Demand Estimation Sub Committee

3.0 Gas Demand EUC Modelling Results
(1 of 3) Introduction
22 May 2024

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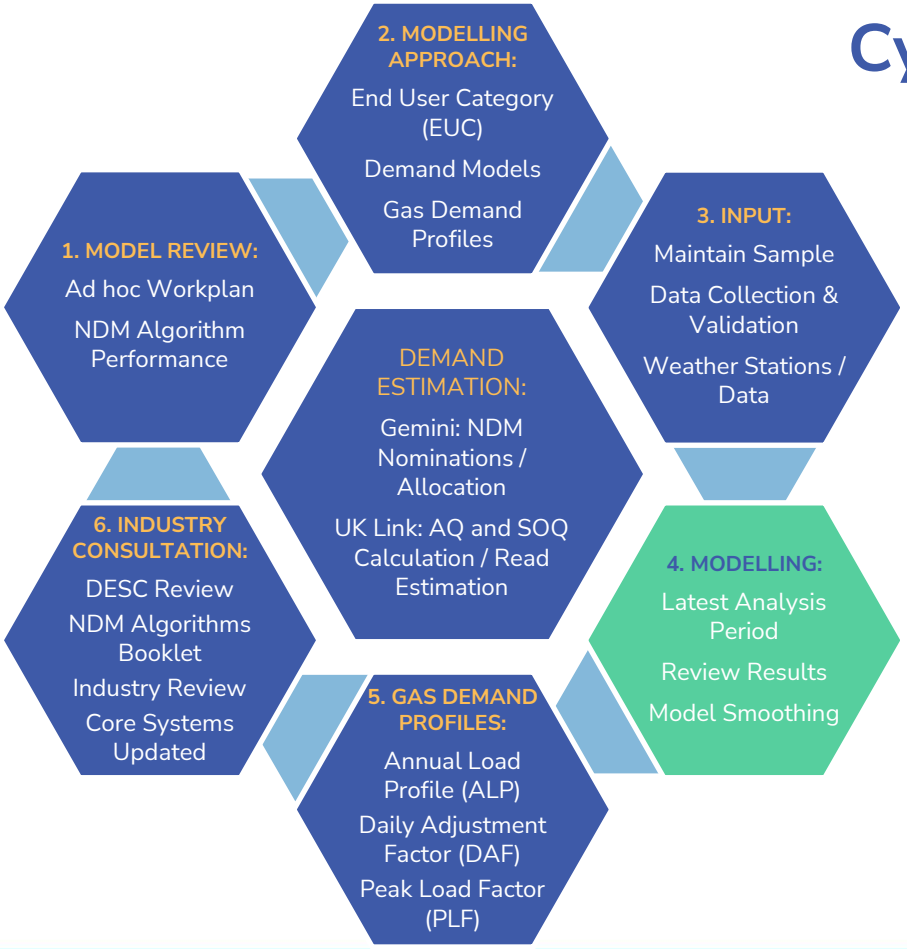
Gas Demand EUC Modelling Results

CONTEXT: DEMAND ESTIMATION CYCLE, TIMETABLE AND OBJECTIVES

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 Modelling phase of the Demand Model cycle

CDSP / DESC Obligations and Timetable: October 2023 to September 2024

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 objective of the “Modelling” phase is to review the outcomes for all End User Category (EUC) Gas Demand Models and confirm which should be used in Demand Model Smoothing

- The objective of today’s meeting is for DESC to:
  - Review Gas Demand Modelling results for both Small and Large NDM EUC Bands

– Where more than one set of results has been produced for an EUC, confirm which should be selected	Approval Required

– Confirm you are satisfied with all the Gas Demand Models that have been selected for deployment in Demand Model Smoothing	Approval Required

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MODELLING APPROACH

Modelling Approach – Basis of 2024 Modelling (1 of 3)

Key aspects of DESC's Modelling Approach 2024 are summarised below:

- Demand Modelling runs and the principles of aggregation where necessary, were agreed by DESC in April
- The Composite Weather Variable (CWV) definitions and Seasonal Normal basis (SNCWV), effective from 1st October 2020, will be used for the last time
- All gas demand modelling is data driven – if the modelling results indicate then Holiday & Weekend Factors, Summer Reductions & Cut-Offs will be applied
- Holiday Factors are determined by an agreed set of Holiday Code Rules set out in Appendix 5 of the Modelling Approach document
- Holidays are excluded from all core regression models, including Domestic EUCs

Modelling Approach – Basis of 2024 Modelling (2 of 3)

