 2 (2021/22) for Gas Year 2023/24 indicating the extent of the year-on-year change

## Smoothed Model Test

Examines Smoothed Model for Gas Year 2023/24 against the Smoothed Model for Gas Year 2022/23 indicating the extent of the year-on-year change



# Volatility Analysis

## Aim

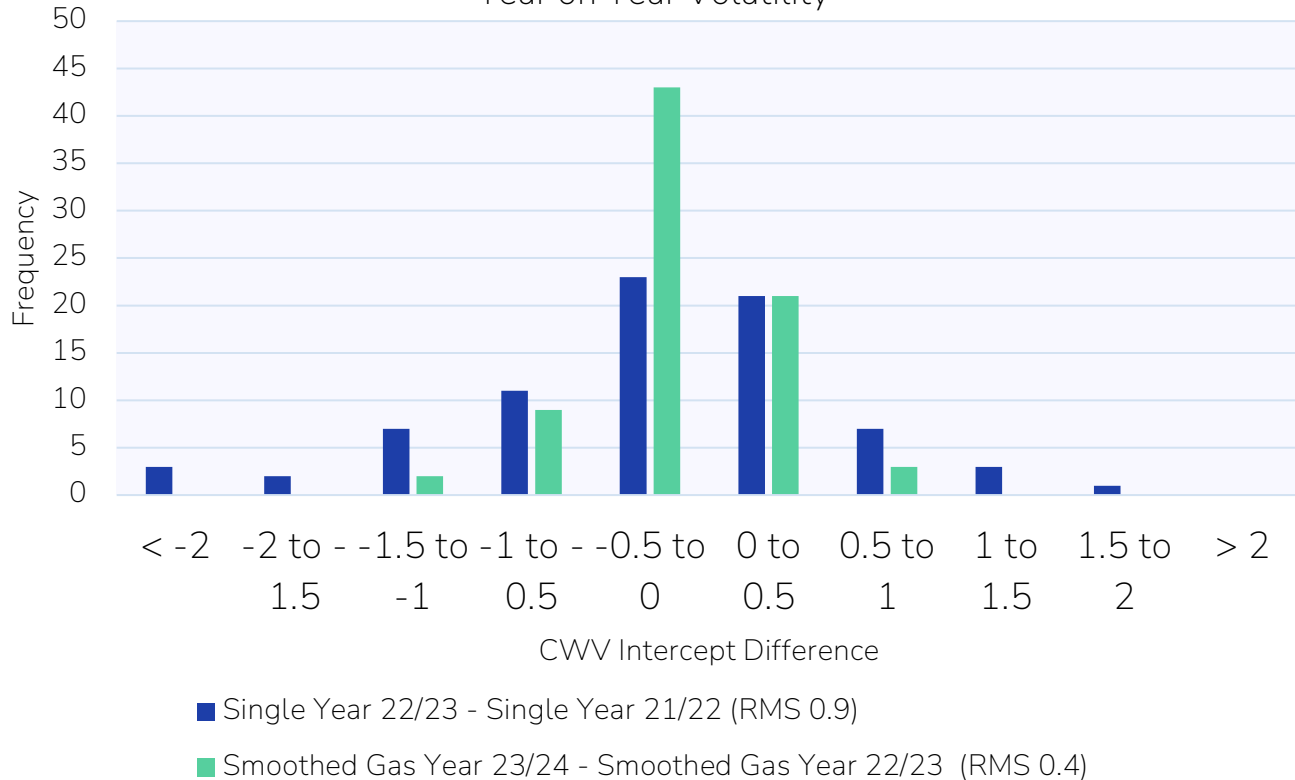
- To assess the level of year-on-year volatility of each model type (Smoothed and Single Year) by comparing the differences between each year
- This is achieved by using variations in the CWV intercepts and calculating the overall RMS values

## Analysis

- Smoothed Model Comparisons
  - Comparison of the CWV intercepts for the Smoothed Models for Gas Year 22/23 and Gas Year 23/24
- Single Year Model Comparisons
  - Comparison of the CWV intercepts for the Single Year Models for Analysis Year 21/22 and Analysis Year 22/23
- Range is used in conjunctions with the RMS to indicate the spread of values
  - Range is the difference between the highest and lowest CWV Intercept comparison values

