Demand Estimation Sub Committee (DESC)
Modelling Approach 2022

Demand Estimation Team

March 2022

MODELLING APPROACH 2022

TERMS AND ABBREVIATIONS USED IN THIS DOCUMENT

In each section any regularly used phrases or abbreviations are set out here as defined terms to provide clarity and avoid repetition in the main body of the document.

Defined Terms

Analysis Period - 1st March 2021 to 31st March 2022

For gas demand EUC modelling purposes, it is necessary to have a full Easter holiday period in the data set being analysed. Therefore a 13-month period from 1st March 2021 to 31st March 2022 is required.

Data Collection Period - 22nd February 2021 to 7th April 2022

For gas demand EUC modelling purposes, it is necessary to have a full week before and after the Analysis Period for in-filling any missing data. Therefore data is required for a period from 22nd February 2021 to 7th April 2022.

Target Gas Year – 1st October 2022 to 30th September 2023

Abbreviations

ALP – Annual Load Profiles
AQ – Annual Quantity
CWV – Composite Weather Variables
DAF – Daily Adjustment Factors
DESC – Demand Estimation Sub Committee
EUC – End User Categories
LDZ – Local Distribution Zone
NDM – Non-Daily Metered
PPM – Pre-payment Meter
SNCWV – Seasonal Normal Composite Weather Variable
TWG – Technical Work Group
UNC – Uniform Network Code
WAR – Winter to Annual Ratio

EXECUTIVE SUMMARY

Context

Gas Demand Profiles represented as 3 parameters which support several key industry processes such as NDM Nominations/Allocations, AQ calculation and Capacity Invoicing.

(i) Annual Load Profile (ALP),
(ii) Daily Adjustment Factor (DAF) and
(iii) Peak Load Factor (PLF)

Each Gas Year the approach to the development of the following year's Gas Demand Profiles (UNC Term – "Derived Factors") is agreed with the Demand Estimation Sub Committee (DESC) and described in a document referred to as the "Modelling Approach". The review and agreement of the Modelling Approach normally takes place around February each year for the following Gas Year. It represents an important milestone which, when achieved, triggers the commencement of the Gas Demand EUC Modelling process.

The Gas Demand EUC Modelling performed in 2022 will drive the new set of industry parameters required for the **Target Gas Year**. Appendix 1 provides a visual representation of the Gas Demand EUC Modelling lifecycle and where this document fits within it.

Contents

The document will provide details regarding the following areas

Daily Gas Consumption Data:
This section covers which years and months of Daily Gas Consumption Data will be used in the modelling analysis, the sources of this data and how the data will be validated and selected.

Daily Weather Data:
This section covers which weather stations and versions of Composite Weather Variables (CWV) and Seasonal Normal weather (SNCWV) will be used in the modelling analysis.

End User Categories (EUC):
This section describes which types of consumers shall be grouped together from the Daily Gas Consumption Data for Gas Demand EUC Modelling.

Gas Demand EUC Modelling:
This section explains the detailed rules applied to the regression analysis which form the basis of the Gas Demand EUC Modelling process.

Demand Model Smoothing:
This section explains how 'smoothing' will be applied to the models for the coming gas year, which effectively averages the impacts of the previous [3] years modelling process to provide a more stable set of models.

Gas Demand Profiles:
This section describes the key output from the Demand Model Smoothing process and the values which will be subject to industry consultation and approval ahead of loading them into Xoserve systems.

NDM Algorithms Booklet:
This section explains how all the information, results and decisions made during the end to end process is summarised and provided to the industry.

Industry Consultation:
This section provides a summary of the key checkpoints in the process and how and when DESC and/or any sub-group of DESC members will be involved in the decision-making process.

Conclusions

This year's document is effectively the same as last years in terms of the principles for how the Gas Demand EUC Modelling shall be carried out. The main differences are:

i) Amendment to the Demand Model Smoothing to reflect the impact of COVID on the data for 2020/21.
ii) Amendment to the Holiday Code Rules following the changes agreed at DESC 2nd March 2022.
iii) Amendment to the Sources section to cover the additional Class 3 data for PPM EUCs.

DAILY GAS CONSUMPTION DATA

Daily Gas Consumption Data is a critical input to the production of Gas Demand Profiles. This data is collected by sampling the NDM population for the **Analysis Period.**

Sources

The expected source of most of the Daily Gas Consumption Data is from sampling managed by Xoserve and the Distribution Networks. The Xoserve sampling is mainly comprised of EUC Band 1 domestic sites. It also includes some EUC Band 1 non-domestic sites and EUC Band 2 sites (non-domestic and domestic). The Distribution Network sampling typically covers EUC Band 2 and above (up to and including EUC Band 9).

Due to declining numbers in both sampling portfolios, at its meeting on 17th November 2015 DESC agreed the use of third-party provided Daily Gas Consumption Data in the Gas Demand EUC Modelling process, which has previously been provided on a voluntary basis.

From 1st March 2019 the implementation of Modification 0654S introduced an obligation into the UNC for the provision of regular Daily Gas Consumption Data from Shippers (with a portfolio >25K) to the Central Data Service Provider (CDSP).

Any data provided by a third party will be required in an agreed format (file format document available on DESC's homepage on the Joint Office website) and be subjected to the same validation rules applied to the Xoserve and Distribution Network sampling.

Following DESC's decision in 2019 to introduce new EUCs in Bands 1 and 2 it will be necessary to collect additional Daily Gas Consumption Data for Gas Demand Profiles which represent

i) meter points in Band 1 (0-73.2 MWh pa) which are categorised as non-domestic,
ii) meter points in Band 1 which use pre-payment meters and
iii) meter points in Band 2 (73.2-293 MWh pa) which are categorised as domestic.

There are a low number of prepayment customers in Band 2 at a national level and creating a Gas Demand Profile for this customer group is reliant on data being provided by third parties.

Following successful analysis in the October 2021 Algorithm Performance, at the DESC meeting in March 2022 it was unanimously agreed that Class 3 data can be used to create a single year model for the Band 1 Prepayment EUC ("01BPD").

Validation and Selection

The Daily Gas Consumption Data collected for the **Analysis Period** will be subject to validation prior to its use in Gas Demand EUC Modelling. The validation criteria aims to strike the balance between maximising the amount of Daily Gas Consumption Data available for modelling and ensuring any erroneous and/or missing data is removed from the process, so as not to have an adverse effect on the modelling results and conclusions.

Appendix 2 displays a summary of the validation criteria to be applied to the various EUC Bands.

Due to different weather sensitivities for small domestic users, DESC agreed at its meeting on 10th December 2018 that it would be good practice if the validated Daily Gas Consumption Data selected for the Band 1 domestic model are sourced appropriately from different sub bands. DESC also recommended applying a stratification method to Band 2 Non-Domestic sites.

This approach will continue this year with the following stratification applied:

Band 1 Domestic: Sub bands: 0-10, 10-20, 20-30 30-73.2 MWh.
Band 2 Non-Domestic: Sub bands: 73.2-140, 140-210, 210-293 MWh.

To avoid removing validated supply points unnecessarily from the modelling process a 5% tolerance (+ or -) will be used when assessing the sub-band proportions for the population and sample data sets. In addition, where the number of supply points drops below the minimum threshold of 30 for any given EUC demand model, stratification principles will not apply.

Where the validated Daily Gas Consumption Data for a EUC Band are well over the ideal target numbers, DESC agreed at its meeting on 10th December 2018 that a process should be created to select the required

amount of data needed to be representative of the population. In this case, this means not using all the available data. DESC agreed that the Xoserve and Distribution Network sampling should be used primarily to retain continuity within the Gas Demand EUC Models. Any additional data obtained from third parties will be randomly selected to avoid any shipper bias in the resulting Gas Demand Profiles.

