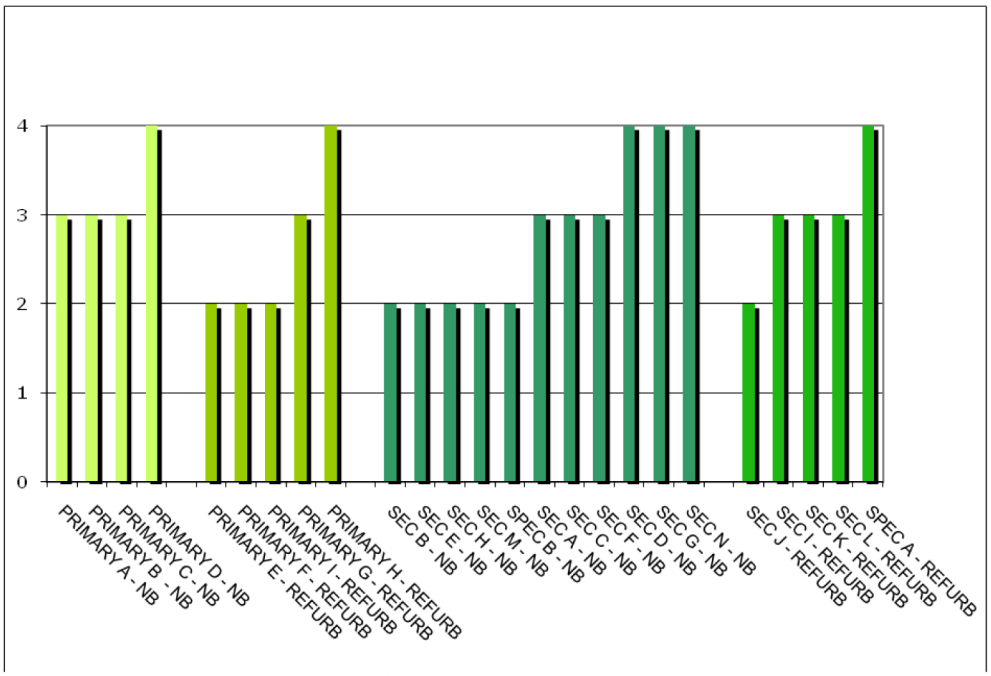


Fig 4: Peer review by sustainability specialists

The sustainability specialists rated 16 schools as acceptable, nine of the schools unacceptable (figure 4). Sustainability was considered the least successful aspect of the review criteria.

- 24% were rated as 'very good', 40% rated as 'pass', 36% rated as 'unsatisfactory'.

Secondary schools were rated higher than primary schools (the sample size between primary and secondary differed slightly).

- 22% of primary schools were rated as 'very good', compared to 25% of secondary schools rated as 'very good'.

Primary new builds were rated higher than primary refurbishment, whereas secondary refurbishments were rated higher than secondary new builds.

- 25% of primary new builds were rated 'very good' and 75% 'pass', whereas 20% of primary refurbishments were rated as 'very good', 20% 'pass' and 60% 'unsatisfactory'.

- 27% secondary new builds were rated 'very good', 27% 'pass' and 45% 'unsatisfactory' whereas 20% of secondary refurbishments were rated as 'very good', 60% 'pass' and 20% 'unsatisfactory'.

