

Demand Estimation Sub Committee (DESC)

Modelling Approach 2021

Draft v0.2

Demand Estimation Team
February 2021

MODELLING APPROACH 2021 – DRAFT**EXECUTIVE SUMMARY****Context:**

Gas Demand Profiles represented as 3 parameters – (i) Annual Load Profile (ALP), (ii) Daily Adjustment Factor (DAF) and (iii) Peak Load Factor (PLF) support several key industry processes such as NDM Nominations/Allocations, AQ calculation and Capacity Invoicing.

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 2021 will drive the new set of industry parameters required for the Gas Year commencing 1st October 2021. Appendix 1 provides a visual representation of the Gas Demand EUC Modelling lifecycle and where this document fits within it.

Questions:

The document will provide answers to 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 in order 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 Xserve 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) To be confirmed after DESC review of workplan items

Input Sought:

DESC and Technical Workgroup Representatives are asked to review the document and raise any questions ahead of a DESC meeting on 24th February 2021 where formal approval will be sought from DESC members.

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.

The latest modelling analysis year requires Daily Gas Consumption Data for the period 1st April 2020 to 31st March 2021.

This 12-month period includes at least one complete Easter holiday weekend in the data sets for that year.

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. Previous Daily Gas Consumption Data collections have been insufficient to derive a Gas Demand Profile and DESC will be provided with options if this year's collection is not sufficient.

Validation and Selection:

The Daily Gas Consumption Data collected for the period 1st April 2020 to 31st March 2021 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.

Where the validated Daily Gas Consumption Data for a EUC Band are well in excess of 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 2020.

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 period 1st April 2020 to 31st March 2021.

The weather variables used in Gas Demand EUC Modelling in 2021 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 expected to be used for Gas Demand EUC Modelling in 2021:

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

There are no expected changes for the above weather stations ahead of the start of Gas Year 2021/22.

END USER CATEGORIES:

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 2021/22 – Bands 1 and 2

The proposed End User Categories for Gas Year 2021/22 for EUC Bands 1 and 2 are displayed in the table below:

Consumption Range (Kwh pa)		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	73200	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*
73201	293000	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 2021/22 – Bands 3 and above

The proposed End User Categories for Gas Year 2021/22 for EUC Bands 3 and above are displayed in the table below:

Consumption Range (Kwh pa)		EUC Description					No. of Models Required
From	To	Bucket Band	WAR Band1	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 2020, 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 2021 analysis which, in the main, will be the same as applied in 2020.

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 and subsequent national and localised lockdowns.

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. All decisions and actions will be agreed with DESC TWG during the core demand modelling period of April to July.

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 2° of data (i.e. that for which the CWV is greater than Max. CWV - 2°).
 - 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 2°, 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 2° 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 2°) 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 2020 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 year 2020/21 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 2021 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 that apply to the Christmas/New Year period are the latest that were agreed following discussion at DESC on 8th November 2011. There are additional planned special bank holidays at present in the training and target years. These are covering VE day (May 2020) and Platinum Jubilee (June 2022)

Appendix 5 provides a summary of the holiday code rules which are applied in the Gas Demand Modelling System.

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 (2020/21).

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 2021 with respect to non-statistically significant (at the 95% confidence level) weekend effects:

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

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. It is anticipated that improved and more insightful modelling results and charts will be provided as a result of the new modelling being used in 2020.

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 2021 analysis, which in the main will be the same as that applied in 2020.

Demand Model Smoothing Approach:

1. Year on year Demand Model Smoothing will be used in the 2021 analysis, in deriving the NDM Derived Factors to be applied to gas year 2021/22.
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. The three years will be 2018/19, 2019/20 and 2020/21. For the first of these three analysis years, 2018/19, the data sets cover a 13-month period (March to March); this is necessary to ensure that there is at least one complete Easter holiday weekend in the data sets for that year. For the second and third analysis year, 2019/20 and 2020/21, the data sets cover a 12-month period (April to March).

