Demand Estimation Technical Work Group

Gas Demand EUC Modelling Results
Analysis Year 2021/22
(1 of 3) Introduction

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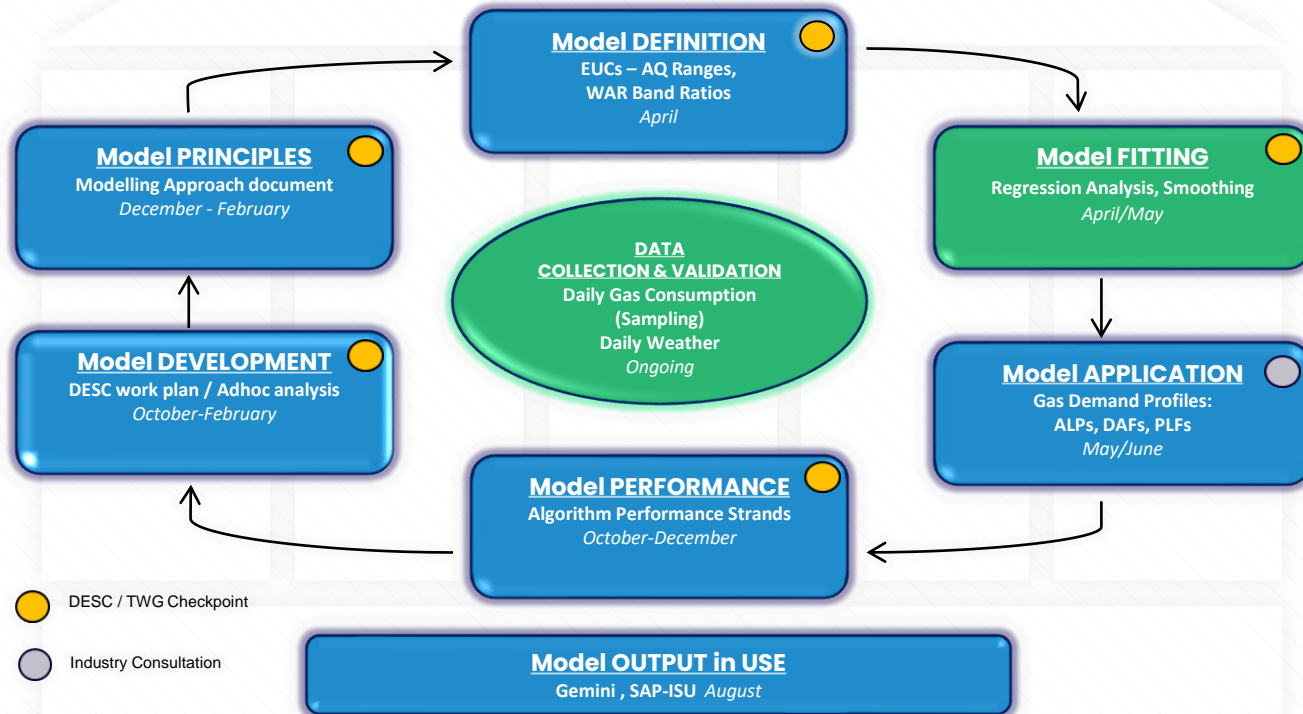 - Large NDM Conclusions and Recommendations

BACKGROUND, TIMETABLE, AND OBJECTIVE OF MEETING

Demand Estimation: Background

- An overview of the Demand Estimation process and output can be found here

- This presentation relates to the "Data Collection & Validation" and "Model Definition" phases of the Demand Model cycle

