Approach to Spring 2017 NDM Analysis

Impacts of Industry change programme:

Ahead of each annual NDM analysis, 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 NDM analysis.

In Spring 2017 the modelling performed will drive the new set of industry parameters required for 1st October 2017. This includes those parameters referenced in the NDM algorithm which supports key processes such as the NDM nominations and allocation processes. As a result of the implementation of UNC Modification 0432 (Project Nexus – Gas Demand Estimation, Allocation, Settlement and Reconciliation reform) the formula for the NDM algorithm is changing to reflect the fact that NDM energy will no longer be the balancing figure in the LDZ, instead being used to calculate a stand-alone bottom up estimate of NDM demand, resulting in a new balancing figure of unidentified gas. There is also the new concept of a Demand Estimation Methodology document where many of the more detailed formulae will reside.

These changes include removal of the Scaling Factor (SF), an amendment to the Weather Correction Factor (WCF) to reflect 'real' variations in weather experience and a change to how the Daily Adjustment Factor (DAF) is calculated as a result of the change to WCF. The Daily Adjustment Factor (DAF) will no longer require the 'SND and weather sensitivity relationship' output from an aggregate NDM demand model to compare to. Updates to the EUC modelling system have been made to incorporate these changes in approach. For the avoidance of doubt the definition of the Annual Load Profile (ALP) remains unchanged.

Background:

The remainder of this document will now deal with the more traditional proposed overall approach to the analysis and to model smoothing.

The last assessment of model smoothing as applied to NDM demand estimation was presented to the TWG meeting on 17th November 2015. 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 TWG'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 2018, with a checkpoint to review this decision in the summer of 2017.

At the meeting on 17th November 2015 DESC also agreed the use of Shipper sample data in the modelling process. Any data provided by a shipper will be required in an agreed format 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.

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. In addition 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 both consumption band and WAR band EUC modelling in these consumption ranges.

The weather variables used in the EUC in spring 2017 will be Composite Weather Variables (CWVs) and Seasonal Normal Composite Weather Variables (SNCWVs). In line with the approach from Spring 2016, the CWVs will be based on a combination of the weather data series derived from the Weather Station Substitution Methodology (WSSM) project and UK Link data. The SNCWVs used will reflect the seasonal normal basis which became effective on 1st October 2015.

There are no weather station changes expected ahead of the start of gas year 2017/18.

The most recent 'health check' report from the Met Office suggests there are ongoing issues with 2 of the gas industry weather stations; Southampton and Filton. It may be advisable for DESC to consider this during 2017 in readiness for possible changes, however both of these issues do not appear to be an imminent threat to the preparations of the NDM Derived Factors for 2017/18.

This document now summarises the proposed overall approach to be applied for the spring 2017 NDM analysis.

Specific Points of Detail:

Model smoothing -

1. Year on year model smoothing will be used in the spring 2017 NDM analysis, in deriving the NDM Derived Factors to be applied to gas year 2017/18.

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 2014/15, 2015/16 and 2016/17. For both the first and second of these three analysis years, the data sets cover a twelve month period

(April to March) while for the third (i.e. the latest) analysis year, 2016/17, 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.

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 2017 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 1 to this note.

6. Following the Autumn 2015 review, the assessment of the approach to model smoothing is scheduled to be reviewed in full again by DESC during the autumn of 2018 following finalisation of the NDM algorithms for 2018/19, pending the checkpoint decision the previous summer in 2017.

Model Re-runs:

1. To assist in any investigation of trends, all three years (i.e. 2013/14, 2014/15 and 2015/16) used in the spring 2016 implementation of model smoothing will be re-run to correctly take into account any changes in holiday periods applicable to the spring 2017 NDM analysis.

2. Only the re-runs from the 2014/15 and 2015/16 data sets will be used (along with the new data sets for 2016/17) in model smoothing, making up the three years of data applied in the spring 2017 analysis.

3. For all EUCs the data sets will cover the 12 month period April to March in 2014/15 and 2015/16 and cover the 13 month period March to March in 2013/14. 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 2017/18 period. Therefore the holiday code rules that apply will be unchanged from the spring 2016 analysis.

   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 (2017/18). 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 “02B” EUCs and above.

