BENCHMARKING FOR DISPLAY ENERGY CERTIFICATES

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BACKGROUND

The Energy Performance of Buildings Directive requires Energy Certificates to be displayed in public buildings over 1000 m^2 total usable floor area that are frequently visited by the public. Display Energy Certificates (DECs) based on actual measured annual energy use became mandatory for these buildings in England, Wales and Northern Ireland in 2008.

The Certificate highlights a numerical indicator of performance, known as the operational rating, which is the ratio of actual energy use of the building to a benchmark figure for buildings of that type. The operational rating is a linear scale running from 0 (true zero-carbon) to 100 (CO_2 emissions at typical stock median performance levels) and beyond. This scale is grouped into increments of 25 to provide the familiar A-to-G letter grade, so median performance lies at the D-to-E boundary and all buildings with emissions over 150% of the benchmark value are classed G. It also shows separate performance indicators and benchmarks for annual use of electricity and of fuel or heat.

The DEC benchmarking approach is designed to provide a simple, low-cost entry level whilst encouraging people to dig more deeply. The rating takes account of mixed uses, local heating degree-days and extended hours of use.

The DEC benchmarks, published as CIBSE TM46 (see box), are based on a rationalisation and considerable simplification of values taken from many sources. Although the system identifies a total of 237 different building Types, each is assigned to one of 29 benchmark Categories. Benchmarks are set at the median level for each category (as far as these were known) for annual use of electricity and of fuel or heat, assuming standard hours of use. The DEC methodology allows bigger benchmarks to be earned where buildings are used for longer, but not just for the presence of technical features such as air-conditioning. Mixed-use benchmarks, e.g. for a school with a swimming pool, can be built up, using the specific component benchmarks and their respective areas.

"Separable" energy end-uses (specific ones that are not included in the benchmark because they are either unusual or highly variable) can be excluded from the benchmarking calculation, although they remain in the carbon footprint shown on the DEC. However, this is only permitted if they are sub-metered and have a report produced on their energy efficiency.

REVIEWING THE BENCHMARKS

In autumn 2009, CIBSE set up a broadly-based committee to review the DEC benchmark values and allowances and gather feedback from the DEC process, including data collected and user comments. In May 2010, CIBSE was given access to the 45,000 DECs that had been lodged on the Landmark national Register from inception to mid-February 2010. CIBSE Research Fund engaged the authors via the UCL Energy Institute to review the data contained in the DEC database, in particular the Operational Ratings, in order to assess the applicability of the CIBSE Benchmarks, and to recommend to DCLG any immediate revisions to the benchmarks or allowances prior to the start of the third year of DECs in 2010.

In the event no urgent changes were identified, giving more time to consider the conclusions. The evidence available from the analysis of the DEC data and the benchmarks review allowed the CIBSE benchmarks group to make a valuable contribution to the UK-GBC report on the role of DECs in support of policies to promote and enhance energy efficiency in all existing non-domestic buildings. REFERENCE: Carbon Reductions in Existing Non-Domestic Buildings - A UK-GBC Task Group on Display Energy Certificates and the Carbon Reduction Commitment Energy Efficiency Scheme March 2011

ANALYSIS OF THE DEC DATA

The first step was to exclude DECs with 'default ratings', which made up 10% of the sample. A few DECs with implausible floor areas or ratings were also excluded, as were buildings heated mainly by electricity. The data set was then filtered to select only the most recent DEC for any given building. The resultant data set comprises 29,310 DEC records, each for a different individual building. This figure is only 65% of the total number of public buildings expected to require a DEC in the impact assessment carried out for the introduction of DECs. We also noted that only about half the buildings that should have renewed their DEC in line with the annual update requirement had done so.

The results of the review are summarised in Figure 1. This shows the distribution of A to G grades for the 17 of the 29 categories of building which had significant representation in the data set. The yellow band represents a D rating, the pale orange an E rating. Since the median is supposed to be at the D/E boundary, the ideal picture in Figure 1 is for the yellow/orange boundary to be in the middle of the chart. And the results show that the benchmarking system works well for those Categories most commonly found in the database, e.g. Schools (15,335 buildings, 52% of the total), where the median of the DEC Grade distribution was within 2% of the benchmark and offices (3,230 buildings, 11%), with the median almost exactly at the D/E boundary. It also works well for clinics, hospitals and emergency service buildings. In all, we found a good correlation between actual operational ratings and the benchmark figures in 94% of the DECs included in the analysis.

We found that many Categories use more electricity and less fuel than the benchmark values, although these often cancelled each other out, making the median of the overall Ratings closer to 100. This reflects the growth in electrical equipment in most buildings over recent years, coupled with the internal heat gains these create, improvements in insulation, boilers and heating controls, and a warmer climate, all of which have combined to reduce heating demand.

