

Transition Bath Schools Energy Project

Summary

In 2009/10 schools in the Bath area collectively spent more than £2.5m on gas and electricity. The Transition Bath Schools Energy Project is a voluntary effort with professional expertise aimed at reducing energy consumption in schools in the Bath area.

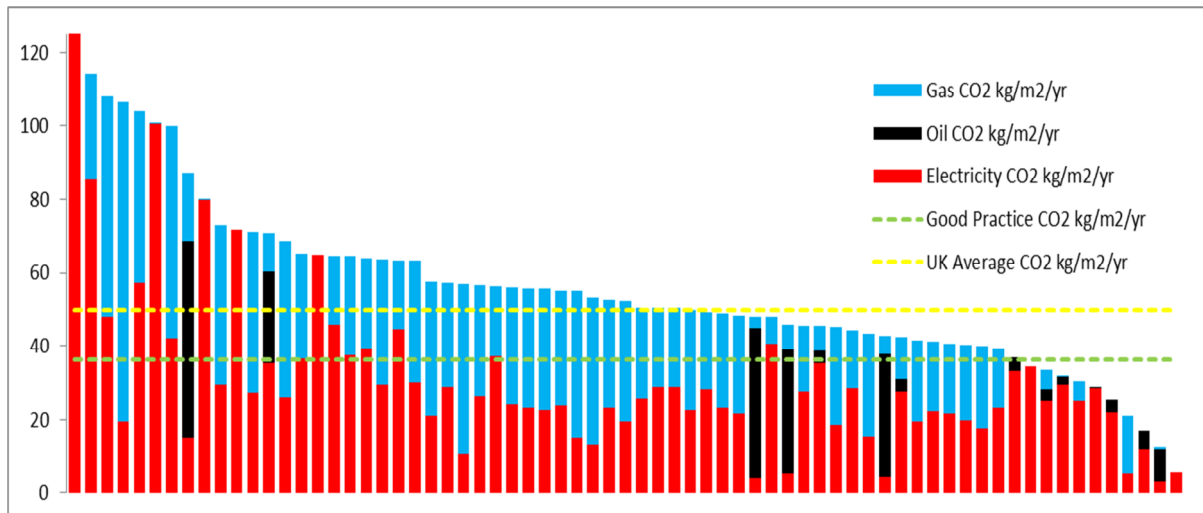
The project started in May 2011 and so far we have worked with 6 schools to analyse their energy usage. From our initial analysis we believe that there is an opportunity to reduce both gas and electricity consumption by an average of 30% at these schools at little or no cost. Our aim is to progressively roll out this program of energy assessment and reduction to all schools in the Bath area. Our long term vision is for schools in the Bath area to perform in line with national good practice benchmarks for energy consumption while providing a comfortable environment for both staff and pupils.

If you are interested in helping us, or are a school who would like help and advice please email us at schoolsenergy@transitionbath.org .

Background

The Transition Bath Schools Energy Project started in May 2011 as a result of a presentation to the Transition Bath Energy Group by a local community energy assessment company Lock-In Energy. Lock-In Energy suggested that there were significant opportunities to improve the energy efficiency of schools in the Bath area based on experience from providing professional energy surveys in schools over the last few years.

The presentation was also coincident with the release of energy consumption data for all large public buildings in the UK by DECC (the Department of Energy and Climate Change) and a quick analysis of this data revealed that schools in the Bath area had a wide range of energy efficiencies; only 10% of the schools meet the Department of Education Best Practice Guidelines and only 40% are better than the UK average despite Bath being in a warmer area of the country.



The graph above illustrates the CO2 emissions on a per floor area basis for the 75 schools in Bath.

The Plan

As a community based voluntary organisation with professional expertise whose aim is to make Bath more sustainable we decided that it would be worth investigating whether there were real opportunities to reduce the energy consumption of schools.

In July 2011 we picked 6 schools (5 primaries, 1 secondary), with whom the group had personal connections and which we felt were representative of the school building stock in Bath. Our initial aim was to offer free energy surveys to these schools and use the knowledge gained to write case studies as examples to the other schools in the Bath area.

Survey work started in July 2011, this work varied from school to school but generally involved a 2 to 3 hour visit where we looked at the heating arrangements (boilers, radiators, thermostatic controls), and electrical appliances (PCs, lighting etc.). We also analysed each schools AMR data (Automatic Meter Reading Data) which provided ½ hourly gas and electricity meter readings for the whole of last year.