Modelling Details

1. The general modelling approach to be adopted for the spring 2017 analysis will be the same as that applied in spring 2016. This approach is detailed in the flowcharts on pages 9 and 10 in Section 3 of the June2016 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 2016 NDM Algorithms booklet.)

3. The data applicable to the analysis year 2016/17 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 2 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 (i.e. the "01B" and "02B" EUCs), for the spring 2017 analysis. This amended 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 1.

7. As set out in Appendix 1, 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. A single EUC will be applied in each LDZ for the consumption range 0 - 73.2 MWh pa. Domestic only data sets will be applied to modelling this consumption range. This is in line with the approach taken in spring 2016. There has been various analysis investigating the appropriateness of this approach which is described in the paragraph below:

   Following a detailed investigation (reported to DESC on 8th November 2007) of the modelling of this consumption range as two sub bands split at 20 MWh pa and at 30 MWh pa, with and without non-domestic supply points included in the upper sub-band, it was clearly shown that given the available sample strength no statistical improvement in the representation of the consumption range was obtained by either sub-bands or the inclusion of non-domestic supply points. Furthermore, a follow-up investigation (reported to DESC on 11th November 2008) of assessing potential breakpoints other than 73.2 MWh pa for dividing the range 0-293 MWh pa, showed clearly that breakpoints lower than 73.2 MWh pa at 30 MWh pa and 60 MWh pa gave no statistical improvement over the currently applied 73.2 MWh pa. The results of a further analysis of three sub-bands of the consumption range 0 to 73.2 MWh pa (split at 10 MWh pa and 20 MWh pa) was presented to DESC on February 1st 2012 which concluded that there was no compelling evidence for dividing the 0-73.2 MWh pa consumption band into three sub bands.

10. The following approach will be taken in spring 2017 with respect to non-statistically significant (at the 95% confidence level) weekend effects:

    For 01B EUCs, a purely domestic sample will be used and 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.

11. 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 -

In line with spring 2016, 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 -

1. The DAFs for gas year 2017/18 will be based on the formula in the Demand Estimation Methodology document. It will no longer be required to be computed using output from an aggregate NDM demand model following the decision to change the NDM algorithm 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 June 2016 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 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 comes into effect on the Project Nexus Implementation Date, 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 that 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).

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 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 2017/18 would be based on the underlying EUC demand models from the spring 2016 NDM analysis. For the avoidance of doubt, the fall-back proposals will use the actual weekend and holiday dates for gas year 2017/18 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 load factors with the corresponding EUC load factors that applied in the previous gas year (in this instance 2016/17). The same approach will be adopted in the 2017 NDM Algorithms booklet.

As first discussed by DESC on 11th February 2015 and finally approved at its meeting on 8th July 2015 the performance evaluation appendix of the 2017 NDM Algorithms booklet will now only include the NDM sample analysis. This represents one of the previously presented three strands of information which is relevant in the new regime. As agreed by DESC at the 7th November 2012 meeting this 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.

Appendix 1 - 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 2016 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 (i.e. the “01B” and “02B” EUCs), for the spring 2017 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 2017 NDM Algorithms booklet, for consistency with previous years' reports.

Appendix 2: Interaction and / or Decision Points			
Phase	**Approx Dates**	**Interaction / Decisions**	**Made by**
Approach to modelling	Winter 16/17	Agree the approach to be taken to modelling for the 2017/18 NDM profiles allowing back runs to be completed and new year modelling.	Technical Workgroup and DESC
Sample data validation	24/04/17 to 28/04/17	Agree modelling runs based on collected data aggregations and WAR band definitions	Technical Workgroup
Single year modelling	02/05/17 to 12/05/17	Possible that any issues with the regression analysis need to be reviewed promptly with consensus decisions made quickly	Technical Workgroup
Single year modelling	15/05/17 to 19/05/17	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	Technical Workgroup
Draft NDM profiles	05/06/17 to 23/06/17	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	03/07/17 to 14/07/17	Review and discuss responses to comments from previous phase. Consensus required prior to releasing Derived Factors for wider industry review	Technical Workgroup and DESC
Final NDM profiles	24/07/17 to 28/07/17	Industry representations to be reviewed along with an agreed response before finalising the NDM Derived Factors	DESC