# Volatility Analysis – Small NDM

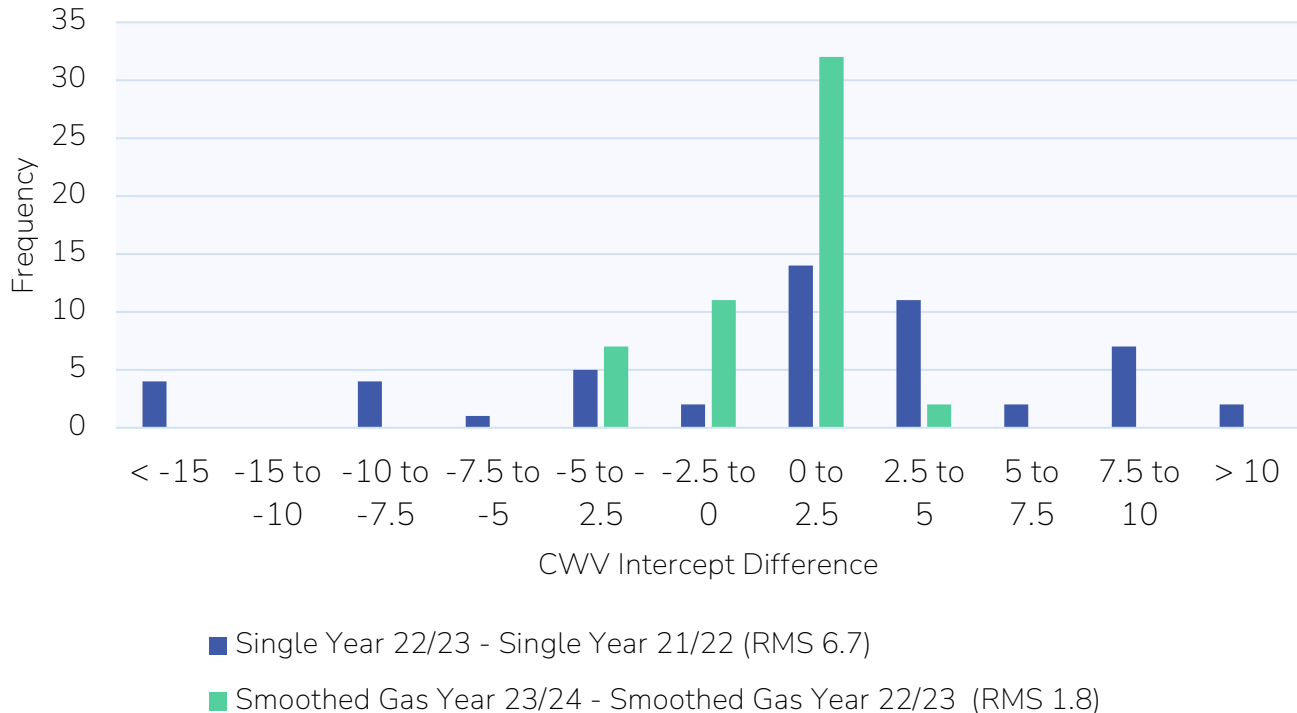
Small NDM Consumption Bands (Bands 1-4, <2,196 MWh p.a.)  
- Year on Year Volatility



- Analysis compared the CWV Intercepts for 78 Small NDM EUCs
- The Smoothed Model comparison has a smaller Range (2.2) of CWV Intercept Differences to the Single Year comparison (4.9)
- The Smoothed Model comparison also has a lower RMS value of 0.4 compared to 0.9
- The Smoothed Model is less volatile for Small NDM EUCs

# Volatility Analysis – Large NDM

Large NDM Consumption Bands (Bands 5-8, between 2,196 and 58,600 MWh p.a.)  
- Year on Year Volatility



- Analysis compared the CWV Intercepts for 52 Large NDM EUCs
- The Smoothed Model comparison has a smaller range of CWV Intercepts to the Single Year comparison (7.4 vs 25.6)
- The Smoothed Model comparison also has a lower RMS value of 1.8 compared to 6.7
- The Smoothed Model is less volatile for Large NDM EUCs