Appendix 3 displays the latest view of the ideal sampling size for post-validation Daily Gas Consumption Data. These numbers are based on a snapshot of the population as of December 2021.

All validated Daily Gas Consumption Data shall be aggregated prior to its use in the Gas Demand Modelling System.

DAILY WEATHER DATA

Daily Weather Data is a critical input to the production of Gas Demand EUC Models.

The latest Gas Demand EUC Modelling analysis year requires daily weather data for the **Analysis Period**.

The weather variables used in Gas Demand EUC Modelling in 2022 will be Composite Weather Variables (CWVs) and Seasonal Normal Composite Weather Variables (SNCWVs).

The CWVs used will reflect the new formula approved by DESC at its meeting on 7th October 2019 and the SNCWVs used will be those approved by DESC at its meeting on 9th December 2019, both of which became effective from 1st October 2020.

Weather Stations

List of weather stations to be used for Gas Demand EUC Modelling in 2022:

LDZ	Temperature	Windspeed	Solar Radiation
SC	Glasgow Bishopton	Glasgow Bishopton	Glasgow Bishopton
NO	Albemarle Barracks	Albemarle Barracks	Durham Weather Station
NW	Rostherne No 2	Rostherne No 2	Rostherne No 2
NE	Nottingham Watnall	Nottingham Watnall	Nottingham Watnall
EM	Nottingham Watnall	Nottingham Watnall	Nottingham Watnall
WM	Birmingham Winterbourne 2	Coleshill	Coleshill
WN	Rostherne No 2	Rostherne No 2	Rostherne No 2
WS	St. Athan	St. Athan	St. Athan
EA	London Heathrow	London Heathrow	London Heathrow
NT	London Heathrow	London Heathrow	London Heathrow
SE	London Heathrow	London Heathrow	London Heathrow
SO	Southampton Oceanographic Institute	Southampton Oceanographic Institute	Southampton Oceanographic Institute
SW	Yeovilton Weather Station	Yeovilton Weather Station	Yeovilton Weather Station

There are no expected changes for the above weather stations ahead of the start of Gas Year 2022/23.

END USER CATEGOERIES

End User Categories represent different groups of gas consumer types and provides a critical input to the production of Gas Demand EUC Models. The proposed EUC groupings need to be defined ahead of the Gas Demand EUC Modelling process.

Proposed EUCs for Gas Year 2022/23 – Bands 1 and 2

The proposed End User Categories for Gas Year 2022/23 for EUC Bands 1 and 2 are displayed in the table below:

Consumption Range (kWh P.A.)		EUC Description	Consumer Type	No. of Models Required
From	To			
0	73,200	xx:Eyy01BND	Domestic	1
0	73,200	xx:Eyy01BPD	Prepayment Domestic	1
0	73,200	xx:Eyy01BNI	I&C	1
0	73,200	xx:Eyy01BPI	Prepayment I&C	1
73,201	293,000	xx:Eyy02BND	Domestic	1
73,201	293,000	xx:Eyy02BPD	Prepayment Domestic	1
73,201	293,000	xx:Eyy02BNI	I&C	1
73,201	293,000	xx:Eyy02BPI	Prepayment I&C	1

Note: It is likely that insufficient Daily Gas Consumption Data will be available (due to low population numbers) for some of these proposed EUCs. At its meeting on 10th December 2018, DESC confirmed the following principle for the proposed EUCs which are most likely to be affected by insufficient data:

For the Prepayment I&C EUCs (xx:Eyy01BPI and xx:Eyy02BPI) the underlying Gas Demand EUC Models can utilise the Non-Prepayment I&C model in the equivalent EUC Band (xx:Eyy01BNI and xx:Eyy02BNI respectively).

For the Prepayment Domestic EUCs in Band 2 (xx:Eyy02BPD) the underlying Gas Demand EUC Models can utilise the Prepayment Domestic EUC in Band 1 (xx:Eyy01BPD).

Proposed EUCs for Gas Year 2022/23 – Bands 3 and above

The proposed End User Categories for Gas Year 2022/23 for EUC Bands 3 and above are displayed in the table below:

Consumption Range (kWh P.A.)		EUC Description					No. of Models Required
From	To	Bucket Band	WAR Band 1	WAR Band 2	WAR band 3	WAR band 4	
293,001	732,000	xx:Eyy03B	xx:Eyy03W01	xx:Eyy03W02	xx:Eyy03W03	xx:Eyy03W04	5
732,001	2,196,000	xx:Eyy04B	xx:Eyy04W01	xx:Eyy04W02	xx:Eyy04W03	xx:Eyy04W04	5
2,196,001	5,860,000	xx:Eyy05B	xx:Eyy05W01	xx:Eyy05W02	xx:Eyy05W03	xx:Eyy05W04	5
5,860,001	14,650,000	xx:Eyy06B	xx:Eyy06W01	xx:Eyy06W02	xx:Eyy06W03	xx:Eyy06W04	5
14,650,001	29,300,000	xx:Eyy07B	xx:Eyy07W01	xx:Eyy07W02	xx:Eyy07W03	xx:Eyy07W04	5
29,300,001	58,600,000	xx:Eyy08B	xx:Eyy08W01	xx:Eyy08W02	xx:Eyy08W03	xx:Eyy08W04	5
58,600,001		xx:Eyy09B					1

In line with the Modelling Approach for 2021, the analysis of the Daily Gas Consumption Data will focus on confirming the most appropriate levels of aggregation to apply to the data sets for the various EUC analyses within the existing EUC boundaries. In line with previous practice, WAR band EUCs over the consumption range 293-2196 MWh pa will be based on the overall range, which should then enable analysis by individual LDZ instead of LDZ groupings.

Exploratory Analyses

During 2013 DESC asked TWG to investigate the boundaries of the current EUC definitions and assess whether any more appropriate NDM groupings exist. Results of this analysis were shared at the TWG meeting on 27th November 2013 and the TWG meeting on 15th January 2014. It was agreed that there did not appear to be any obvious 'new bandings' emerging, however TWG did make a recommendation to DESC to merge bands 07 (14650 – 29300 MWh pa) and 08 (29300 – 58600 MWh p.a.) for Gas Demand EUC Modelling purposes only, owing to the similarity in their profiles. DESC had already previously agreed that should it become necessary due to insufficient Daily Gas Consumption Data, the sampling applicable to consumption bands 07 and 08 could be combined for WAR band Gas Demand EUC Modelling in these consumption ranges.

At its meeting on 13th February 2018 DESC agreed to retain the existing EUC definitions in terms of AQ ranges, however it was agreed that an updated review of the boundaries which define the EUCs for the Large NDM population should be added to DESC's ad hoc work plan.

GAS DEMAND EUC MODELLING:

This section provides a broad outline of the proposed modelling approach to be adopted for the 2022 analysis which, in the main, will be the same as applied in 2021.

Impacts of COVID-19 on Demand Modelling

The proposed modelling approach covers a 'standard' analysis year. It is likely adhoc actions and analysis may be required to understand observed demand behaviour following the unique circumstances of the COVID-19 pandemic.

Actions could range from removal of specific days / periods from the analysis (minimum possible intervention) through to not using the latest collected sample data at all (maximum possible intervention), in the derivation of this year's Gas Demand Profiles. The actions may vary across sectors e.g. Domestic and I&C.

It was agreed at the DESC meeting on 24th May 2021 that it would not be appropriate to use the data collected in the period April 2020 to March 2021 to influence future gas demand profiles for I&C EUCs. As a result only 01BND EUCs used data from April 2020 to March 2021. See Demand Model Smoothing section for more information.

