Modelling Approach: Spring 2019

Ahead of the commencement of the annual process to develop the End User Category (EUC) demand models required by the NDM algorithms, it is customary to prepare a note for Demand Estimation Sub Committee (DESC) and its Technical Workgroup (TWG) setting out the proposed approach to the next cycle of modelling analysis.

Appendix 1 provides a visual representation of the EUC demand model lifecycle and where this document fits within it.

Background:

In spring 2019 the modelling performed will drive the new set of industry parameters required for the Gas Year commencing 1st October 2019. The parameters referenced in the NDM algorithm support key processes such as the NDM nominations and allocation processes.

The implementation of UNC Modification 0432 (Project Nexus – Gas Demand Estimation, Allocation, Settlement and Reconciliation reform) in 2017 changed the overall daily Demand Attribution calculation. As a result unidentified gas is now the balancing figure in the LDZ instead of NDM demand.

The NDM algorithm, which also changed following the implementation of UNC Modification 0432, is now used to calculate a stand-alone bottom up estimate of NDM demand. The Demand Estimation Methodology document is where many of the more detailed formulae now reside.

Since the implementation of UNC Modification 0432, parts of the industry have raised concerns with the new regime, in particular the levels of observed unidentified gas. It is acknowledged that the EUC demand models produced by this process, in order to calculate the bottom up estimate of NDM demand, have a strong association with unidentified gas levels.

This modelling approach document refers to any industry developments over the past 12 months, such as UNC Modifications, change proposals and UiG Task Force recommendations, which are linked to the NDM algorithm.

Modelling Approach:

The remainder of this document will now deal with the proposed overall approach to the data collection, analysis and model smoothing.

Demand Data:

The latest analysis year requires daily demand data for the period 1st March 2018 to 31st March 2019. This 13 month period is necessary to ensure that there is at least one complete Easter holiday weekend in the data sets for that year.

The expected source of the majority of the daily demand data is from the Xoserve managed sample and the Network managed sample. The Xoserve managed sample is mainly comprised of EUC Band 1 domestic sites, although it also includes some EUC Band 2 sites (both non-domestic and domestic). The Network managed sample covers EUC Band 2 and above (up to and including EUC Band 8).

Due to declining numbers in both of these samples, at its meeting on 17th November 2015 DESC agreed the use of third party sample data in the modelling process. 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 current modelling sample. All validated sample data shall be aggregated prior to its use in the EUC modelling system.

At its meeting on 13th February 2018 DESC agreed to produce additional EUC demand models to 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, iii) meter points in Band 2 (73.2-293 MWh pa) which are categorised as domestic. Due to the low number of prepayment customers in Band 2, it was decided that insufficient data would be available to derive a demand model for this customer group. This approach will be followed this year but will only be possible if we can source daily demand data from third parties.

MOD0654S (mandating the provision of NDM sample data) is due to be implemented on 1st March 2019. This modification will introduce an obligation into the UNC for the provision of regular NDM sample data from Shippers to the Central Data Service Provider (CDSP). Although this mod will be implemented, the sample data that is provided voluntarily is still required for the period up to 31st March 2019.

Weather Data:

The weather variables used in the EUC demand modelling in spring 2019 will be Composite Weather Variables (CWVs) and Seasonal Normal Composite Weather Variables (SNCWVs). In line with the approach from spring 2018, the CWVs will be based on a combination of the weather data series derived from the Weather Station Substitution Methodology (WSSM) project, UK Link and SAP-ISU data. The SNCWVs used will reflect the seasonal normal basis which became effective on 1st October 2015.

At its meeting on 5th September 2018, DESC discussed the closure of Filton weather station. Analysis of a suitable substitute station was presented and DESC agreed on Yeovilton being the preferred station. This means from 1st October 2018 the CWV for LDZ SW now uses the weather data from Yeovilton with bias adjustments applied to mimic Filton. The bias adjusted CWV for SW will be applied up until 30th September 2020. After this period the CWV will be calculated using optimised parameters derived directly from Yeovilton weather station.

