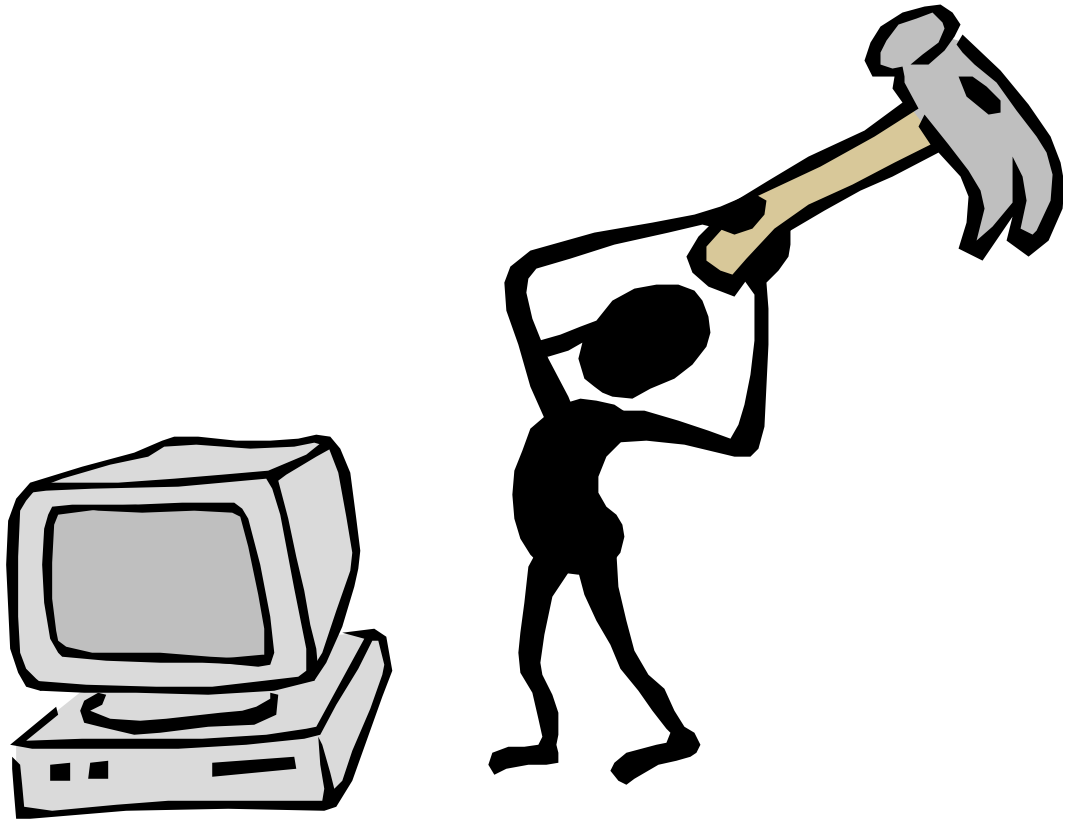
CENTRAL ENERGY EFFICIENCY FUND

TECHNICAL FIXES

AND



GOOD NEWS STORIES

CONTENTS

AUTOFLAME CONTROL ON FOUR OIL-FIRED BOILERS

ROYAL GROUP OF HOSPITALS, BELFAST

The Problem

The site, which consists of several buildings, some approaching 100 years old, is served by four main boilers. All burned heavy oil, two having been converted from coal burning. All four boilers are over 20 years old. The project was intended to improve boiler control and hence boiler efficiency.

The Plan

It was decided to install an approved Micro Modulation and Exhaust Gas Analysis Trim System, combined with boiler sequencing.

The Action

Immediately following installation, the boilers were converted to dual fuel (natural gas / heavy oil) burning, with natural gas as the lead fuel. The project was monitored over 2 years, from April 1996 to March 1998.

The Figures

The work was estimated at £ 44,000, which was met from the Central Energy Efficiency Fund. The lowest tender was £ 57,710, and the additional cost was met from the Royal Group of Hospitals' own budget. Energy consumption reduced from 327191 GJ to 21801 GJ (degree day corrected), and running costs showed a saving of £ 49,611, giving a payback of slightly over one year.