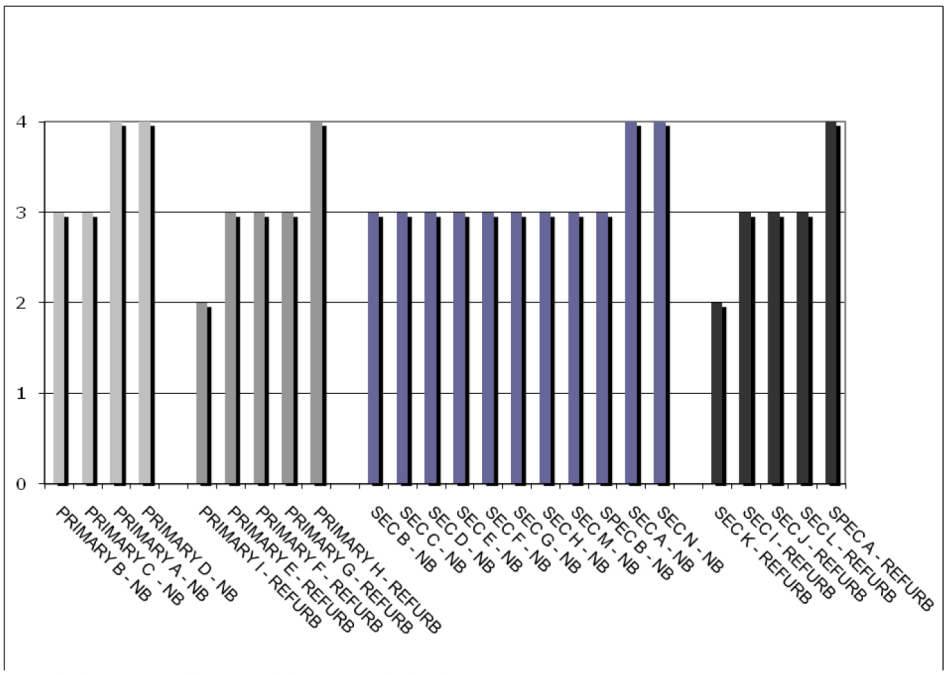


Fig 5: Peer review by ICT specialists

The ICT specialists rated 23 schools of the schools as acceptable, two of the schools unacceptable (figure 5).

- 24% were rated as 'very good', 68% rated as 'pass', 8% rated as 'unsatisfactory'.

Secondary schools were rated higher than primary schools (the sample size between primary and secondary differed slightly).

- 33% of primary schools were rated as 'very good', compared to 18% of secondary schools rated as 'very good'.

Primary new builds were rated higher than primary refurbishment, whereas secondary new builds were rated higher than secondary refurbishment.

- 50% of primary new builds were rated 'very good' and 50% 'pass', whereas 20% of primary refurbishments were rated as 'very good', 60% 'pass' and 20% 'unsatisfactory'.

- 18% secondary new builds were rated 'very good', 82% 'pass', whereas 20% of secondary refurbishments were rated as 'very good', 60% 'pass' and 20% 'unsatisfactory'.

Reviewers' responses reflected many of the same views as the users, partly because they were judging the success of the school by the way it met the current needs of its users. However, the review teams also considered the design and management reasons behind the issues. The review teams' professional view was informed by comparison with the different schools evaluated, considering a more strategic level of evaluation. This differed from the school users' evaluations which were based on a longer period of occupation and encounters with issues on a more day-to-day level.

In Kenton School, for example, (secondary-age) students thought the toilets were unpleasant to use and they didn't like them being locked during lesson times (although they recognised there was a greater risk of vandalism if they were open all the time).

- **ICT Infrastructure**

Although responses were positive overall, a few problems were raised. The main concern was about not having wireless access throughout the school (and sometimes the grounds). Some (mainly students) raised issues around accessing the network from home and not having access to equipment whenever/wherever it was needed. Another problem that was often mentioned was the glare/reflection from daylight/sunlight making interactive whiteboards difficult to see.

- **Noise**

In response to the question about being distracted by noise, many students said they were distracted by noise to some degree inside or outside the classroom. However the same students often said they could still hear the teacher adequately (see paragraph on Noise above). Our conclusion is that some distraction is inevitable, in the majority of cases unavoidable and not a serious problem. However in some cases (revealed in workshop discussions), noise did seem to be a real concern. Examples of noise disturbance given by students included sounds coming from other classrooms when the corridor door was left open and noise of student activity outdoors when windows were open. This was consistent with the peer review discussed above (see Environmental performance in use - Thermal comfort in summer).

5.3 Environmental performance-in-use

Buildings should perform better and much more sustainably than they do currently - objectively evaluated evidence suggests that building performance is often poor compared to the original design intent.

Each school's annual energy consumption was considered as a breakdown of the heating demand (gas/fossil fuels/biomass) and electrical demand which covers lighting, small power, equipment etc.

