

APPENDIX C – DOMESTIC ECONOMY 7 PROFILE CLASSES

Appendix C describes the procedures for splitting and aligning the Economy 7 demand profiles into switched and base load for use in the regression analyses. For Profile Class 2 (Domestic Economy 7), this process has three main steps:

1. Compare the demand profile for customers with storage heating and/or immersion heating to that for customers without either, and hence estimate the fraction of total demand (for each Settlement Period within the standard E7 window of 00:30 to 07:30 GMT) that represents switched load.
2. Use the fractions from step (1) to split the demand profile for each switching regime into base and switched load.
3. Calculate a weighted average of the demand profiles for each switching regime to construct base and switched load demand profiles for the Domestic Economy 7 Profile Class as a whole.

The switched load fractions from step (1) are also used to split the Non-Domestic Economy 7 demand profile into base and switched load. Note that the Non-Domestic sample does not include customers on regimes other than the standard 00:30-07:30, so there is no need to combine data for different switching regimes.

The remainder of this Appendix describes each of these steps in detail.

For the purposes of this Appendix, the year is divided into GMT days (running from 00:00 GMT to 00:00 GMT), each of which contains 48 Settlement Periods. Note that this is different to the approach taken in the regression analysis, where the year is divided into Settlement Days (running from 00:00 clock time to 00:00 clock time). This Appendix therefore uses a different notation to the remainder of the Service Description:

- For the purposes of this Appendix only, subscript 'T' denotes a GMT day (running from 00:00 GMT to 00:00 GMT); and Settlement Period 1 in a given day always starts at 00:00 GMT;
- In the remainder of the Service Description, subscript 'T' denotes a Settlement Day (running from 00:00 local time to 00:00 local time); and Settlement Period 1 in a given day starts at 23:00 GMT during British Summer Time.

Domestic E7 (Step 1) – Estimation of Switched Load Fraction

For the Domestic Economy 7 Profile Class (i.e. Profile Class 2), the equation for the stratum-weighted demand value (see paragraph 4.4.2 of this Service Description) is applied to give a stratum-weighted average demand for the Profile Class as a whole (referred to in this Appendix by the acronym y^{PC2}_{Tj}):

$$y^{PC2}_{Tj} = S_h (W_h y_{Thj})$$

where:

T	=	GMT Day
j	=	Settlement Period (labelled from 00:00 GMT as explained above)
h	=	Stratum
i	=	All customers i in stratum h
W_h	=	Stratum weight for stratum h
y_{Thj}	=	the average demand for GMT Day T, stratum h and Settlement Period j (i.e. the simple arithmetic mean of the y_{Tij} values for all customers i in stratum h)

The equation is also applied separately to three sub-groups of customers within Profile Class 2, deriving a separate stratum-weighted average demand for each:

- Group A – Customers with Storage and Immersion Heating. This section uses the acronym y^A_{Tj} for the stratum-weighted average demand of this group of customers in Settlement Period j of GMT Day T.
- Group B – Customers with Immersion Heating but no Storage Heating. This section uses the acronym y^B_{Tj} for the stratum-weighted average demand of this group of customers in Settlement Period j of GMT Day T.
- Group C – Customers without Storage or Immersion Heating. This section uses the acronym y^C_{Tj} for the stratum-weighted average demand of this group of customers in Settlement Period j of GMT Day T.

Note that customers with Storage Heating but no Immersion Heating are not included in any of the groups (A, B or C). However, their data is still used in the calculation of the overall Profile Class demand y^{PC2}_{Tj} . There are very few such customers, typically less than 5 in the sample.

For the avoidance of doubt, it should be noted that the three customer groups (A, B or C) include E7 customers from all switching regimes, not just the standard 00:30 – 07:30 regime.

For each of the fourteen Settlement Periods in the standard 00:30 – 07:30 GMT regime period, the average demand shapes (y^A_{Tj} , y^B_{Tj} and y^C_{Tj}) are used to calculate average demand values for Storage Heating and Immersion Heating:

$$y^{Immersion}_{Tj} = \max(0, y^B_{Tj} - y^C_{Tj})$$

$$y^{Storage}_{Tj} = \max(0, y^A_{Tj} - y^B_{Tj})$$

which are then combined to create a composite switched load profile:

$$y^{PC2_Switched}_{Tj} = y^{Immersion}_{Tj} * F_{Immersion} + y^{Storage}_{Tj} * F_{Storage}$$

where $F_{Immersion}$ and $F_{Storage}$ are the fractions of the total Domestic E7 sample that have storage heating and immersion heating respectively.

Note: in each case demand values outside the standard 00:30-07:30 regime period should be set to 0.