The Outcome

The energy savings were greater than expected, due both to the deficiencies in the old system and to increased efficiencies arising from the conversion to natural gas burning. Automation using the Autoflame control system has inspired confidence that the boilers are operating at optimum performance. The project has also proved to be profitable, as indicated by the above figures.

INSTALLATION OF PROGRAMMABLE THERMOSTATS IN TWENTY PROPERTIES

SOUTHERN EDUCATION AND LIBRARY BOARD

The Problem

Many small rural schools have historically had very simple oil boiler installations comprising a pump and time switch located within the boiler house. No temperature control in terms of classrooms thermostat was included. To turn the system off required a visit by the Principal to the boiler house resulting in the disruption of classes. More and more heat was wasted by opening windows etc.

The Plan

To install modern programmable thermostats in the Principal's classroom which operate both as a time switch and thermostat. This option facilitates both room temperature control and the option of early boiler shut off

The Savings

Savings occurring from five typical sites were 30,075 kWh (2848 litres) or 10% of consumption. Financial savings of £1,034 were realised across these locations giving a payback of 1.8 years on the £1,900 investment

The Energy Problem

In the past two and three classroom schools were provided with oil fired boiler systems providing heating and DHW for the kitchen. Normal arrangements included a simple time switch and circulating pump situated within the boiler house and operated from the main panel. Many of the schools have had fabric improvements such as roof insulation, draught proofing, or insulated panels installed; however temperature control remained a major difficulty. A further problem arose in that most schools of this size do not employ a full time caretaker. In order to control the heating the Principal needed to visit the boiler house as necessary. Invariably this led to wastage, as it is not always feasible to leave a classroom during lessons.

Annual Energy Consumption 4303 GJ **Annual Energy Cost £16,000**

THE PLANNED SOLUTION

In order to meet both the temperature and control requirements it was deemed that a programmable thermostat could be used most effectively. Location of the unit to reduce management time, and provide effective control of the temperature throughout

was crucial. Sites invariably required to be visited individually and thermostats located appropriately.

Integration of the new controls with existing systems required careful attention, as some systems where there was a kitchen DHW requirement needed a separate time switch retained.

Estimated Capital Cost: £6,500.00

EXPECTED OUTCOME

The overall aim of the project was to reduce the amount of management time required to manage the heating, reduce overall energy consumption and generally improve the teaching environment through accurate and timely control.

Estimated Annual Energy Savings: 717 GJ
Estimated Annual Cost Savings: £2,400

THE SAVINGS ACHIEVED

Five of the sites have been used as an example of what can be achieved. One of the sites actually increased consumption due to the misunderstanding of the correct operation at school level. This has been rectified and it is anticipated that savings will now occur in line with other sites.

Annual Energy Savings Achieved over 5 sites

Cost Savings - £1,034 Energy Savings — 30075 kWh (2848 litres)

Estimated Savings 20 Sites using above results

Cost Savings - £4,236 Energy Savings - 433 GJ

CONCLUSION

It is recognised that the 10% overall energy saving is not fully in line with that envisaged at project outset. Nevertheless 433 GJ still represents a significant reduction overall. Cost savings were significantly higher than anticipated giving an overall payback on the project of 1.6 years. Comfort levels and control throughout the buildings has been improved significantly

REVIEW/FOLLOW UP ACTION

It is proposed that each school be visited on regular occasions to ensure settings are correct and the relevant personnel are aware of how to use the controls to their full extent.

EXTRACTS FROM TEAM SYSTEM

League Table of Oil Costs Move for Oct97-Sep98 compared to Oct96-Sep97					
Site	Ref	Name	Cost (£)	Move	Move %
ST MALACHYS PS BALLYMOYER	262	0398	535	18	3
DROMINTEE PS	119	0324	703	-149	-17
ST JOSEPHS PS MEIGH	255	0392	477	-185	-28
ST MICHAELS PS CLADY	287	0424	344	-154	-31
BRACKENAGH WEST	80	0024	643	-565	-47
Total (5 Accounts)			2702	-1034	-28