Model DEFINITION
EUCs – AQ Ranges,
WAR Band Ratios
April

Model PRINCIPLES
Modelling Approach document
December - February

Model FITTING
Regression Analysis, Smoothing
April/May

**DATA
COLLECTION & VALIDATION**
Daily Gas Consumption
(Sampling)
Daily Weather
Ongoing

Model DEVELOPMENT
DESC work plan / Adhoc analysis
October-February

Model APPLICATION
Gas Demand Profiles:
ALPs, DAFs, PLFs
May/June

Model PERFORMANCE
Algorithm Performance Strands
October-December

DESC / TWG Checkpoint

Industry Consultation

Model OUTPUT in USE
Gemini , SAP-ISU *August*

Demand Estimation Timetable - 2022

High Level View of Demand Estimation Timetable 2022 - Key Checkpoints														
PHASE	**MILESTONE**	**CHECKPOINT**	**JAN**	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC**
1. MODEL PRINCIPLES	Modelling Approach 2022 Approved	DESC Meeting			02-Mar									
2. DATA COLLECTION & VALIDATION	Daily Gas Consumption Data validated	Internal				14-Apr								
3. MODEL DEFINITION	Agree Data Aggregations / WAR Band Limits	TWG Meeting				27-Apr								
4. MODEL FITTING	Gas Demand EUC Modelling review	TWG Meeting					24-May							
5. MODEL APPLICATION	Publication of Draft Gas Demand Profiles	Website						10-Jun						
5. MODEL APPLICATION	Gas Demand Profiles Approved for wider industry	DESC Meeting							07-Jul					
5. MODEL APPLICATION	Final Approval of Gas Demand Profiles	DESC Meeting							21-Jul					
6. MODEL OUTPUT IN USE	SAP-ISU and Gemini updated	Internal								14-Aug				
7. MODEL DEVELOPMENT	Adhoc Work-plan approved	DESC Meeting							21-Jul			05-Oct		
8. MODEL PERFORMANCE	NDM Algorithm Performance - Strands 1 to 3 Review	DESC Meeting												13-Dec

Objectives of Meeting

- The objective of the "Model Fitting" phase is to review the outcomes for all Gas Demand Models and confirm which should be used in Demand Model Smoothing (a key input to the next phase "Model Application")

- Objective of today's meeting is for TWG 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

  - Confirm you are satisfied with all Gas Demand Models that have been selected for deployment in the next activity, namely Demand Model Smoothing

MODELLING APPROACH

Modelling Approach – Basis of 2022 Modelling (1 of 2)

Key aspects are:

- Daily Gas Consumption Data was validated and, where necessary, selected in line with the stratification method

- Demand modelling runs and any necessary aggregations (following validation and selection) were agreed by TWG in April

- The Composite Weather Variable (CWV) definitions and Seasonal Normal basis (SNCWV), effective from 1st October 2020, will be used

- New Demand modelling rules for defining holiday periods to be used following agreement by DESC at it's meeting on 2nd March 2022. These are the first changes to Holiday definitions since the 2012 modelling year

- In line with recent years, holidays have been excluded from the regression models for Domestic EUCs

- All gas demand modelling is data driven – if the modelling results indicate then Holiday & Weekend Factors, Summer Reductions & Cut-Offs will be applied

Modelling Approach – Basis of 2022 Modelling (2 of 2)

- Warm-weather cut-offs:
  - Not applied to EUC models < 293 MWh pa, meaning 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 from 3 years

- Summer Reductions:
  - 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. 30th May 2021 to 26th September 2021
  - Above 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 in NDM Algorithms Booklet (Sections 3 & 4)

- The Gas Demand Modelling performed this year will be the third set of analysis to be performed using the newly implemented Demand Estimation EUC Gas demand modelling system

ANALYSIS PERIOD TIMELINE

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

- Last year's Analysis Period (April 2020 to March 2021) was impacted heavily by the COVID-19 lockdowns and restrictions and as such DESC decided not to use the data collected for the I&C EUCs

- As agreed by DESC in the Modelling Approach, this year's Analysis Period runs from 1st March 2021 to 31st March 2022. The 13-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 - these include extreme weather events, COVID-19 restrictions and increases in Gas Prices

- The COVID-19 restrictions within this year's Analysis Period are expected to have had less impact despite some restrictions being in place at the beginning of the Analysis period. There are less compelling reasons to not include data now as consumer behaviour settles into a 'new normal', hence decision to use majority of data

- Chart of GB WCF for Analysis Period opposite
- Much colder than Seasonal Normal for April and May 2021
- February and March 2022 3rd warmest and 4th warmest on record respectively (gas industry records)

GB WCF - (CWV Deviation from SNCWV)
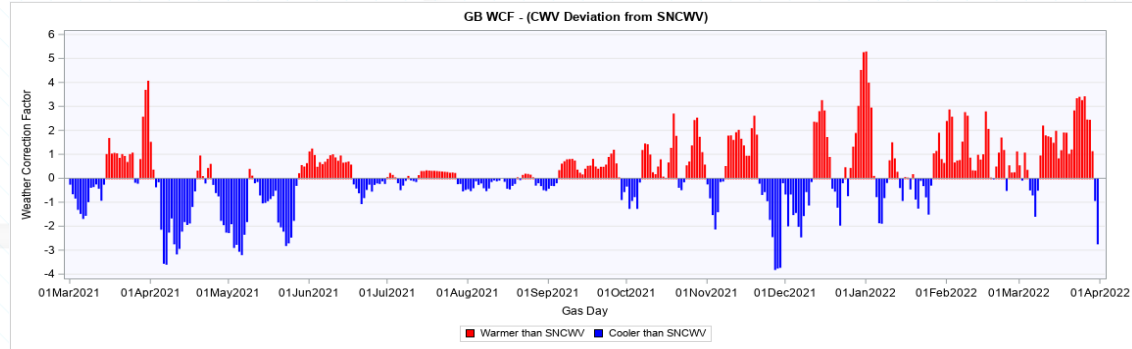
- Wholesale Gas Prices increased significantly during Analysis Period
– see chart of System Average Price (SAP)
- Possible consumer behaviour changes may be present as a result