The detail on the annual heating and electrical consumption was based on measured data obtained from the school, collected through their monthly meter readings, utilities bills, or from records of energy use collected by the school's LA energy manager. To provide comparison across the schools, the common metric kwh/m^2/yr, was used which describes the amount of energy consumed each year per square metre of floor area.

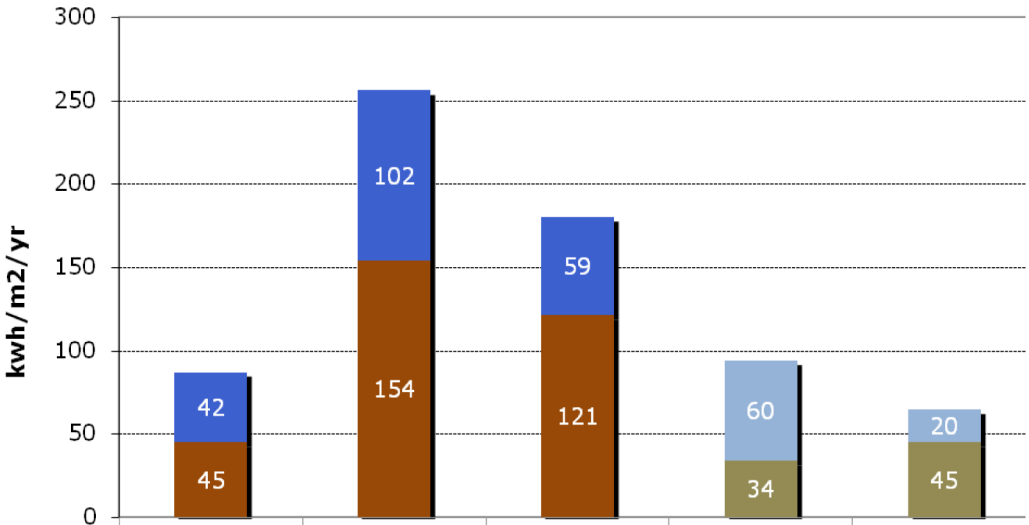
It was not possible within the scope of this review to include where energy was used in the school, or to give a detailed breakdown of which components were using what energy. This data would help to inform an approach to achieving energy efficiencies and an energy reduction strategy.

5.3.1 Annual energy consumption of evaluated schools compared to benchmark

The energy performance (for both heating and electrical consumption) of all the evaluated schools (apart from one) was high compared with current benchmarks - DfE's 'Energy and Water Benchmarks for Maintained Schools in England 2002-2003'. (See figures 21 and 22, and Appendix D, annual energy consumption of evaluated schools).

These benchmarks were based on the broad range of energy-in-use data of the existing school building stock, including schools of the two previous major UK school re-building programmes - Victorian and 1950s schools.

Heating demand was contributing by far the largest part of the energy demand in comparison to the electrical demand. This is worrying as it is the reverse trend of what has been seen recently in schools with low energy consumption where the heating component plays a much smaller part of the total energy consumption due to better performance of the building fabric and seasonal control of the heating system.



	Annual energy use of best performing POE school (kwh/m2/yr)	Annual energy use of worst performing POE school (kwh/m2/yr)	Annual energy use of mean POE school (kwh/m2/yr)	Annual energy use of PFI school paymechanism benchmark 27kgCO2/m2/yr e	Annual energy use of DfE's benchmarks- Top 10% percentile (kwh/m2/yr)
Electricity	42	102	59	60	20
Heating	45	154	121	34	45

Fig 20: Benchmark comparison of POE schools with mean, best and worst energy consumption.

The annual heating use ranged from about 45 to 155 kwh/m^2/yr, whilst the electrical use ranged from about 25 to 100 kwh/m^2/yr compared to school benchmarks[3] , with an annual heating use of 45 kwh/m^2/yr and an electrical use of 20 kwh/m^2/yr. See figure 20. This shows a wide difference in the range of annual energy consumption between the highest and lowest consumptions of the POE schools. Most of the schools' energy consumption were clustered

[3] Top 10% of schools that used the least energy consumption across all UK schools (based on DfE's *Energy and Water Benchmarks for Maintained Schools in England 2002-2003'*),

around the higher levels, with the mean POE school being nearly 280% more than the benchmark.