There are no expected changes for the remaining weather stations ahead of the start of gas year 2019/20.

End User Categories:

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 modelling purposes only, owing to the similarity in their profiles. DESC had already previously agreed that should it become necessary due to limited sample strength, the data sets applicable to consumption bands 07 and 08 could be combined for WAR band 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 adhoc work plan.

As previously mentioned, DESC also agreed to produce demand models which could support additional EUCs in Band 1 (0-73.2 MWh pa) and Band 2 (73.2-293 MWh pa).

The proposed End User Categories for Gas Year 2019/20 are displayed in the tables below and are in line with those proposed in change proposal XRN4665 – "Creation of New End User Categories".

The table below represents EUC Bands 1 and 2 including the additional definitions

Consumption Range (Kwh pa)		EUC	Comments	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	0*
73,201	293,000	xx:Eyy02BND	Domestic	1
73,201	293,000	xx:Eyy02BPD	Prepayment Domestic	0*
73,201	293,000	xx:Eyy02BNI	I&C	1
73,201	293,000	xx:Eyy02BPI	Prepayment I&C	0*

*Note: Due to a lack of sample data (low population numbers), DESC confirmed at its meeting on December 10th 2018, the following:

For the Prepayment I&C EUCs (xx:Eyy01BPI and xx:Eyy02BPI) the underlying demand model will be the Non-Domestic (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 demand model will be the Prepayment Domestic EUC in Band 1 (xx:Eyy01BPD).

The table below relates to the remaining EUCs - Bands 3 and above - which are not proposed to change.

Consumption Range (Kwh pa)		EUC Description					No. of Models req'd
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

Model smoothing:

The last assessment of model smoothing as applied to NDM demand estimation was presented at the DESC meeting on 8th October 2018. The results of the assessment confirmed that the objective of 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 3 year model smoothing in the manner currently applied. DESC also agreed that the next review of the application of model smoothing should take place in autumn 2020.

This document now summarises the proposed overall approach to be applied for the spring 2019 NDM analysis.

Specific Points of Detail:

Model smoothing:

1. Year on year model smoothing will be used in the spring 2019 NDM analysis, in deriving the NDM Derived Factors to be applied to gas year 2019/20.

2. In the absence of evidence of trends in the parameters of the year on year models, simple averaging will be applied to the NDM models feeding into model smoothing.

3. The NDM models for three years will be used for model smoothing. The three years will be 2016/17, 2017/18 and 2018/19. For both the first and third of these three analysis years, the data sets cover a thirteen 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 analysis year, 2017/18, the data sets cover a twelve month period (April to March).

   Note: For those additional EUCs which require new data streams it is likely that the required historic daily demand data will be unavailable to create 3 years of models, in which case 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. This is the approach adopted for each NDM analysis since spring 1999 (i.e. all previous NDM analyses in which model smoothing was applied), and there is no real alternative to this. 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 spring 2019 analysis.

5. The approach to 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 2 to this note.

6. Following the Autumn 2018 review, the assessment of the approach to model smoothing is scheduled to be reviewed in full again by DESC during the autumn of 2020 following finalisation of the NDM algorithms for 2020/21.

Model Re-runs:

1. To assist in any investigation of trends, all three years (i.e. 2015/16, 2016/17 and 2017/18) used in the spring 2018 implementation of model smoothing will be re-run to correctly take into account any changes in holiday periods applicable to the spring 2019 NDM analysis.

   Note: For the additional EUCs, in the event that daily demand 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 2016/17 and 2017/18 data sets will be used (along with the new data sets for 2018/19) in model smoothing, making up the three years of data applied in the spring 2019 analysis.

3. For all EUCs the data sets will cover the 12 month period April to March in 2017/18 and cover the 13 month period March to March in 2016/17 and 2018/19. All these contain at least one Easter holiday weekend.