- **Warm weather cut–offs** are not applied to EUC Models <293 MWh p.a. This means no cut-off is placed on warm weather demand reduction, in EUC models representing nearly 80% of NDM load
  - Any cut-offs are based on modelling results over all 3 years
- **Summer reductions** can apply to EUC models over the period from the Sunday before Spring Bank Holiday Monday to last Sunday in September
  - i.e. 28 May 2023 to 24 September 2023
  - This applies along with the more general summer holiday period in July and August
  - Any summer reductions are based on modelling results over 3 years
- Modelling Methodology is covered in the NDM Algorithms Booklet Sections 3 and 4

Modelling Approach – Basis of 2024 Modelling (3 of 3)

Sample Data Aggregation

- The optimum result is always to model an EUC based on Individual LDZ analysis
- Sometimes this is not feasible due to low sample counts and in these cases, aggregations are required
- Where aggregations are required, we take the following approach
  - Use sample data for LDZs which share weather data e.g. NW and WN
  - Use sample data for bordering LDZs, adding more as required
  - Group sample data into North (7 LDZs) and South (6 LDZs) regions
  - Group all sample data for the EUC together

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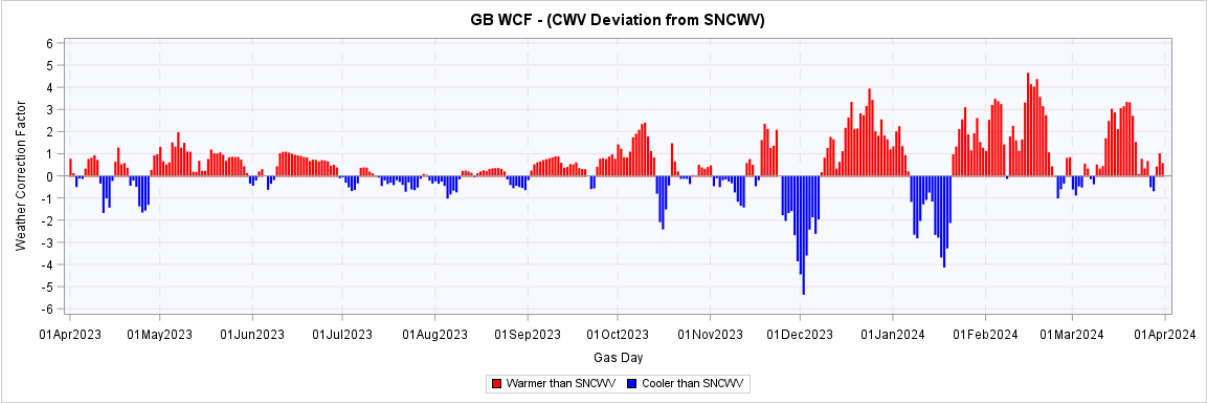
ANALYSIS PERIOD TIMELINE

Analysis Period Timeline - Points of Note (1 of 2)

- As agreed by DESC in the Modelling Approach, this year's Analysis Period runs from 1 April 2023 to 31 March 2024. The 12-month period was chosen to ensure we had sufficient Easter Holiday data points to calculate relevant Holiday Factors
- Prior to reviewing the Small and Large NDM EUC Modelling results for this period, it is worth recalling any significant external factors that may have had an impact which could explain any outliers, for example extreme weather events and increases in Gas Prices

A Chart of GB Weather Correction Factor (WCF) for the Analysis Period is below

- Spikes of colder than Seasonal Normal weather early December 2023 and mid-January 2024
- June 2023 was warmest June on record, Feb 2024 warmest February on record. September 2023 second warmest September on record (gas industry records)



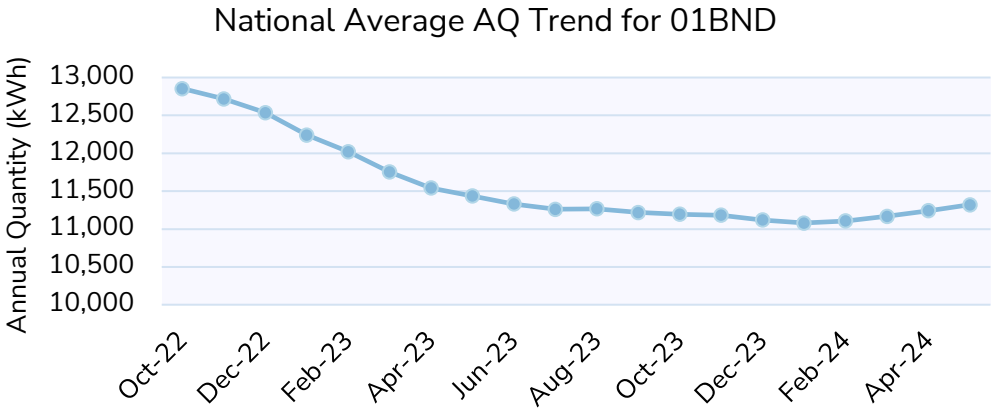
Analysis Period Timeline - Points of Note (2 of 2)

