

ENERGY SAVINGS FROM INTELLIGENT METERING AND BEHAVIOURAL CHANGE: CASE STUDY BRIDGE JUNIOR SCHOOL, LEICESTER, UK

This case study examines the benefits to a UK school of monitoring its gas, electricity and water consumption using an automatic monitoring and targeting system.

General description

Description of the building

Bridge Junior School has 354 pupils ranging from 7 to 11 years old. The building, constructed in the 1970's, is owned by Leicester City Council.

The school is part of a 'Social Cohesion Project', which links with a number of organisations including the local catholic school amongst others to enhance racial harmony.

The School's buildings have a total floor area of 1,349m².

Location

The school is situated in a densely populated area of the city of Leicester in the UK, located at a latitude of 54° 37N and longitude of 1° 33W.

Leicester is a city with a long and varied past engrained in the fabric of its buildings and the character of its businesses and people. It is also a city which looks to the future, with the commitment to develop a quality environment over the next thirty years.

Levels of energy consumption

Table 1 presents the UK benchmark figures for energy and water consumption, based on survey data of over 10,000 primary schools, 2000-2001.

	Good practice	Typical	Poor practice
	kWh/m ² /annum	kWh/m ² /annum	kWh/m ² /annum
Electricity	25	34	47
Fossil fuel	110	157	209
	m ³ /pupil/annum	m ³ /pupil/annum	m ³ /pupil/annum
Water	2.7	3.8	5.6

Table 1: UK benchmark for energy consumption in primary schools



Installation of the metering and monitoring equipment has revealed that the School's annual consumption for the 12 months from 01/09/05 is as shown in Table 2.

Electricity	80,844.23 kWh	59 kWh/m ²
Gas	196,557.92 kWh	146 kWh/m ²
Water	3,442 m ³	9.7 m ³ /pupil

Table 2: School's annual consumption

Gas consumption is 146kWh/m², indicating better than typical and towards good practice.

Electricity consumption is 59kWh/m² and water consumption is 9.7m³/pupil. These figures are both very high, indicating the need for investigation.

Behavioural patterns

The school's operational hours are 09:00 to 16:00 with additional evening and weekend use. Cleaners and maintenance staff are in the building an hour before and two hours after school closes. The school is closed for 13 weeks of the year for holidays.

Needs assessment

Monitoring objectives

Under the UK's Local Management of Schools, Leicester schools have had devolved budgets since the 1990s, which means that the schools are responsible for managing their own finances, including the payment of utility bills.

However there was no information available to the local authority unless requested directly from the school, who would have had to make meter readings and/or provide details from billing information. In addition schools were unable to obtain profile data for energy and water or outside air temperature. This information can now be accessed by the school from the Energy Management Bureau, a service provided by Leicester City Council who instigated the installation of automatic meter reading systems from energy metering and monitoring company Energy Metering Technology.

Parameters to monitor

Energy and water are the most controllable elements in the school's budget and by using simple and cost effective efficiency measures utility bills can often be reduced. For this reason these parameters were chosen to be monitored.

In addition developing the whole school approach to energy within the school achieves a great deal. It covers a wide range of National Curriculum provision, can help develop attitudes and skills for life for the children, whilst at the same time achieving a genuine reduction in the School's utility bills.

Monitoring systems

The intelligent metering system used in Leicester was supplied by Energy Metering Technology of the UK. This includes the *Data Bird* data transmission system and the *Dynamat* software (a comprehensive monitoring and targeting package).

Hardware

The main electricity and water meters were replaced with pulsed output meters. The main water meter was replaced with a pulsed output meter and an interface to the existing main gas meter was installed.

'Chatterbox' and 'chick' transmitters were installed and finally the meters were connected to the data logger.

Communication (Data Transmission Protocols)

The Data Bird System uses low power radio at a local level to automatically transmit meter readings to a central receiver/data logger, thus avoiding the need for conventional hard wiring.

Data management (Data storage)

The meter reading data is then automatically downloaded to a PC at the Energy Efficiency Centre, where it is analysed using the *Dynamat* software which produces complex graphs on a day-on-day, week-on-week, etc. basis.

The automatic meter reading package and analysis software (*Dynamat*) provides automatic data collection and validation. It highlights immediate problems and indicates faults and unusual consumption. The meter reading, profiling and analysis shows day peaks and night/weekend lows. It can reveal leaks and wastage.

This automatic reading of meters and data analysis allows monitoring against historical targets or theoretical guidelines. Consumption can be related to weather, occupancy, production or a signature of past consumption profiles.