Results of initial case studies/analysis

Our initial findings are:

- If our initial sample of 6 schools is representative it should be possible to reduce gas consumption by an average of 30% at schools in Bath at little or no cost to the schools simply by better managing when boilers are turned on and off.
- Many of the schools also appear to have problems with the thermostatic control of the temperature in their classrooms during the winter, some classrooms are too cold, but many are too hot. At present teachers solve the overheating problem by opening the windows – which is not a good use of energy. We feel we can provide some practical – largely free suggestions for how this can be improved saving significant amounts of energy.

- Electricity consumption during school hours is harder to reduce but about 40% of a typical school's electricity consumption is outside school hours (evenings, weekends and holidays) – we feel there are opportunities to reduce this by turning equipment off or ensuring the appliances are left in standby mode. We are running a pilot study at 2 of the schools to see what is achievable.

The impact of our work so far

Most of the schools we have visited have been supplied with a detailed 20 to 40 page report. A summary of the main recommendations for each school appears below. It is likely that there will be further recommendations on electricity consumption for all the schools once we have completed a detailed exercise in reducing consumption at schools C and F. We won't know the exact impact of our recommendations until the end of the winter, but some schools have already seen a reduction in line with our expectations of the 'potential impact' of the changes:

School (Anonymous)	Suggested Improvement	Cost	Potential Impact
School A	Fix problem with optimal start on boiler controller which was starting the schools boiler at 01:30am each morning last year	Free	40% saving in gas bill
	Put in place a process for the annual programming of holidays	Free	10% saving in gas bill
	Replace boiler, which is 50 years old and very inefficient (only 10% when heating water)	£20,000	40% further saving in gas bill
	Install cavity wall insulation	£6,000	18% reduction in gas consumption
School B	Fix problem with optimal start on boiler controller which was starting the schools boiler at 03:00am each morning last year	Free	40% saving in gas bill
	Put in place process for annual programming of holidays into	Free	10% saving in gas bill
	Refurbish 50 year old radiator enclosures and vents	£500 to £1000	10% saving in gas bill
School C	Fix broken boiler controller which had been running 24x7 for most of 2010/2011	£2,000	60% to 70% saving in gas bill
	Replace boiler	£20,000	Further 30% saving
	Install timers for electric heaters in toilets	£200	8% saving in electricity bill
	Implement improved shutdown/standby policy on ICT equipment	Free to £200	20% saving in electricity bill
School D	Make sure heating is turned off over summer, hot water not left on over holidays	Free	15% saving in gas bill

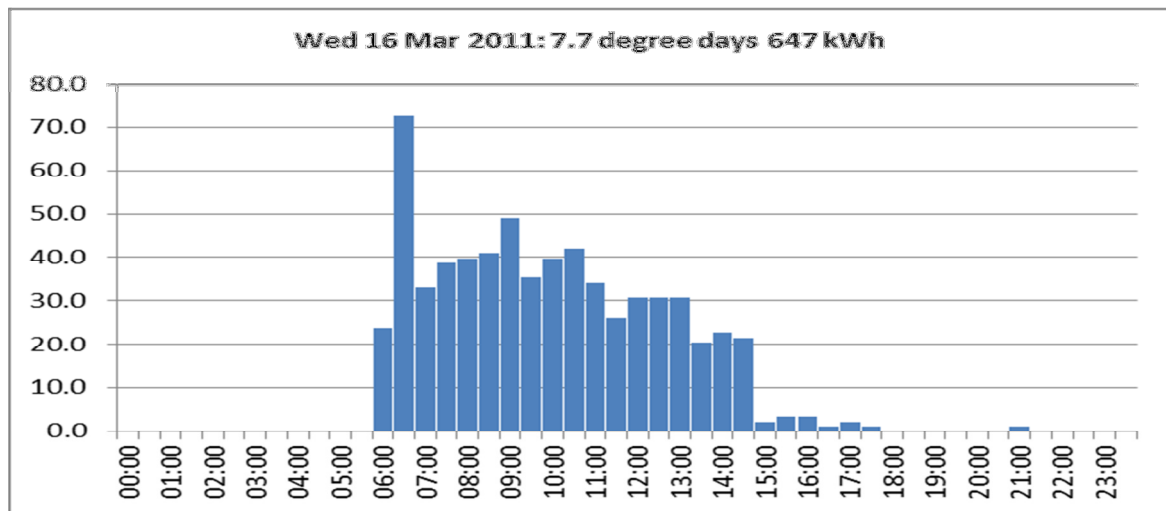
	Consider installing a smaller separate boiler for hot water only, as currently main boilers are only 10% efficient at producing hot water	£2000	15% saving in gas bill
	Install cavity wall insulation	£2000	5% saving in gas bill
	Install 50 kWp of solar PV panels on flat roof	Free	50% saving in electricity bill
School E	Make sure heating/hot water turned off at weekends and during holidays. And, especially not left on 24x7 after evening events	Free	15% saving in gas bill
School F	Consider replacing oil boiler with gas boiler	£60,000	£18,000 per annum savings
	Reduce weekend gas consumption, make sure gas heaters are switched off in temporary classrooms overnight and at weekends	Free	Up to 25% reduction in gas consumption
	Look at reducing number of appliances left on outside school hours, improve configuration of air conditioning in server room	Free to £2,000	Up to 20% reduction in gas consumption