Note: For the relatively new EUCs in Bands 1 and 2 which require new data streams it is possible that the required historic Daily Gas Consumption Data will be unavailable to create 3 years of models, in which case Demand Model Smoothing will be limited to the number of years models available. Any subsequent references to model smoothing in this document and the use of 3 years will have the same rationale applied.

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 2021 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 to this note.
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. 2017/18, 2018/19 and 2019/20) used in the 2020 implementation of model smoothing will be re-run to correctly consider any changes in holiday periods applicable to the 2021 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. Only the re-runs from the 2018/19 and 2019/20 Daily Gas Consumption Data will be used (along with the Daily Gas Consumption Data for 2020/21) in Demand Model Smoothing, making up the three years of data applied in the 2021 analysis.
3. For all EUCs the Daily Gas Consumption Data will cover the 12-month period April to March in 2019/20 and 2020/21 and cover the 13-month period March to March in 2018/19. All these contain at least one Easter holiday weekend.
4. 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 will be 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 will be asked to support Xoserve's recommendation to continue with the application of three-year Demand Model Smoothing in the manner currently applied. DESC will also be asked to agree that the next review of the application of Demand Model Smoothing should take place in Autumn 2022.

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:

- the Annual Load Profile (ALP) – represents the daily consumption profile for an EUC
- the Daily Adjustment Factor (DAF) – represents the daily weather sensitivity of demand for an EUC
- 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 gas year 2021/22 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 2020 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). The same approach will be adopted in the 2021 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* - 1) Weather Analysis, 2) Unidentified Gas Analysis and 3) 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	Made by
Approach to modelling	Winter 20/21	Agree the approach to Gas Demand EUC Modelling for the 2021/22 Gas Demand Profiles, allowing back runs to be completed and new year modelling. DESC meeting scheduled for 24th February 2021	Technical Workgroup and DESC
Daily Gas Consumption Data validation	19/04/21 to 28/04/21	Agree Gas Demand EUC Modelling runs based on collected data aggregations and WAR band definitions. TWG meeting scheduled for 28th April 2021	Technical Workgroup
Gas Demand EUC Modelling	28/04/21 to 21/05/21	Possible that any issues with the regression analysis need to be reviewed promptly with consensus decisions made quickly.	Technical Workgroup
Gas Demand EUC Modelling	24/05/21 to 24/05/21	Review of all resulting Gas Demand EUC Models. Decisions likely to be required on which models are best for certain EUC/LDZ combinations. Choice of models will be offered that the group shall be required to select. TWG meeting scheduled for 24th May 2021	Technical Workgroup
Draft Gas Demand Profiles	07/06/21 to 25/06/21	Review will be required of the draft Gas Demand Profiles for all EUCs such as Annual Load Profiles and Daily Adjustment Factors.	Technical Workgroup and DESC
Draft Gas Demand Profiles	28/06/21 to 07/07/21	Review and discuss responses to comments from previous phase. Consensus required prior to releasing Gas Demand Profiles for wider industry review. DESC Meeting scheduled for 7th July 2021	Technical Workgroup and DESC
Final Gas Demand Profiles	19/07/21 to 21/07/21	Industry representations to be reviewed along with an agreed response before finalising the Gas Demand Profiles. DESC Meeting scheduled for 21st July 2021	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 gas year 2021/22 would be based on the underlying Gas Demand EUC Models from the 2020 analysis. For the avoidance of doubt, the fall-back proposals will use the actual weekend and holiday dates for gas year 2021/22 and would be available using the rules applicable post the implementation of UNC Modification 0432 (Project Nexus – Gas Demand, Allocation, Settlement and Reconciliation reform).