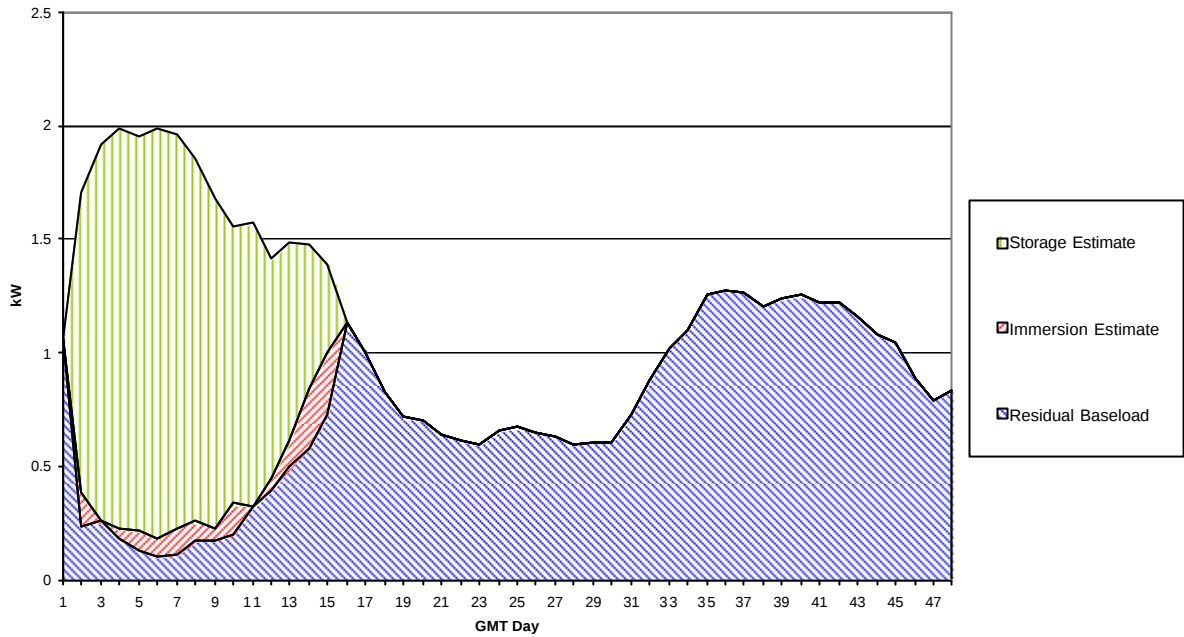


Figure 1 Storage and Immersion Heater Customer Demand Estimates

The switched fractions for each half-hour of the standard 00:30–7:30 regime period (i.e. each value of j from 2 to 15) are then calculated as follows:

$$Y_{Tj}^{\text{FRACTION}} = \max(1, Y_{Tj}^{\text{PC2_Switched}} / Y_{Tj}^{\text{PC2}})$$

Domestic E7 (Step 2) – Split Demand into Base and Switched for Each Regime

The next step of the process is to split the demand values for each separate switching regime in the sample into base and switched load, using the fraction determined in step 1.

In order to do this, stratum weighted average demands must be calculated for all allowable regime sub-groups. Regimes must be seven hour continuous and not more than 1 hour outside the standard 00:30-07:30 regime. There are therefore five regimes potentially eligible for inclusion: 00:30-07:30, 00:00-07:00, 01:00-08:00, 01:30-08:30 and 23:30-06:30. However, a given regime will only be included in the calculation where the sample size is sufficient to create a viable grouping.

This Appendix uses the subscript 'C' to denote a regime included in the calculation, and the acronym y_{TCj} for the stratum-weighted average demand of regime 'C' in Settlement Period j of GMT Day T . The switched load fractions calculated in step 1 are then applied to the y_{TCj} values for each regime to calculate the switched load $y_{TCj}^{\text{PC2_Switched}}$ for each regime as follows:

$$y_{TCj}^{\text{PC2_Switched}} = Y_{T(j-n)}^{\text{FRACTION}} * y_{TCj}$$

where:

- For a given regime 'C', the calculation is performed for those Settlement Periods which fall within the switched load period for that regime. In the case of the 01:30 – 08:30 regime, for example,

the calculation would be performed for Settlement Periods 4 to 17. For all other Settlement Periods, the value of $y_{PC2_Switched_TCj}^{PC2_Switched}$ is zero.