League Table of Oil Usage Move for Oct97-Sep98 compared to Oct96-Sep97					
Site	Ref	Name	kWh	Move	Move %
ST MALACHYS PS BALLYMOYER	262	0398	51251	8898	21
DROMINTEE PS	119	0324	66960	2540	4
ST JOSEPHS PS MEIGH	255	0392	47148	-4587	-9
ST MICHAELS PS CLADY	287	0424	32743	-8403	-20
BRACKENAGH WEST	80	0024	61785	-28523	-32
Total (5 Accounts)			259887	-30075	-10

League Table of Oil Usage and Costs for Oct97-Sep98					
Site	Ref	Name	kWh	Cost (£)	p/Unit
DROMINTEE PS	119	0324	66960	703	1.05
BRACKENAGH WEST	80	0024	61785	643	1.04
ST MALACHYS PS BALLYMOYER	262	0398	51251	535	1.04
ST JOSEPHS PS MEIGH	255	0392	47148	477	1.01
ST MICHAELS PS CLADY	287	0424	32743	344	1.05
Total (5 Accounts)			259887	2702	1.04

INSTALLATION OF BOILER SHORT CIRCUIT PREVENTION VALVES

POLICE AUTHORITY FOR NORTHERN IRELAND – MOUNTPOTTINGER POLICE STATION

The Problem

In central heating installations with multiple boilers, heat losses can occur when only one boiler is firing, due to water circulation through the unused boilers.

The Plan

To fit valves to prevent circulation through the unused boilers.

The Action

Valves were fitted during 1997/98, using finance supplied from the Central Energy Efficiency Fund. Oil use was monitored during 1998/99.

The Figures

The installation was carried out for the previously estimated cost of £ 1,800. During the previous year, energy consumption for the whole site had been 1992 GJ, at a cost of £6815.As other energy saving work was carried out at the same time, it was necessary to estimate the level of savings due to this particular project. For this purpose, it is assumed that this work should save around 3% of the site's energy consumption. On this basis, it is estimated that savings due to this project amounted to 60 GJ a year, giving an annual cost saving of £ 204, and hence a payback of almost 9 years.

The Outcome

Although this project is satisfactory from a purely functional point of view, the above figures show that retro-fitting of valves to prevent boiler short circuiting may not be cost–effective when carried out in isolation.

INSTALLATION OF BOILER SHORT CIRCUIT PREVENTION VALVES

POLICE AUTHORITY FOR NORTHERN IRELAND – NORTH QUEEN STREET RUC STATION

The Problem

In multi-boiler installations heat losses can occur due to water circulating through boilers which are not firing during periods of low heat requirement.

The Plan

It was decided to fit each boiler with a motorised valve which could be operated through the heating control system to close when the boiler is not firing.

The Action

When originally planned, the estimated cost of the project was £1600, but due to delay in implementation and a rise in the cost of equipment, the actual cost was £2056. The valves were successfully installed and performance monitored during the following 12 months.

The Outcome

A saving of £1025 was obtained in the cost of oil for the site, representing an energy saving of 313 gigajoules and suggesting a payback of 2 years. These figures compare very favourably with the estimated savings of £740 and 176 gigajoules, although other factors such as good housekeeping and increased energy awareness may have contributed. Taking these figures, the payback is still under 3 years, and the project also secured environmental benefits by reducing emissions to the atmosphere by approximately 14 tonnes of carbon dioxide annually.

REPLACEMENT OF ELECTRIC HEATING WITH OIL FIRED HEATING

QUEEN'S UNIVERSITY, BELFAST

The Problem

The heating systems in two of the University's student houses, accommodating 28 students, consisted of Economy 7 storage heaters in common areas and electric bar and oil filled radiators in students' rooms. This was very expensive to run with costs for the period 1992-1995 averaging £9,445 per year.

The Plan

The existing heating systems were to be replaced with an oil-fired central heating system at an estimated cost of £19,000.

Delivered energy to the electric heating systems in the student houses was 440,000 kWh. It was estimated that the required delivered energy for the oil system would be approximately 158,000 kWh, representing a saving of over 60% in the energy required to heat the buildings.

The Action

The electric heating systems in the 2 buildings were replaced in August 1995 with an oil-fired system at a total cost of £19,000. The new system is controlled through the University's Energy Management System and programmed to run only when students are in residence.