Automatic reporting is on a regular, and on an exception, basis identifying trends that fall out of tolerance. Easy import and export of data enables data and reports to be saved in other formats so that information can be sent electronically. The software provides information which allows production of bills which enables Leicester City Council to recharge tenants for their individual usage.

Within the European Commission supported Intelligent Metering Project (ref. EIE/04/107/S07.38635) the half hourly information, once collected, is also transmitted to a common database and is used to generate consumption graphs which are displayed on the project website (www.intelmeter.com). The school can then access their information via the Internet.

Costs

The cost of installation was £1,576. This includes hardware and installation costs.

Monitoring Management

Procedures

The system is configured to automatically send data to Leicester City Council's Energy Management Team.

Responsibilities

As with all of the buildings based in Leicester reviewing the monitoring output

has been the responsibility of the Energy Management Bureau, a service provided by Leicester City Council.

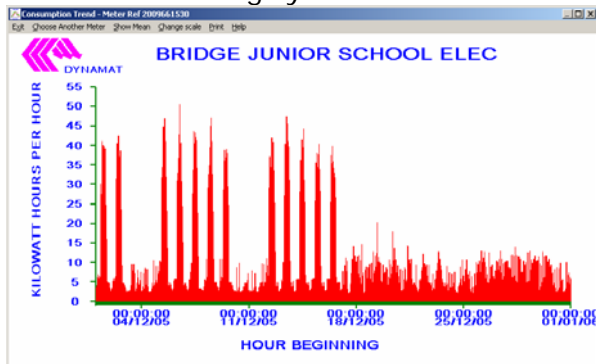
Data Analysis

Energy performance analysis

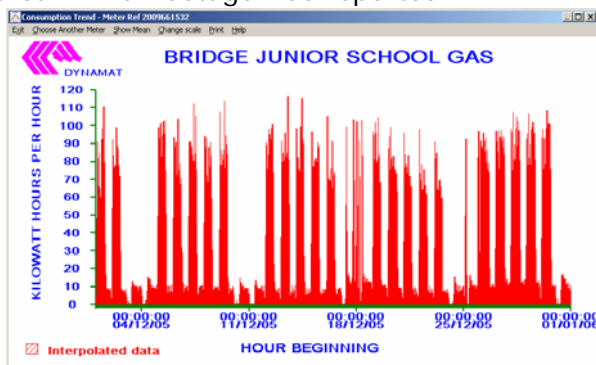
The gas usage is weather (degree day) related. However, electricity and water analysis is based on signature profiling. Signature profiling is the process by which the actual consumption is compared to the typical pattern of consumption for the building, in this case the software continuously learns the consumption pattern and uses the shape of the past consumption profile to predict future consumption. Alarms can be set to indicate higher, or lower, than expected usage.

Saving identification

The monitored electricity use profile (below) shows good low overnight usage and occupancy control. However, it was recognised that over the Christmas holidays there is wastage as the profile shows that the pumps were working to service the heating system.

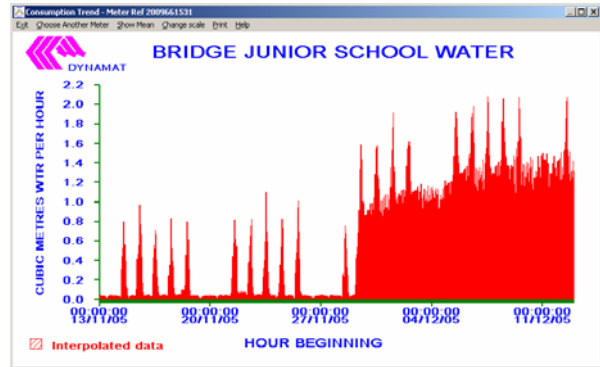


The gas profile for the same period (below) shows that the heating is well controlled during normal occupancy, but that the heating was left on during the Christmas break. The wastage was reported.