Understanding Schools Energy Consumption patterns using AMR data

AMR data (Automatic Meter Reading data) provides us with ½ hourly meter readings for the last year. By analysing each school’s consumption we are able to spot opportunities for saving energy. Over the last few months we have developed a number of tools which help us to analyse the data automatically.

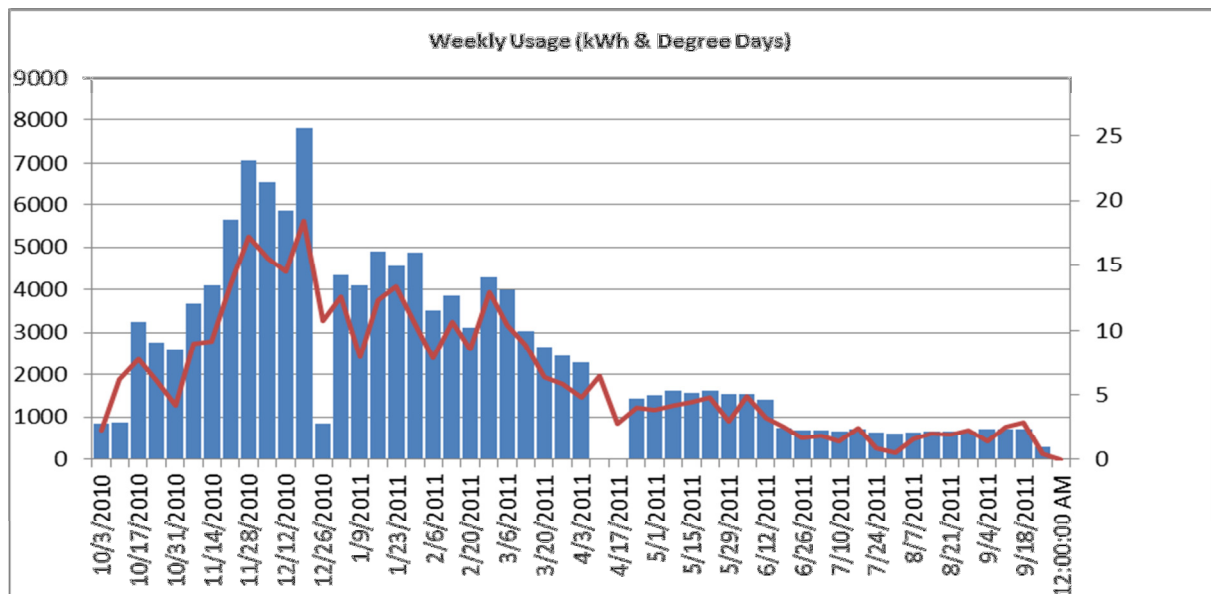
Gas consumption patterns

A typical daily winter’s day gas consumption pattern for a well-managed boiler is as follows:



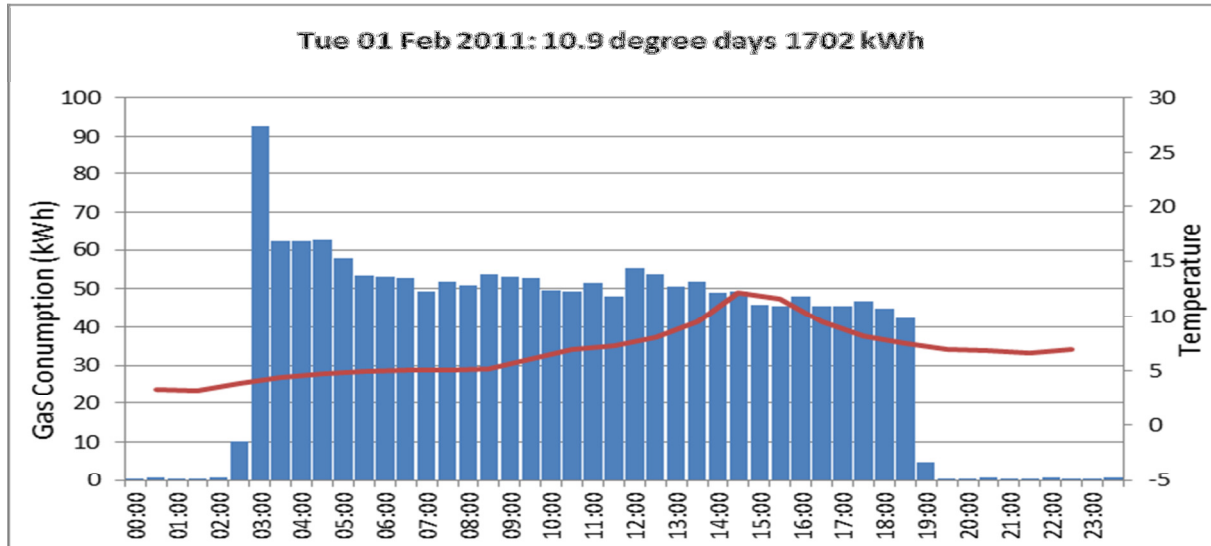
The heating comes on at about 6.15am, the initial peak consumption lasting about 45 minutes when most of the gas is used to heat up the hot water cylinder, pipework and radiators. Consumption rises from 7.00am to 9.00am as external doors are left open to allow teachers and pupils to enter the school. After 9.00am consumption gradually reduces as the outside temperature increases. Eventually the heating is automatically turned off at 3.00pm.

Over the period of year the typical gas consumption pattern is as follows:



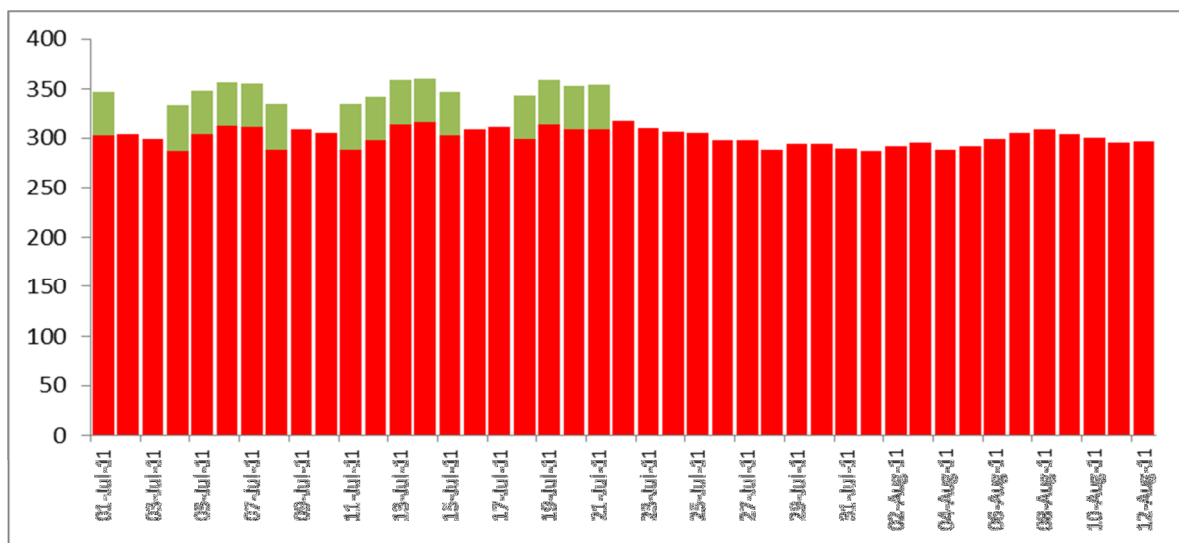
The consumption (blue bars) gradually rises as it gets colder (red line) during the winter. There are occasional drops in consumption when the school is unoccupied over Xmas and Easter.