Model Smoothing Review

# PREDICTABILITY ANALYSIS

# Predictability Analysis - Datasets

Single Year Datasets			Smoothed Model
Year	01BND*	All other EUCs	
Year 1	2020/21	2019/20	} For Gas Year 2023/24
<b>Year 2</b>	2021/22	2021/22	
<b>Year 3</b>	2022/23	2022/23	
Year 1	2019/20	2018/19	} For Gas Year 2022/23
Year 2	2020/21	2019/20	
Year 3	2021/22	2021/22	

\*DESC agreed in 2021 that due to the impact of COVID-19 lockdowns on the sample, only 01BND would use the data for 2020/21

## Single Year Test

Examines Year 3 (2022/23) against Year 2 (2021/22) for Gas Year 2023/24 indicating the year-on-year change

## Smoothed Model Test

Examines Year 3 (2022/23) against the Smoothed Model for Gas Year 2022/23 indicating the difference between the latest Single Year and the Smoothed Model

# Predictability Analysis

## Aim

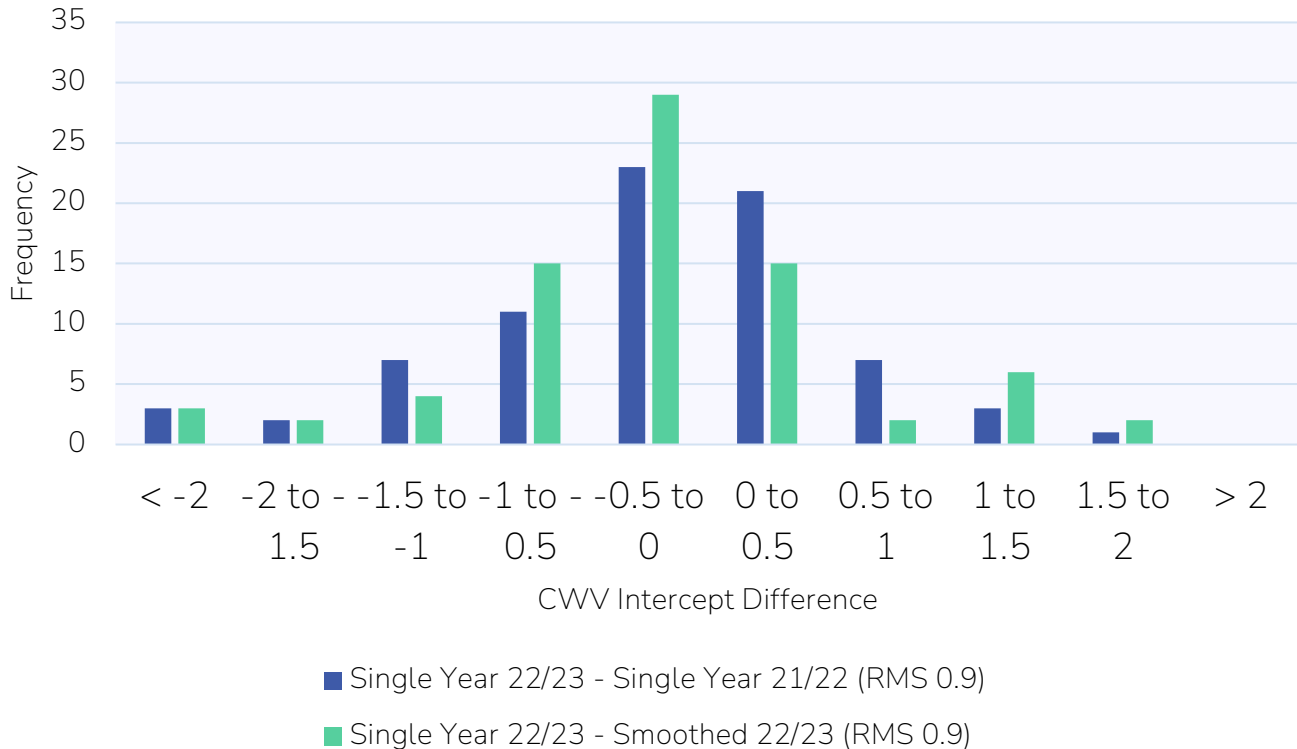
- To assess the predictive ability of each model type (Smoothed and Single Year) by comparing the difference of the actual CWV intercept from the most recent data set (i.e. 2022/23) to the Single Year Model and the Smoothed Model
- This is achieved by using variations in the CWV intercepts and calculating the overall RMS values