All of the schools in this POE would have been designed and constructed to meet the minimum standards of the 2006 Part L requirements of the Building Regulations; however it is questionable that the minimum standards were being achieved.

Heating use

A school with a relatively low energy use sees an annual heating load of around 45 kwh/m^2/yr.

The schools in this study included a commendable refurbishment project where 'fabric first' was one of the key solutions as part of the environmental strategy. The existing external walls, windows and roof were upgraded to improve thermal performance (and thus the comfort of students and staff) and this played a vital role in reducing energy consumption. However, the majority of the schools had considerably higher heating demands, with 90% being from about 100 to 180 kwh/m^2/yr (for both new build and refurbishment projects).

Electrical use

In recent years, schools have experienced increases in electrical usage with the introduction of electrical equipment ranging from ICT, photocopiers printers, interactive whiteboards in classrooms through to external flood lighting for sports and security lighting. A school with a relatively low energy use sees an annual electrical load of around 30 kwh/m^2/yr.

The schools in this study ranged from about 25 kwh/m^2/yr to 100 kwh/m^2/yr, with the majority clustered between 40 and 80 kwh/m^2/yr (for both new build and refurbishment projects).

5.3.2 Comparison of energy consumption between primary, secondary and Special schools

There was little difference, in terms of total energy consumption, between the different types of school in the study. This reflects the findings in the DfE's benchmarks.

Heating use for the secondary schools, with a range of about 45 to 180 kwh/m^2/yr, was similar to the range for primary schools of about 45 to 150 kwh/m^2/yr. Heating use for Special schools were not the highest, but at the higher end of the range, despite the heat used to maintain the temperature of hydrotherapy pools.

Electrical loads of the secondary schools, with a range of about 40 to100 kwh/m^2/yr, were slightly higher than the range for primary schools at about 25 to 60 kwh/m^2/yr.

