Department of Energy & Climate Change

Appendix B – Checking the accuracy of your baseline(s)

Electricity Demand Reduction pilot

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Contents

Checking the Accuracy of Your Baseline(s)

1.   Overview

The Baseline Calculation Spreadsheets clearly state whether the baseline that you have proposed to use for your metered project meets the required accuracy requirements. It will state either yes or no (please note you have to enter baseline data for this to show). The following information explains the calculations behind the baseline and what you can do to try to ensure that your baseline meets the required accuracy. Please note that if the baseline does not meet accuracy requirements it may indicate that you are using the wrong metered option.

2.   Partial Measurement

If you have chosen Partial Measurement approach as your chosen M&V approach, you will establish the baseline by taking measurements of the equipment's present level of demand. This information is entered into the spreadsheet as explained in Section 3. In order to use the Partial Measurement option demand must be relatively consistent. If you have entered a sufficient amount of meter readings (you must enter at least 6 readings) and the accuracy requirements state "No", this may indicate that the demand levels are variable. Check the chart entitled "Baseline kW Demand" are all the bar chart columns consistent?

2.   Average Demand Readings

The average readings approach is used when kW consumption on the site is not driven by an external factor often referred to as an "independent variable". Therefore demand will be relatively consistent and will not be impacted by changes in temperature or daylight (as an example).

The baseline spreadsheet for Full Measurement Average Readings will automatically calculate if the baseline readings you have entered fulfil accuracy requirements. You must enter at least 6 readings for this box to state either "Yes" or "No".

If your baseline does not meet accuracy requirements please consider the following:

- Have you entered enough readings?
- Check the chart entitled "Baseline kW Demand Weekdays (4-8pm)" are the reading over time consistent?

3.   Regression Analysis

Regression analysis can be determined as the process of finding a mathematical relationship between a dependent variable (in this case electricity demand) and independent variables. A regression analysis is used to determine if kW consumption on a site is driven by any external factors. This can include external temperature, daylight minutes or a buildings occupancy levels.

The Full Measurement (Sub Metering or Whole Building) regression spreadsheet allows you to test if the kW consumption in your baseline has a significant relationship with any independent variables.

Regression Analysis

This is a statistical approach used to estimating relationships between a dependent and independent variables. In this context, the dependent variable is energy (kWh) or demand (kW) and the aim of regression analysis is to determine how the dependent variable will change when the independent variable(s) change.

For illustrative purposes the following chart illustrates the relationship between a building's average peak kW demand and the associated total for Heating Degree Days for the same time period.
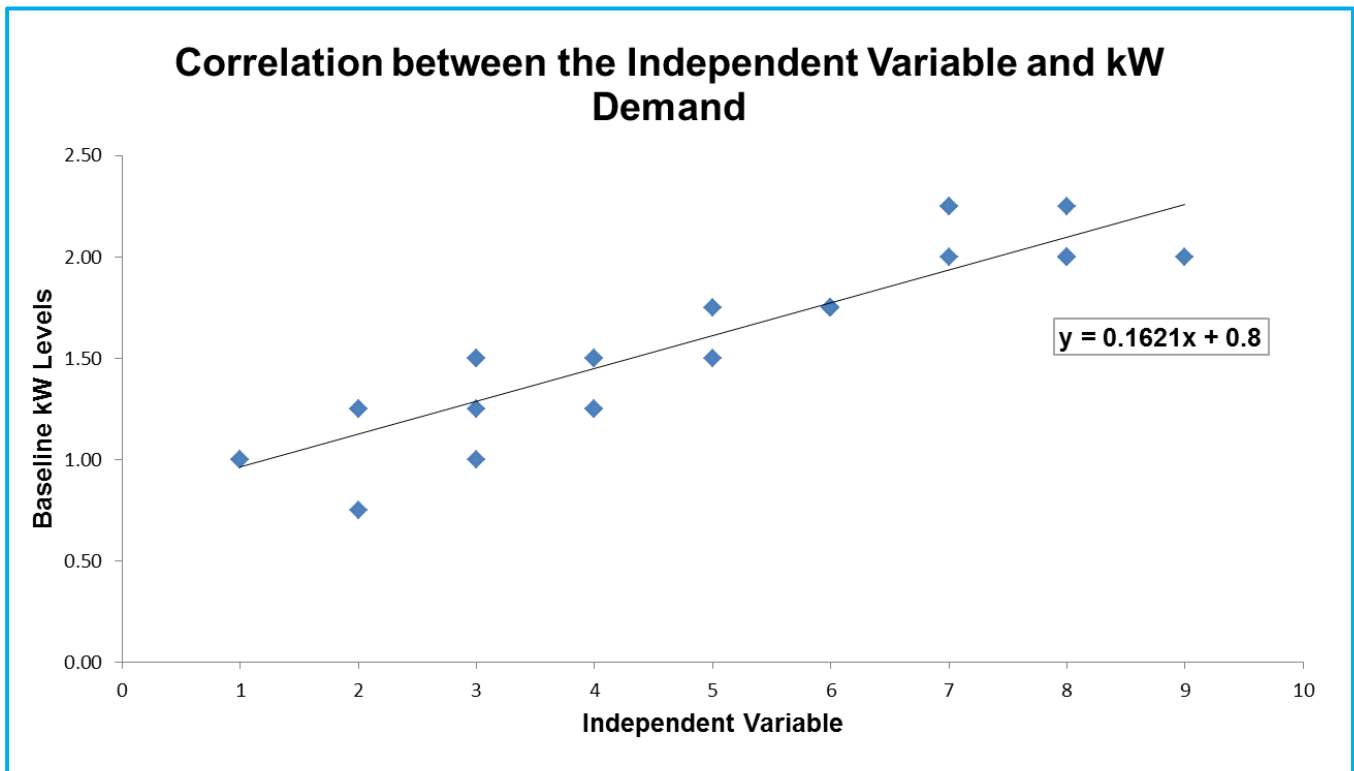
In this case, the half-hourly kWh data recorded between 4 and 8pm on weekdays has been converted into an average peak kW demand value.

