Commitment to reduce carbon emissions on the Government Estate by 10% - weather correction methodology

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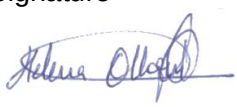
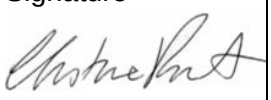
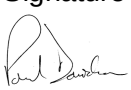
Signature 	Signature 	Signature 	Signature 
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Commitment to reduce carbon emissions on the Government Estate by 10% - weather correction methodology

The purpose of this document is to provide an explanation of the methodology used to weather correct the consumption data provided by departments for the assessment of the Government's 10% reduction in carbon emissions commitment.

Background

The weather, in particular the external temperature, can have a significant effect on the annual energy consumption of a building. In years where the winter is colder than normal, the heating energy consumption will tend to be higher. Conversely, when winters are milder, the annual energy consumption is likely to be lower than normal. So to compare the energy consumption of a building (or organisation) over time it is desirable to adjust the heating energy consumption to exclude the effect of variations in the external temperature and so give a better reflection of changes in underlying energy efficiency over time. This adjustment is achieved by applying a weather correction factor to the energy consumption data.

Methodology

To compare the annual energy performance of government departments for the 10% commitment, a weather correction factor is applied to heating energy use which is based on heating degree days (HDD), where the number of HDD is a measure of the amount of time, and by how much, the average temperature on a particular day (Tmean) is below 15.5 ^{o}C (the base temperature)[1].

So for example, if the average temperature on one day is 10.5°C, then there are 5 heating degree-days for that day. To get the annual heating degree days (AHDD) all positive values of HDD are summed for each day in the year. In the same way, to obtain monthly degree days or "year to date" degree days, the sum of degree days in these time periods is used.

The weather correction factor is then the number of heating degree days in a reference period divided by the number of heating degree days for the period of analysis.

$$\text{Weather Correction Factor (baseline)} = \frac{\text{Sum of HDD (reference period)}}{\text{Sum of HDD (baseline period)}}$$

Similarly

$$\text{Weather Correction Factor (reporting period)} = \frac{\text{Sum of HDD (reference period)}}{\text{Sum of HDD (reporting period)}}$$

Multiplying the actual heating energy consumption for a given year by the appropriate weather correction factor then gives a measure of what the energy consumption would have been in the reference year[2].

For the 10% commitment baseline period there were 2339 heating degree days (HDD) for the UK Mainland region, which is colder than the reference period (2105 HDD) and therefore a weather

[1] Several specific formulae are used to calculate this depending on a set of given temperature conditions -for details see http://vesma.com/ddd/index.htm and click on "Degree days explained"

[2] For the 10% commitment the HDD for the reference period is based on the long term average value for the 10 years preceding 09/10.

correction of 0.90 would be applied to the actual heating energy consumption. As a result, the weather corrected heating energy consumption for the baseline will therefore be 10% lower than the actual consumption. It will not be possible to determine the annual heating degree days for the reporting period until after the period has ended and the degree-day data is published.

Although we know department's energy consumption by fuel type, we do not know for all departments the specific fuel types which are used for space heating. It is therefore assumed that only fossil fuels and other heat sources are used for space heating. Furthermore, it is also assumed that only 75% of these fuels are used for space heating, and are therefore subject to this weather correction procedure. The remaining 25% is assumed to be used for end uses which are not affected by external temperature, such as the provision of hot water.

As well as correcting for heating energy use, it would also be desirable to weather correct electricity consumption for cooling energy use, as air conditioned buildings are likely to use more energy in years when the weather is warmer. However, in the UK, cooling demand is largely driven by the amount of internal gains (heat generated by people and equipment within the building) and solar gains (sunlight) rather than by external temperature. As the relationship between external temperature and cooling is complex this means that it will vary significantly from building to building and a simple adjustment factor based on cooling degree days alone is probably not appropriate. Additionally, electricity consumption for air conditioning would need to be separately reported in order to perform a meaningful correction and this information may not be easily available. So, whilst it is desirable to adjust departmental energy consumption for cooling demand, it is not currently feasible. However, as more buildings in the UK are becoming air conditioned this issue warrants further investigation.

Degree day regions

Temperatures vary considerably across the UK and to take account of this there are 18 weather correction regions. HDD are determined on a regional basis[3] using the following different regions[4]:

1. Thames Valley
2. South Eastern
3. Southern
4. South Western
5. Severn Valley
6. Midland
7. West Pennines
8. North Western
9. Borders
10. North Eastern
11. East Pennines
12. East Anglia
13. West Scotland
14. East Scotland
15. NE Scotland
16. Wales
17. Northern Ireland
18. NW Scotland

When departments submitted their 09/10 annual returns under SOGE[5] they were requested to state which region(s) their buildings/sites etc. are in so that the most appropriate regional weather

[3] Degree days can be downloaded from the website www.vesma.com
[4] http://www.carbontrust.co.uk/cut-carbon-reduce-costs/calculate/energy-metering-monitoring/pages/degree-days.aspx
[5] The same degree day regions have been assumed for the 10% analysis as those provided by departments in the 09/10 SOGE out turn data.

correction factor can be applied to the consumption on a building/site basis if at all possible. If a department has a large number of buildings spread across the UK they may choose to apply an average factor (e.g. “UK Mainland”, which is an average of the different regions making up the UK mainland) rather than supplying consumption data for each individual building to be weather-corrected for the appropriate region.