4. 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 no planned special bank holidays at present for the 2019/20 period.

   Therefore the holiday code rules that apply will be unchanged from the spring 2018 analysis. Appendix 3 provides a summary of the holiday code rules which are applied in the EUC 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 model smoothing in spring 1999 and continues to be appropriate because EUC sample data from geographically adjacent LDZs are usually aggregated to allow some EUCs to be modelled. Both population and sample 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 EUC profiles for the target gas year (2019/20).

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.

Demand Data Validation and Selection:

The daily demand dataset collected for the period 1st March 2018 to 31st March 2019 will be subject to validation prior to its use in developing the EUC demand models. The validation criteria aims to strike the balance between maximising the amount of sample sites available for modelling and ensuring any erroneous and/or missing data is removed from the process, so not to have an adverse effect on the modelling results and conclusions.

Appendix 4 displays a summary of the validation criteria to be applied to the various EUC Bands.

UIG Taskforce findings showed that there are different weather sensitivities for small domestic users compared with the Band 1 average. DESC agreed at its meeting on 10th December 2018 that it would be good practice if the validated sample sites selected for the Band 1 domestic model are sourced appropriately from different sub bands. This stratification would be applied using the following proposed sub-bands: 0-10, 10-20, 20-30 30-73.2 MWh. DESC also recommended applying a stratification method to Band 2 Non Domestic sites (proposed sub-bands to be confirmed).

Where the validated sample points for a particular 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 sample points needed for the sample to be representative of the population. In this case this means not using all of the sample points available. DESC agreed that the Xoserve and Network managed samples should be used primarily to retain continuity within the demand models. Any additional sites obtained from third party provided data will be randomly selected to avoid any shipper bias in the demand profiles created.

Appendix 6 displays the latest view of the suggested target sample size. These numbers are based on a snapshot of the population as of September 2018.

Modelling Details:

1. The general modelling approach to be adopted for the spring 2019 analysis will be the same as that applied in spring 2018. This approach is detailed in the flowcharts on pages 9 and 10 in Section 3 of the June 2018 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 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 or not 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. Model smoothing considers three years' models and the application of summer reductions or not to the smoothed model is dependent on all of 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 June 2018 NDM Algorithms booklet.). Note: This approach will also be applied to the new EUCs in Bands 1 and 2.

3. The data applicable to the analysis year 2018/19 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 Appendix 5 below).

4. The 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 spring 2019 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 2.

7. As set out in Appendix 2, 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 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 spring 2019 with respect to non-statistically significant (at the 95% confidence level) weekend effects:

   For those EUCs where the demand models use a domestic sample (xx:Eyy01BND, xx:Eyy01BPD and xx:Eyy02BND) all positive non-significant weekend effects will be retained at their original values.

   For all of 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 samples applicable to the 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 sample numbers for more robust demand modelling and merge two bands which analysis has shown to display similar consumption behaviour.

    It is recommended that the 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 demand models, used for deriving the final smoothed model for EUC bands 07 and 08, will all be based on the combined approach.

Exploratory Analyses – End User Categories:

In line with spring 2018, the exploratory NDM analyses 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.

Derived Factors:

“Derived Factors” is a UNC Term and it represents three core 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

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 2019/20 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 NDM Algorithm.

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 June 2018 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 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).

ALP and DAF Factors:

During the development of the ALPs and DAFs for Gas Year 2018/19, DESC approved an amendment to the Demand Estimation Methodology (3.4.4). This update proposed that the ALPs and DAFs produced by the Demand Estimation process should be multiplied by a set of factors for use in the daily Gas Nominations and Allocations calculations.

These factors were developed by a member of the Demand Estimation Sub Committee and were designed to minimise the volatility of unidentified gas. DESC decided at its meeting on 10th December 2018 that they would like the option to utilise such factors again in 2019/20. This would, however, require a new set of factors to be calculated and a change to the Demand Estimation Methodology (3.4.4) which currently states the factors will be in place for Gas Year 2018/19 only.