Additionally, the radiators were fitted with thermostatic valves allowing individual control of the temperature in students' rooms.

The Outcome

The first annual cost for running the new system was £3,542 representing a saving of £5,903. This gives a simple payback on the £19,000 capital cost of 3.22 years.

Both staff and students have commented on how much warmer and more comfortable the buildings have become. It is also a much safer environment without the large number of private electric fires previously found in the students' rooms

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INSTALLATION OF ENERGY EFFICIENT MOTORS IN MAIN OPERATING THEATRE AIR CONDITIONING SYSTEM

ROYAL GROUP OF HOSPITALS, BELFAST

The Problem

The air conditioning system in the main theatre block had been in operation since 1964. The fan motors, although reliable, were the original models and did not offer the same efficiency as equivalent modern motors.

The Plan

To install modern motors, which are lighter, smaller and more efficient.

The Action

The Central Fund approved the estimated cost of £ 4,000. However, installation costs pushed the tender price above the allocation, and the scheme was delayed until a revised approach had been developed which reduced the original price. The final installation cost was £ 3,150.

The Figures

The project was monitored from April 1998 to March 1999. Electricity consumption decreased from 530 GJ/year to 366 GJ/year – a saving of 164 GJ/year, compared to an estimate of 72 GJ/year. Annual running costs dropped by £ 2,000, twice the estimated amount, giving a payback on the final cost of 1.57 years.

The Outcome

Both cost and energy savings were twice the estimated figures, reflecting the very low efficiency of the original motors compared to modern equivalents. An additional bonus is greatly reduced noise from the plant.

INSTALLATION OF FREQUENCY INVERTERS (VARIABLE SPEED DRIVES)

THE ULSTER MUSEUM, BELFAST

The Problem

The Ulster Museum building dates from 1912, with an extension added in the 1960s.

There are 6 fully air conditioned zones running 24 hours a day, 365 days a year. Some parts of the building require humidification or dehumidification.

The fans attached to the air conditioning were always running at 100%. Overall electrical consumption averaged 110,000 kWh with the air-conditioning accounting for about 65% of the total.

The Plan

It was recognised that if the fan motors could be operated at reduced speeds considerable reductions in electricity consumption and cost could be achieved. It was therefore decided to install frequency inverters to 3 of the larger zones, to run the fans at a maximum of 80% of the normal speed.

The Action

Following discussions, in-house and with control consultants, a contract was placed for the installation of frequency inverters in the 3 zones. The existing TREND building energy management system was used to set new fixed points for the motor speeds in order to give the required internal conditions.

The Outcome

Reducing the running speed of the fans in these 3 zones to 80% of the maximum produced an estimated saving of 38% in the amount of electricity used, with an associated cost saving of £13,511. The total installation cost was £15,800, giving a simple payback of 1.17 years.

REPLACEMENT OF HEATING WITH QUARTZ IN TWENTY SCHOOL MEALS KITCHENS

SOUTHERN EDUCATION AND LIBRARY BOARD

The Problem

Many school meals kitchens especially in the maintained sector have been historically heated with electric fan heaters rated at 3 and 6kW. Some of these heaters have been poorly located and in many cases were running uncontrolled for much of the day. This resulted in considerable heat waste, with a significant cost penalty.

The Plan

To install modern, directional quartz type electric heating, complete with time control resulting in reduced electricity consumption and improved comfort conditions throughout the buildings.

The Savings

Savings accruing from five typical sites were 21677 kWh/annum or 17% of total consumption. This equates to £2,657 giving a 3-year payback on an investment of £ 7,715.79 at these locations.

The Energy Problem

Most meals kitchens have historically been constructed as flat roof extensions to existing school buildings. In most cases due to both the poor fabric of the buildings, the necessary extraction of heated air and the internal limited wall space, suitable heating has proved difficult to provide. Wall mounted fan heaters have been provided in a large number of situations; however manual control and limited directional capability have long thwarted the provision of desirable comfort conditions.

Annual Energy Consumption — 950 GJ **Annual Energy Cost - £35,470**

THE PLANNED SOLUTION

In order to reduce both the directional and control requirements it was deemed that Quartz electric heating complete with time controls was most suitable for the application. In addition as Quartz heating has no moving parts maintenance costs would be reduced significantly.

