UK6

Slough Grammar School, UK

1 Photo

Figure 1: Slough Grammar School, Front and side view of the 1930s facade

2 Project summary

The business manager of the school has taken an active lead in the upgrading of the energy systems in the school. In 1997 the central oil fired boilers were replaced with new gas boilers. The following year, after the sealing of underground ducts containing asbestos insulation, new pipework was run at high level in corridors.

In 2001, Slough Grammar School took part in the Energy Services for Schools Programme run by the Energy Saving Trust. A 5 year energy services contract was set up and under this contract, controls on the electric heating of relocatable type classrooms and occupancy control of lighting in classrooms and other areas were installed.

A condition of the energy services funding was monitoring of the energy consumption in following years. This led to the latest initiative in 2002-2003 which is the development of a low cost automatic utilities auditing system using real time monitoring of energy consumption and remote meter reading technology. With the introduction of competition to energy supply in the UK budgeting of expenditure and monitoring of consumption based on bill information has become very unreliable. Automatic utility auditing solves this problem and provides and accurate means of bill verification. The AUA at Slough Grammar School has identified several problems in the period including an incorrectly commissioned building management system and a leak in the water main.

3 Site

The school is located in the town of Slough in the south western suburbs of London in the south of England. Latitude: 51.5°N. Longitude: 0.5°W. Altitude: 30 m above sea level.
Mean annual temperature: 12.8°C, mean winter temp.: 6.3°C.

4 Building description /typology

Slough Grammar School is an 11-18 mixed selective school which has traditionally served the towns of Slough and Windsor. It is a specialist language college serving a multi-ethnic community providing language support for a large number of languages and a hub for 6 or 7 feeder primary schools. In September 1993 the school became grant-maintained. It is now a foundation school which means it has considerable control over its own running cost budgets.
The buildings comprise, of the original listed 1914 main two storey block fronting the road which is of brick construction (see photo), which was added to in the 1930s, a major two storey flat roofed extension built in 1996 and a canteen block. There are also a number of relocatable buildings on the site.
Currently the school are in the final stages of negotiation of a Public Private Partnership contract to build a new £10m facility including pre-school nursery, gymnasium, canteen, community sports facilities and classroom accommodation.

4.1 Typology / Age

Typology/Age	Pre 1910	1910-1930	1930-1950	1950-1970	1970-
The village school					
The central corridor school					
The side corridor school					
The pavilion school					
The main hall school		●	●		
The comb-shaped school					
The open-plan school					
The cluster school					

Educational level: 11-18 years

4.2 General information

The company responsible for the energy services contract is Chalmor, through their 'Energy Governor' scheme. Chalmor conceived the project and provided the initial capital funding for the energy saving measures and carried out the installation work. They are also responsible for providing an ongoing energy management service throughout the contract period and they will carry out any maintenance to the measures that is required during this time.
Energy Services Direct (ESD), an independent consultancy that specialises in energy management services for schools, is working in partnership with Chalmor on this scheme. ESD carried out the initial survey at the school to identify the energy saving measures to be installed and the potential energy cost savings from these. They are also providing the ongoing energy management support and energy
monitoring, and will prepare the annual energy audits each year that will confirm the monetary value of the energy savings achieved.
The school itself takes responsibility for providing ESD with weekly meter readings and copies of their energy bills. They have also undertaken to implement any actions agreed in the Energy Policy and the Annual Reports.

In addition to the financing of the agreed energy saving measures, the energy services contract includes the development of an energy policy and action plan to help the school to address energy conservation across the whole school. The school plans to offer a service to take over premises management of any interested primary schools in its area in order to facilitate economies of scale and to cascade good practice. Following the success of this energy services contract, this approach to improved energy management is likely to be used in these primary schools as well.
The school already acts as a hub providing ICT support to its feeder primary schools. Gap year students are trained as ICT technicians to help with this.
The school has been developing its information technology rapidly in recent years and has a 5 year Information and Communication Technology development plan involving a partnership agreement with Tulip Computers. There are 6-7 dedicated IT rooms with desktop computers and a number of trolleys of laptop computers which use a wireless network. The school has a Schools Information Management System (SIMS) which is used for administration but is not used for energy management. All staff have laptop computers.

