Within-day Shape Analysis

As per the action, we (Demand Forecasting, E.ON UK) have investigated the relationship between gas demand and two-hourly temperatures by taking advantage of proprietary Smart data. The objective of our analysis was to establish two-hourly interval weightings which most appropriately reflect the sensitivity of demand to temperatures within each predefined two-hour interval. The overall aim was to verify whether the currently applied weightings used in the CWV calculation are appropriate. Our results suggest that the current industry weightings are, indeed, appropriate.

The sample:

In accordance with well-recognised model smoothing techniques, three years of smart meter data were used as the basis of our demand variable. In order to elicit the 'temperature-effect' from the data, we deliberately restricted the sample to EUC01B who are hypothesised to be more weather sensitive end users than, say, larger SME or Corporate end users. The analysis is based on data from 01/02/2011 until 31/02/2014. By nature, the sample is unbalanced; E.ON did not have Smart meters present in all LDZs until the middle of 2012. Further, at a meter point level, the sample is further unbalanced, i.e. meters do not have a complete set of readings covering all periods in the sample. Consequently, it was decided that the best approach to mitigate these issues was to create a panel model which could handle an unbalanced data set, as well as creating an average demand variable for each day/period/LDZ combination. This was simply calculated by taking the total demand for each day/period/LDZ combination and dividing through by the number of meter reads for that day/period/LDZ. This means there exists a demand and temperature observation for each day/period/LDZ combination where meters were present in that LDZ. In total, the sample consists of 68,864 unique Smart meters, and for any given period/day/LDZ combination the number of meter reads is never less than 430. This gives us confidence that the average demand for each combination is relatively robust.

The temperature for each two-hour interval is simply the temperature as measured at the mid-point of the interval, e.g. 01:00 for the 00:00-02:00 interval.

The Model:

Once the data were verified and the variables were created, a fixed effects model was estimated for each period. Simply,

$$AvgDemand_{day,ldz} = \alpha + \beta Temperature_{day,ldz} + \varepsilon$$

The Hausman test suggests that a random effects model is more appropriate than a fixed effects model, which implies that there are no significant differences in behaviour between LDZs in relation to their reaction to changes in temperature. Further, the models' residuals are well-behaved and no discernable issues are present. In turn, in order to render the model coefficients comparable, a simple elasticity for each two-hour interval was constructed. This methodology should be caveated with the fact it assumes that the elasticities are constant. Subsequently, each two-hour interval was ranked and weighted according to its elasticity. Overall, the results are consistent with the currently applied industry weightings:

