

## Modelling Approach: Spring 2018

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.

### Impacts of UNC Modification 0432 implementation:

In spring 2018 the modelling performed will drive the new set of industry parameters required for 1<sup>st</sup> October 2018. 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 has changed to reflect the fact that NDM energy is no longer 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 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. As industry discussions continue over the coming weeks and months, for example in Review Group 0631 and the UNC Unidentified Gas Workgroup, it is possible that there could be urgent changes to the formulae used to derive Demand Estimation parameters and/or the current End User Category definitions

~~As a result late amendments to this document could be necessary prior to the commencement of the modelling process in spring 2018~~

### Background:

The remainder of this document will now deal with the ~~more traditional~~ 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 April 2017 to 31st March 2018.

The expected source of the majority of the daily demand data is from the Xserve managed sample and the Transporter managed sample. The Xserve 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 Transporter 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 13<sup>th</sup> 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 and iv) meter points in Band 2 which use pre-payment meters.

These additional EUCs will only be possible if we can source daily demand data from third parties (ideally for the three year period of 1<sup>st</sup> April 2015 to 31<sup>st</sup> March 2018 to enable model smoothing).

### Weather Data:

The weather variables used in the EUC demand modelling in spring 2018 will be Composite Weather Variables (CWVs) and Seasonal Normal Composite Weather Variables (SNCWVs). In line with the approach from Spring 2017, 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 1<sup>st</sup> October 2015.

~~There are no weather station changes expected ahead of the start of gas year 2018/19. At its meeting on 26<sup>th</sup> July 2017 DESC concluded there was no new intelligence which meant there was an imminent threat to the preparations of the NDM Algorithms for 2018/19. DESC concluded that the topic should be reviewed again in July 2018.~~  
At its meeting on 13<sup>th</sup> February 2018 DESC discussed the future of the Filton weather station following intelligence relating to possible closure and relocation of the site. DESC has agreed to proceed with the modelling using Filton weather data and continues to monitor the situation. There are no expected changes for the remaining weather stations ahead of the start of gas year 2018/19.

**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 27<sup>th</sup> November 2013 and the TWG meeting on 15<sup>th</sup> 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 2018/19 are displayed in the tables below:

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

Consumption Range (Kwh pa)		EUC Description			No. of Models req'd
From	To	Domestic	Non-Domestic	Pre-Payment	
0	73,200	xx:Eyy01B	xx:Eyy01I	xx:Eyy01P	3
73,201	293,000	xx:Eyy02B	xx:Eyy02I	xx:Eyy02P	3

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

Consumption Range (Kwh pa)		Bucket Band	EUC Description				No. of Models req'd
From	To		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 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 its meeting on 26<sup>th</sup> July 2017, DESC confirmed they were happy with this decision.

This document now summarises the proposed overall approach to be applied for the spring 2018 NDM analysis.

**Specific Points of Detail:**

**Model smoothing:**

1. Year on year model smoothing will be used in the spring 2018 NDM analysis, in deriving the NDM Derived Factors to be applied to gas year 2018/19.
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 2015/16, 2016/17 and 2017/18. For both the first and third of these three analysis years, the data sets cover a twelve month period (April to March) while for the second 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.

Note: For those EUCs which require new data streams (xx:Eyy01I, xx:Eyy01P, xx:Eyy02B, xx:Eyy02P) 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 2018 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 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.

#### Model Re-runs:

1. To assist in any investigation of trends, all three years (i.e. 2014/15, 2015/16 and 2016/17) used in the spring 2017 implementation of model smoothing will be re-run to correctly take into account any changes in holiday periods applicable to the spring 2018 NDM analysis.

Note: For new EUCs (xx:Eyy01I, xx:Eyy01P, xx:Eyy02B, xx:Eyy02P), 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 2015/16 and 2016/17 data sets will be used (along with the new data sets for 2017/18) in model smoothing, making up the three years of data applied in the spring 2018 analysis.
3. For all EUCs the data sets will cover the 12 month period April to March in 2015/16 and 2017/18 and cover the 13 month period March to March in 2016/17. 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 2018/19 period.

Therefore the holiday code rules that apply will be unchanged from the spring 2017 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 (2018/19).

Following evidence presented at the 15<sup>th</sup> 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 "02B" EUCs and above.

Note: This approach will also be applied to the new EUCs in Bands 1 and 2.

#### Demand Data Validation:

The daily demand dataset collected for the period 1<sup>st</sup> April 2017 to 31<sup>st</sup> March 2018 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.