Year of construction: 1914, 1930, 1996
Year of renovation (as described here): 1997-2003
Total floor area:
Number of pupils: 1200
Number of classrooms:
Typical class room
size:
window/glass areas:
number of pupils:
Hours of operation: Entire building is used from 8am to 4.30pm, Monday to Friday. There is very little out of hours use apart from small parts of the building.

4.3 Architectural drawings

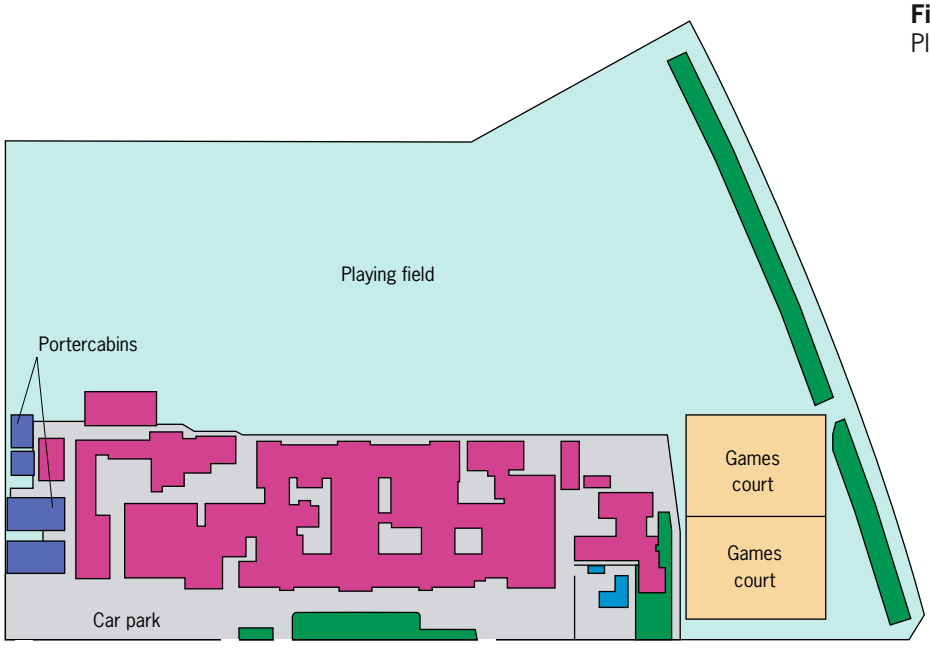

Figure 2: Slough Grammar School, Plan

5 Previous heating, ventilation, cooling and lighting systems

The heating system was previously served by central oil fired boilers. The oil fired boiler-house contained blue asbestos insulation which had to be removed before the replacement with new gas-fired boilers could take place. The LTHW is generally pumped to zones of radiators. Lighting is by standard fluorescent fittings.

6 Retrofit energy saving features

The energy saving measures to be installed were identified from an initial energy survey of the school, which identified that the total utility expenditure (ie, water and energy) was over £39,000, with fossil fuel consumption 133% above target and electricity consumption 70% above target (where the target is the mid point of the 'medium' target range quoted in "A Guide to the Whole School Approach"). Based on this survey, an energy policy was prepared that included details of recommended improvement measures and a proposal was submitted to the Energy Saving Trust for funding support.

Once approval for the grant was received, a five year contract was drawn up and agreed and the energy

saving measures - heating controls and lighting controls - were installed.

6.1 Energy saving concept

In 1997 new central LTHW natural gas fired boilers and new control systems were installed. The space which previously housed the oil tanks was converted into office accommodation. The pipework was replaced in 1998.

Automatic Utility Auditing system

Energy Metering Technology have a well established AUA system called DATA BIRD that has been proven in the major energy consumers market since it was developed in 1993-94. However this equipment is too powerful and too expensive to use in schools and has been used mainly by organisations that have a utilities bill that justifies the employment of an on-site utilities manager. The aim of this project was to develop CHICK, a "son of DATA BIRD", a low cost hardware solution that would enable meter data to be stored and analysed automatically off site. In this way a bureau service, central organisation can provide help and assistance to many schools, and economies of scale obtained, reducing the cost of providing the service.