## Analysis

- Smoothed Model Comparisons
  - Comparison of the CWV intercepts for the Single Year Model for Gas Year 22/23 and the Smoothed Model for Gas Year 22/23
- Single Year Model Comparisons
  - Comparison of the CWV intercepts for the Single Year Model for Analysis Year 21/22 and Analysis Year 22/23

# Predictability Analysis – Small NDM

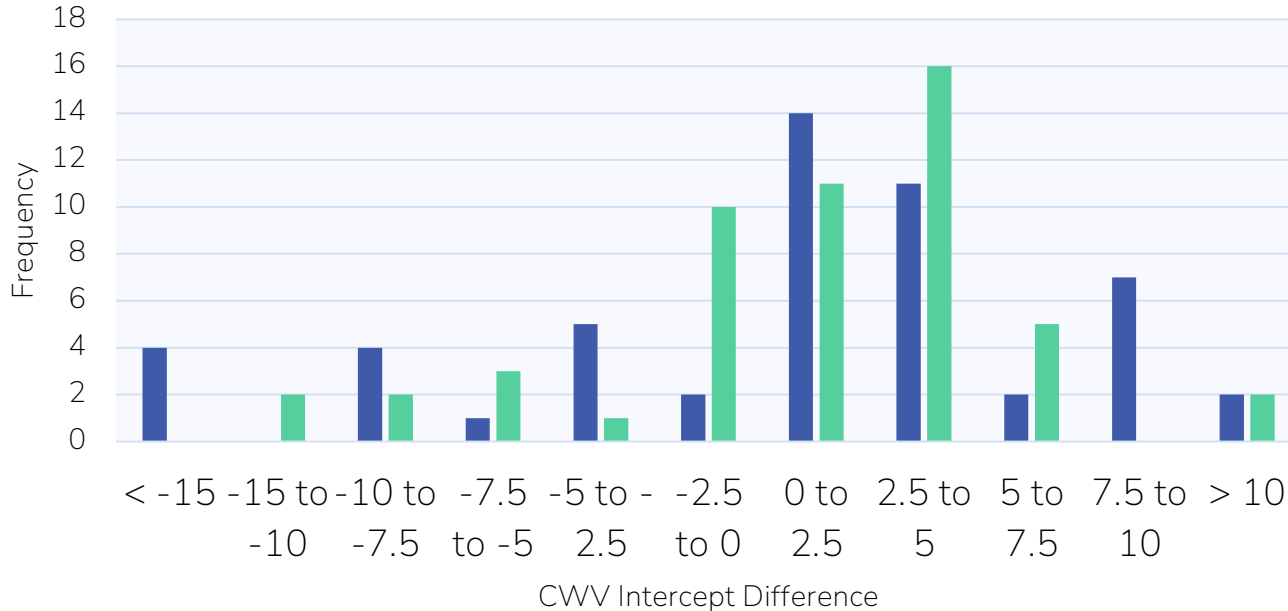
Small NDM Consumption Bands (Bands 1-4, <2,196 MWh p.a.) -  
Predictive Ability



- Analysis compared the CWV Intercepts for 78 Small NDM EUCs
- The Single Year comparison has a similar Range to the Single Year / Smoothed Model comparison
- Both comparisons have the same RMS (0.9)
- The Smoothed Model has the same predictability as the Single Year Model for Small NDM EUCs

# Predictability Analysis – Large NDM

Large NDM Consumption Bands (Bands 5-8, between 2,196 and 58,600 MWh p.a.) - Predictive Ability



- Single Year 22/23 - Single Year 21/22 (RMS 6.7)
- Single Year 22/23 - Smoothed 22/23 (RMS 5.5)