To the extent possible, we also examined median Ratings for all building Types within each Category. Many of the 237 available Types and 11 of the 29 Categories had small sample sizes[1]. 85 Types were not found at all, being either small buildings (so well below the 1000 m^2 threshold) or rare in the public sector. In 10 building Types and four Categories, affecting just 6% of the DECs reviewed, median Ratings were more than 25 points away from the benchmark value, i.e. more than one Grade higher or lower than that intended.

In two Categories, the benchmarks appeared to be too generous:
- *Entertainment halls and Theatres.* Benchmark data originated from commercial theatres and cinemas, while the DEC data set includes public sector halls, most of which are less heavily used or are using less energy.
- *Dry sports and leisure facilities.* We suspect that the benchmark data was collected from more intensively-used facilities. Sports centres have also received considerable attention to energy saving in recent years.

In the other two Categories the benchmarks appeared to be too small:
- *Laboratories and Operating Theatres.* Here there was little data upon which to base the original benchmarks. Special energy uses also need to be identified better. Where electrical equipment has high loads it may need to be added to the list of separable uses.

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[1] Categories with fewer than 50 DECs included: Large non-food shop, Small food store, Large food store, Bar, pub or licensed club, Hotel, Covered car park, Public buildings with light usage, Public waiting or circulation, Terminal, and Cold storage.

- *Workshops.* These use benchmarks based on relatively lightly-used facilities for semi-industrial buildings. Many of the data set records in this category were for Sorting Offices with heavy process loads which have not yet been identified as separable energy uses.

Day centres have also proved to have high emissions in relation to the Schools & seasonal public buildings Category, while Hostels are low users in relation to Long term residential. Median ratings for mechanically ventilated and air conditioned offices are 32% higher than the General office Category, but this is not unexpected. Their ratings are likely to improve once the benchmarking system is applied in more depth, taking better account of long hours of use and of special areas and separable energy end-uses. The review team and the CIBSE benchmarks review group recommend that the existing allowances for separable energy uses be applied and the results reviewed.

Only 153 DECs (0.3% of the database) made use of separables of any kind. This very low figure probably indicates a lack of sub-metering installed, but perhaps also insufficient awareness of this provision in the methodology. It also suggests that some buildings which currently have poorer ratings would benefit from measurement of separable energy uses. There is also a strong case in a number of Categories to allow more major electrical equipment as a separable in order to make the DEC Rating more representative.

A number of commentators have argued for DECs to include allowances for high occupancy density. While obviously important, this was considered when TM46 was developed, but rejected owing to a lack of robust, low-cost methods for collecting accurate density information, without which there would be considerable potential for abuse. In 2010, CIBSE's benchmarking committee reviewed data on government offices collected by Investment Property Databank for the OGC, which demonstrated a poor correlation between energy use and occupancy levels. The conclusion was that benchmarking per m^2 was more reliable, and that occupancy-related benchmarks should be regarded as complementary indicators and reported voluntarily, at least until robust methods of measuring and recording occupation density have been developed.

CONCLUSIONS

BUILDING TYPES IN NEED OF REVIEW
The initial DEC benchmarks and Categories were created from data from many sources, which were variable in their date, quality, accuracy and representation of the stock as a whole. Some building Types had very little data at all to inform their allocation - for example, Crown Courts were put in the General Office Category, and Prisons in Long term residential. As data came in, it was anticipated that some building Types would turn out to be in the wrong Category, or might even require new ones. In the event, only ten of the 237 building Types appear to be significantly outside their Category or benchmark and would benefit from adjustments or re-allocation. However, these represent only 6.2% of the DECs reviewed.

SEPARABLE ENERGY USES
There appears to be a strong case to extend the definition of separables to electrical 'process' equipment in a range of benchmark Categories. The prospect of a better DEC Rating is likely to drive building owners and occupiers to meter more separables, and the requirement for a report will help them to understand how to improve the performance of technical equipment often outside the understanding of DEC assessors. To define what should or should not be eligible will require more work and industry consultation.

OCCUPANCY DENSITY
It can reasonably be argued that more densely-occupied buildings should have a larger benchmark, but a serious constraint is how to verify the intensity of occupancy over a year.

However, in the same way that separables are allowed if properly metered, buildings with good occupant counting systems might potentially be permitted to make allowances.