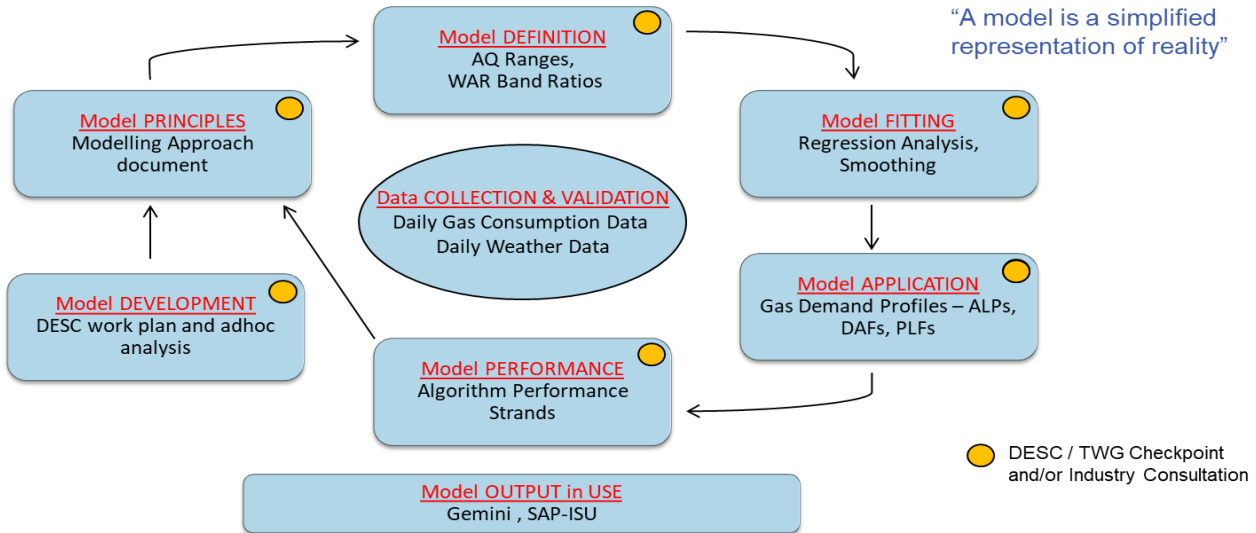
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APPENDIX

Appendix 1 - EUC Demand Model Lifecycle

Overview: EUC & 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 2021 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	28 or more	28 or more	N/A	20 or more	13:01	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	40 or more	20 or more	N/A	20 or more	08:01	N/A

Where:

Summer period is defined as 1st April 2020 to 30th September 2020.

Winter period is defined as 1st October 2020 to 31st March 2021.