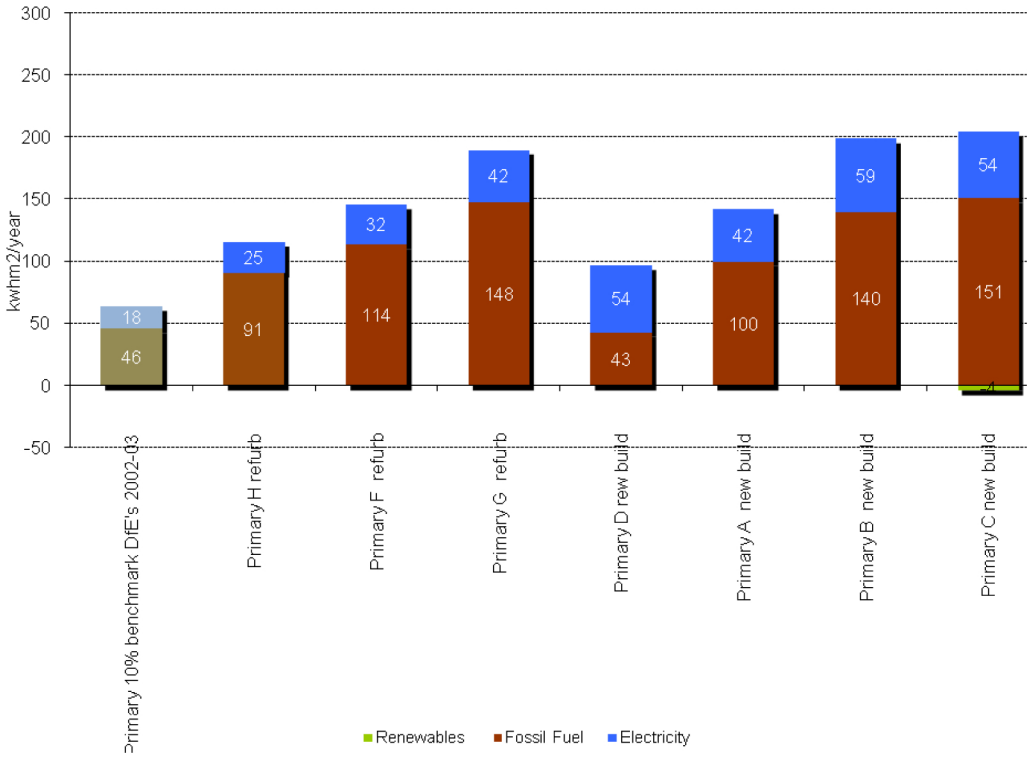


Fig 21: Benchmark comparison - annual energy consumption of primary schools

The energy performance of the primary schools

In the primary schools evaluated, the energy performance of a new build was similar to that of a refurbishment school. From the sample range the majority of both new build and refurbishment projects were using too much energy on heating; however, we do have two examples with a better performance, one a refurbishment and one a new build school.

The key point is that a better performing refurbishment can be achieved, demonstrated in this case where the first step was to improve the building 'fabric first'. The expectation is that all new builds can achieve good performance, driven by compliance with building regulations.

Two schools that had the lowest annual energy consumption were designed and constructed by local authority teams that had experience of good school design. These schools continue to be part of their local authority asset management where a more unified approach of continual improvement can be considered to achieve long term efficiencies, providing good value in looking after the public assets.

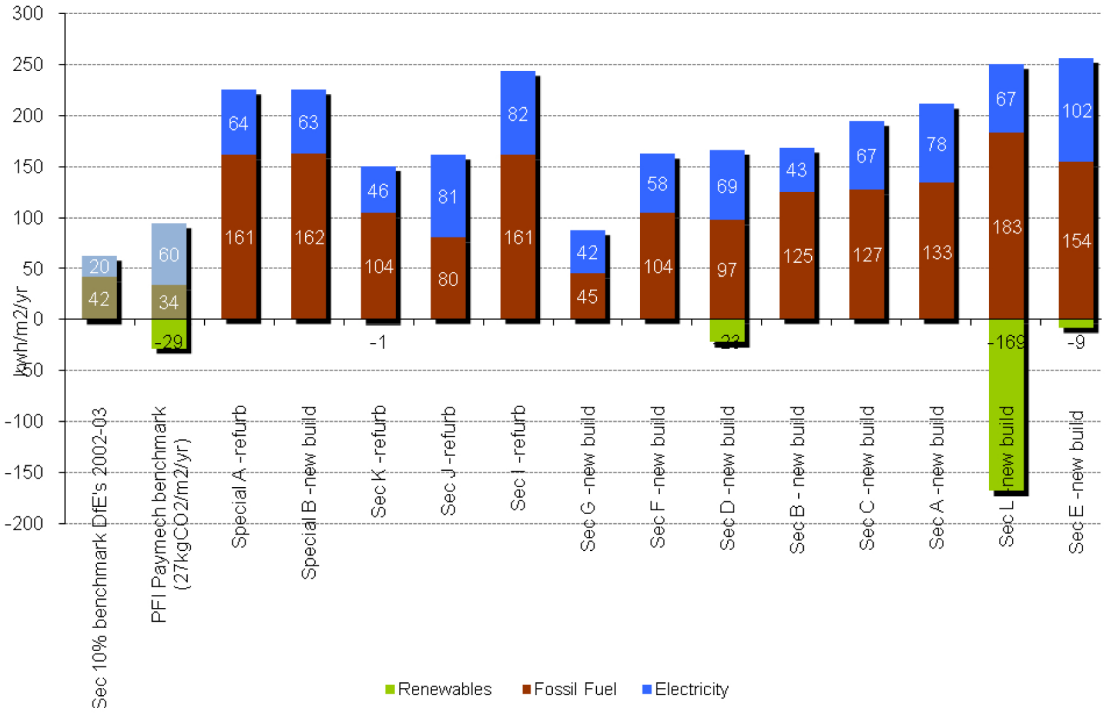


Fig 22: Benchmark comparison - annual energy consumption of secondary schools

The energy performance of the secondary schools

The energy performances of the new build and refurbishment secondary schools were similar to the primary schools. More importantly, all apart from one were annually consuming 200% to 400% more energy than they should be. The one good energy performing school was a local authority designed, procured and asset managed school.

