Using Display Energy Certificates to quantify energy consumption in the UK non-domestic building stock

Authors:

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Introduction

The 2 million non-domestic buildings in the UK account for around 19% of national CO_2 emissions. Due to the slow turnover of stock however, this country cannot rely solely on the energy efficiency of new buildings to achieve significant reductions in emissions from the sector. Effective improvement of the existing stock requires an extensive knowledge of the factors that determine energy performance. Unfortunately, despite much research into the non-domestic building stock, DECC acknowledges that there is still a "*…lack of … comprehensive understanding of its composition and energy use." (DECC, 2009)*

Methodology

Display Energy Certificates (DECs), mandatory for public buildings over 1000m² since 2008, provide an important step towards an understanding of non-domestic energy use. They present actual metered energy use for electrical and fossil-thermal energy use, allowing a comparison for each building against other buildings in it's category. DECs also display a building's annual CO2 emissions, the floor area, HVAC (Heating, Ventilation and Air Conditioning) system, main heating fuel, and details of any renewable energy generated on site. (CLG, 2008)

A database of 25,000 DECs lodged in 2008 and 2009 was obtained in late 2010 through a Freedom of Information request to the Department for Communities and Local Government. This included DECs for a range of public buildings types, including:

- Accomodation
- Cultural and Entertainment Venues
- High Street Agencies
- Hospitals and Emergency Services
- Offices
- Schools
- Swimming Pools, Sports and Fitness Centres
- Universites
- Workshops

So far, analysis has been carried out on Schools and Offices, which make up the two largest categories by number.

For each of these categories, extra datasets were added to allow analysis of a greater number of factors than allowed by the DECs themselves. For the schools, data from the Ofsted Inspection Reports Database was added, with information on pupil numbers, gender, age range, school type, boarding provision, religious character and specialist status.

Data from the Valuation Office Agency , showing office internal spaces, and from the UK Government Property and Land Assets database, showing building age, and employee numbers was added to the offices data. A visual survey of offices was also carried out using Google Streetview and EDINA Digimap, in order to categorise each office into one of four generic office types (see Figure 1),.

Figure 1: Generic Office Types, illustrated using results from the survey of public offices buildings in the UK (Left: Google Streetview, Right, Digimap)

Results: Schools

The figures for school energy use indicated that the current DEC methodology tended to overestimate typical fossil-thermal consumption, and underestimate typical electrical consumption. Furthermore, the study showed a significant increase in median electrical consumption from primary to secondary schools, and then a further jump to academies (see Figure 2). This leads to much higher median CO_2 emissions in academies than other schools..

The significantly higher emissions associated with the academies is unexpected as they tend to be newer schools; either recently built or refurbished. However, the increase, due largely to electrical consumption, may be associated increased usage of educational equipment and computers.

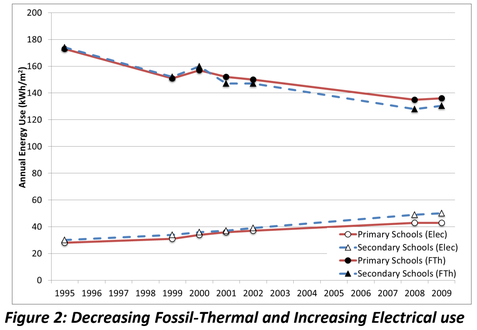

Figure 2: Decreasing Fossil-Thermal and Increasing Electrical use in Primary and Secondary schools since 1995

Comparison with schools survey data from the BRE (1998) and the Department of Education (2003) showed that in the past thirteen years, both primary and secondary schools show considerable reductions in typical fossil-thermal energy use, of 21% and 24% respectively. However this is offset by an increase in electrical use, leading to higher CO_2 emissions in both cases. This confirms fears that overall schools emissions would rise over time, due to increased electricity use (GAP, 2006).

Results: Public Offices

Firstly, it was noted that the CIBSE benchmarks used to produce the DECs match well with the overall results, again confirming a previous CIBSE study (Bruhns et al, 2011). A sample of around 300 offices was categorised into categories according to size, complexity and prestige, based on previous office benchmarking work (BRECSU, 2000). When the results were compared against the benchmarks only the fossil-thermal benchmarks for the simpler Type 1 and Type 2 offices (see Figure 3) were similar, while the other fossil-thermal and all of the electrical figures were much lower than there respective benchmarks.

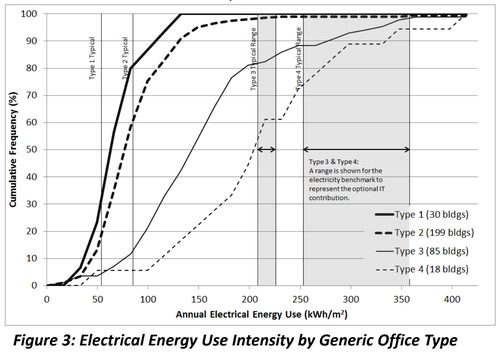

Figure 3: Electrical Energy Use Intensity by Generic Office Type

It should be noted however that the Type 4 'Prestige' offices still showed a median electrical consumption 50-200% higher than the other types, indicating higher use of electrical equipment and air conditioning.

A further comparison with a small sample of private offices (BBP, 2010) suggested that public sector offices have lower emissions than their private counterparts, particularly for prestige offices. This indicates that while the DEC energy use results may be useful in analysing the general stock for simpler offices, it may not be applicable to high end prestige private offices.

Conclusions

This work highlights the potential for the DEC database to be used to evaluate the UK non-domestic building stock, as well as a means of improving the DEC process over time.

The breadth and depth of information provided by the DECs allows the potential for an understanding of the non-domestic stock that would not be otherwise possible. Furthermore, given the requirement for buildings to renew their DECs annually, the DEC database provides an invaluable opportunity for systematic, long-term monitoring of progress towards the Government's emissions reduction targets across the non-domestic building stock as a whole.

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Acknowledgements

We are grateful to the EPSRC for funding our studentships in Cambridge, and to our supervisors Koen and Torwong for their ongoing advice and support.

For Further Information:

Please contact dtg22@cam.ac.uk. More information on the DEC database used in this study, including the schools DEC data, will be available shortly on the Cambridge Department of Architecture website: http://www.arct.cam.ac.uk

The Schools' paper is currently freely available here: http://www.tandfonline.com/doi/abs/10.1080/09613218.2011.628457