The **Analysis Period** (to date) has not included any significant regulatory business restrictions and therefore the likely proposal will be to include all the 2021/22 data in the creation of the gas demand profiles.

Modelling Approach

1. This approach is detailed in the flowcharts shown in Appendix 4 (which is also explained on pages 9 and 10 in Section 3 of the 2020 NDM Algorithms booklet).

A broad outline of the approach is reproduced below:

a. Exclude warm weather data and summer data (i.e. June to September) and fit a line to the remaining data. Any flat Gas Demand EUC Models are detected and re-run with all the data.

b. Warm weather data (for exclusion) is defined in this context as the warmest 2º of data (i.e. that for which the CWV is greater than Max. CWV - 2º).

c. Assess the excluded summer data against the line fitted in step (a) to establish whether a summer reduction is required. The current condition of a 5% bar before any summer reduction is considered to apply to each individual year model will be retained.

d. Reintroduce the summer data into the data set (after inflating by any summer reduction identified in step c; if no summer reduction is identified then there would be no inflation). Fit a line to the augmented data set, excluding the warmest 2º, to establish whether a cut-off is appropriate, considering potential cut-offs in the range 0.5 to 4 degrees below the maximum value of the composite weather variable. The criterion applied from spring 2001 onwards, of a 20% improvement in the mean square residual over that obtained by using the straight line alone, will be retained in assessing whether there should be a cut-off applied to each individual year model.

e. If a cut-off is not required, then reintroduce the warmest 2º of data and fit a line to the entire data set.

f. Demand Model Smoothing considers three years' models and the application of summer reductions or not to the smoothed model is dependent on all the years contributing to the smoothed model. Thus, it is possible that the smoothed model will not incorporate a summer reduction, in spite of a summer reduction being identified for one (or more) of the individual years. To cover this eventuality, it is necessary in each year's modelling to produce models with and without summer reductions. The model without summer reductions will be produced by including summer data (except for the warmest 2º) in the regression in step a above, and fitting a cut-off if necessary, as in steps d and e above.

2. As previously agreed and implemented from the spring 2002 NDM analysis onwards, weekend effects for the "01B" EUCs will be modelled using the same "variable weather sensitivity" form of model used for all other EUCs. (This form of the model is set out in Section 3 of the 2021 NDM Algorithms booklet.). Note: This approach will also be applied to the new EUCs in Bands 1 and 2.

3. The Daily Gas Consumption Data applicable to the **Analysis Period** will not have been analysed previously, and so, investigation of the most appropriate data aggregations, determination of WAR band limits, etc., will be undertaken with respect to this data set. This will be done in conjunction with the Technical Work Group (a decision point described in the Industry Consultation section of this document).

4. The Gas Demand EUC Models for all EUCs will allow the possibility of summer cut-offs and summer reductions being applied.

Note however that cut-offs will not be applied to the models derived for consumption bands up to 293 MWh pa for the 2022 analysis. This approach was agreed by DESC in December 2003, with a view to mitigating instability during the summer and was also applied to all previous NDM analyses from spring 2004 onwards.

5. In any single LDZ, the same definition of CWV will be used for all runs (i.e. for all EUCs in that LDZ and for all years of data).

6. Weekend, holiday and summer reductions will be calculated (where appropriate) as the average of the percentage reductions estimated for the three individual years' models; where applicable the CWV cut-off (at which models cease to be weather sensitive) will be the simple average of the three separate estimates. If for one or two of the three years there is no CWV cut-off, the maximum value of the CWV will be substituted as the cut-off for those years. Further details are provided in the attached Appendix 6.

The holiday codes were reviewed over winter 2021-22 and changes agreed by DESC on the 2nd March 2022**.** Appendix 5 provides a summary of the holiday code rules which are applied in the Gas Demand Modelling System with changes highlighted.

There are additional planned special bank holidays at present in the data. These are covering VE day (May 2020) and Platinum Jubilee (June 2022).

The set of holiday days applied to the analyses will be the union of the holidays applying to England and Wales on the one hand and Scotland on the other. This approach has been used since the adoption of Demand Model Smoothing in 1999 and continues to be appropriate because Daily Gas Consumption Data from geographically adjacent LDZs are usually aggregated to allow some EUCs to be modelled. Both population and sampling disposition are such that this aggregation of data is essential to enable modelling of all EUCs in all LDZs.
No judgemental alterations will be made to the disposition or derived values of the ensuing holiday codes when they are applied to deriving Gas Demand Profiles for the Target Gas Year.

Following evidence presented at the 15th February 2017 DESC meeting which reviewed the performance of the “01B” EUC models during the summer months, a decision was made to exclude holidays from the regression models for “01B” EUCs, which now brings them in line with the practice used for all other EUCs.
Note: This approach will also be applied to the additional EUCs in Bands 1 and 2.

7. As set out in Appendix 6, the key aspect of averaging the models will be to average the ratio of the slope to the constant term, from each year's model. These ratios are equivalent to the reciprocals of the CWV intercepts.

8. Prior to the averaging, any Gas Demand EUC Models giving non-negative slopes on initial analysis (excluding the warmest weather from the regression), will be re-fitted to the entire data set. Any positive slopes remaining will be set to zero. This has become established practice.

9. The following approach will be taken in 2022 with respect to non-statistically significant (at the 95% confidence level) weekend effects:

a. For those EUCs where the Gas Demand EUC Models is based on domestic consumers (xx:Eyy01BND, xx:Eyy01BPD, xx:Eyy02BND and xx:Eyy02BPD) all positive non-significant weekend effects will be retained at their original values.
b. For all the remaining EUCs, all negative non-significant weekend effects will be retained at their original values.

10. For large NDM (i.e. above 2196 MWh pa), the consumption band break points by which large NDM EUCs are defined will remain in line with current practice. However, it is intended following the DESC decision on 12th February 2014 that the Daily Gas Consumption Data applicable to the Gas Demand EUC Models for consumption ranges 14650 - 29300 MWh pa and 29300 - 58600 MWh pa (EUC bands 07 and 08, respectively)

will be combined. This will provide better sampling numbers for more robust Gas Demand EUC Modelling and merge two bands which analysis has shown to display similar consumption behaviour.

It is recommended that the Daily Gas Consumption Data will be combined in this way for the consumption band EUCs and the WAR band EUCs. Even when data is combined in this way, separate EUCs will be defined for consumption band and WAR band EUCs in the consumption ranges 14650 - 29300 MWh pa and 29300 - 58600 MWh pa. This year the aggregations for the underlying Gas Demand EUC Models, used for deriving the final smoothed model for EUC bands 07 and 08, will all be based on the combined approach.

Reporting

The output from this process is provided at the May DESC's Technical Workgroup meeting.

Results of the Gas Demand EUC Modelling process will be provided as usual in the NDM Algorithms Booklet (Sections 4 and 5).

DEMAND MODEL SMOOTHING:

This section provides a broad outline of the proposed overall approach to Demand Model Smoothing for the 2022 analysis. This in the main will be the same as that applied in 2021 in the sense that it will be smoothed over the most recent 3 years of **used** data.

Demand Model Smoothing Approach

1. Year on year Demand Model Smoothing will be used in the 2022 analysis, in deriving the NDM Derived Factors to be applied to the **Target Gas Year**.

2. In the absence of evidence of trends in the parameters of the year on year Gas Demand EUC Models, simple averaging will be applied to the models feeding into Demand Model Smoothing.