Considering the energy performance of the schools against the current PFI payment mechanism benchmark (equivalent of 27kgCO_2/m^2/year), heating should account for roughly a third of the total energy use, and electrical use two-thirds. Excluding the one well-performing school, none of the evaluated schools reached the equivalent of the PFI benchmark. Heating caused the biggest concern as the discrepancy between actual energy use and benchmark was the greatest.

The POE heating use range was about 45 to 180 kwh/m^2/yr, compared to the PFI benchmark of 34 kwh/m^2/yr. The POE electrical use range was about 40 to 100 kwh/m^2/yr, compared to the PFI benchmark of 60 kwh/m^2/yr.

5.3.3 Schools' carbon performance

Carbon emissions from electricity and gas are an important aspect of schools' energy consumption. The main issue is the greater impact of electrical energy consumption compared to gas, as it has a higher carbon factor. Improvements made to schools' electrical energy performance would significantly reduce environmental impact.

To provide comparison across the schools, the metric $kgCO_2/m^2/yr$, has been used which describes the amount of carbon emitted each year per square metre of floor area. The table below shows the schools' current annual carbon emissions generated through fossil fuel use (brown) and electricity use (blue), and, to neutralise emissions, the offset contribution by renewable technology (green)

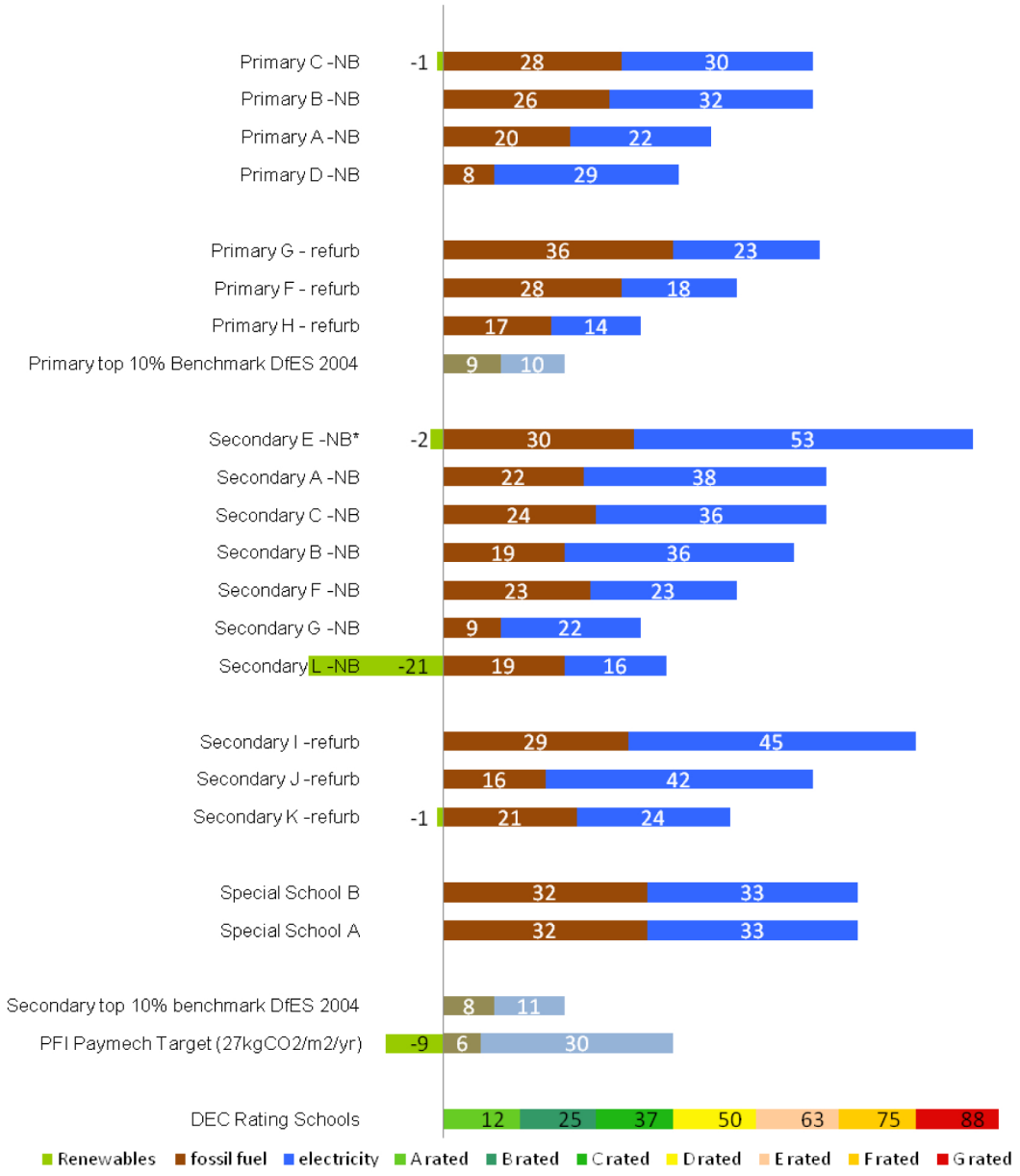


Fig 23: Benchmark comparison - annual carbon emissions $kgCO_2m^2/yr$