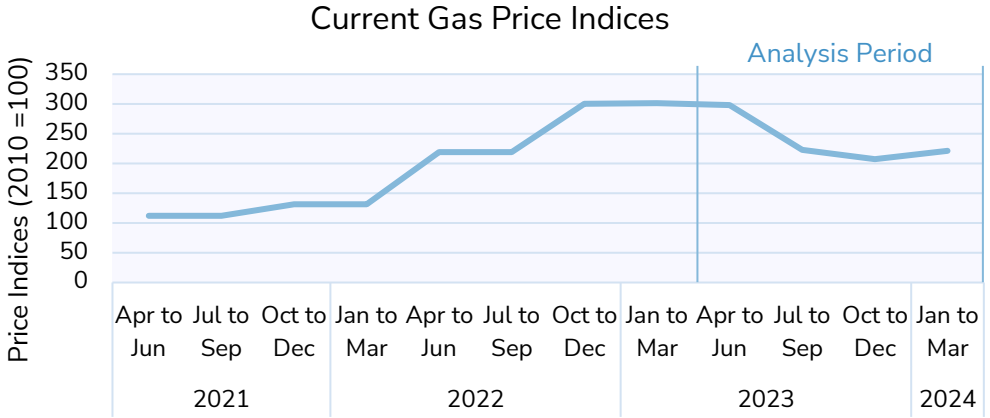
The chart on the right is of an average AQ trend for Band 1 Domestic non-prepayment meters

- The Average AQ has increased for the last 4 months after a long period of decreasing AQ
- This suggests the end of price driven energy conservation as seen in Gas Year 2022/23

The lower chart shows the current Gas Price Indices for the last 3 years

- Prices were still very high in the first quarter of the Analysis Period and this is reflected in the results for some EUCs
- Prices are still high compared to pre-2022





Gas Demand EUC Modelling Results

MEASURES

Measures – What are they?

- The analysis carried out, aims to assist in the creation of profiles based on the relationship between demand and weather
- This is an opportunity to view results so far and identify the best fit model based on available Daily Gas Consumption Data
- The key measures used to identify most appropriate model are:
  - **R squared (R^2) Multiple Correlation Coefficient**
    - Statistical tool for identifying 'goodness of fit' (includes plot of seasonal residuals)
    - Value will range from 0 to 100% (100% indicating a perfect fit / direct relationship)
  - **Indicative Load Factors (ILFs)**
    - ILFs indicate the weather sensitivity of a model
    - Values are expected to be comparable across individual EUCs
- Additional Model Summary Insight is provided in the form of:
    - Scatter Correlation plot; Residuals Histogram; Time series of Actual and Fitted demands

Measures – Indicative Load Factors

- Indicative Load Factors (ILFs) provide an indication of the weather sensitivity for a Gas Demand Model
- ILFs are only used to compare prospective Gas Demand Models as an aid to making decisions on model choice
- It is expected that there should be distinguishable ILF values between EUC Consumption bands and WAR bands
- ILFs are not the same as proper Peak Load Factors (PLFs) and their values are not an indicator of the values of proper PLFs (ILFs not used for determining NDM capacities). Formulas below:
  - **PLF** = average daily demand (i.e. AQ/365) / 1 in 20 peak demand (simulated)
  - **ILF** = (AQ/365) / model demand corresponding to 1 in 20 CWV

Measures – How to Interpret EUC Summary Results

- The table on the right shows an example of how the R^2, Sample Size and ILF results are presented for each EUC
- R^2 and ILF results have been compared to the average of the previous 2 years used Analysis Periods (years vary by Model and is covered in the slide text)
- R^2 arrows and colours indicate the following movements

↑	Greater than 2.5% increase
↗	less than 2.5% increase
↔	No change
↘	less than 2.5% decrease
↓	Greater than 2.5% decrease

