Spring 2010 NDM Analysis - Proposed Approach

Background

Ahead of each annual NDM analysis, it is customary to prepare a note for DESC setting out the proposed approach to the next NDM analysis. In particular, this note deals with the overall approach to the analysis and the approach to model smoothing.

The bi-annual assessment of model smoothing as applied to NDM demand estimation will be presented to the DESC meeting on 10th November 2009. The results of the assessment support the continued application of model smoothing in the manner currently applied.

In addition DESC has previously agreed that should it become necessary due to limited sample strength, the data sets applicable to consumption bands 07 (14650 - 29300 MWh pa) and 08 (29300 - 58600 MWh pa) could be combined for both consumption band and WAR band EUC modelling in these consumption ranges. However, the spring 2008 and 2009 NDM analyses did not require such a combination of data to be applied.

Also, while there are no weather station changes expected ahead the start of gas year 2010/11, a comprehensive review of CWVs is underway. For each LDZ, revised definitions of CWVs and new seasonal normal weather bases (whatever basis might eventually be adopted) will be presented to DESC on 22nd December 2009. EUC and aggregate NDM demand modelling in spring 2010 will use these new CWVs and SNCWVs.

Using new CWVs and SNCWVs in spring 2010 is a major change. Consequently, no further significant changes are proposed for the spring 2010 analysis. In the light of the CWV and SNCWV revisions, making concurrent further changes to the underlying basis of EUC and aggregate NDM demand modelling is considered inappropriate.

This note summarises the overall approach proposed for the spring 2010 NDM analysis. Please note significant changes from last years approach are shown in blue text.

Specific Points of Detail

Model smoothing

1. Year on year model smoothing will be used in the spring 2010 NDM analysis, in deriving the NDM proposals to be applied to gas year 2010/11.

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 2007/08, 2008/09 and 2009/10. For both the first and third of these three analysis years, all data sets cover a twelve month period (mid-March to mid-March or April to March) while for the second (i.e. the middle) analysis year, 2008/09, the data sets applied to modelling EUCs above 293 MWh pa cover a 13 month period March to March; this is necessary to ensure that there is at least one Easter holiday weekend in the data sets for that year. Note that the mid-March to mid-March data sets of 12 months duration, which are applied to modelling EUCs below 293 MWh p.a. always include at least one Easter holiday period in every 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 2010 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 as an appendix to this note.

6. In line with previous commitments to bi-annual assessment, it is proposed that the approach to model smoothing should be reviewed in full again by DESC during the autumn of 2011, following finalisation of the NDM algorithms for 2011/12.

Model Re-runs

1. To assist in any investigation of trends, all three years (i.e. 2006/07, 2007/08 and 2008/09) used in the spring 2009 implementation of model smoothing will be re-run to correctly take in to account changes in weather variable definitions (CWVs and SNCWVs) and any changes in holiday periods applicable to the spring 2010 NDM analysis.

2. In order to leave open the possible introduction (should the analyses indicate merit in doing so) of a new consumption band breakpoint at 1465 MWh pa in terms of EUC definitions, appropriate back-runs of these consumption band aggregations will be undertaken.

3. Only the re-runs from the 2007/08 and 2008/09 data sets will be used (along with the new data sets for 2009/10) in model smoothing, making up the three years of data applied in the spring 2010 analysis.

4. For EUCs in consumption ranges above 293 MWh pa, the data sets will cover the 12 month period April to March in 2007/08 and 2009/10. For these EUCs in 2008/09, the data sets will cover the 13 month period March to March (to ensure the presence of at least one Easter holiday weekend in that year's data sets).

5. For EUCs for the consumption ranges 0-73.2 MWh pa and 73.2-293 MWh pa, the analyses will in the case of all three years be done on data sets covering 12 months. These data sets run from mid-March to mid-March in each analysis year and therefore always contain at least one Easter holiday weekend.

6. 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. The disposition of holiday codes and the actual holiday factor values (if any) that are applied will be derived from the modelling and will be as indicated by the characteristics of the various applicable data sets themselves. 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 (2010/11).

Modelling Details

1. The general modelling approach to be adopted for the spring 2010 analysis will be the same as that applied in spring 2009. This approach is detailed in the flowcharts on pages 29 and 30 of the spring 2009 NDM Report. A broad outline of the approach is reproduced below :

   a. Exclude warm weather data and summer data (ie. 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 (ie. 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. It is proposed that the current condition of a 5% bar before any summer reduction is considered to apply is 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. It is proposed that 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, is retained in assessing whether or not there should be a cut-off.