3. The Gas Demand EUC Models for three years will be used for Demand Model Smoothing. Due to the DESC decision on 24th May 2021 not to use the data collected in the period April 2020 to March 2021 for all EUCs except 01BND, it would be inappropriate to include it now for smoothing purposes. As a result only 01BND EUCs used data from April 2020 to March 2021

a. For 01BND EUCs only, the three contributing years will be 2019/20, 2020/21 and 2021/22.
b. For 01BPD EUCs only, there will be one contributing year – 2021/22
c. For all other EUCs the three contributing years will be 2018/19, 2019/20 and 2021/22.

The table below outlines which analysis periods will be used for Model Smoothing and which of the Analysis Periods contain 13 months in order to include a full set of Easter holiday codes.

Analysis Period	01BND EUCs	01BPD EUCs	All Other EUCs	13 Month Period
2018/19			✓	✓
2019/20	✓		✓	
2020/21	✓			
2021/22	✓	✓	✓	✓

4. In applying smoothing, models from equivalent WAR bands in the three separate years will be averaged although WAR band limits change from year to year.

As a subsidiary point there is also a strong stability incentive to retain the current period (December to March) in the definition of the WAR values and therefore the existing definition will be retained for the 2022 analysis.

5. The approach to Demand Model Smoothing will be at the level of the underlying demand models, as was the case in the previous analyses. Further details are attached in Appendix 6.

6. Following the Winter 2020 review, the assessment of the approach to Demand Model Smoothing is scheduled to be reviewed in full again by DESC during the Autumn of 2022 following finalisation of the NDM algorithms for 2022/23.

Models for Historical Years

1. To assist in any investigation of trends, all three years (i.e. 2018/19 2019/20 and 2020/21) will be re-run to correctly consider any changes in holiday periods applicable to the 2022 analysis.
Note: For the additional EUCs, if Daily Gas Consumption Data for these years is not available, model re-runs will be limited to the number of years available, possibly none.

2. Two of the three re-runs from the 2018/19, 2019/20 and 2020/21 Daily Gas Consumption Data will be used (along with the Daily Gas Consumption Data for 2021/22) in Demand Model Smoothing, making up the three years of data applied in the 2021 analysis. See table above for a breakdown of periods by EUC.

3. The principles set out above for the Gas Demand EUC Modelling will also be applied to the historical years.

Reporting

The parameters for the smoothed models will be provided in electronic form for each of the three years feeding into Demand Model Smoothing. For all final smoothed EUC models, information (i.e. values of factors and flags where these apply to each model) pertaining to: summer cut-off, summer reduction, non-holiday weekend effects, and holiday effects will be provided in electronic form. All CWV intercepts (for each year's models and for the smoothed model) will be provided in electronic form.

Demand Model Smoothing Assessment

The last assessment of Demand Model Smoothing as applied to NDM demand estimation was presented at the DESC meeting on 24th February 2021. The results of the assessment confirmed that the objective of Demand Model Smoothing to reduce year on year volatility in the EUC models was being achieved. DESC supported Xoserve's recommendation to continue with the application of three-year Demand Model Smoothing in the manner currently applied. DESC agreed that the next review of the application of Demand Model Smoothing should take place in Autumn 2022 and could possibly be delayed by a further year should DESC agree there were more useful work plan items for DESC to analyse.

GAS DEMAND PROFILES

"Derived Factors" is the UNC Section H Term to represent the Gas Demand Profiles which represent the three key output parameters from the Demand Estimation process.

These three parameters are:

(i) the Annual Load Profile (ALP) – represents the daily consumption profile for an EUC
(ii) the Daily Adjustment Factor (DAF) – represents the daily weather sensitivity of demand for an EUC
(iii) the Peak Load Factor (PLF) – a factor used to determine the peak load of a supply point within an EUC

Derived Factors

The Demand Estimation Methodology document provides the formula for each of the parameters above, with further clarification provided below on how the parameters are derived.

1. The DAFs for **Target Gas Year** will be based on the formula in the Demand Estimation Methodology document. It is no longer required to be computed using output from an aggregate NDM demand model following the decision to change the Supply Meter Point Demand Formula.

2. In calculating DAF values in the case where the smoothed model has a cut-off, the reduction in the magnitude of weather sensitivity will be phased in as described in Section 9 on page 2 of the 2021 NDM Algorithms booklet. This approach has been in place since its introduction at the time of the spring 1997 NDM analysis.

3. Peak Load Factor computations for each EUC will be based on the relevant smoothed model.

One of the key components of the EUC peak load factor is the estimate of the 1 in 20 Peak Day Demand (PDD).
Prior to the implementation of UNC Modification 0331 the formula for calculating the Peak Load Factors was defined in specific detail in Section H of the UNC, including exactly how the PDD should be calculated (with different approaches for the Small and Large NDM sector), however it now states that "*the relevant sub-committee will determine the 1 in 20 peak day demand*". The Demand Estimation Methodology, the supporting document which came into effect following the implementation of UNC Modification 0432 on 1st June 2017, makes no distinction between Small and Large NDM and simply states that "*the PDD will be determined by simulation using a long period of actual historic CWV data for the relevant LDZ*".

Therefore the proposed approach for both Small and Large NDM uses simulation using the smoothed EUC demand model in conjunction with the database of historic daily composite weather variable values for the appropriate LDZ. This is in line with DESC's decision in February 2016 to approve this approach.

4. In the context of the non-application of cut-offs to Gas Demand EUC Models in consumption range 0-293 MWh pa, and as agreed by DESC in December 2003, the values of ALPs for EUCs in this consumption range will be constrained to be never less than 1% of their maximum values. Note that this is a safeguard against a theoretical possibility of negative ALPs arising (in the profiles computed for all gas years since 2004/05 it has never been necessary to invoke this constraint).

Reporting

Section 10 of the NDM Algorithms booklet customarily contains a comparison of the proposed EUC Peak Load Factors with the corresponding EUC Peak Load Factors that applied in the previous gas year (in this instance 2020/21 for all EUCs, as values are recalculated every year even if the underlying models haven't changed). The same approach will be adopted in the 2022 NDM Algorithms booklet.

NDM ALGORITHMS BOOKLET

The outcomes of the annual Gas Demand EUC Modelling process are summarised each year in the NDM Algorithms booklet which is usually published at similar time as the proposed algorithm values.

The booklet will include several sections and will summarise key decisions and outcomes, such as:

a) Numbers of validated data points used in the Gas Demand EUC Modelling
b) EUC definitions
c) Data aggregations used in the Gas Demand EUC Modelling (e.g. where data has been aggregated across multiple LDZs and/or consumption bands)
d) WAR Band boundaries to be applied for the coming year
e) Outcomes of the Gas Demand EUC Modelling, including regressions parameters and load factors
f) A review of the performance of the NDM algorithm during the previous full gas year -
    a. Weather Analysis,
    b. Unidentified Gas Analysis and
    c. NDM Daily Demand Analysis

INDUSTRY CONSULTATION

The consultation process on the proposed Gas Demand Profiles takes place during June and July although DESC and its Technical Workgroup are provided with regular updates at certain key checkpoints and must provide their approval at each stage – see proposed timetable below:

Phase	Approx. Dates	Interaction / Decisions	Meeting Schedule	Made By
Approach to Modelling	Winter 2021	Agree the approach to Gas Demand Modelling for the 2021/22 Gas Demand Profiles	DESC – 2nd March 2022	Technical Workgroup and DESC
Daily Gas Consumption Data Validation	18/04/22 to 27/04/22	Agree Gas Demand Modelling Runs based on collected data aggregations and WAR band definitions	TWG – 27th April 2022	Technical Workgroup
Gas Demand EUC Modelling	27/04/22 to 23/05/22	Prompt review and consensus decisions regarding any potential issues arising from regression analysis		Technical Workgroup
Gas Demand EUC Modelling	24/05/22	Review of all resulting Gas Demand EUC Models. Decision likely to be required on which models are best for certain EUC/LDZ combinations. Choice of models will be offered for group selection	TWG – 24th May 2022	Technical Workgroup
Draft Gas Demand Profiles	06/06/22 to 24/06/22	Review of Gas Demand Profiles for all EUCs including Annual Load Profiles and Daily Adjustment Factors		Technical Workgroup and DESC
Draft Gas Demand Profiles	27/06/22 to 07/07/22	Review and Discuss responses to comments from previous phase. Consensus required prior to releasing Gas Demand Profiles for wider industry review	DESC – 7th July 2022	Technical Workgroup and DESC
Final Gas Demand Profiles	18/07/22 to 19/07/22	Industry representations to be reviewed along with an agreed response before finalising the Gas Demand Profiles	DESC – 19th July 2022	DESC

Fall-back Position

Section H of UNC states that, in the event DESC does not wish to approve the proposed Gas Demand Profiles (ALPs, DAFs and Peak Load Factors) derived from this year's process, then DESC has the option of rejecting them and using the 'fall-back' position. The fall-back position for the coming year would normally be the use of EUC definitions and Gas Demand Profiles based on the underlying Gas Demand EUC Models from the previous year's analysis.

Therefore, the fall-back position that would apply is that EUC definitions and Gas Demand Profiles applied to the **Target Gas Year** would be based on the underlying Gas Demand EUC Models from the 2021 analysis. For the avoidance of doubt, the fall-back proposals will use the actual weekend and holiday dates for the **Target Gas Year** and would be available using the rules applicable post the implementation of UNC Modification 0432 (Project Nexus – Gas Demand, Allocation, Settlement and Reconciliation reform).

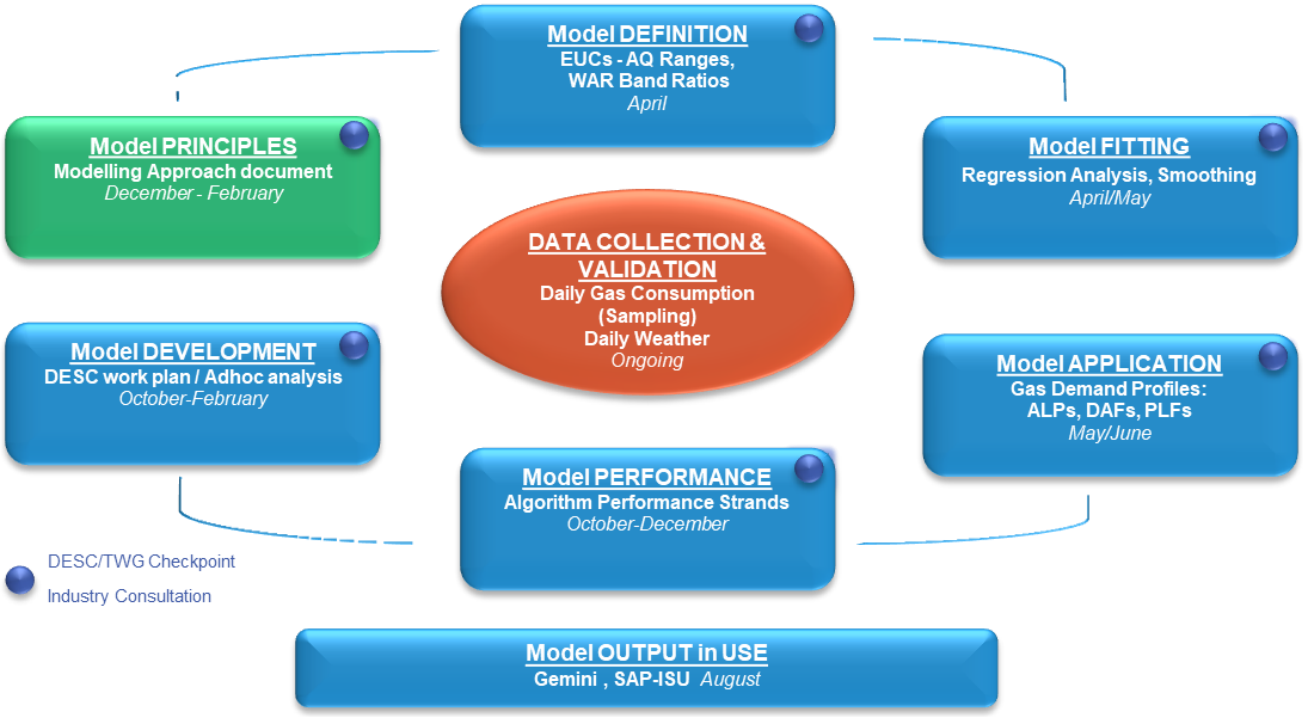
End of Main Document

APPENDIX

Appendix 1 - EUC Demand Model Lifecycle

Overview: EUC and Demand Model Lifecycle

The purpose of the Gas Demand EUC model is to represent the behaviour and reactions of the EUC population



Appendix 2 –Daily Gas Consumption Data Validation

The following provides the proposed validation criteria for use against the Daily Gas Consumption Data in the 2022 Gas Demand EUC Modelling. Section 1 of the NDM Algorithms Booklet will contain further details of the validation process and outcomes.

Small NDM: 0 to 2,196 MWh p.a.

Source	EUC Bands	Missing Days		Consecutive Zeros		Spike Ratios	
		Summer	Winter	Summer	Winter	Summer	Winter
Xoserve Managed Sample (and any third-party data)	01 and 02	15 or more	15 or more	N/A	33 or more	15:01	08:01
Network Managed Sample (and any third-party data)	02, 03 and 04	33 or more	28 or more	N/A	20 or more	10:01	05:01

Large NDM: >2,196 MWh p.a.

Source	EUC Bands	Missing Days		Consecutive Zeros		Spike Ratios	
		Annual	Winter	Annual	Winter	Annual	Winter
Network Managed Sample (and any third-party data)	05,06,07 and 08	44 or more	20 or more	N/A	20 or more	08:01	N/A

Where:
Summer period is defined as 1st March 2021 to 30th September 2021
Winter period is defined as 1st October 2021 to 31st March 2022
Annual period is defined as 1st March 2021 to 31st March 2022