Annual period is defined as 1st April 2020 to 31st March 2021

Appendix 3 Population and Target Numbers

Population Numbers as at December 2020

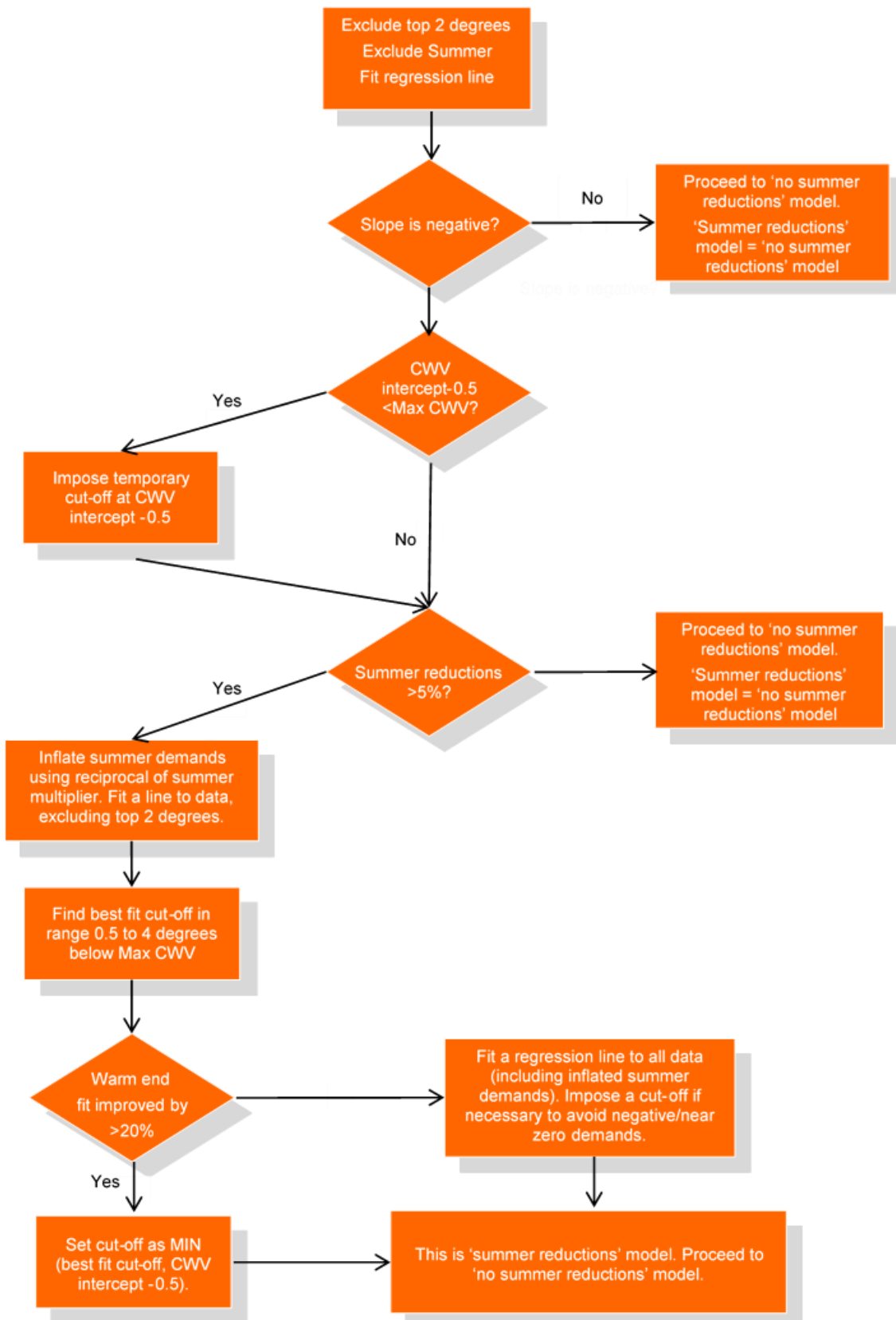
Population Size - December 2020 NDM - Class 3 and 4 only																
EUC Band	AQ Range (mWh)	Customer Type	LDZ													Total
			SC	NO	NW	NE	EM	WM	WN	WS	EA	NT	SE	SO	SW	
01	up to 73.2	Dom Non Pre Pay	1,849,871	1,166,282	2,565,421	1,333,200	2,276,401	1,932,414	236,416	798,771	1,869,633	2,066,137	2,392,238	1,690,128	1,531,142	21,708,054
		I&C Non Pre Pay	41,163	26,808	69,117	39,139	56,430	48,161	7,362	20,740	43,575	66,075	59,630	41,286	40,411	559,897
		Dom PrePay	226,009	111,809	287,323	117,628	192,596	191,664	28,368	90,458	142,252	256,350	238,187	96,758	108,018	2,087,420
		I&C PrePay	241	153	497	237	253	324	35	178	264	556	507	158	162	3,565
02	73.2 to 293	Dom Non Pre Pay	4,133	2,029	4,983	2,974	3,731	3,713	288	939	3,964	8,181	7,208	3,321	2,512	47,976
		I&C Non Pre Pay	12,524	7,607	17,635	9,633	14,779	13,951	1,796	4,683	12,130	18,430	16,083	12,126	10,158	151,535
		Dom PrePay	163	105	235	134	158	266	20	46	126	297	204	61	89	1,904
		I&C PrePay	4	4	6	3	4	5	0	0	9	12	9	4	2	62
03	293 to 732	All	4,365	2,381	4,964	2,599	4,018	3,933	450	1,252	3,375	5,871	4,402	3,319	2,591	43,520
04	732 to 2,196	All	1,937	892	2,012	1,034	1,618	1,694	225	573	1,428	2,727	1,648	1,352	1,011	18,151
05	2,196 to 5,860	All	437	233	492	278	416	434	53	131	308	720	334	264	202	4,302
06	5,860 to 14,650	All	147	74	167	104	164	127	29	44	111	184	96	100	100	1,447
07	14,650 to 29,300	All	54	24	73	38	84	52	8	19	48	39	24	33	43	539
08	29,300 to 58,600	All	14	15	38	13	53	32	2	18	21	21	12	11	13	263
Total			2,141,062	1,318,416	2,952,963	1,507,014	2,550,705	2,196,770	275,052	917,852	2,077,244	2,425,600	2,720,582	1,848,921	1,696,454	24,628,635