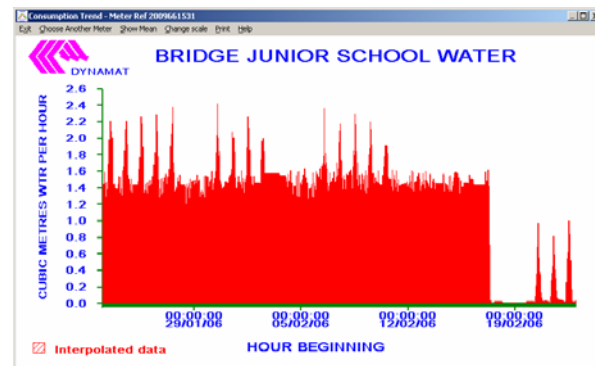


Analysis of the water profile showed an increase in the base load from the 29/11/05 (below). The equivalent to 9,636 cubic meters per annum was suddenly

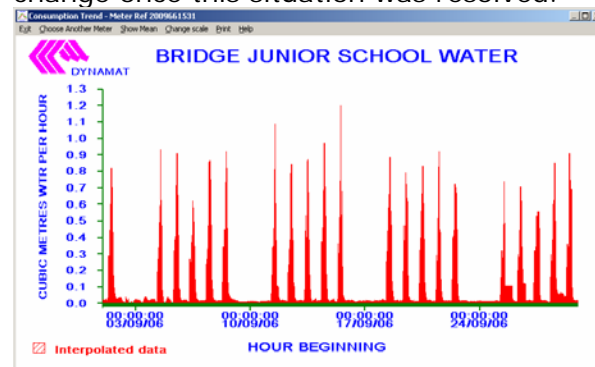
being consumed. This was correctly identified as a leak in the system.



After investigation it was discovered that the leak was under the newly built extension to the school. A new water main was laid down going around the building saving any further loss of water.



The above profile shows the consumption change once this situation was resolved.



The water profile (above) shows that there is still some consumption outside operating hours. (This suggests that there is another leakage, which could be dripping taps, overflows, header tanks etc. yet to be identified). Although less than 0.01m³ of water/hour this still represents an opportunity to save £140/year.

Lessons learnt

These leaks would not have been identified if the School had not been on the metering and monitoring system.

Training package

A training package, produced as part of the intelligent metering project was presented at a launch event attended by a representative from the school. The training package's aim was to provide support so that building users could change their usage patterns in order to save energy and water. It considered the drivers required for behavioural change:

Enabling - This is the range of techniques and factors where the intervener provides alternatives to existing unsustainable actions and behaviours.

Engaging - These are the tools available to communicate with and engage in the sustainable development process.

Incentivising - In this case they are municipal interventions, for example rewards for reducing energy and water use.

To ensure that these drivers translate into real change **catalysing** is required. This is where combinations of the three drivers are brought together with one key element that stimulates mainstream change in actions and behaviour.

Training used

As well as the launch event a specific training visit was made to the school to further discuss details for the training and to review the immediate and future potential for energy efficiency and hence cost saving measures.

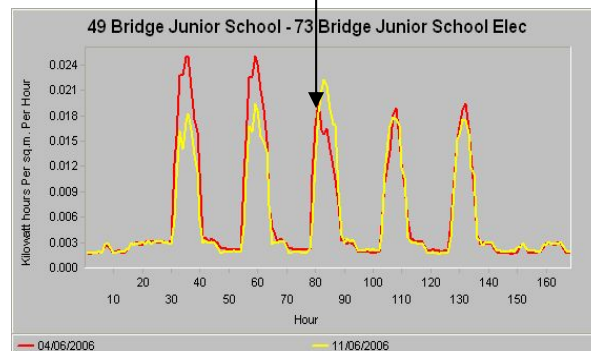
Analysis of training actions

An electricity consumption graph for Bridge Junior School from the project website showing daily electricity use in the week of the training meeting (below) indicates that there was a saving in electricity made as a result of the training meeting. An action plan detailing targets for actions for the short and medium term was also developed as part of the outcome from this meeting. This is being progressed and it is hoped that further savings can be identified.

Lessons learnt

Training for behavioural change can have a direct impact on energy savings.

7th June: Training



Conclusions

Assessing savings

Purely from the projected annual water losses from the leak identified the saving was 9,636 cubic metres of water, saving £12,048 and 5.3 tonnes of CO₂/year. In addition further wastages were identified in terms of unnecessary gas usage during the holidays. It appears that following the training visit to the school there has been at least a short-term reduction of about 20-25% in peak electricity demand.

Assessing project success

Purely based on a financial assessment the system has paid for itself in 3 months, using the water savings alone for this analysis. This project has shown that well designed and efficiently managed services not only result in energy savings, but also in an improved and more comfortable environment for pupils and staff. Since monitoring started, this school has:

1. Improved and sustained energy efficiency by undertaking good housekeeping measures.
2. Saved potentially £12,048 by taking corrective measures as soon as the high base load was identified and reported to the school.
3. Identified responsibilities within the School for energy resources.

By monitoring the energy and water in Bridge Junior, savings have been achieved by empowering the school to make changes/repairs when required.