The 2 graphs above are 'normal', our analysis attempts to spot anomalies, so for example the daily winter gas consumption pattern for school A was as follows:



In this example the boiler is turning on 5 hours too early, which it did for the whole of last year and was not turning off until 18:30pm. So the boiler was on for 15.5 hours rather than the 8 hours which might be required. Correcting this timing should save the school about 50% of its gas consumption.

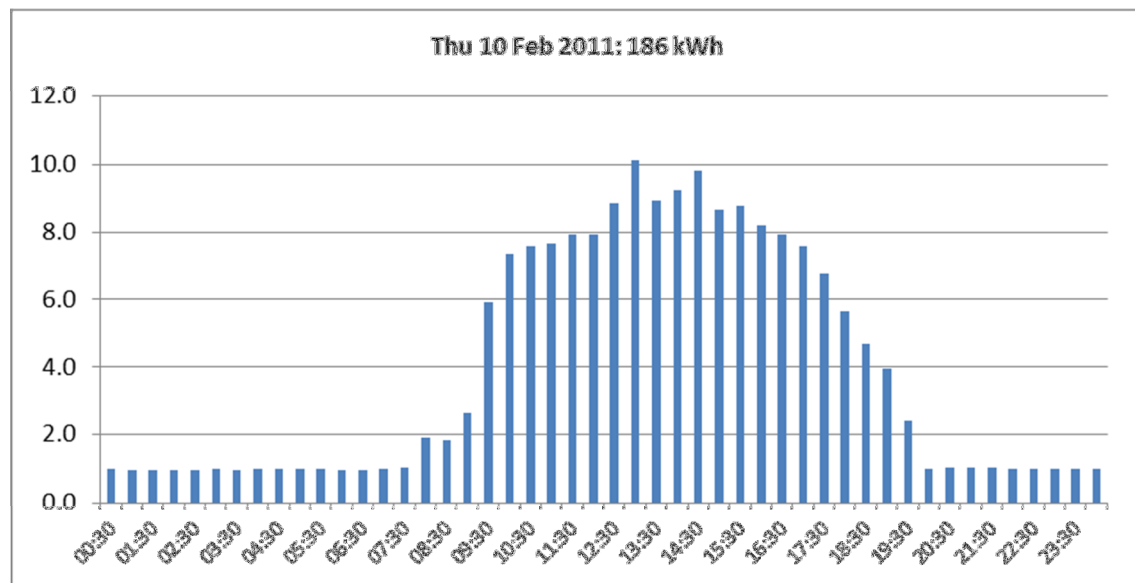
In addition to these basic problems it appears that the hot water heating systems at most schools are very inefficient. In a number of cases the boilers are less than 10% efficient – they should be 90% efficient. The graph below shows the gas consumption at School A from just before the summer holidays into the holidays when the school was unoccupied. The boiler was accidentally left on both over the weekends and during the holidays, but it does help to illustrate the inefficiency of the boiler – there is little difference in consumption between days when the school is occupied and when it is not:



The green bar illustrates the approximately 50 kWh which would be necessary to supply hot water at the school in the summer on weekdays when the school is occupied, the red is wasted heat, mainly being lost in the boiler room – there is little difference in gas consumption between occupied and unoccupied days. In this case to solve the ‘problem’ the school would have to invest about £2,000 to install a modern condensing boiler just to supply hot water in the school but the school would get its money back in gas savings in under a year.