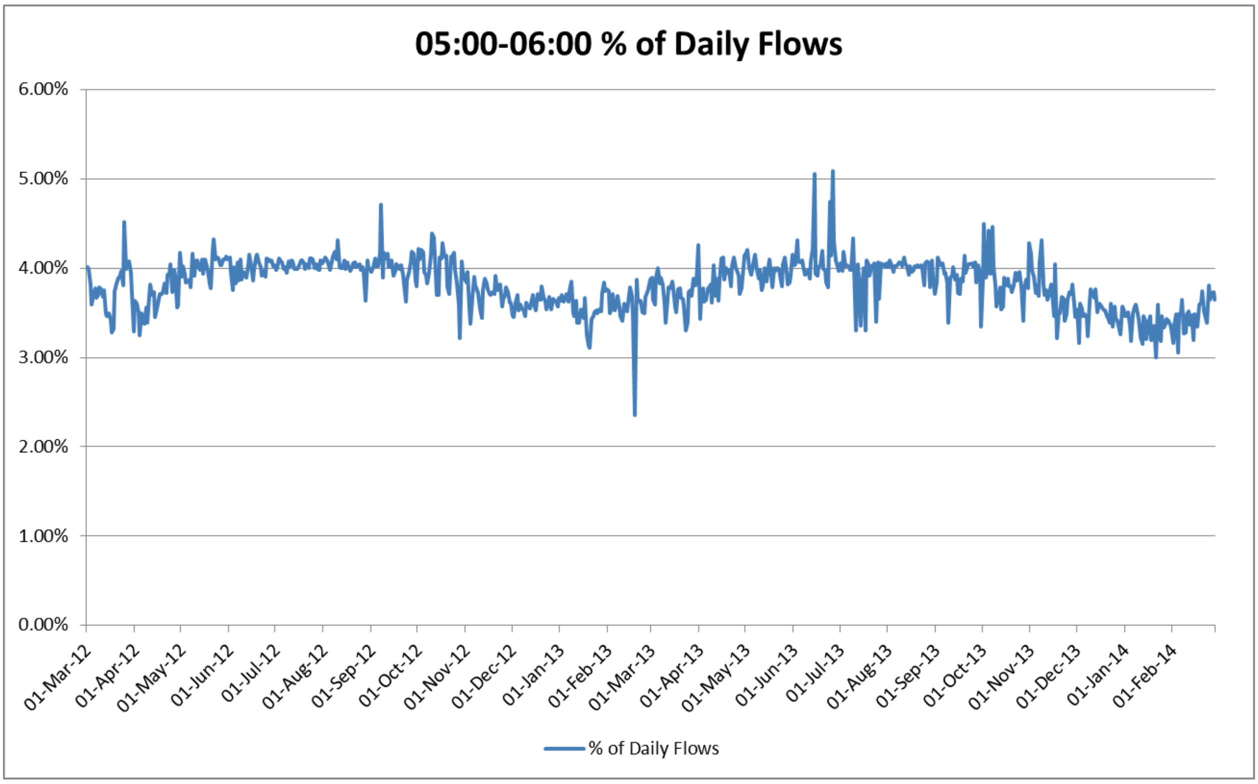
Period	Time	Coefficient	Temperature/Average Demand ratio	Elasticity	Weighting	Rank
1	00:00-02:00	-0.10	1.36	-0.13	2.6%	12
2	02:00-04:00	-0.11	1.31	-0.14	2.8%	11
3	04:00-06:00	-0.23	1.08	-0.25	4.8%	10
4	06:00-08:00	-0.59	0.76	-0.45	8.7%	8
5	08:00-10:00	-0.46	1.06	-0.49	9.5%	6
6	10:00-12:00	-0.35	1.47	-0.51	9.9%	5
7	12:00-14:00	-0.34	1.61	-0.54	10.6%	4
8	14:00-16:00	-0.41	1.50	-0.62	12.2%	2
9	16:00-18:00	-0.61	1.07	-0.65	12.8%	1
10	18:00-20:00	-0.58	0.99	-0.57	11.2%	3
11	20:00-22:00	-0.48	1.00	-0.48	9.5%	7
12	22:00-24:00	-0.23	1.20	-0.28	5.4%	9

The results:

As expected, the most sensitive parts of the day are between 06:00-22:00, which is intuitive and in line with the current CWV weightings of 10% for each two-hour period within this region. Specifically, the most sensitive interval is between 16:00 and 18:00, followed by 14:00 to 16:00. The least temperature-sensitive period is between 22:00-06:00, with the intermittent periods within this interval being the least sensitive.

The impact of localisation:

Given the impending implementation of the new gas day which will run from 05:00-05:00am rather than 06:00-06:00am, it seemed a natural extension of our analysis to estimate the likely impact of the gas day change, by calculating the approximate demand which falls between 05:00am and 06:00am. This will provide an indication as to if the current profiles may need to be adjusted in order to take account of the new gas day.



The analysis takes the total daily consumption for each LDZ within the sample, calculates the percentage of the each day's demand which falls between 05:00am and 06:00am and then corrects for unseasonal weather by taking the deviance in actual weather from normal and adjusting by using the sensitivity weightings calculated above.

Overall, the results have limited seasonality which provides a relatively robust average of 3.75%. That is, on average, 3.75% of a day's demand falls between 05:00am and 06:00am. There exists some noise around this average, although most of this can be accounted for by either some abnormally high/low readings or very few meter reads which renders the average less reliable.