Note: A decision to proceed with such factors should be considered alongside any recommendations from the UIG Workgroup which may mitigate the need for the approach taken in 2018.

Fall-back Position:

Section H of UNC states that, in the event DESC does not wish to approve the proposed derived factors (ALPs, DAFs and Peak Load Factors) derived from the spring analysis, 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 derived factors based on the underlying EUC demand models from the previous year's spring NDM analysis.

Therefore the fall-back position that would apply is that EUC definitions and derived factors applied to gas year 2019/20 would be based on the underlying EUC demand models from the spring 2018 NDM analysis. For the avoidance of doubt, the fall-back proposals will use the actual weekend and holiday dates for gas year 2019/20 and would be available using the rules applicable post the implementation of UNC Modification 0432.

Reporting:

The parameters for the smoothed models will be provided in electronic form for each of the three years feeding into 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.

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 2018/19). The same approach will be adopted in the 2019 NDM Algorithms booklet.

The performance evaluation appendix of the 2019 NDM Algorithms booklet includes four strands of information:
1) Weather Analysis, 2) Unidentified Gas Analysis, 3) NDM Daily Demand analysis and 4) Reconciliation Analysis.

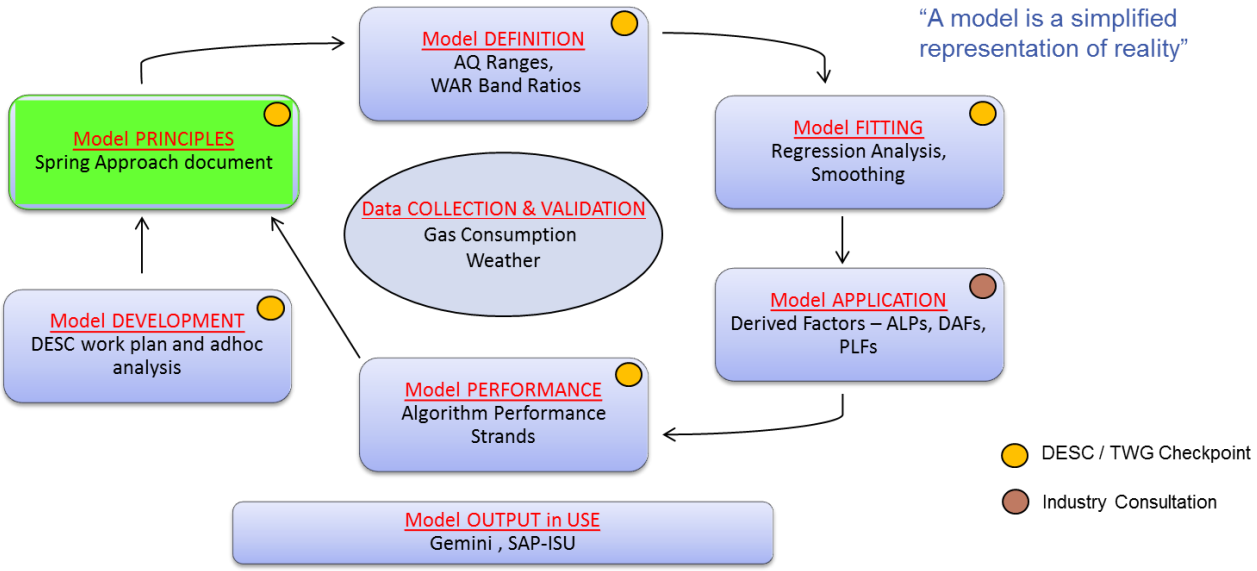
As agreed by DESC at the 7th November 2012 meeting this evaluation will be a repeat of the gas year analysis published in the autumn / winter period. The analysis will not be updated prior to inclusion in the NDM Algorithms booklet.