   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 Appendix 3, on page 21 of the spring 2009 NDM Report.) As in previous years, holidays will not be excluded from the regression models for "01B" EUCs.

3. The data applicable to the analysis year 2009/10 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.

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 2010 analysis. This amended approach was agreed by DESC in December 2003, with a view to mitigating summer scaling factor instability 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 Appendix attached hereto.

7. As set out in the Appendix, 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. In line with previous practice, a single EUC will be proposed in each LDZ for the consumption range 0-73.2 MWh pa. Also, in accordance with previous practice, domestic only data sets will be applied to modelling this consumption range. 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.

10. For the "01B" EUCs, a pragmatic approach will be taken with respect to weekend effects taking into consideration both observed weekend scaling factor patterns and the prevalence or otherwise of non-positive and/or non-statistically significant (at the 95% level) weekend effects arising from the individual years' models over the weekend days (Friday, Saturday, Sunday). This is consistent with the approach taken during spring 2009 and previous years' NDM analyses.

11. For large NDM (i.e. above 2196 MWh pa), the consumption band break points by which large NDM EUCs are defined will remain the same as in spring 2009 (and all previous years) as required by UNC Clause H1.7.5. However, if sample numbers prove to be insufficient in the most recent year's data sets, it has been agreed with DESC that the samples applicable to consumption ranges 14650 - 29300 MWh pa and 29300 - 58600 MWh p.a. (EUC bands 07 and 08, respectively) may be combined to obtain samples of adequate strength for more robust demand modelling.

    The data may be combined in this way for either the consumption band EUCs or for the WAR band EUCs or for both, depending on whether sample deficiencies require it. Even if 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 p.a. and 29300 - 58600 MWh p.a.

    However, if data has been combined, the underlying demand models applicable to the most recent year of data will be the same for some of these EUCs. For the avoidance of doubt, previous years' data sets for these EUCs, included in deriving the final smoothed model, will be at the level of aggregation that applied at the time (i.e. bands 07 and 08 are separately modelled). Thus, despite any aggregation of data in the most recent year's data sets, the derived factors (i.e. ALPs, DAFs and load factors) will in general be different for each of these EUCs.

    One issue with combining data sets for bands 07 and 08 for WAR bands analyses was revealed during the spring 2009 analysis using the then most recent 2008/09 data set. The models for corresponding WAR bands for bands 07 and 08 are distinctly different. For example, they have markedly different indicative load factors. Therefore, combining these data sets may not be the most appropriate approach to take. The WAR band models based on combined data sets may be inappropriate for both bands. It may therefore be more sensible to accept the models based on smaller data sets. Bearing this in mind, appropriate recommendations will be made to DESC at the early June 2010 Technical Forum based on the results from the most recent 2009/10 data sets.

Exploratory Analyses

As with previous years including spring 2009, it is proposed that the exploratory NDM analyses will focus on confirming EUC definitions (small NDM only) and establishing the most appropriate levels of aggregation to apply to the data sets for the various EUC analyses.

Additionally, as in all previous years, it is proposed that exploratory analyses will be undertaken to establish whether to analyse the consumption range 293-2196 MWh pa as a single data set or to undertake the analysis over this consumption range in more than one set. The alternatives examined will be: 293-732 MWh pa and 732-2196 MWh pa, which was the approach adopted, for these consumption band EUCs only, from the spring 2002 analysis onwards, or including a further consumption band breakpoint at 1465 MWh pa to give three consumption band ranges: 293-732 MWh pa, 732-1465 MWh pa and 1465-2196 MWh pa.

Similarly, as in all previous years, it is proposed that exploratory analyses are undertaken to establish whether to continue to analyse the consumption range 73.2-293 MWh pa as a single data set.

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.

Note that, with the possible exception of the requirements of potential new EUC definition break-point at 1465 MWh pa, whatever the outcome of the analysis of the 2009/10 NDM sample data, the models from the previous two years, used for smoothing purposes, will be based on the aggregations applied in those years' analyses.