Target Sample Numbers based on above population size

Target Sample Size - December 2020 NDM - Class 3 and 4 only																	
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	385	5,004
		I&C Non Pre Pay	381	380	383	381	382	382	366	378	382	383	383	381	381	4,943	
		Dom PrePay	384	384	384	384	384	384	380	383	384	384	384	383	384	4,986	
		I&C PrePay	148	110	217	147	153	176	32	122	157	228	219	112	114	1,935	
02	73.2 to 293	Dom Non Pre Pay	352	324	357	341	349	349	165	273	351	368	366	345	334	4,274	
		I&C Non Pre Pay	374	366	377	370	375	375	317	356	373	377	376	373	371	4,780	
		Dom PrePay	115	83	146	100	112	158	19	41	95	168	134	53	72	1,296	
		I&C PrePay	4	4	6	3	4	5	0	0	9	12	9	4	2	62	
03	293 to 732	All	354	332	357	335	351	351	208	295	346	361	354	345	335	4,324	
04	732 to 2,196	All	321	269	323	281	311	314	142	230	303	337	312	300	279	3,722	
05	2,196 to 5,860	All	205	145	216	162	200	204	47	98	171	251	179	157	133	2,168	
06	5,860 to 14,650	All	107	62	117	82	115	96	27	40	86	125	77	80	80	1,094	
07	14,650 to 29,300	All	47	23	61	35	69	46	8	18	43	35	23	30	39	477	
08	29,300 to 58,600	All	14	14	35	13	47	30	2	17	20	20	12	11	13	248	
Total			3,191	2,881	3,364	3,019	3,237	3,255	2,097	2,636	3,105	3,434	3,213	2,959	2,922	39,313	