SAP Prices:
01/03/2021 to 31/03/2022
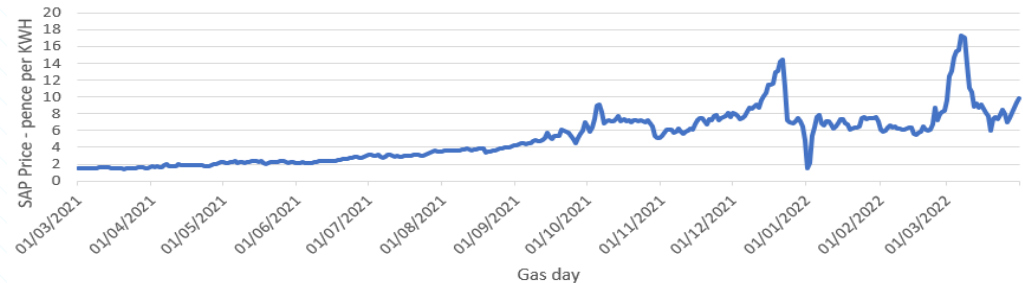
- March 2021: First phase of lifting of lockdown restrictions begins
- May 2021: Second phase of lifting of lockdown restrictions
- July 2021: 'Freedom day' all domestic (non international travel related) restrictions lifted
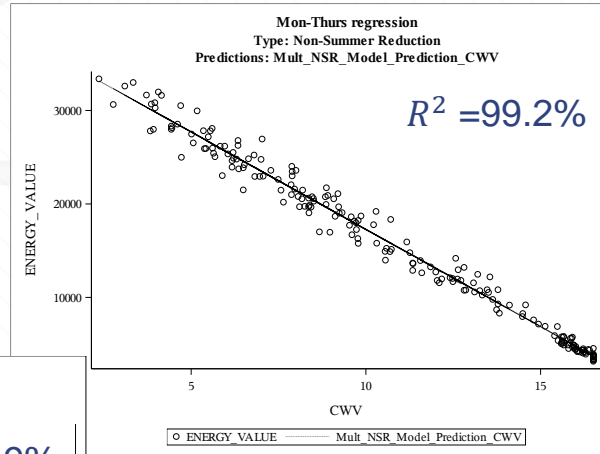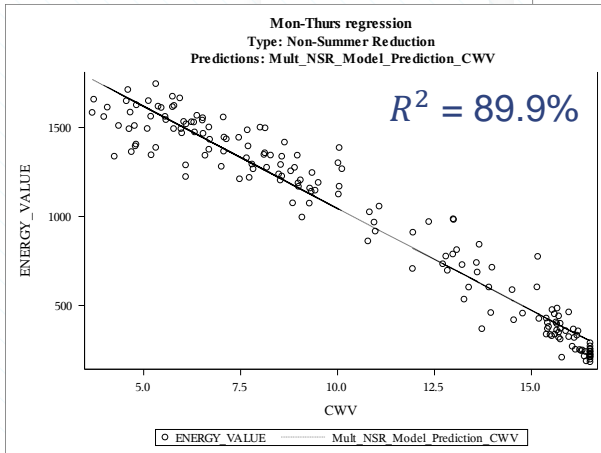
MEASURES

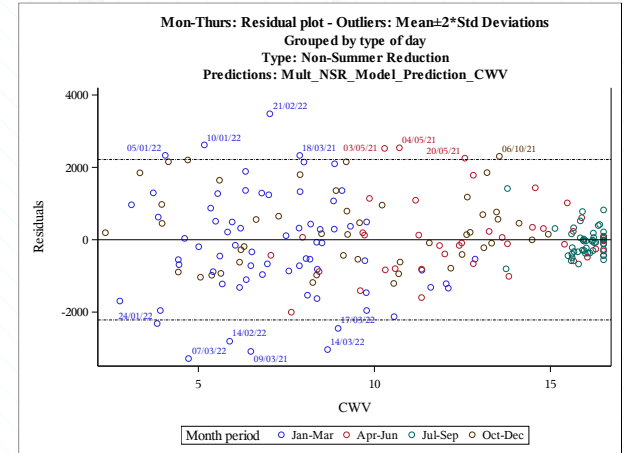# Measures – What are they?