- Analysis compared the CWV Intercepts for 52 Large NDM EUCs
- The Single Year comparison has a slightly smaller range compared to the Single Year / Smoothed Model comparison (25.6 vs 26.9)
- The Single Year to Smoothed Model comparison has a smaller RMS (5.5 vs 6.7)
- The Smoothed Model is more predictive for Large NDM EUCs



Model Smoothing Review

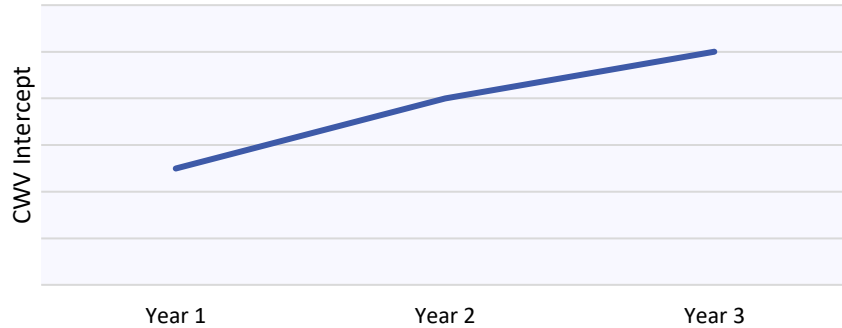
# TREND ANALYSIS

# Trend Analysis – CWV Intercept

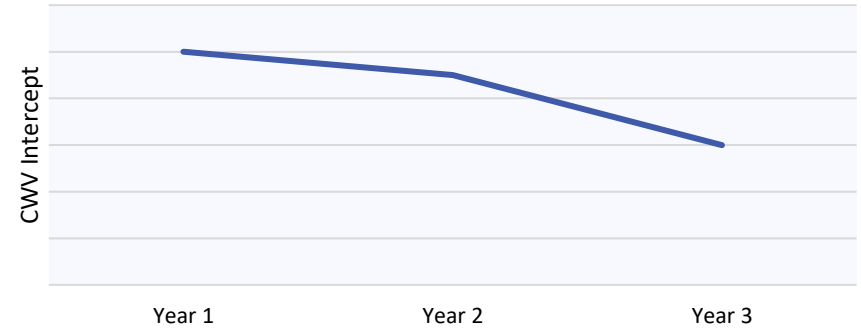
- This Trend Analysis looks at the change in CWV intercept over time
- Trend analysis is used to help determine if smoothing using averaging or model extrapolation is a more predictive methodology
- Current Smoothing methodology uses an average method over 3 year (weighted 33%, 33%, 34%)
- There are 4 possible trends in the analysis (graphically illustrated on the following slide)
  - Upward trend, the CWV intercept increases year-on-year
  - Downward trend, the CWV intercept decreases year-on-year
  - Unchanged, the CWV changes very little year-on-year (within 2%)
  - Mixed, CWV intercept movements are a mix of up and down

# Trend Analysis – CWV Intercept - Possible Outcomes

## Upward Trend



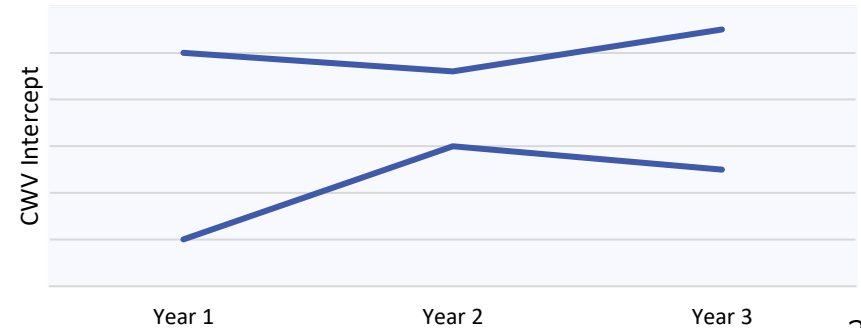
## Downward Trend



## Unchanged



## Mixed (2 examples)



# Trend Analysis – CWV Intercept – EUC Counts

The tables below show an EUC count for the 4 different CWV Intercept trends

- Pre-payment meter EUCs have been excluded as they are either not modelled (I&C), or do not have enough years in the data to calculate a trend (Domestic)
- Band 9 EUCs are also excluded, however for this analysis the WAR Bands have been included