- ILF arrows and colours indicate the following movements

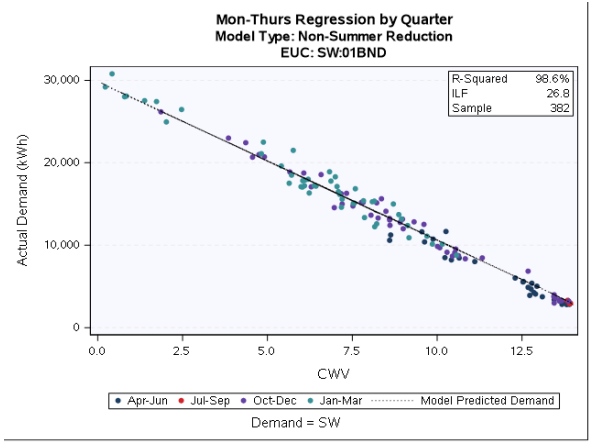
↑	ILF has increased (less weather sensitive)
↔	ILF is unchanged
↓	ILF has decreased (more weather sensitive)

- Sample sizes are illustrated using a coloured circle
  - Sample size below minimum of 30 sample meter points
  - Sample size above minimum but below target
  - Sample size meets target

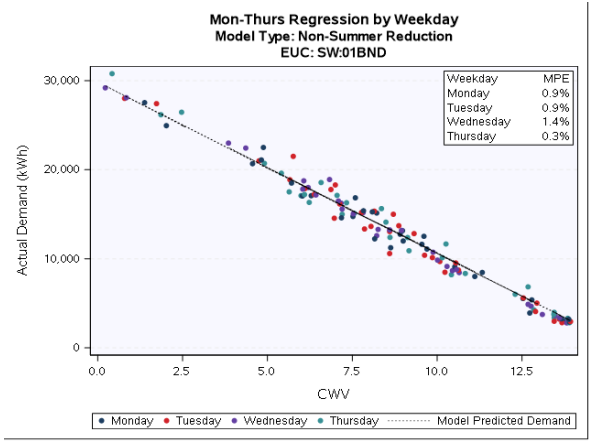
	R^2			Sample Size		ILF		
LDZ	Avg. prev 2 years	2023/24		2023/24		Avg. prev 2 years	2023/24	
SC	98.2%	↘	**97.2%**	●	**256**	37.4	↓	**37.1**
NO	94.0%	↑	**98.5%**	●	**383**	38.0	↔	**38.0**
NW	97.4%	↗	**98.3%**	●	**385**	35.3	↓	**34.2**
NE	97.8%	↗	**98.3%**	●	**385**	35.9	↑	**36.1**
EM	98.8%	↘	**98.7%**	●	**306**	33.9	↓	**31.9**
WM	98.5%	↓	**92.0%**	●	**359**	33.5	↔	**33.5**
WN	96.8%	↗	**98.0%**	●	**224**	35.4	↓	**33.4**
WS	95.0%	↑	**99.4%**	●	**248**	33.8	↓	**32.4**
EA	98.4%	↗	**98.7%**	●	**25**	33.4	↓	**31.1**
NT	99.0%	↘	**99.0%**	●	**202**	34.4	↑	**37.3**
SE	98.8%	↓	**96.0%**	●	**268**	32.6	↑	**33.3**
SO	98.4%	↗	**98.7%**	●	**244**	30.3	↓	**27.8**
SW	98.1%	↗	**98.8%**	●	**385**	30.6	↓	**29.1**

Measures : Understanding Charts (1 of 3)

- We provide a number of different charts to aid interpretation of the modelling results

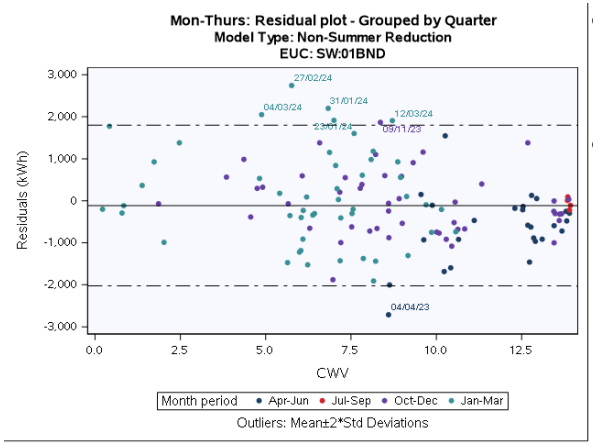


- Monday to Thursday (core model) Regression is shown by quarter and by weekday
- The results by quarter include the R^2, ILF and sample count, plus any demand data aggregation is provided in the footnote