Metrics for intensity of use need to be agreed for each benchmark Category, e.g. perhaps the number of pupils on roll might suit schools; and person hours per year for offices with robust information from security access systems.   The data could potentially be used to adjust the DEC benchmark, to enable a comparable allowance for intensity of use as is currently available for hours of use. This or a similar process might also enable better account to be taken of unoccupied space in the building. Meanwhile, with small additions to the XML schema for DECs, one could build up the evidence base by allowing assessors to collect data on intensity of use and to record this when lodging their DECs.
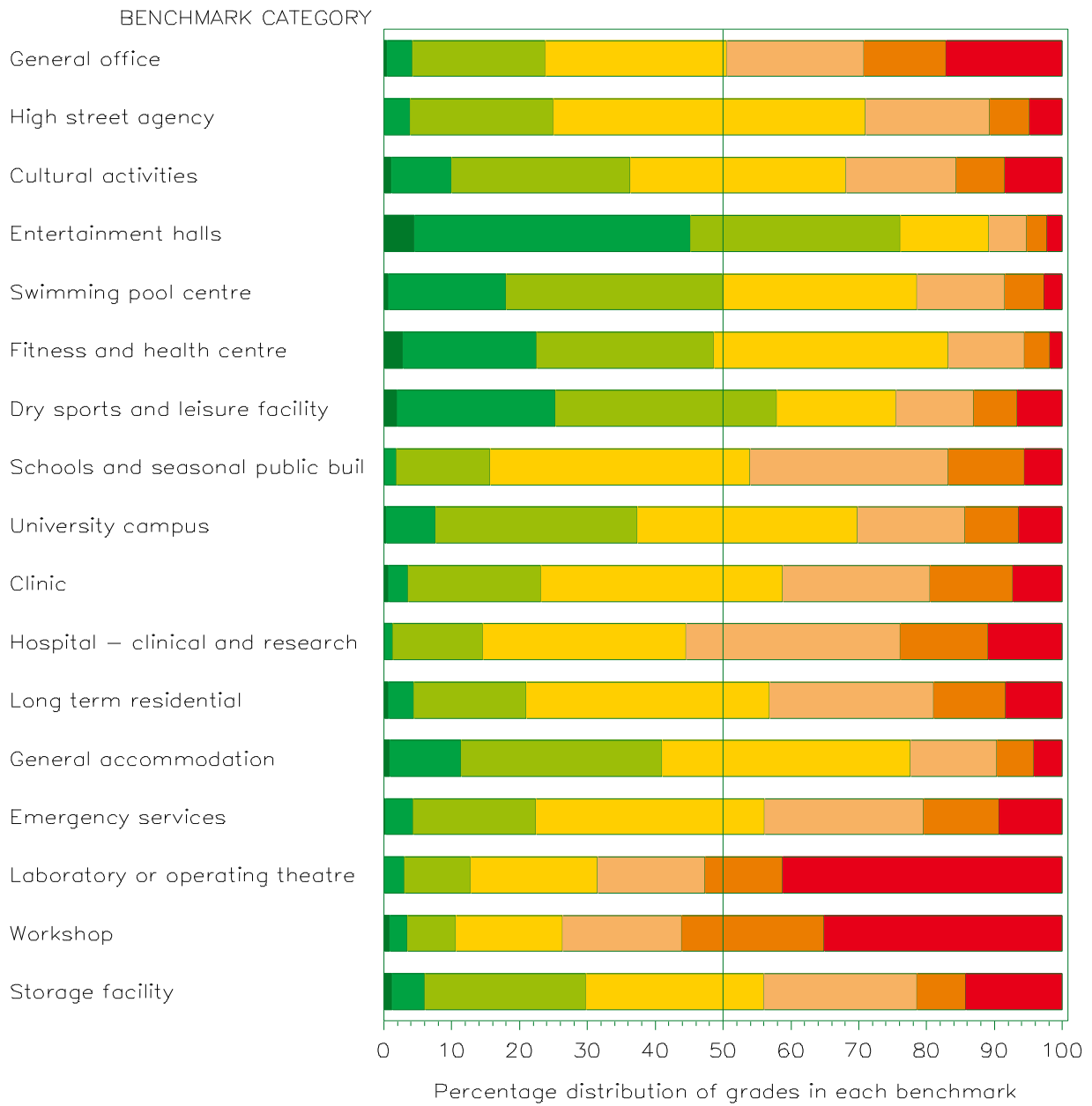
NEXT STEPS
Following this initial review the CIBSE Benchmarking group is now considering appropriate ways to address the ten building types and four categories that require adjustment of the benchmarks in some way. CIBSE will be consulting on these once proposals are ready.

CIBSE is also in discussion with several sectors about the current benchmarks, and how to collect data to assess the appropriateness of the benchmarks for a rollout of DECs to private sector buildings. We will continue to work with the relevant sectoral bodies, including the British Property Federation and the British Council for Offices, with the Departments for Communities and Local Government and Energy and Climate Change and with the UKGBC.

DEVELOPING THE DEC BENCHMARKS

In late 2006, the Department of Communities and Local Government (DCLG) invited CIBSE to advise on the benchmarking system for DECs. The CIBSE Research Fund commissioned a scoping study which concluded that existing benchmarks were inconsistent and out of date and recommended a new approach, which DCLG accepted. During 2007 CIBSE developed the benchmarking system and undertook successful stakeholder consultations on the benchmarks to be used for generating DECs, which were published as CIBSE TM46: Building Energy Benchmarks, in 2008.

Percentage grade distribution within Benchmarks
Filtered data — 29,320 Ratings count>80 (decv04 15/8/10)

BENCHMARK CATEGORY

Percentage distribution of grades in each benchmark

Grade ■ A ■ B ■ C ■ D ■ E ■ F ■ G