- For a given regime 'C', the offset 'n' in the term $y_{T(j-n)}^{FRACTION}$ is the number of Settlement Periods time difference between regime 'C' and the standard 00:30-07:30 regime. In the case of the 01:30 – 08:30 regime, for example, n would take the value +2. The function of this offset value n is to ensure that the $y_{Tj}^{FRACTION}$ values used are always those for periods 2 to 15, not those for the periods relevant to regime 'C'.
- In the case of the 23:30-06:30 regime (for which n takes the value -2), applying the above equation to period 48 will produce a value of j larger than 48 i.e. $y_{T(50)}^{FRACTION}$. In this context, period 50 of day T has to be interpreted as period 2 of day (T+1). To put this more formally:

$$y_{PC2_Switched_TCj}^{PC2_Switched} = y_{(T+1)(j-n-48)}^{FRACTION} * y_{TCj} \text{ (if } j-n>48\text{)}$$

The base load demand y_{TCj}^{BASE} is then calculated for each GMT Day D, Settlement Period j and regime C by subtracting the switched load from the total:

$$y_{TCj}^{BASE} = y_{TCj} - y_{PC2_Switched_TCj}^{PC2_Switched}$$

Domestic E7 (Step 3) – Calculate Weighted Average of Demand for Each Regime

Calculation of the final switched load demand profile is made by offsetting the load for each individual regime into Settlement Periods 1-14 (as required for the regression analysis), and weighting by sample population estimates.

The following diagram illustrates this process of aligning different regimes on the standard Settlement Periods 1-14:

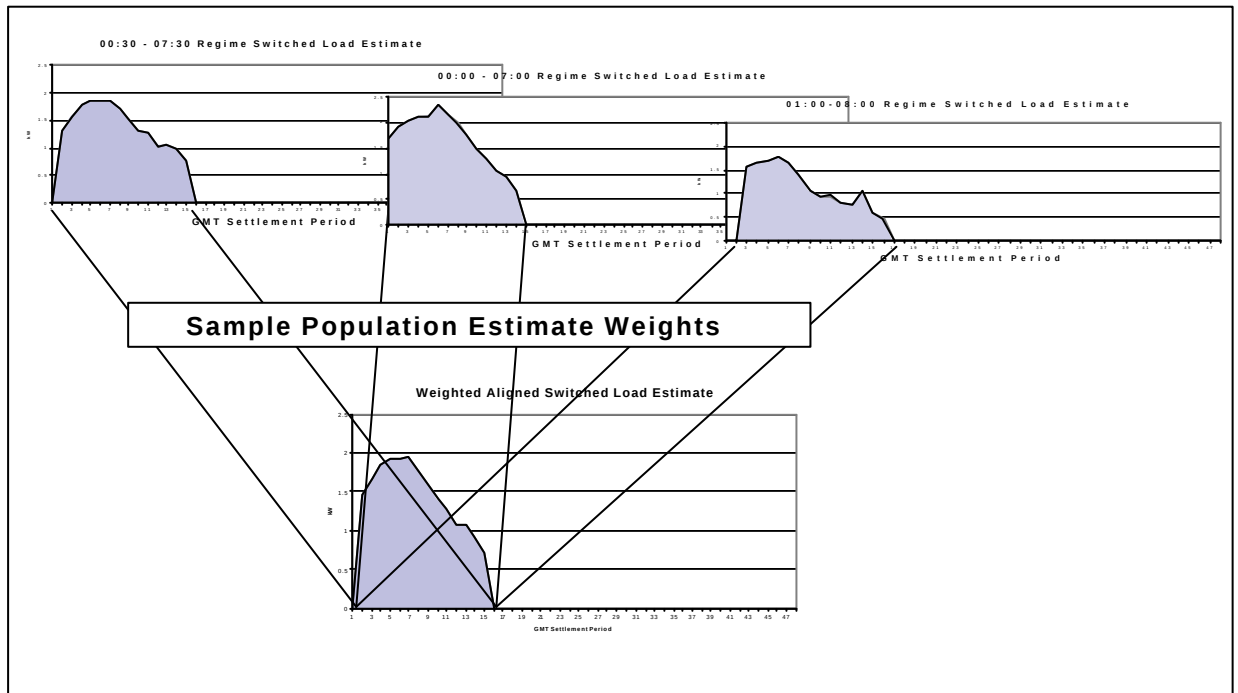


Figure 2 Switched Load Alignment Procedure

Mathematically, this process of alignment and weighting is achieved by calculating the final switched load demand values y_{TQj} for the 14-period switched load profile (for each GMT Day T and each Settlement Period j in the range 1 to 14) in accordance with the following formula:

$$y_{TQj} = S_C (y_{TC(j+n+1)}^{PC2_Switched} * PE_C) / S_C (PE_C)$$

where:

- PE_C is the sample population estimate for regime 'C'
- S_C denotes summation over all regimes
- For a given regime 'C', the offset 'n' is the number of Settlement Periods time difference between regime 'C' and the standard 00:30-07:30 regime (as defined in step 2 above). In this case the (j+n+1) subscript in the equation is being used to 'move' the switched load periods from the Settlement Periods relating to that particular regime into periods 1-14.
- In the case of the 23:30-06:30 regime (for which n takes the value -2), applying the above equation to period 1 will produce a value of j less than 1 i.e. $y_{T(0)}^{PC2_Switched}$. In this context, period 0 of day T has to be interpreted as equivalent to period 48 of day (T-1).