Electricity consumption patterns

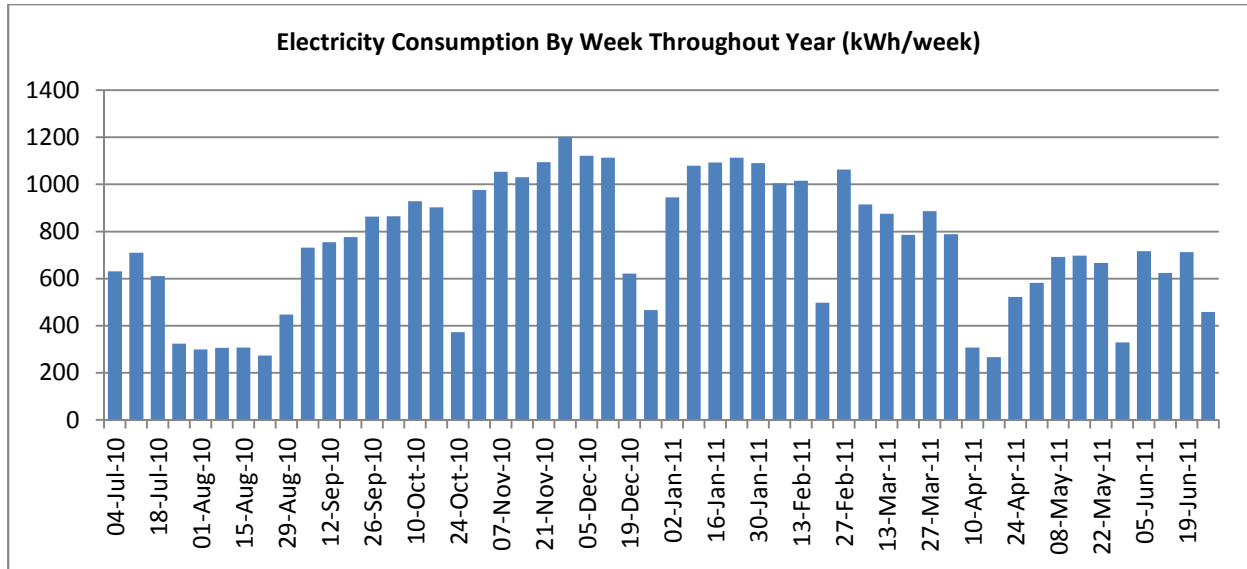
The electricity consumption during a typical school day is as follows:



This is a consistent pattern, found at all the schools we have looked at. Electricity consumption rises during the day as lighting and computers are turned on, and goes back to a ‘base load’ overnight. Reducing electricity consumption during school hours is difficult without capital investment. Some behavioural work like training pupils and staff to turn off lighting when daylight is sufficient or rooms are not occupied may reduce consumption by 10%. The most obvious upgrade would be to invest in new 30% more efficient modern fluorescent lighting – something for which B&NES council offer a low cost loan.

The other potential reduction is to reduce the overnight base load. Although this looks small on the graph, it actually represents 40% of most schools’ electricity bills as schools are only occupied for about 15% of the year (190 days x 8 hours). We have been running pilot projects at 2 of the schools to investigate how this can be reduced – our aim is reduce this by 75% by automatically switching as many appliances off as possible when the schools are unoccupied. This would represent up to a 30% reduction in annual electricity consumption. Over the next few months we should come to some conclusions about the best way of doing this and if it is possible – we would then attempt to roll out these ideas to other schools in the Bath area. The likely implementation would involve the installation of cheap time switches and changes to ICT policy/configuration.

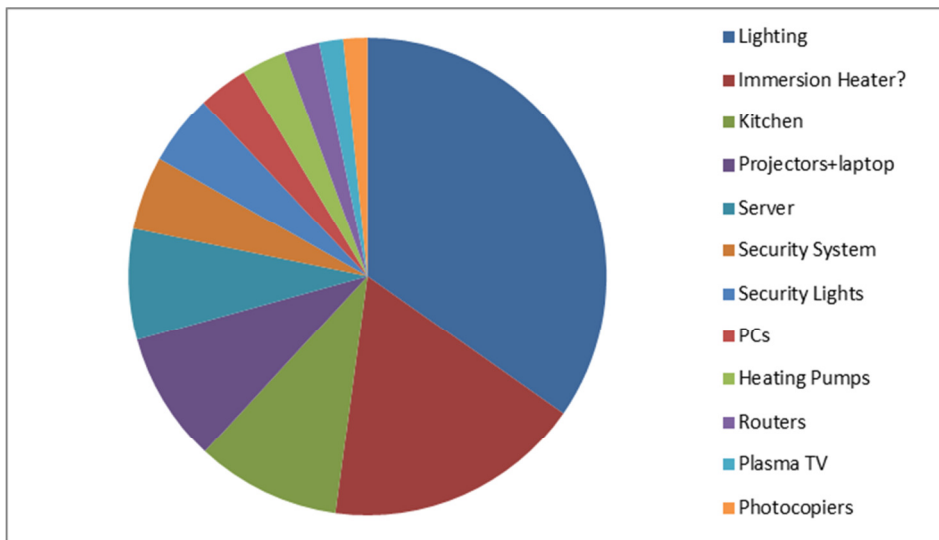
The annual electricity consumption patterns at most schools is as follows:



Consumption rises during the winter because of shorter daylight hours which require more lighting. Consumption drops during the holidays, but is unnecessarily high.

Electricity Analysis

We have also provided to a number of schools a breakdown of how their electricity is consumed. This allows schools to make more informed decisions about which if any electrical appliances they might consider replacing. An example breakdown for a primary school appears below:



We have also provided analyses of the impact of installing solar photovoltaic panels – this has ranged from a 30% to 50% reduction in school’s electricity usage. Generally these are provided free by a number of companies, including [Bath & West Community Energy](#).

Unfortunately unless schools move quickly it looks as though the government is going to halve the Feed-in-Tariff subsidy in the very near future making these investments much less economic and it is likely that the offers of ‘free’ electricity may be withdrawn.

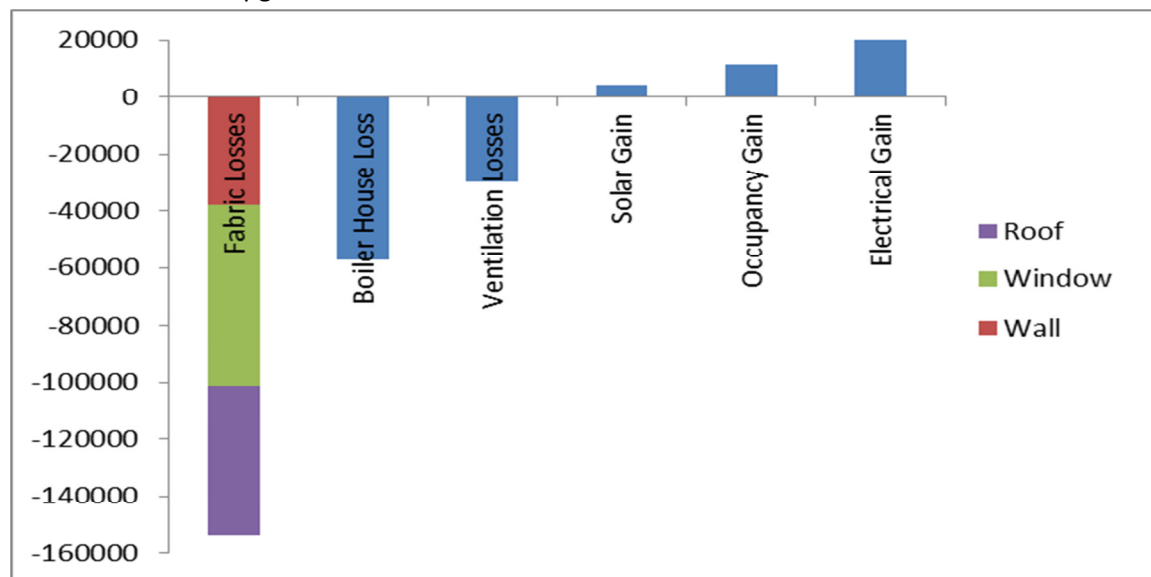
Fabric Analysis

At some of the schools we have carried out an analysis of the building fabric to see how much reduction in heating and gas consumption would occur if for example cavity wall insulation double glazing and loft insulation were installed. This allows the schools to make an assessment of the benefits of the upgrades.