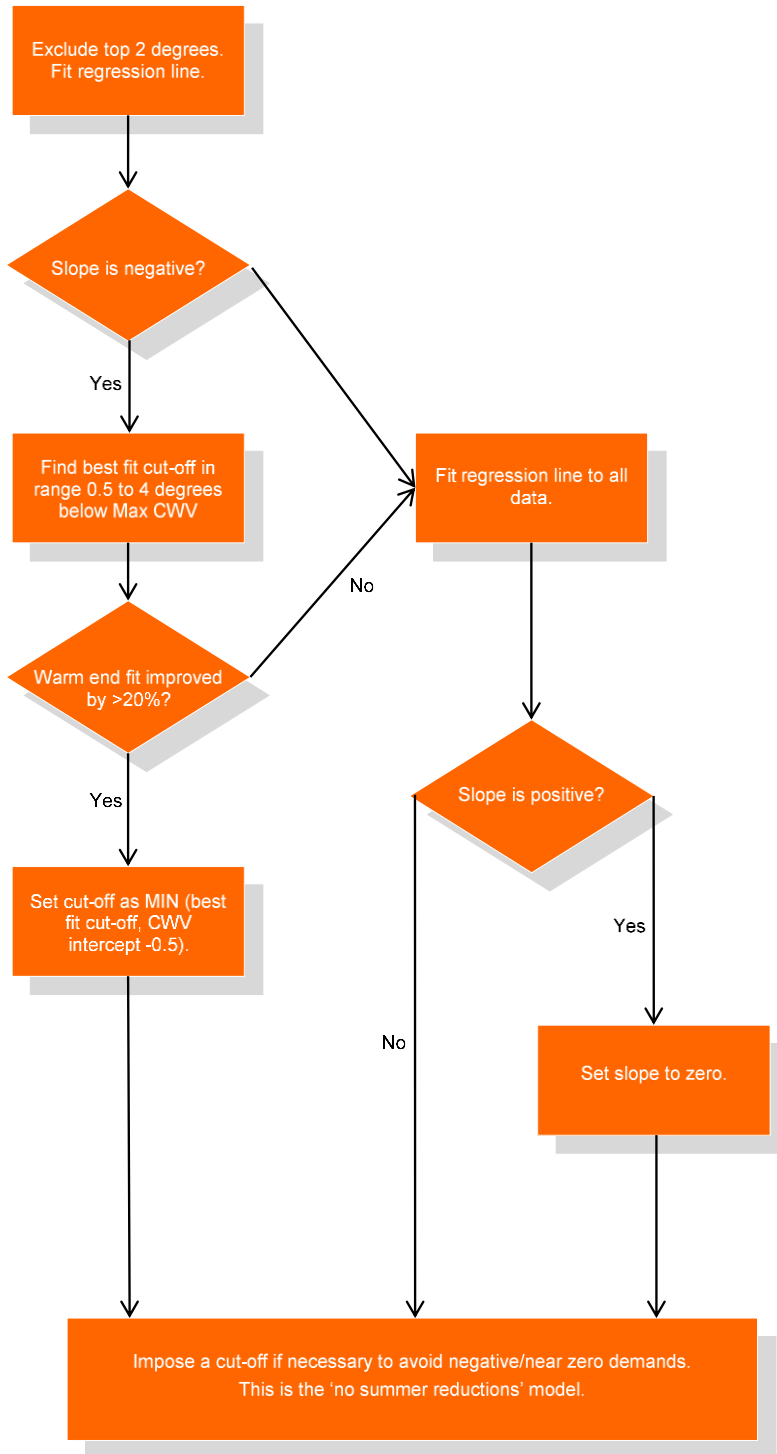
Appendix 4 – Gas Demand EUC Modelling Approach (Potential Summer Reductions)

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

Proposed holiday periods and codes for use in 2021 Gas Demand EUC Modelling are as follows:

Christmas/New Year (Holiday codes 1, 2, 3, 4, and 5)

Holiday period starts on the Monday before 25th December (but if 25th December falls on a Monday, Tuesday or Wednesday, starts on the Friday before 25th December) and ends on the first Friday on or after the second New Year bank holiday in Scotland.

Holiday code 1:

25th December

Holiday code 2:

26th December, January 1st and any remaining bank holidays (except 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 day before second Scotland New Year bank holiday inclusive

Holiday code 4:

Remaining days before 24th December

Holiday code 5:

Remaining days (will always include second Scotland New Year bank holiday)

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 (2018-2020) and also how it is applied in calculating derived factors for Gas Year 2021/22 (2021)