End of Main Document

Appendix

Appendix 1 - EUC Demand Model Lifecycle

The purpose of the EUC Demand Model is to represent the behaviour and reactions of the EUC Population



Appendix 2 - EUC Model Smoothing

The key stages of the end user category (EUC) 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 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 a 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 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, $C2(smoothed) = \{C2(yr.\ 1) + C2(yr.\ 2) + C2(yr.\ 3)\}/3$

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 (Pt as described in Section 3 of the spring 2018 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 spring 2019 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 NDM profiling parameters and capacity estimation parameters.

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 has 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 2019 NDM Algorithms booklet, for consistency with previous years' reports.

Appendix 3 – Holiday Code Rules

Proposed holiday periods and codes for use in spring 2019 EUC modelling

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)

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.

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.

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 4 – Demand Data Validation

The following provides the proposed validation criteria for use against the daily demand data in the spring 2019 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 2018 to 30th September 2018.
Winter period is defined as 1st October 2018 to 31st March 2019.
Annual period is defined as 1st March 2018 to 31st March 2019.

Appendix 5 – Interaction and Decision Points

Phase	Approx. Dates	Interaction / Decisions	Made by
Approach to modelling	Winter 18/19	Agree the approach to be taken to modelling for the 2019/20 NDM profiles allowing back runs to be completed and new year modelling.	Technical Workgroup and DESC
Sample data validation	22/04/19 to 26/04/19	Agree modelling runs based on collected data aggregations and WAR band definitions TWG meeting scheduled for 24/04/19	Technical Workgroup
Single year modelling	29/04/19 to 10/05/19	Possible that any issues with the regression analysis need to be reviewed promptly with consensus decisions made quickly	Technical Workgroup
Single year modelling	13/05/19 to 17/05/19	Review of all single year modelling results. 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 DESC Meeting scheduled for 15/05/19	Technical Workgroup
Draft NDM profiles	03/06/19 to 21/06/19	Review will be required of draft NDM Derived Factors for all EUCs such as Annual Load Profiles and Daily Adjustment Factors.	Technical Workgroup and DESC
Draft NDM profiles	01/07/19 to 08/07/19	Review and discuss responses to comments from previous phase. Consensus required prior to releasing Derived Factors for wider industry review TWG and DESC Meeting scheduled for 08/07/19	Technical Workgroup and DESC
Final NDM profiles	22/07/19 to 26/07/19	Industry representations to be reviewed along with an agreed response before finalising the NDM Derived Factors DESC Meeting scheduled for 22/07/19	DESC

Appendix 6 – Target Sample Size

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	Domestic	384	384	384	384	384	384	383	384	384	384	384	384	384	4,991
		I&C	380	379	382	380	381	381	364	377	381	382	382	380	380	4,929
		PrePayment	384	383	384	383	384	384	380	383	383	384	384	383	383	4,982
02	73.2 to 293	Domestic	338	291	344	329	334	328	120	231	340	363	358	330	312	4,018
		I&C	374	367	377	371	375	375	322	358	373	377	376	373	371	4,789
		PrePayment	47	26	56	41	39	53	3	26	31	69	40	13	17	461
03	293 to 732	All	355	331	357	337	352	351	212	293	347	361	353	345	337	4,331
04	732 to 2,196	All	326	273	325	286	314	317	150	231	307	340	315	304	287	3,775
05	2,196 to 5,860	All	223	154	230	169	208	216	53	108	185	260	192	166	142	2,306
06	5,860 to 14,650	All	113	74	112	85	126	111	23	40	82	137	75	79	81	1,138
07	14,650 to 29,300	All	54	25	61	35	68	43	14	21	32	39	29	31	39	491
08	29,300 to 58,600	All	16	14	26	14	35	27	1	14	16	13	14	13	9	212
		Total	2,994	2,701	3,038	2,814	3,000	2,970	2,025	2,466	2,861	3,109	2,902	2,801	2,742	36,423

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