Trend	Consumption Band EUCs	
	2022 Count	2023 Count
Down	19	21
Mixed	83	70
Unchanged	6	9
Up	22	30
<b>Total</b>	<b>130</b>	<b>130</b>

Trend	All EUCs	
	2022 Count	2023 Count
Down	84	89
Mixed	258	212
Unchanged	52	54
Up	48	87
<b>Total</b>	<b>442</b>	<b>442</b>

# Trend Analysis – CWV Intercept – LDZ Breakdown

- The majority of the models show no trend, with the year-on-year movements either mixed or unchanged
- Breaking this down into LDZ, none of the EUCs or LDZ show a consistent trend

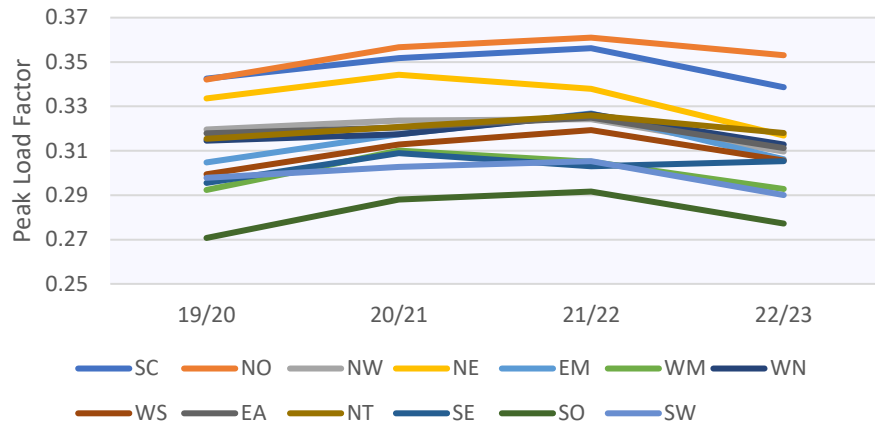
	EA	EM	NE	NO	NT	NW	SC	SE	SO	SW	WM	WN	WS
01BND	Unch'd	Down	Down	Mixed	Unch'd	Down	Down	Mixed	Down	Down	Mixed	Unch'd	Unch'd
01BNI	Mixed	Mixed	Down	Mixed	Mixed	Down	Mixed	Mixed	Mixed	Down	Unch'd	Mixed	Mixed
02BND	Mixed	Down	Down	Mixed	Up	Down	Down	Mixed	Mixed	Mixed	Down	Down	Up
02BNI	Down	Down	Down	Unch'd	Down	Up	Mixed	Mixed	Down	Mixed	Mixed	Mixed	Mixed
03B	Up	Mixed	Mixed	Up	Unch'd	Up	Up	Up	Up	Mixed	Mixed	Mixed	Mixed
04B	Mixed	Mixed	Unch'd	Up	Mixed	Mixed	Up	Mixed	Up	Up	Mixed	Mixed	Mixed
05B	Unch'd	Up	Mixed	Up	Mixed	Mixed	Mixed	Up	Up	Mixed	Mixed	Mixed	Up
06B	Mixed	Mixed	Up	Mixed	Mixed	Up	Up	Mixed	Down	Up	Mixed	Up	Up
07B	Mixed	Mixed	Mixed	Mixed	Mixed	Up	Mixed	Mixed	Mixed	Mixed	Up	Up	Mixed
08B	Mixed	Mixed	Mixed	Mixed	Mixed	Up	Mixed	Mixed	Mixed	Mixed	Up	Up	Mixed