- Analysis carried out aims to assist in the creation of profiles based on the relationship between demand and weather

- 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
        - Scatter Correlation plot; Residuals Histogram; Time series of Actual and Fitted demands

Measures – R Squared Example

**Plot of Demand vs CWV
and Line of Best Fit**
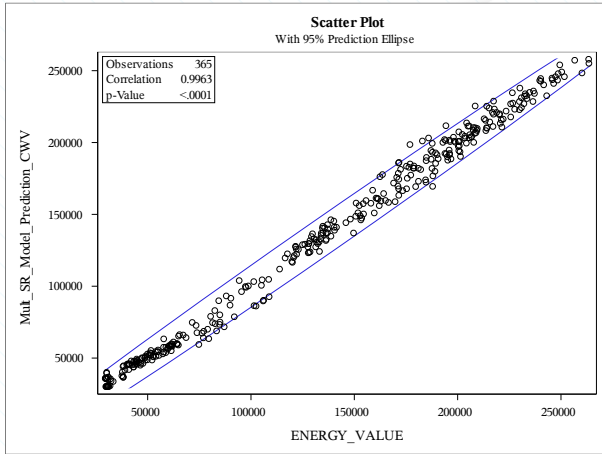Provides view of EUC Demand
Model Performance (R^2)

Mon-Thurs regression
Type: Non-Summer Reduction
Predictions: Mult_NSR_Model_Prediction_CWV

R^2 =99.2%

Plot of Seasonal Residuals
View of any potential seasonal
bias and labelled outliers

Mon-Thurs: Residual plot - Outliers: Mean±2*Std Deviations
Grouped by type of day
Type: Non-Summer Reduction
Predictions: Mult_NSR_Model_Prediction_CWV

Mon-Thurs regression
Type: Non-Summer Reduction
Predictions: Mult_NSR_Model_Prediction_CWV

R^2 = 89.9%

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

  - ILF = (AQ/365) / model demand corresponding to 1 in 20 CWV

Measures – Additional Model Summary Insight Examples

Scatter Plot
With 95% Prediction Ellipse

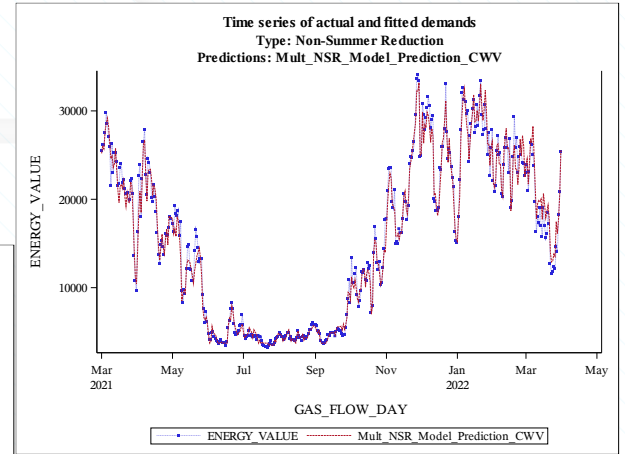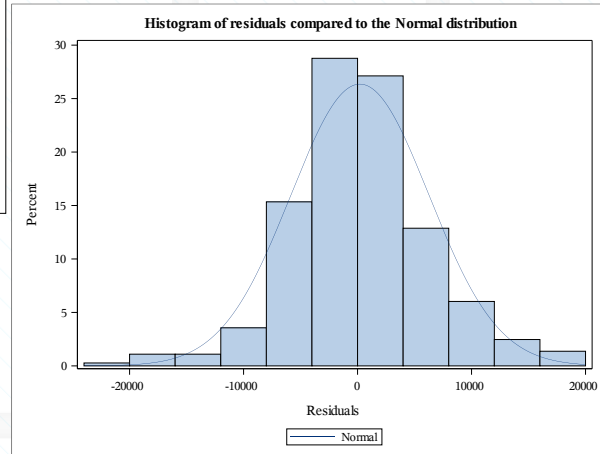| Observations | 365 |
| Correlation | 0.9963 |
| p-Value | <.0001 |

Scatter Correlation Plot
View of the Actual Demand vs Fitted Demand correlation

Residuals Histogram
Assessment of residuals compared to Normal distribution

Histogram of residuals compared to the Normal distribution

Time Series of Actual & Fitted Demands
Time series of model performance

Time series of actual and fitted demands
Type: Non-Summer Reduction
Predictions: Mult_NSR_Model_Prediction_CWV