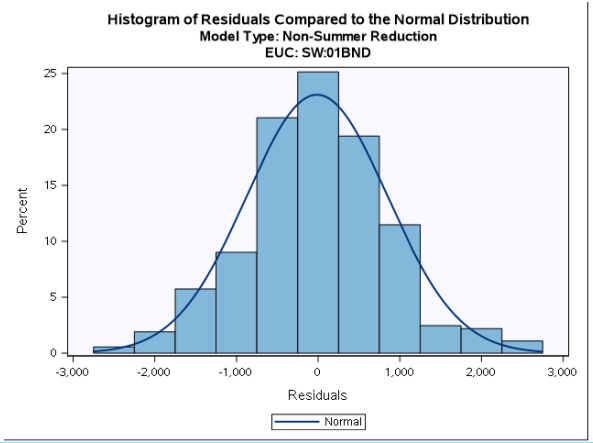
- The results by weekday include the MPE by weekday
  - Where the MPE is negative this indicates an under allocation
  - Where the MPE is positive this indicates an over allocation
- Data points close to the Model Predicted Demand line indicate a robust model

Measures : Understanding Charts (2 of 3)

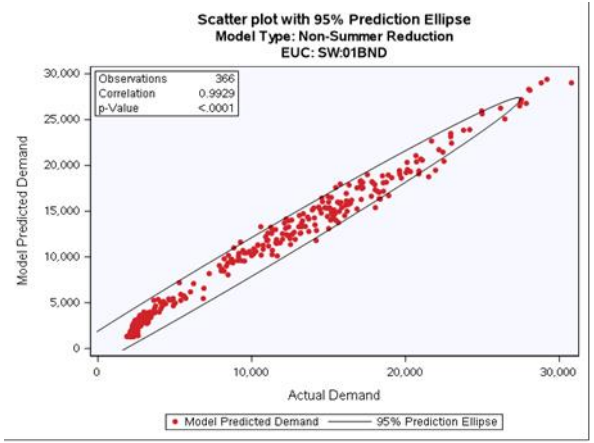


- Monday to Thursday (core model) Residuals are shown by quarter
- The residual is the difference between the Model Predicted Demand and the Actual Demand
  - Negative Residuals are where actual consumption was much lower than the model predicted
  - Positive Residuals are where actual consumption was much higher than the model predicted

- Residuals are also provided as a histogram compared to a normal distribution curve
- Histograms can show if the results are skewed or if data issues are causing unusual spikes

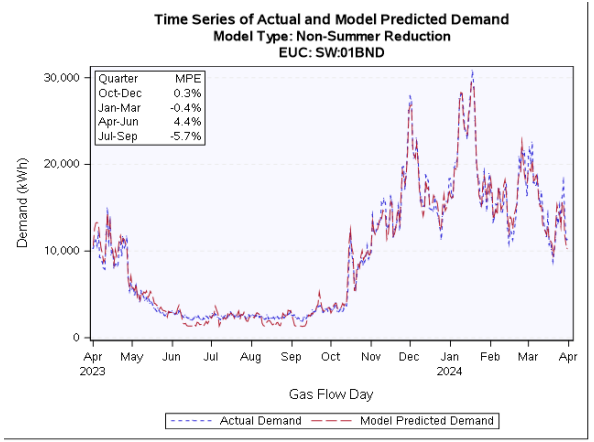


Measures : Understanding Charts (3 of 3)



- A scatter plot of Model Predicted Demand vs Actual Demand is provided with a 95% ellipse
- The smaller the ellipse, the more confident the model is at predicting actual demand
- A tight grouping of data points on the diagonal indicated a good correlation between the model and actual demand

- The results are also shown on a timeseries of Model Predicted Demand and Actual Demand
- This chart also includes the MPE by quarter
  - Where the MPE is negative this indicates an under allocation
  - Where the MPE is positive this indicates an over allocation



Measures : Understanding Outliers

- Outliers occur when the Residual (difference between the predicted and actual volumes) is more than 2 standard deviations from the mean
- Outlier analysis is a useful high level sense check of modelling results in an EUC
  - It can help reveal potential issues with the data or unusual events
  - As a result of the outlier analysis, occasionally we may decide to remove data points from the modelling
- The example chart on the right highlight's outliers – the dotted lines mark 2 standard deviations from the mean and datapoints outside of these lines (with dates) are outliers
  - All days are included in the Outliers by Month chart
  - The Residual plot with highlighted outliers is the Monday to Thursday core only
  - Negative outliers are where actual consumption was much lower than the model predicted
  - Positive outliers are where actual consumption was much higher than the model predicted