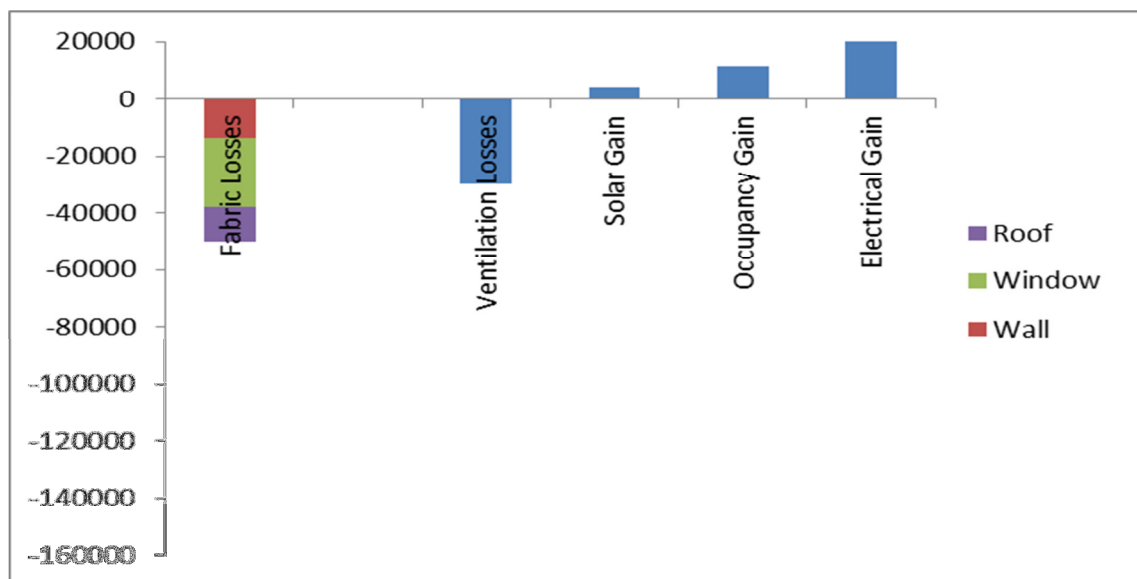
A very general rule of thumb for this type of work is:

Improvement	Cost	Payback time in energy savings
Cavity Wall Insulation	£6/m ²	6 years
Loft Insulation (pitched roof)	£6/m ²	6 years
Flat roof insulation	£50/m ²	30 years
Double Glazing	£100/m ²	30 years

More detailed analysis, which is quite time consuming, which we have carried out at a few schools shows the impact on the school as a result of some of these upgrades. The first graph shows the school before the upgrade:



And after insulating the cavity walls, installing double glazing, loft insulation and fixing the boiler, the impact looks like this:



The total net heating requirement has been reduced from 200,000 kWh to 40,000 kWh.

What this serves to illustrate is that once the fabric of a school is improved that most schools actually need very little heating. Unlike domestic premises a much greater proportion of the heating is provided by its occupants (i.e. 20 to 30 pupils in each classroom) and electrical equipment (lighting and PCs).

To express this in another way, the achievable benchmark for the total fuel use (for heating and hot water) of a school that is well insulated, has an efficient modern gas boiler and is well-controlled is 50 kWh/m²/year compared with the current UK school average of about 170 kWh/m²/year. The Bath schools we have looked at so far have a fuel use at least three to four times this level and in one case nearly six times; only 3 schools out of 75 in Bath appear to meet this benchmark.

Conclusions

From the 6 schools we have worked with so far there appear to be opportunities to reduce energy consumption by about 30% at little or no cost – through improving the timing of boilers, improving thermostatic control of classrooms so windows are left open less often in the winter and through better management of electrical devices being left on when the schools are unoccupied. If this small sample is representative of Bath schools as a whole then these savings if rolled out to all Bath schools have the potential to save £500K per year which would be made available to fund other school activities.

Our short-term plan is to analyse as many schools gas meter readings (AMR data) as possible before the winter sets in as we think there are significant free opportunities to save energy by improving the controls of schools' boilers.

In the medium term we would like to build a standalone website, specifically for this schools project – so we can provide much more detailed advice to schools on how they can reduce their energy

consumption. We would then plan on providing detailed surveys at any Bath school which requested our support.

The Transition Bath Schools Energy Project aims to work with schools, community members and the BANES council in reducing energy use in schools in the Bath area. We are very happy to provide help to schools and are looking for 'energy champions' within each school to help us roll this program out to all Bath schools.

If you would like to volunteer to help or to get your school involved please contact us on schoolsenergy@transitionbath.org – we are happy to provide training if required.

In addition if you are from outside the Bath area and you would like advice or would like to provide us with some feedback or offers of help, please email us.

Transition Bath, November 2011