The Automatic Utility Auditing system used comprises six small radio transmitters sending readings to a central receiver/logger unit. Five of the transmitters are connected to the pulse output ports of the utility meters (three gas, one electricity and one water), and continually count the pulses from the meter, using an electronic counter that stays in step with the reading on the meter face. The sixth transmitter has an outside air temperature sensor that enables the system to calculate how much energy the school should be using for space heating. The electricity, gas and temperature transmitters are mounted in simple wall mounted enclosures with long life batteries. Figure 2 is a schematic of the CHICK system.

Interfacing to the water meter using an above ground installation was expensive to install and difficult to make totally vandal proof. The CHICK transmitter is fitted in a small sealed section of plastic pipe, fitted in the ground next to the water meter pit with the top end at ground level. It can be fitted with a simple core drill even where the meter is in a hard road or driveway, and you can even drive the school bus over it!

Every 30 minutes the transmitters send a reading to a receiver/logger unit in the finance office. The receiver/logger date and time stamps the reading and stores it in a rolling data buffer. This battery backed-up memory continually stores the last 16 days worth of readings.

The logger is connected to the school's Ethernet network, and is downloaded by EMT's remote bureau service, through a secure opening in the firewall assigned by the local education authority's IT manager. The data is automatically loaded in to the DYNAMAT automatic utilities auditing software, which produces a weekly report for the school highlighting any anomalies and deviations from target consumption.