# Trend Analysis – Peak Load Factors

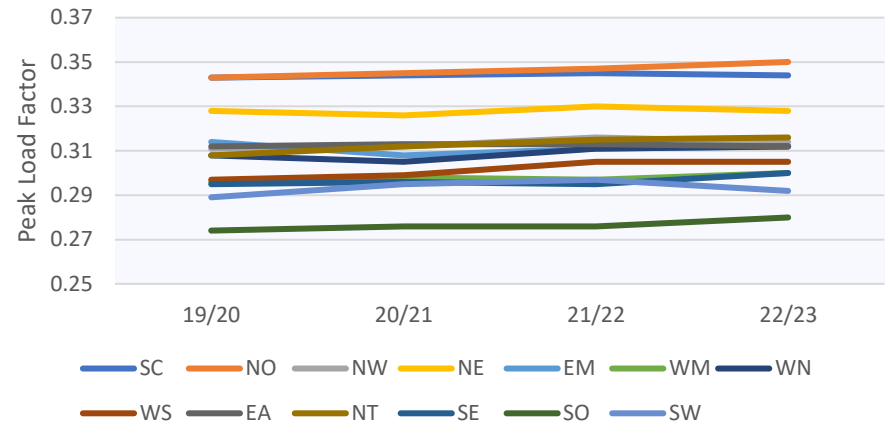
- This Trend Analysis looks at the change in Peak Load Factors, comparing the year-on year movement for Single Year Models vs Smoothed Models
- Full Consumption Band Analysis is available in the accompanying document, some key EUCs are included in these slides

# Trend Analysis – Peak Load Factors – 01BND

01BND Single Year Load Factors



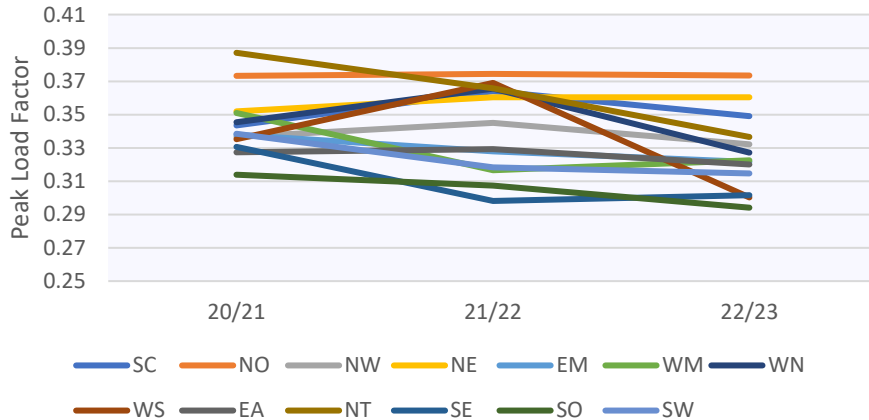
01BND Smoothed Load Factors



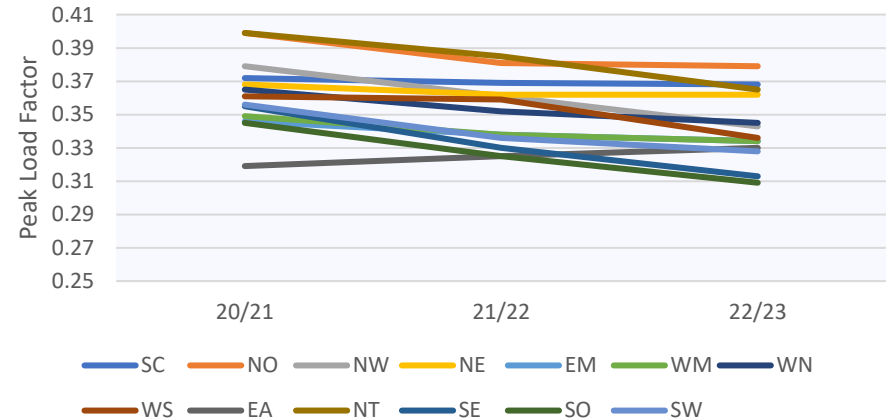
- Two LDZs are showing a trend over the past 3 years (NE and WM, both down on the previous year)
- There is no clear trend in the Single Year values for the other LDZs and the Smoothed factors are much less volatile
- For the two LDZs showing a trend, the movement for the previous year (19/20 to 20/21) was against the trend