Appendix 3 Population and Target Numbers

Population Numbers as at December 2021

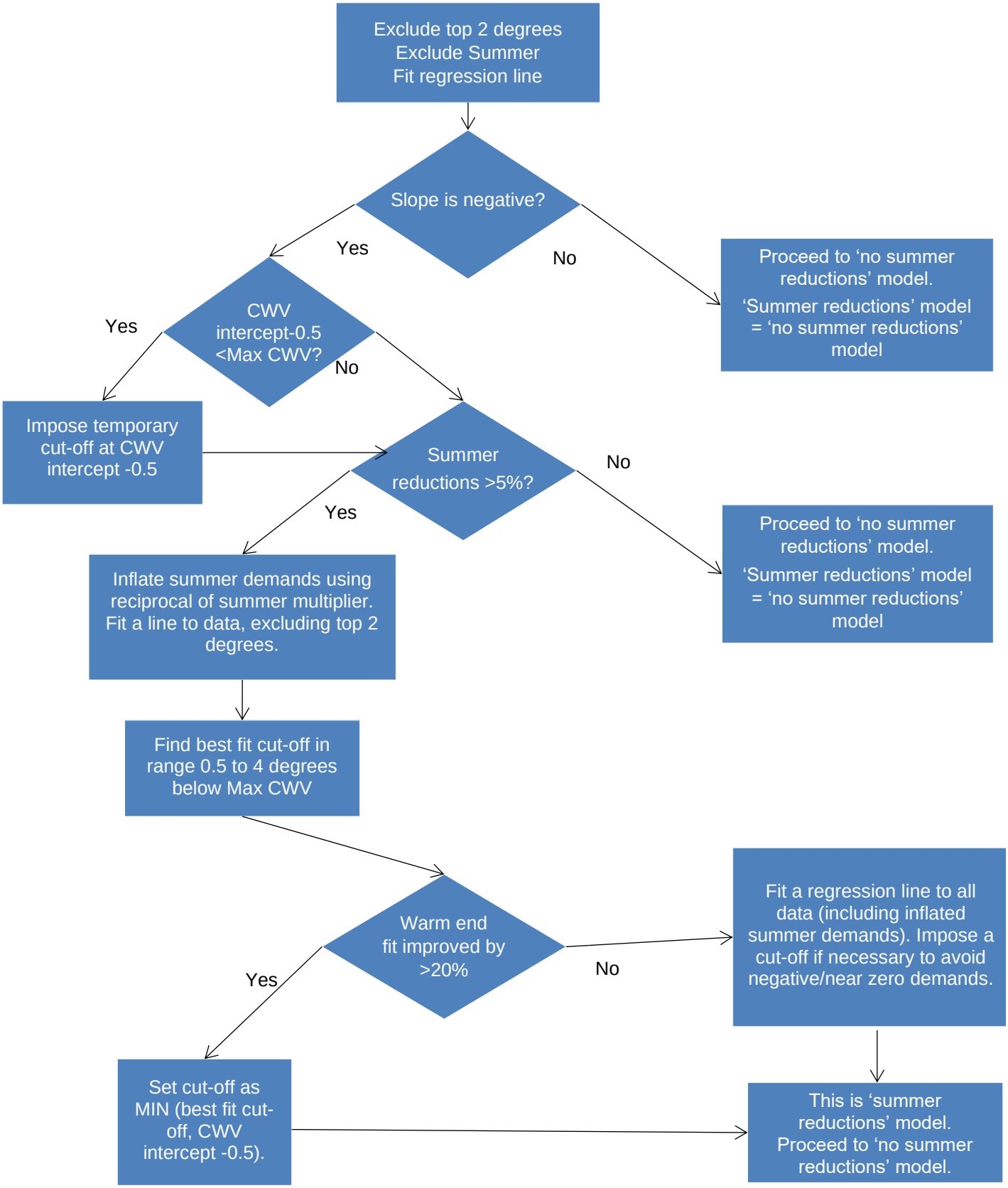
Population Size - December 2021															
EUC Band	AQ Range (mWh)	Customer Type	LDZ												Total
			SC	NO	NW	NE	EM	WM	WN	WS	EA	NT	SE	SO	SW	
01	up to 73.2	Dom Non Pre Pay	1,893,581	1,190,544	2,616,547	1,358,300	2,323,852	1,971,998	242,551	814,227	1,907,531	2,095,953	2,432,989	1,721,892	1,563,834	22,133,799
		I&C Non Pre Pay	37,949	24,004	60,457	33,567	48,654	42,443	6,542	18,708	38,379	59,040	53,217	37,319	35,823	496,102
		Dom PrePay	208,593	100,948	263,663	109,194	176,194	176,251	25,527	81,816	129,693	239,372	218,055	87,279	97,165	1,913,750
		I&C PrePay	199	126	430	221	239	302	28	155	220	515	449	137	140	3,161
02	73.2 to 293	Dom Non Pre Pay	5,052	2,653	6,381	3,919	5,172	4,738	368	1,250	4,916	9,570	8,590	4,093	3,293	59,995
		I&C Non Pre Pay	11,640	6,900	16,381	8,905	13,687	12,618	1,692	4,510	11,360	16,851	15,082	11,527	9,618	140,771
		Dom PrePay	137	103	249	129	145	183	8	49	133	236	170	55	66	1,663
		I&C PrePay	9	9	10	7	6	7	0	0	5	14	16	7	4	94
03	293 to 732	All	4,312	2,339	4,926	2,565	4,089	3,769	434	1,225	3,331	5,626	4,240	3,299	2,502	42,657
04	732 to 2,196	All	1,930	913	1,962	1,066	1,632	1,701	231	592	1,427	2,741	1,708	1,373	1,067	18,343
05	2,196 to 5,860	All	480	224	501	276	389	442	52	132	323	739	335	266	198	4,357
06	5,860 to 14,650	All	139	76	161	110	187	136	24	48	112	175	84	98	104	1,454
07	14,650 to 29,300	All	55	27	74	35	85	48	12	18	48	45	35	32	39	553
08	29,300 to 58,600	All	17	16	40	13	55	33	3	17	25	24	17	11	17	288
		Total	2,164,093	1,328,882	2,971,782	1,518,307	2,574,386	2,214,669	277,472	922,747	2,097,503	2,430,901	2,734,987	1,867,388	1,713,870	24,816,987

Target Sample Numbers based on above population size

Target Sample Size - December 2021															
EUC Band	AQ Range (mWh)	Customer Type	LDZ												Total
			SC	NO	NW	NE	EM	WM	WN	WS	EA	NT	SE	SO	SW	
01	up to 73.2	Dom Non Pre Pay	385	385	385	385	385	385	384	385	385	385	385	385	385	5,004
		I&C Non Pre Pay	381	379	383	381	382	382	364	377	381	383	382	381	381	4,937
		Dom PrePay	384	384	384	384	384	384	379	383	384	384	384	383	383	4,984
		I&C PrePay	131	95	203	141	148	169	26	111	140	221	207	101	103	1,796
02	73.2 to 293	Dom Non Pre Pay	358	336	363	351	358	356	188	294	357	370	369	352	345	4,397
		I&C Non Pre Pay	373	365	376	369	374	374	314	355	372	376	375	373	370	4,766
		Dom PrePay	101	81	151	97	105	124	8	44	99	147	118	48	56	1,179
		I&C PrePay	9	9	10	7	6	7	0	0	5	14	15	7	4	93
03	293 to 732	All	354	331	357	335	352	349	204	293	345	360	353	345	334	4,312
04	732 to 2,196	All	321	271	322	283	312	314	145	233	303	338	314	301	283	3,740
05	2,196 to 5,860	All	214	142	218	161	194	206	46	98	176	253	179	158	131	2,176
06	5,860 to 14,650	All	102	64	114	86	126	101	23	43	87	120	69	78	82	1,095
07	14,650 to 29,300	All	48	25	62	32	70	43	12	17	43	40	32	30	35	489
08	29,300 to 58,600	All	16	15	36	13	48	30	3	16	24	23	16	11	16	267
		Total	3,177	2,882	3,364	3,025	3,244	3,224	2,096	2,649	3,101	3,414	3,198	2,953	2,908	39,235

