

Information paper – 16

Heating degree days

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This information paper is one of a series of papers written during the preparation of the book **What Colour is Your Building?** (www.whatcolourisyourbuilding.com). The papers do not form part of the book and have not been peer reviewed. They provide further technical detail, analysis and information to support statements made in the book. All of the papers can be downloaded from www.wholecarbonfootprint.com.

Heating degree days

This information paper provides a brief overview of heating degree days and their application in building energy benchmarking.

1. WHAT ARE HEATING DEGREE DAYS AND WHY DO WE NEED THEM?

The energy used for heating and cooling can vary each year due to the climate. A mild winter does not mean that the heating system has suddenly become more energy efficient. Also, if the building owner implements energy improvements to the heating system, and then the energy consumption increases because it was a colder winter than the previous year, it does not mean that the improvements were ineffective – the energy bill would have been higher still without them. This is why degree days are a useful tool, allowing changes in energy performance to be detected and to substantiate energy management improvements.

There are two types of degree days: heating and cooling. Heating degree days (HDD) are a measure of how much (in degrees), and for how long, the outside air temperature was below a base temperature. The base temperature represents the temperature below which the building needs heating. This is typically set at 15.5°C in the UK for most buildings, but in hospitals it might be 18°C. Choosing the right base temperature is important, and lower temperatures may be more appropriate in well-sealed and insulated office buildings. Traditionally HDD data was only available for 15.5°C but websites now allow users to select a base temperature.

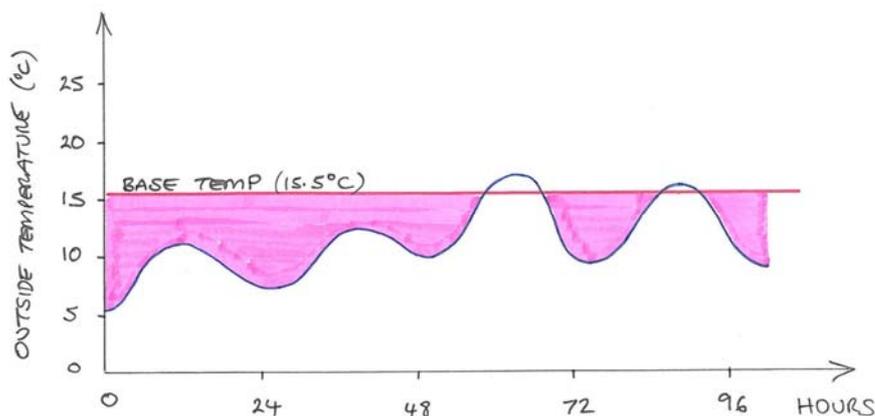


Fig 1 Heating Degree Days – the shaded area is the degree day value for the period

2. USING HEATING DEGREE DAYS IN ENERGY BENCHMARKING

There are a variety of methodologies to compare energy performance over different time periods using HDDs. The crudest is to divide the energy consumption by the HDDs over a given time period and compare these ratios. The data in Table 1 is taken from the Manchester office building featured in the case study in Section 6.1 of Chapter 6.

	Gas consumption (kWh)	HDD	kWh/HDD
2010	406,076	2,672	152
2011	285,582	1,993	143
% change	30%	25%	6%

Table 1 Gas consumption and HDD in example office building over two years

This simplistic analysis shows that while there was a 30% reduction in gas consumption between 2010 and 2011, it was also a much milder winter. The comparison of kWh/HDD ratios suggests that the changes to the AHU hours of operation implemented in September 2011 have had some benefit, resulting in an energy saving of around 6%. Comparing the 6 month heating period after the AHU timer clock changes to that one year earlier shows more clearly the benefit of the reduced operating hours on the building heating energy – refer to Table 2. The hours of operation were reduced by 67% and the heating energy consumption has been almost halved.

6 month period	Gas consumption (kWh)	HDD	kWh/HDD
Oct 10 – Mar 11	245,725	1,903	129
Oct 10 – Mar 12	101,215	1,475	69
% change	59%	22%	47%

Table 2 Gas consumption and HDD in example office building during two heating periods

A more detailed approach is set out in the Carbon Trust's *Degree days for energy management* (CTG004), which uses monthly data and applies a statistical procedure called 'cumulative sum of the difference' (CUSUM). This method couldn't be reliably applied to the Manchester office building above. The kWh to HDD chart showed too much scatter which is likely due to the issues with manually reading the gas meter and interpolation of monthly gas consumption on the energy bills – refer to Figure 2. Accurate half hourly metering of the gas would reduce the scatter allowing the CUSUM methodology to be implemented.

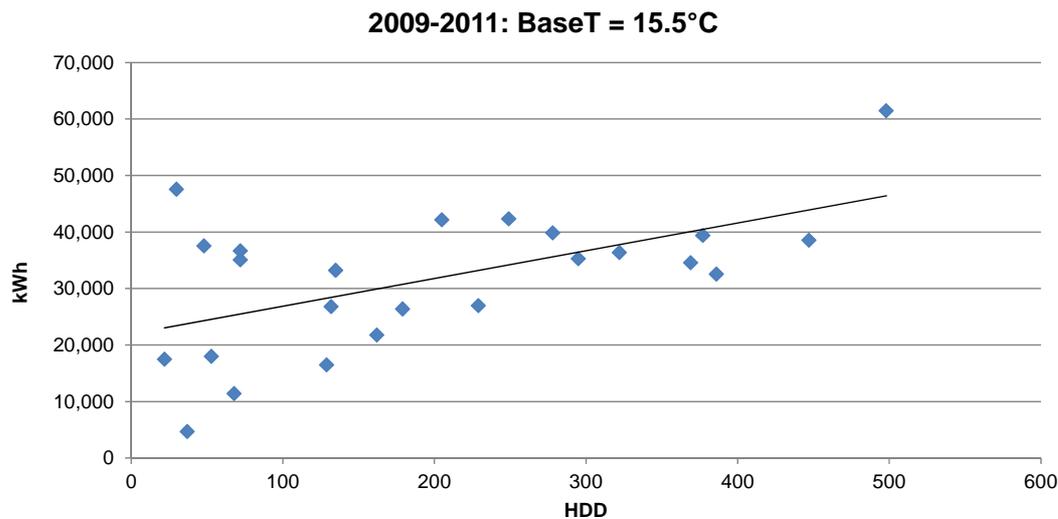


Fig 2 kWh v HDD chart for example office building

3. HEATING DEGREE DAYS IN RATING TOOLS

The Display Energy Certificate methodology incorporates HDDs to make adjustments to the heating energy benchmark depending on whether it was a mild or cold winter in that location (based on postcode) for the 12 months that the rating is undertaken.

Energy Star uses heating and cooling degree days to establish a climate benchmark for a location based on data from the 6,000 buildings in the Commercial Building Energy Consumption Survey (CBECS) – refer to www.eia.doe.gov/emeu/cbecs/contents.html.

FURTHER GUIDANCE

- *Degree days for energy management*, Carbon Trust CTG004
- www.degreedays.net
- www.degreedays.net/introduction
- www.eci.ox.ac.uk/research/energy/degreedays.php#degreedays

The inevitable legal bit

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