Derived Factors

1. The DAFs for gas year 2010/11 will continue to be computed based on aggregate NDM demand.
   It was pointed out ahead of the spring 2009 NDM analysis that UNC did not specify that the aggregate NDM demand model used for computing Derived Factors (UNC term) should be a forecast model, nor did it explicitly state that this should be a historical model (EUC demand models are necessarily always based on historical data). Due to previous practice and therefore implicit convention, the model of aggregate NDM demand used prior to spring 2009 was a forecast model for the target gas year. There was no specific UNC requirement for this to be the case. Accordingly, for the spring 2009 NDM analysis historical models of aggregate NDM demand were derived and used to compute DAFs and, for computing large NDM EUC load factors, 1 in 20 peak demand values for aggregate NDM based on these historical models were derived and used.

   It was noted that the single representation made on the NDM proposals for 2009 and subsequent discussions at DESC in July 2009 indicated concerns about the mechanical use of a historical demand model. However, only two approaches are available in this respect: either the approach reverts back to using forecast models provided by Transporters or a historically based modelling approach is retained. Transporters recommend against changing back to forecast models with just one year of use of historical models (insufficient to gain a reasonable understanding of material impacts of that approach).

   Therefore, it is proposed that for the NDM proposals for 2010/11, the historical aggregate NDM demand modelling approach is retained. The aggregate NDM models used will be models obtained from the average of three previous gas years aggregate NDM data modelled against weather (in this instance gas years: 2006/07, 2007/08 and 2008/09). The ensuing averaged historical model would be applied to the day of the week and holiday pattern of the target gas year but no forecast element would pertain to the model. With respect to a possible fallback position that may arise one year later in spring 2011, the same historical model will be applied to the day of the week and holiday pattern of the gas year 2011/12 to obtain a model appropriate for use in 2011/12 in case the fallback position has to be implemented following a disapproval in summer 2011 of the proposals for 2011/12.

2. Load factor computations for each EUC will be based on the relevant smoothed model. This is the same approach as adopted for all NDM analyses since spring 1999.

3. 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 on page 71 of the spring 2009 NDM Report. This approach has been in place since its introduction at the time of the spring 1997 NDM analysis.

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 proposed for all gas years since 2004/05 it has never been necessary to invoke this constraint).

Fallback position

For clarification, it should be noted that should the final NDM proposals made for gas year 2010/11 be formally disapproved as a result of an application for disapproval made to and upheld by Ofgem, then the fallback position that would apply is that EUC definitions and derived factors (ALPs, DAFs and load factors) would be applied to gas year 2010/11 based on the underlying EUC demand models from the spring 2009 NDM analysis *and the historical aggregate NDM demand models* for 2010/11 computed in spring 2009. For the avoidance of doubt, the fallback proposals will be consistent with the pattern of days of the week and holidays that apply in 2010/11.

Reporting

The parameters for the smoothed models will be published, in an Appendix to the spring 2010 NDM Report.

As usual, all model parameters (for each of the three years feeding into model smoothing) will be provided in electronic form. 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.
As in the spring 2009 NDM Report, all CWV intercepts (for each year's models and for the smoothed model) will be included in the report.
The performance evaluation appendix of the spring 2010 NDM Report will continue to have the now customary three strands of information (WCFs & SFs, RVs and NDM sample analysis).

Early Preview

Subject to the continued use of historical aggregate NDM demand modelling in the spring 2010 NDM analysis and subject also to acceptance at the 4th June 2010 Technical Forum and DESC meeting of the proposed treatment of the most recent 2009/10 data set and specifically acceptance of the resulting EUC demand models, it would be possible to provide (by publishing on the xoserve website) an early preview of ALP, DAF and load factor values for all EUCs as well as aggregate NDM SND and WSENS values for each LDZ by 11th June 2010. If further modelling work is required after the 4th June 2010 meetings, this early preview will not be possible.

Appendix – 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 0.84 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:

$$D_t(yr) = 1 + C_2(yr)*CWVt + C_3(yr)*Fri + C_4(yr)*Sat + C_5(yr)*Sun$$

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

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

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

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

The multiplicative day of week/holiday factors (P_t as described in Appendix 3 of the spring 2009 NDM Report) 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 2010 analysis. This amended approach was agreed by DESC in December 2003, with a view to mitigating summer scaling factor instability and was 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:

$$D_t = C_1 + C_2*CWVt + C_3*Fri + C_4*Sat + C_5*Sun$$

C_1 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 spring 2010 NDM Report, for consistency with previous years' reports.