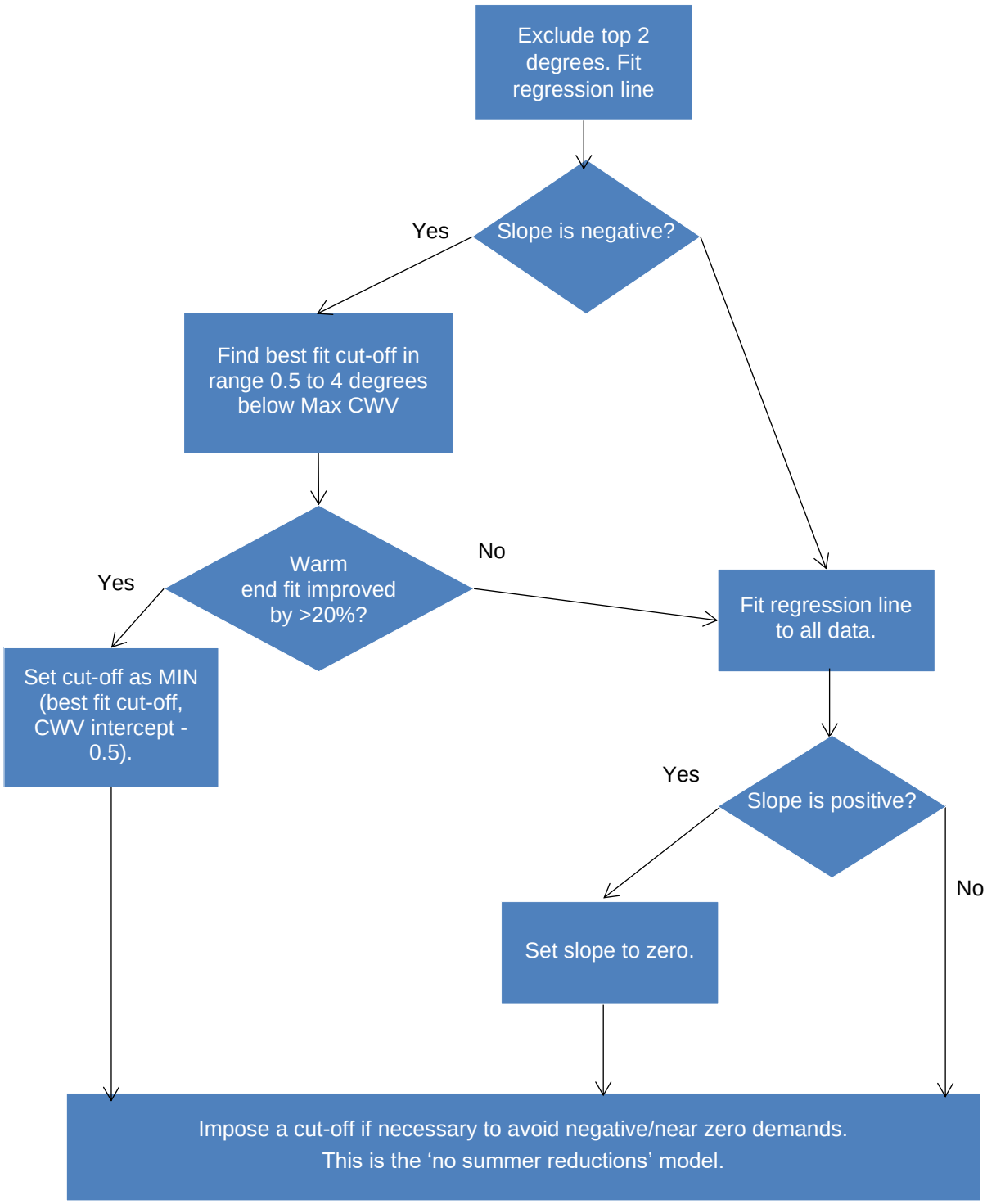
Appendix 4 – Gas Demand EUC Modelling Approach (Potential Summer Reductions)

MONDAY-THURSDAY MODEL WITH POTENTIAL SUMMER REDUCTIONS



Appendix 4 – Gas Demand EUC Modelling Approach (No Summer Reductions)

MONDAY–THURSDAY MODEL WITH NO SUMMER REDUCTIONS



Appendix 5 – Holiday Code Rules

Holiday Code Rules were reviewed winter 2021-22 and changes agreed by DESC in spring 2022.
Current holiday periods and codes for use in Gas Demand EUC Modelling are as follows with recent revisions highlighted:

Holiday Code 1: Not currently in use

Christmas/New Year (Holiday codes 2, 3, and 4) England and Wales LDZs
Holiday period starts on 23rd December and ends on the New Year Bank Holiday if it is a Monday, Sunday 3rd if New Year's Day is Friday, or first Friday in January in all other cases.

Holiday code 2: 25th, 26th December, January 1st and any remaining Bank Holidays (excludes second Scotland New Year Bank Holiday) and any other Saturdays and Sundays in the period

Holiday code 3: Any remaining Mondays to Fridays between 24th December and 1st January

Holiday code 4: **:** Remaining Mondays to Fridays before 24th December and after 1st January

Christmas/New Year (Holiday codes 2, 3, and 4) Scotland LDZs
Holiday period starts on 23rd December and ends on the Second New Year Bank Holiday if it is a Monday or Tuesday, or the first Friday in January in all other cases.

Holiday code 2: 25th, 26th December, January 1st and any remaining Bank Holidays (excludes second Scotland New Year Bank Holiday) and any other Saturdays and Sundays in the period

Holiday code 3: Any remaining Mondays to Fridays between 24th December and 1st January

Holiday code 4: **:** Remaining Mondays to Fridays before 24th December and after 1st January including Second Bank Holiday in Scotland only

Following feedback during the 2020 representation process, we have provided the following table to show the Christmas holiday codes and how they are used in training the model (2018-2021) and how it is applied in calculating derived factors for **Target Gas Year**.

Training Periods								Target Year	
Christmas 2018		Christmas 2019		Christmas 2020		Christmas 2021		Christmas 2022	
Date	Hol Code	Date	Hol Code	Date	Hol Code	Date	Hol Code	Date	Hol Code
Fri 21/12/2018		Sat 21/12/2019		Mon 21/12/2020		Tue 21/12/2021		Wed 21/12/2022	
Sat 22/12/2018		Sun 22/12/2019		Tue 22/12/2020		Wed 22/12/2021		Thu 22/12/2022	
Sun 23/12/2018	2	Mon 23/12/2019	4	Wed 23/12/2020	4	Thu 23/12/2021	4	Fri 23/12/2022	4
Mon 24/12/2018	3	Tue 24/12/2019	3	Thu 24/12/2020	3	Fri 24/12/2021	3	Sat 24/12/2022	2
Tue 25/12/2018	2	Wed 25/12/2019	2	Fri 25/12/2020	2	Sat 25/12/2021	2	Sun 25/12/2022	2
Wed 26/12/2018	2	Thu 26/12/2019	2	Sat 26/12/2020	2	Sun 26/12/2021	2	Mon 26/12/2022	2
Thu 27/12/2018	3	Fri 27/12/2019	3	Sun 27/12/2020	2	Mon 27/12/2021	2	Tue 27/12/2022	2
Fri 28/12/2018	3	Sat 28/12/2019	2	Mon 28/12/2020	2	Tue 28/12/2021	2	Wed 28/12/2022	3
Sat 29/12/2018	2	Sun 29/12/2019	2	Tue 29/12/2020	3	Wed 29/12/2021	3	Thu 29/12/2022	3
Sun 30/12/2018	2	Mon 30/12/2019	3	Wed 30/12/2020	3	Thu 30/12/2021	3	Fri 30/12/2022	3
Mon 31/12/2018	3	Tue 31/12/2019	3	Thu 31/12/2020	3	Fri 31/12/2021	3	Sat 31/12/2022	2
Tue 01/01/2019	2	Wed 01/01/2020	2	Fri 01/01/2021	2	Sat 01/01/2022	2	Sun 01/01/2023	2
Wed 02/01/2019	4	Thu 02/01/2020	4	Sat 02/01/2021	2	Sun 02/01/2022	2	Mon 02/01/2023	2
Thu 03/01/2019	4	Fri 03/01/2020	4	Sun 03/01/2021	2	Mon 03/01/2022	2	Tue 03/01/2023	4 (SC)
Fri 04/01/2019	4	Sat 04/01/2020		Mon 04/01/2021	4 (SC)	Tue 04/01/2022	4 (SC)	Wed 04/01/2023	
Sat 05/01/2019		Sun 05/01/2020		Tue 05/01/2021		Wed 05/01/2022		Thu 05/01/2023	
Sun 06/01/2019		Mon 06/01/2020		Wed 06/01/2021		Thu 06/01/2022		Fri 06/01/2023	

Holiday code 5: Not currently in use

Easter (Holiday codes 6, 7 and 8)
From Wednesday before Good Friday to the Friday after Good Friday (10 days).