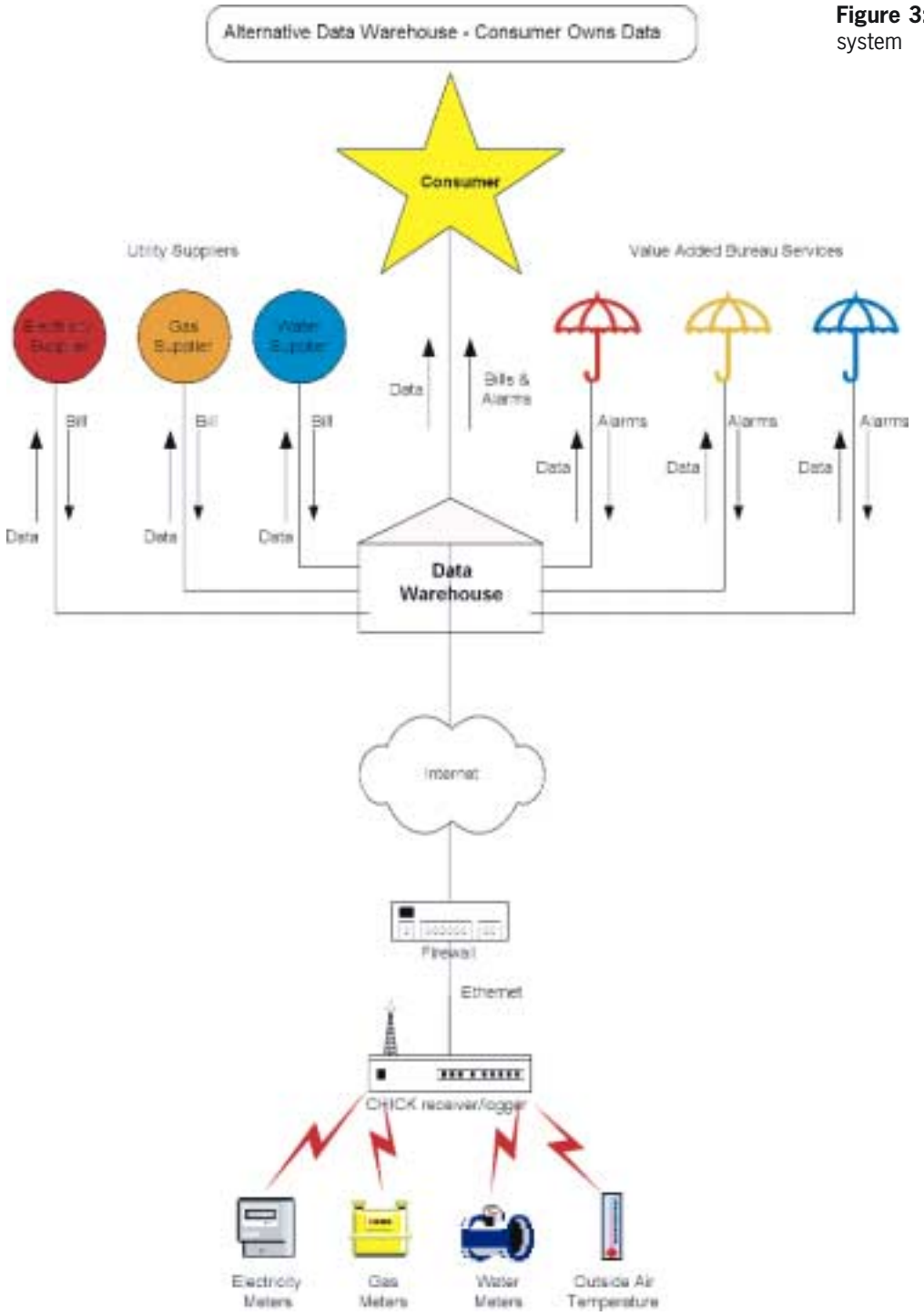

Figure 3: Schematic of the CHICK system

Whilst the school has not yet been introduced to the detailed consumption and cost analysis possible by the system they have already gained much from:
1. Identification of some simple savings opportunities.
2. Comfort that the system is continuously monitoring all their utilities consumptions and providing automatic "eyes and brains" on the consumption, exception reporting when any extraordinary circumstance has occurred.
3. Enhanced awareness of the staff to conserve energy.

It is hoped that with a small amount of training the school will be able to use the data to:
1. Carry on optimising and driving down consumption
2. Use the system to assist financial control
3. Provide continuous data to allow students to run interesting environmental and IT based projects.

6.2 Building

6.3 Heating
The heating controls fitted under the energy services contract consist of optimum start and electronic temperature control to the areas of the school with electric heating (mainly relocatable classrooms).

6.4 Ventilation:

6.5 Lighting
The lighting controls fitted under the energy services contract consist of automatic occupancy and daylight sensing controls in the 48 rooms identified as having potential for good levels of energy savings.

6.6 Other environmental design elements

7 Resulting Energy Savings

Energy Saving examples of CHICK
The project was primarily using the school to finally develop and prove the hardware and DYNAMAT software as a AUA tool for utilities management. It was not concerned with use of the tool for its intended purpose. However simple utilities savings opportunities have been found during the course of this project. Below are some typical examples to demonstrate the power of the system.
Figure 4 shows the electricity consumption for the school. Most of 20kW base load you can see on the graph are the boiler room pumps and fans left running overnight and during Christmas holidays. A saving of £3,500 can be made per annum. This could not have been discovered from regular utility company billing and would have continued to cost the school.
Figure 5 clearly shows an increase in water consumption while the Caretaker was on holiday, which was immediately detected by the system. The School Business Manager was alerted, and when the Caretaker returned he found a tap left on. The cost over the 2 week period was £100.
The base load visible on Figure 6 is a result of a worn washer on an outside tap at rear of Canteen, which was costing £800 p.a.
Too small to show up by checking bills, known about but not considered significant, easily identified and quantified by Automatic Utilities Auditing.
The CHICK system at Slough Grammar is still running and data is being automatically analysed. The following are examples of recent anomalies (and under survey at the time of writing).