Training Periods						Target Year	
Christmas 2018		Christmas 2019		Christmas 2020		Christmas 2021	
Date	Hol Code	Date	Hol Code	Date	Hol Code	Date	Hol Code
Tue 18/12/2018		Wed 18/12/2019		Fri 18/12/2020		Sat 18/12/2021	
Wed 19/12/2018		Thu 19/12/2019		Sat 19/12/2020		Sun 19/12/2021	
Thu 20/12/2018		Fri 20/12/2019	4	Sun 20/12/2020		Mon 20/12/2021	4
Fri 21/12/2018	4	Sat 21/12/2019	2	Mon 21/12/2020	4	Tue 21/12/2021	4
Sat 22/12/2018	2	Sun 22/12/2019	2	Tue 22/12/2020	4	Wed 22/12/2021	4
Sun 23/12/2018	2	Mon 23/12/2019	4	Wed 23/12/2020	4	Thu 23/12/2021	4
Mon 24/12/2018	3	Tue 24/12/2019	3	Thu 24/12/2020	3	Fri 24/12/2021	3
Tue 25/12/2018	1	Wed 25/12/2019	1	Fri 25/12/2020	1	Sat 25/12/2021	1
Wed 26/12/2018	2	Thu 26/12/2019	2	Sat 26/12/2020	2	Sun 26/12/2021	2
Thu 27/12/2018	3	Fri 27/12/2019	3	Sun 27/12/2020	2	Mon 27/12/2021	2
Fri 28/12/2018	3	Sat 28/12/2019	2	Mon 28/12/2020	2	Tue 28/12/2021	2
Sat 29/12/2018	2	Sun 29/12/2019	2	Tue 29/12/2020	3	Wed 29/12/2021	3
Sun 30/12/2018	2	Mon 30/12/2019	3	Wed 30/12/2020	3	Thu 30/12/2021	3
Mon 31/12/2018	3	Tue 31/12/2019	3	Thu 31/12/2020	3	Fri 31/12/2021	3
Tue 01/01/2019	2	Wed 01/01/2020	2	Fri 01/01/2021	2	Sat 01/01/2022	2
Wed 02/01/2019	5	Thu 02/01/2020	5	Sat 02/01/2021	2	Sun 02/01/2022	2
Thu 03/01/2019	5	Fri 03/01/2020	5	Mon 03/01/2021	2	Mon 03/01/2022	2
Fri 04/01/2019	5	Sat 04/01/2020		Mon 04/01/2021	5	Tue 04/01/2022	5
Sat 05/01/2019		Sun 05/01/2020		Tue 05/01/2021	5	Wed 05/01/2022	5
Sun 06/01/2019		Mon 06/01/2020		Wed 06/01/2021	5	Thu 06/01/2022	5
Mon 07/01/2019		Tue 07/01/2020		Thu 07/01/2021	5	Fri 07/01/2022	5
Tue 08/01/2019		Wed 08/01/2020		Fri 08/01/2021	5	Sat 08/01/2022	
Wed 09/01/2019		Thu 09/01/2020		Sat 09/01/2021		Sun 09/01/2022	
Thu 10/01/2019		Fri 10/01/2020		Sun 10/01/2021		Mon 10/01/2022	

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 codes 9 and 10)

From Saturday immediately preceding bank holiday, for 9 days in total. (Holiday runs from Saturday to Sunday).

Holiday code 9:

First bank holiday in May; Saturdays and Sundays in period above.

- Note Friday 8th May 2020 (VE Bank Holiday) will be treated as Holiday Code 9 as per DESC agreement

Holiday code 10:

All other days in period above.

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:

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:

GAS_FLOW_DAY	Holiday based on	
	Existing Rules	Revised Platinum Jubilee
Sun 29/05/2022	11	11
Mon 30/05/2022	11	12
Tue 31/05/2022	12	12
Wed 01/06/2022	12	12
Thu 02/06/2022	12	11
Fri 03/06/2022	12	11
Sat 04/06/2022	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 codes 15 and 16)

From Sunday 8 days before bank holiday to Tuesday immediately after bank holiday.

Holiday code 15:

August bank holiday; Saturdays and Sundays in period above.

Holiday code 16:

All other days in period above.

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:

$$Dt(yr) = 1 + C2(yr)*CWVt + C3(yr)*Fri + C4(yr)*Sat + C5(yr)*Sun$$

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, $C2(\text{smoothed}) = \{C2(\text{yr. 1}) + C2(\text{yr. 2}) + C2(\text{yr. 3})\}/3$

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 (Pt 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: $Dt = C1 + C2*CWVt + C3*Fri + C4*Sat + C5*Sun$

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 2021 NDM Algorithms booklet.