The chart shows that there is a positive relationship between Heating Degree Day and average peak kW demand over the period considered. This indicates that as the external temperature decreases the building average peak demand increases.

It tells us that there is a fixed component of energy consumption, plus a variable component depending on the independent variable, in this case:

Expected weekly consumption = 0.1621 kW per Heating Degree Days + 0.8 kW

This equation provides a baseline for comparison once the new equipment has been installed – all we need to know is the post-installation values for degree days and the expected value can be calculated. The values of the fixed and variable components of the equation can also be determined using standard functions of common spreadsheet software for a given dataset (e.g. for the underlying data shown in the chart).

In the Full Measurement (Sub Metering or Whole Building) regression spreadsheet you can enter the available independent variable information that you have into the spreadsheet as explained in Section 3. The chart will show you if there is any relationship with your associated

variable. Please note that the resolution of the data must be the same as the resolution you are using for your average peak kW demand. For example if you are using average peak kW demand per day you must use daily Heating Degree Days or daily occupancy rates.

Accuracy Statistics

There are numerous statistics that indicate if the baseline you are proposing has met accuracy requirements.

Standard Error

A key indicator of the accuracy of the baseline is the standard error. The baseline spreadsheets estimate this automatically once you have entered enough baseline points. In IPMVP it is stated that the expected saving from your project should be at least twice as much as the standard error calculated for the baseline in order for the model to be considered statistically valid, i.e. accurate enough to measure savings at the expected level.

Note that the savings should be compared at the same resolution as the data used for the regression model, e.g. if weekly totals are used, then the average weekly savings should be compared. For the data in the previous chart, the standard error is 19.93 kW; as the regression analysis has been carried out for weekly data, the expected weekly savings would need to be greater than 39.86 kW in order to meet this criterion.

If the standard error of the baseline is high compared to the estimated savings it indicates that there is variation in your baseline data. If you are using average readings please consider introducing an independent variable as this may help to explain the variation in kW consumption.

Statistical significance: p-values

If you are using Regression analysis you need to test whether the variable you have chosen is significant, you should consider the "p values".

p-values

In statistical significance testing, a p-value quantifies the probability that the variable you have tested has no influence on demand or energy consumption. A common threshold for p-values is 0.05 or lower, i.e. the probability that the independent variable actually has no effect is less than 5%.

For the baseline data used in the previous chart, the p-value is equal to 0.00000000139 i.e. a very small number; this indicates that Heating degree days are significant as the threshold of 0.05 has easily been met.

Multiple Regression

It is possible for some buildings that there is more than one significant independent variable, leading to more than one routine adjustment. These can also be determined using regression analysis, but it is important to establish which variables are relevant by calculating p-values for each variable and including these in the M&V Plan. Where the calculation of routine adjustments is not straightforward, you should contact DECC to discuss the format of your M&V Plan edr-project@decc.gsi.gov.uk