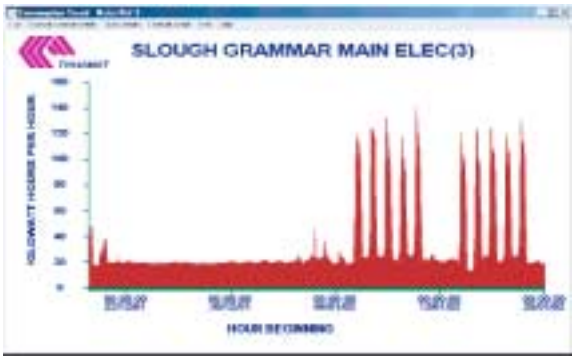

Figure 4: Electricity consumption

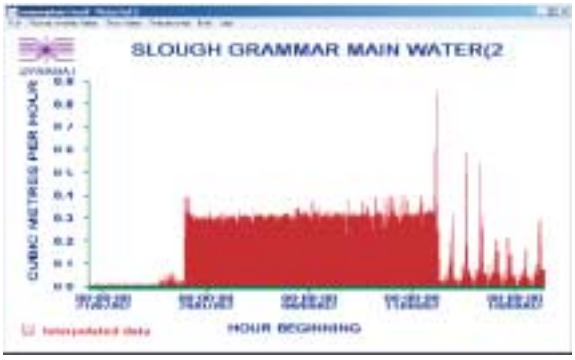

Figure 5: Water consumption

Figure 6: Water consumption

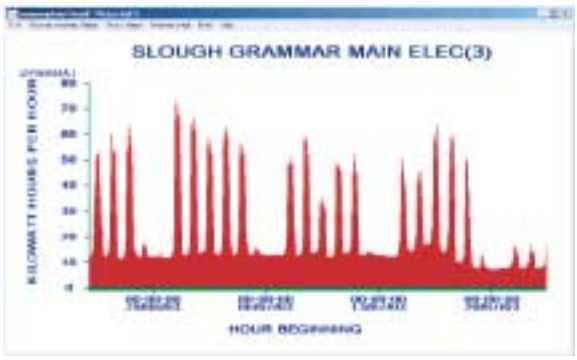

Figure 7: Electricity consumption

The significant base load shown in Figure 7 drops from 12 to 7 kW at the end of term, shown on the graph by the clear drop of electricity consumption around the 20th July. What has still been left running needs to be investigated to ensure there is a minimum electricity usage over the summer.

Energy Consumption Details
Actual energy consumptions were not known before the system was installed, so the first year's data will form the baseline for measuring subsequent energy savings.

Consumption recorded by the system for the first half of 2003 was: -

Electricity	**144,327 KWH**
Canteen Gas	*11,569 KWH*
Extension Boilers Gas	*38,677 KWH*
Main Boilers Gas	*465,700 KWH*
Total Gas	**515,946 KWH**
Water	**1,055 CU.M**

In addition there is also an oil fired boiler serving the canteen but this boiler will be replaced in the future new building programme which includes a new canteen.

thus there has been no financial risk to the school (all risk is being taken by the energy services company).
A fuel bill rebate of almost £14,000 has been claimed by the school following the survey carried out to identify potential energy cost savings.
Slough Grammar School is now seeking to assist other schools to obtain the benefit of energy services arrangements.
The school were not charged for the Automatic Utility Auditing installation, and the actual installation cost is difficult to separate out from the R&D activity being carried out by EMT on the site. However, the cost of an equivalent system supplied and installed, according to EMT's published prices, would be £1,640.

10 Experiences/Lessons learned

10.1 Energy use

10.2 Impact on indoor climate
No information available.

10.3 Economics
No information available.

10.4 Practical experiences of interest for a broader audience
The conclusions from the project are that good, reliable and accurate high frequency data (every 10 minutes) was obtained by the AUA system for electricity, gas and water and also local outside air temperature. The readings could be collated into a remote data store and then automatically analysed and utilities savings opportunities simply identified. Thus a new tool has been developed to provide a new way to manage utilities on school sites.
When the school's Business Manager, Jackie Wardle, was originally approached by EMT to use the school as an example site, she stated that she had not received an accurate utility meter reading or accurate bill, for any of the school's utility supplies for over three years. Now, if she wanted, she could have them every 10 minutes. However this is not necessary as the data can be automatically analysed and provide regular reports and exception reports when consumption patterns change.

11 General data

11.1 Address of project
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11.2 Project dates
1997-2003

11.3 Date of this report/revision no.
August 2003/Revision 1

12 Acknowledgements

National, international support programmes:
Energy Services for Schools programme of the Energy Saving Trust
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13 References

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See http://www.est.org.uk/energy-services/est.html?energy-services-case-studies.html Case study 11

www.schoolenergy.org.uk

Energy Metering and Targeting www.eccl.co.uk