PfS's current carbon performance targets for PFI schools require a 27kgCO_2/m^2/yr benchmark to be met. The data collected from the one PFI school in this POE (school L - new build) shows the complex issue of carbon performance. While the carbon emissions off set by renewable technology meet the carbon performance target, the school still has one of the highest energy consumptions. The carbon profile of a well-performing school should have both low energy consumption and low net carbon emissions, after taking account of the renewable energy used.

5.3.4 Display Energy Certificates (DEC) ratings for schools

A DEC is a way of showing the energy efficiency of a building. It contains three main charts – the operational rating (a measurement of the energy efficiency of the building, on a scale from A to G where A is the most efficient and G is the least efficient); carbon dioxide emissions; and previous operational ratings from the last three years, which help to inform whether the energy efficiency has improved. Since October 2008, regulations require occupiers of school buildings with floor areas of more than 1000m^2 to have a DEC, based on the actual measured annual energy consumption.

All but one of the eligible POE schools (open a full calendar year) held a DEC certificate. However 37% of the DEC ratings were not current, but were for the school prior to being rebuilt or refurbished.

The range of current ratings was from B to F, with the majority being a D rating. This is against a current benchmark of B rating, based on the current PFI payment mechanism (equivalent of 27kgCO_2/m^2/year). During discussion with the head teacher of the best performing B-rated school, she said they were working towards improving the rating, further evidence of the school's 'energy literacy' by using measurement to inform improvement.