The final base load demand estimate is calculated by a similar process of weighting together the regime base loads using sample population estimates, but without the issue of aligning the different regimes. For each Settlement Period j of each GMT Day d, the y_{TQj} values for the base load profile are calculated as follows:

$$y_{TQj} = S_C (y_{TCj}^{BASE} * PE_C) / S_C (PE_C)$$

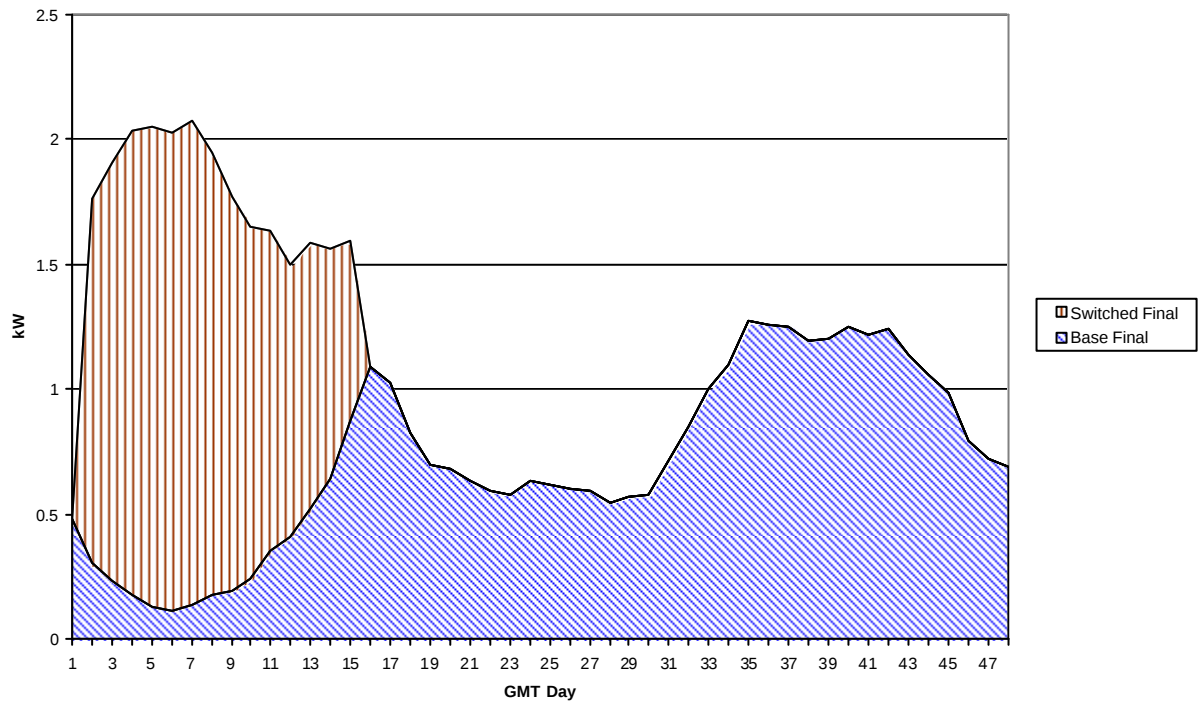


Figure 3 Final Switched and Base Load Estimates

Non-Domestic E7

The base load and switched load demand values for the Non-Domestic Economy 7 Profile Class are constructed by splitting the overall demand in the same ratio as the base and switched load for Profile Class 2:

Create stratum-weighted average demand values for the Profile Class as a whole (referred to in this section by the acronym y^{PC4}_{Tj}):

$$y^{PC4}_{Tj} = S_h (W_h y_{Thj})$$

These total values are then split into base and switched load by applying the fraction calculated previously for Profile Class 2:

$$Y^{FRACTION}_{Tj} = \max(1, Y^{PC2_Switched}_{Tj} / Y^{PC2}_{Tj})$$

to the overall demand for Profile Class 4. For the switched load profile, values of $y^{PC4_Switched_Final}_{Tj}$ are calculated (for each GMT Day T and each Settlement Period j in the range 2 to 15) as follows:

$$Y^{PC4_Switched_Final}_{Tj} = Y^{FRACTION}_{Tj} * y^{PC4}_{Tj}$$

However, because the regression analysis requires switched load demand values y_{TQj} for periods 1-14 rather than periods 2-15, these values are 'shifted' by one period as follows:

$$Y_{TQj} = Y^{PC4_Switched_Final}_{T(j-1)}$$

Finally, the base load demand values are calculated (for each GMT Day T and Settlement Period j) by deducting the switched load profile from the total load:

$$Y_{TQj} = y^{PC4}_{Tj} - Y^{PC4_SWITCHED_FINAL}_{Tj}$$

The switched and base load estimates can now be entered into the regression process.