Holiday code 6: Easter Saturday and Easter Sunday

Holiday code 7: Good Friday and Easter Monday

Holiday code 8: All other days in the period above.

First Bank Holiday in May (Holiday code 9) Excluding Domestic EUCs
From Saturday immediately preceding Bank Holiday, for 3 days in total.

Holiday code 9 I&C: First Bank Holiday in May; Saturday and Sunday immediately prior

Note: In 2020 when the Bank Holiday was moved to Friday 8th for VE day, the dates used for code 9 are 8th, 9th and 10th May (Friday to Sunday)

Holiday code 10: Not currently in use

Spring Bank Holiday (Holiday codes 11 and 12)
From Sunday immediately preceding bank holiday, for a week.

Holiday code 11: Spring bank holiday; Saturdays and Sundays in period above

Holiday code 12: All other days in period above.

For 2022 Platinum Jubilee: (For information only)
The spring bank holiday is amended from being Monday 30th May 2022 to now occur on Thursday 2nd June 2022 with the Platinum Jubilee bank holiday on the 3rd June 2022 with the following table showing the proposed changes:

	Holiday Based On	
Gas Flow Day	**Existing Rules**	**Revised Platinum Jubilee**
Sun 29th May 22	11	11
Mon 30th May 22	**11**	**12**
Tue 31st May 22	12	12
Wed 1st June 22	12	12
Thu 2nd Jun 22	**12**	**11**
Fri 3rd Jun 22	**12**	**11**
Sat 4th Jun 22	11	11

General Summer Holiday (Holiday codes 13 and 14)
17 days from first Friday on or after 19th July.

Holiday code 13: Saturdays and Sundays in period above.

Holiday code 14: All other days in period above.

August Bank Holiday (Holiday code 15) England and Wales LDZs only
From Saturday immediately preceding Bank Holiday, for 3 days in total.

Holiday code 15: August bank holiday; Saturday and Sunday immediately prior

Holiday code 16: Not Currently in use

Special Codes for Summer Reductions
These special codes are used for certain EUCs where summer reductions need to be modelled.

All non-holiday days over the period from the start of the England and Wales Spring Bank Holiday period above to the to the last Sunday in September are assigned the following codes:

Holiday code 17: Non-holiday Monday to Thursdays in this summer reductions period

Holiday code 18: Non-holiday Fridays in this period

Holiday code 19: Non-holiday Saturdays in this period

Holiday code 20: Non-holiday Sundays in this period

Appendix 6 - Demand Model Smoothing

The key stages of the end user category (EUC) Demand Model Smoothing process are explained below. This is unchanged from previous practice.

Produce models for the EUC based on the data for each of the last three years. In the case that summer reductions have been applied in an individual year, two versions of the Gas Demand EUC Model for that year exist, one with summer reductions and one without summer reductions. Where summer reductions are applied, the magnitude of these reductions is expressed in terms of a summer multiplier applied to the fitted daily demands over the non-holiday days from the spring bank holiday period to the last weekend in September. For example, a summer multiplier of 0.870 means that fitted demands are reduced by 13% over this period. If no summer reductions are applied, the summer multiplier takes value of 1.

Decide whether to apply summer reductions to the final smoothed model. The criterion applied in making this decision is as follows. The summer multipliers for the three individual year models for the EUC are averaged. If this average summer multiplier is less than the critical value of 0.9 (a 10% reduction), summer reductions are applied in the smoothed model; the
Summer multiplier for the smoothed model is this average value. If the average summer multiplier is greater than or equal to the critical value, summer reductions are not applied to the smoothed model.

For example, for an EUC with summer multipliers of 1.000 (i.e. no summer reductions), 0.820, and 0.840 in the individual years, the average summer multiplier is 0.887. This is less than the critical value of 0.9, so a summer reduction is applied to the smoothed model.

This decision process allows a unique Gas Demand EUC Model to be selected for each individual year. If summer reductions are to be applied in the smoothed model, the version of each individual year's model with summer reductions (if such a version exists) is selected. Otherwise, the version without summer reductions is selected for each individual year.

At this stage, the decision as to whether to set weekend effects to zero is taken.

The selected individual year models for the EUC are standardised, by dividing through by the constant for that individual year. This gives a model for each year (yr) of the form:

$$D_t(yr) = 1 + C2(yr)*CWV_t + C3(yr)*Fri + C4(yr)*Sat + C5(yr)*Sun$$

This standardisation ensures that all three individual year models give the same normalised daily demand value (i.e. 1.0) for a non-holiday Monday to Thursday at 0° CWV. This ensures that equal weight is given to each individual year in the smoothing process.

Each individual parameter of the initial smoothed model for the EUC is calculated by averaging the values of the parameter over the three individual years.

For example, C2(smoothed) = {C2(yr. 1) + C2(yr. 2) + C2(yr. 3)}/3

The constant (which is 1 in the standardised model) and the slope of the smoothed model are then multiplied by the constant term of the original (unstandardised) model for the most recent year. Note that this step has no effect on the NDM profiling or capacity estimation parameters, but it gives model parameters of the same scale as that of the model for the most recent individual year.

The multiplicative day of week/holiday factors (P_t as described in Section 3 of the spring 2019 NDM Algorithms booklet) are calculated for the smoothed model for the EUC. These are calculated for each day as averages of the corresponding values in the three individual years' models.

A decision is made as to whether to apply a composite weather variable cut-off to the smoothed model for the EUC. Application of a CWV cut-off has the effect of causing the fitted demand to level off for values of CWV above the cut-off. The criterion used in making the decision is as follows. The value of the CWV cut off is estimated for each year's model. If no cut-off is required, the cut-off value for that year is set to the maximum CWV for the LDZ. The three individual years' CWV cut-offs are then averaged. If this average value is less than the maximum CWV for that LDZ, a CWV cut-off is set at this value in the smoothed model. Otherwise no CWV cut-off is applied to the smoothed model. Note however that cut-offs will not be applied to the models derived for consumption bands up to 293 MWh pa, for the 2020 analysis. This amended approach was agreed

by DESC in December 2003, with a view to mitigating instability during the summer and has been applied to all NDM analyses since spring 2004.

The ensuing form of model is used in the calculation of the Gas Demand Profiles.

A form of the smoothed model is also produced with additive weekend effects. The averaged standardised parameters for each day from Friday to Sunday are multiplied by the constant term of the original unstandardised model for the most recent year, to give additive weekend effects for the smoothed model.

This gives a smoothed model of the form: $D_t = C1 + C2*CWV_t + C3*Fri + C4*Sat + C5*Sun$

C1 as the same value as the constant term of the EUC model for the most recent year. This is a simple form of the smoothed model because it does not embody such features as holiday effects, summer cut-offs and summer reductions. The parameter values for this form of model will be shown in the 2022 NDM Algorithms booklet**.**