#### Modelling Details:

1. The general modelling approach to be adopted for the spring 2018 analysis will be the same as that applied in spring 2017. This approach is detailed in the flowcharts on pages 9 and 10 in Section 3 of the June 2017 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 2° of data (i.e. that for which the CWV is greater than Max. CWV- 2°).
  - c. Assess the excluded summer data against the line fitted in step (a) to establish whether a summer reduction is required. The current condition of a 5% bar before any summer reduction is considered to apply to each individual year model will be retained.
  - d. Reintroduce the summer data into the data set (after inflating by any summer reduction identified in step c; if no summer reduction is identified then there would be no inflation). Fit a line to the augmented data set, excluding the warmest 2°, to establish whether a cut-off is appropriate, considering potential cut-offs in the range 0.5 to 4 degrees below the maximum value of the composite weather variable. The criterion applied from spring 2001 onwards, of a 20% improvement in the mean square residual over that obtained by using the straight line alone, will be retained in assessing whether 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 2° 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 2°) in the regression in step a above, and fitting a cut-off if necessary, as in steps d and e above.
2. As previously agreed and implemented from the spring 2002 NDM analysis onwards, weekend effects for the "01B" EUCs will be modelled using the same "variable weather sensitivity" form of model used for all other EUCs. (This form of the model is set out in Section 3 of the June 2017 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 2017/18 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 (~~i.e. the "01B" and "02B" EUCs~~), for the spring 2018 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 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. At its meeting on 13th February 2018 DESC agreed three A single EUCs will be applied in each LDZ for the consumption range 0 - 73.2 MWh pa. These will be defined as follows:
    - a) ~~xx:Eyy01B - Domestic only data sets will be applied to modelling this consumption range. This is in line with the approach taken in spring 2017.~~
    - b) ~~xx:Eyy01I - Non Domestic data sets~~
    - c) ~~xx:Eyy01P - Pre-Payment data sets~~

There has been various analysis investigating the appropriateness of ~~this approach~~ the consumption range 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.

At its meeting on 13th February 2018 DESC agreed three EUCs will be applied in each LDZ for the consumption range 73.2 - 293 MWh pa. These will be defined as follows:

- a) xx:Eyy02B - Domestic only data sets
- b) xx:Eyy02I - Non Domestic data sets
- c) xx:Eyy02P - Pre-Payment data sets

10. The following approach will be taken in spring 2018 with respect to non-statistically significant (at the 95% confidence level) weekend effects:

For 01B, 01P, 02B and 02P 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 – End User Categories:**

In line with spring 2017, 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.

The proposed End User Categories for Gas Year 2018/19 are displayed in the table below:

Consumption Range (Kwh pa)		Consumption Band	WAR Band 1	WAR Band 2	WAR Band 3	WAR Band 4	No. of Models req'd
From	To						
0	73,200	xx:Eyy01B	-	-	-	-	4
73,201	293,000	xx:Eyy02B	-	-	-	-	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					4

In addition to the above proposal, as a result of discussions at DESC and the points raised in UNC Modification-0644, it is possible that DESC may wish for additional End User Categories to be defined in the current 01 and 02 consumption bands. The bands would not require a change to the consumption range but may involve different EUCs based on the type of site



~~usage e.g. domestic, non-domestic or pre-payment meters. This would impact the EUCs in rows 1 and 2 of the table above i.e. 0 to 293,000 Kwh pa.~~

#### Derived Factors:

“Derived Factors” is a UNC Term and it represents the 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 2018/19 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 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 2017 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).

#### 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 2018/19 would be based on the underlying EUC demand models from the spring 2017 NDM analysis. For the avoidance of doubt, the fall-back proposals will use the actual weekend and holiday dates for gas year 2018/19 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 2017/18). The same approach will be adopted in the 2018 NDM Algorithms booklet.

The performance evaluation appendix of the 2018 NDM Algorithms booklet will now include four strands of information:

1) Weather Analysis, 2) Unidentified Gas Analysis, 3) NDM Daily Demand analysis and 4) Reconciliation Analysis.

The inclusion of strand 4 'Reconciliation Analysis' in the 2018 NDM Algorithms booklet depends on DESC confirming the scope and detail of this 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.