# Trend Analysis – Peak Load Factors – 02BNI

02BNI Single Year Load Factors



02BNI Smoothed Load Factors

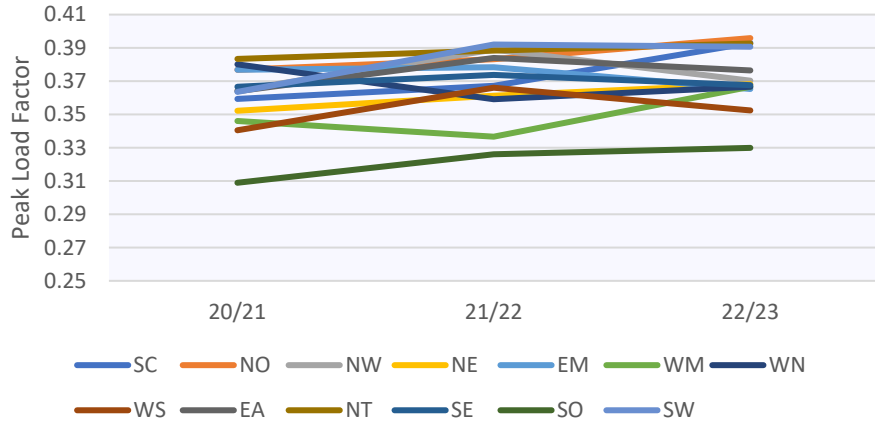


- Models were not re-run for 20/21 due to the impact of Covid 19 on the sample, therefore only the last 3 years are included in the charts (as 20/21 values are almost identical to 19/20)
- 4 LDZs (EM, NT, SO and SW) are showing a trend in the single year values (all down on the previous year), with the rest of the results mixed
- There is no clear trend across all LDZs

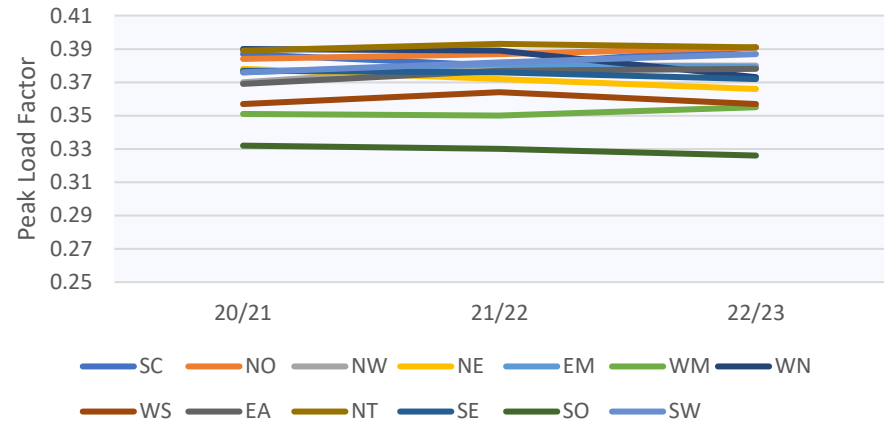


# Trend Analysis – Peak Load Factors – 04B

04B Single Year Load Factors



04B Smoothed Load Factors



- Models were not re-run for 20/21 due to the impact of Covid 19 on the sample, therefore only the last 3 years are included in the charts (as 20/21 values are almost identical to 19/20)
- 5 LDZs (SC, NO, NE, NT and SO) are showing a trend over the 3 years (all increasing year-on-year), with the others showing mixed year-on-year movements
- There is no clear trend across all LDZs

# Conclusion

- Based on these and previous results, the current 3-year model smoothing is deemed to be appropriate and fit for purpose due to:
  - clear reduction of year-on-year Volatility
  - no degradation in model Predictability
  - no evidence of Trends being missed
- Please see the accompanying 5.1 Model Smoothing Review Supporting Document for the full results, available [here](#)
- The recommendation of the Demand Estimation team of the CDSP is to continue with the current model smoothing methodology
- DESC May wish to consider reviewing on an ad hoc basis rather than the current 2-to-3-year review cycle