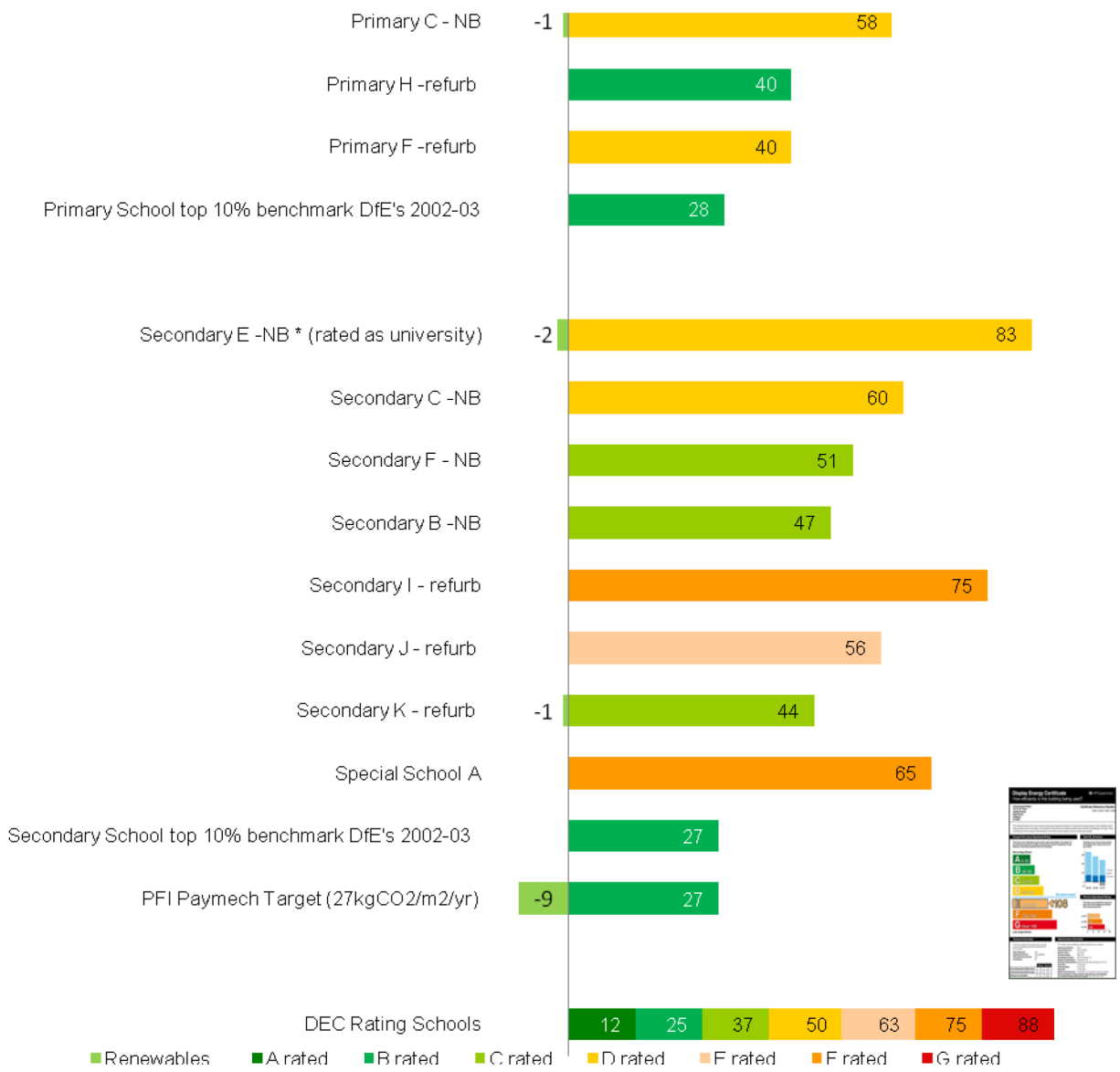


Fig 24: Benchmark comparison of DEC Ratings (Benchmarks use 2003 conversion factors)

5.3.5 BREEAM Assessment

In March 2005 it became a DfES requirement that all major new school buildings and refurbishment projects above a threshold register for a BREEAM assessment and achieve at least a 'very good' BREEAM rating[4].

[4] projects valued at over £500 000 for primary schools and £2 million for secondary schools, and involving rebuilding or complete refurbishment of more than 10% of the floor area of a school. As part of the wider Capital Review, the application of BREEAM assessments to school buildings is currently being evaluated to assess whether the benefits can be justified in relation to the burdens they impose on project delivery.

The OGC's 'Common Minimum Standards for the Built Environment' require BREEAM Excellent ratings, 'unless site constraints or project objectives mean that this requirement conflicts with the obligation to achieve value for money'. The requirement for school buildings is to be 'very good' rather than 'excellent' until the technical and financial implications of the higher standard are known. All of the POE schools met the requirement to register for a BREEAM assessment; however the findings and conclusions varied across the different school types.

- For the primary new builds, around 75% of the schools were registered for BREEAM 2006 Schools; however no results have been confirmed yet.
- For the primary refurbishments, none of the schools were registered.
- For the secondary new builds, 10 of the 11 schools were registered for BREEAM 2005 Schools, BREEAM 2006 Schools or BREEAM Bespoke 2005. About 70% of the schools have no results confirmed yet. One school had received a 'good' rating and two schools 'very good'.
- For the secondary refurbishments, 2 of the 5 schools were registered for BREEAM 2005 Schools; however no results have been confirmed yet.

The BREEAM requirement on these schools covers the design and construction process. As the majority of the schools have been open for more than 12 months since the completion of the build process, the expectation would be for the BREEAM process to have been completed too.

As very few results have been confirmed the findings of this evaluation are not sufficiently conclusive to give an understanding of the impact of BREEAM assessments.