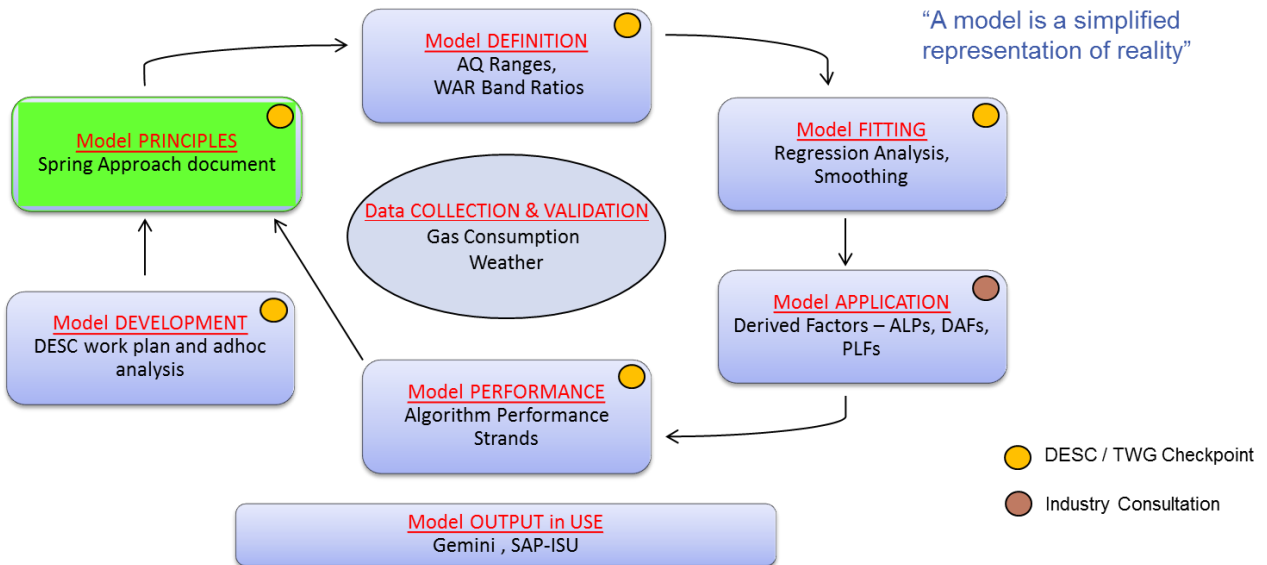
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Appendix

Appendix 1 - EUC Demand Model Lifecycle

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

"A model is a simplified representation of reality"





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

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

The multiplicative day of week/holiday factors (Pt as described in Section 3 of the spring 2017 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 2018 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 2018 NDM Algorithms booklet, for consistency with previous years' reports.

**Appendix 3 – Holiday Code Rules**

Proposed holiday periods and codes for use in spring 2018 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 2018 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
Transporter Managed sample (and any third party data)	02, 03 and 04	28 or more	28 or more	N/A	20 or more	13:01	05:01

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

Source	EUC Bands	Missing Days		Consecutive Zeros		Spike Ratios	
		Annual	Winter	Annual	Winter	Annual	Winter
Transporter Managed sample (and any third party data)	05, 06, 07 and 08	40 or more	20 or more	N/A	20 or more	08:01	N/A

Where:

Summer period is defined as 1st April 2017 to 30th September 2017.

Winter period is defined as 1st October 2017 to 31st March 2018.

Annual period is defined as 1st April 2017 to 31st March 2018.

## Appendix 5 – Interaction and Decision Points

Phase	Approx. Dates	Interaction / Decisions	Made by
Approach to modelling	Winter 17/18	Agree the approach to be taken to modelling for the 2018/19 NDM profiles allowing back runs to be completed and new year modelling.	Technical Workgroup and DESC
Sample data validation	23/04/18 to 27/04/18	Agree modelling runs based on collected data aggregations and WAR band definitions  TWG Teleconference scheduled for 24/04/18	Technical Workgroup
Single year modelling	30/04/18 to 11/05/18	Possible that any issues with the regression analysis need to be reviewed promptly with consensus decisions made quickly	Technical Workgroup
Single year modelling	14/05/18 to 18/05/18	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 15/05/18	Technical Workgroup
Draft NDM profiles	04/06/18 to 22/06/18	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	02/07/18 to 13/07/18	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 09/07/18	Technical Workgroup and DESC
Final NDM profiles	23/07/18 to 27/07/18	Industry representations to be reviewed along with an agreed response before finalising the NDM Derived Factors  DESC Meeting scheduled for 24/07/18	DESC

**End of Document**