From assessments and surveys undertaken it was noted that if adequate heating is provided for the first hour on entry, cooking appliances could almost provide sufficient heating for most of the remainder of the day. The vegetable preparation areas are seen as priority in this respect and were consequently targeted during the project.

Estimated Capital Cost - £22,500

EXPECTED OUTCOME

To reduce the meals kitchens' annual energy consumption while improving the comfort conditions generally throughout.

Estimated Annual Energy Saving: **323 GJ**
Estimated Annual Cost Savings: **£7,650**

THE SAVINGS ACHIEVED

Five of the sites have been monitored fully. There has been no significant change in meals output or building fabric at any of the locations therefore they can be regarded as very representative of the buildings as a whole

Annual Energy Savings Achieved — 5 sites

Cost Savings - £2,657 **Energy Savings —78 GJ**

Estimated Savings 20 Sites Using Above Results

Cost Savings - £10,628 **Energy Savings -312 GJ**

NB: Some of the cost savings can be attributed to reductions in the cost of electricity in 1997/98 compared to 1996/97.

CONCLUSION

The energy and cost savings of 17% and 23% respectively have proved the scheme was very worthwhile. The Board has adopted this approach throughout when heaters require replacement in meals kitchens.

Expectations at the outset have largely been met, maintenance costs have reduced and comfort conditions generally have improved.

EXTRACTS FROM TEAM SYSTEM

League Table of Electric, Elec Sub Costs Move for Jul97-Jun98 compared to Jul96-Jun97						
Site	Ref	C	Name	Cost (£)	Move	Move %
ST MARYS PS BALLYGAWLEY	270	T	H8732801	2731	-307	-10
ST CLARES CONVENT PS NEWRY	231	T	D1402502	99	-30	-23
ST COLMANS ABBEY PS	232	T	D1410909	3894	-1244	-24
ST BRIGIDS PS AUGHER	226	T	H8805908	1589	-561	-26
DRUMHILLERY PS	122	E	M0055	825	-515	-38
Total (5 Accounts)				9137	-2657	-23

League Table of Electric, Elec Sub Usage Move for Jul97-Jun98 compared to Jul96-Jun97						
Site	Ref	C	Name	kWh	Move	Move %
ST MARYS PS BALLYGAWLEY	270	T	H8732801	31563	-1104	-3
ST CLARES CONVENT PS NEWRY	231	T	D1402502	483	-40	-8
ST COLMANS ABBEY PS	232	T	D1410909	47216	-10239	-18
ST BRIGIDS PS AUGHER	226	T	H8805908	18060	-4570	-20
DRUMHILLERY PS	122	E	M0055	9162	-5724	-38
Total (5 Accounts)				106483	-21677	-17

OIL AND ELECTRICITY SAVING MEASURES

CARRICK PRIMARY SCHOOL, LURGAN

The Problem

This small primary school, with an enrolment of around 420, was built in the 1930s of standard block/brick construction. The original building was a 2-storey block with a pitched roof. Various extensions have since been added to this block during the 1960s and 1970s, some of which were constructed with flat roofs, bringing the total floor area of the school to 2830 sq metres.

There had only ever been partial roof insulation installed and no cavity wall insulation whatsoever in any of the buildings. Historically, therefore, the school had always been cold and draughty and subsequently at various time of the day a large number of electrical heaters (fan heaters; convector heaters) were switched on by teachers etc to help boost the heating output supplied by the school's oil fired boiler. In addition, the main heating system had very poor controls and no facility for zoning the various areas of the school.

All of this resulted in very poor comfort conditions in the school and very high energy consumption for the school as a whole. The average total consumption, both oil and electricity, was around 573,000 kWh per annum, which was considered excessive for a school of this size.

The Plan

Following a survey of the premises a plan of action was devised which included the installation of zoning controls and optimising/compensating controls to the heating system. On the electrical side it was also decided to install low energy lighting where required throughout the school.

Energy savings achievable as a result of these works were estimated to he around 41,600 kWh per annum, with cost savings estimated at £4,000 per annum.

In addition to the works above the Board's Maintenance Department were planning to carry out

(i) a rewiring programme of the school;

(ii) the installation of some roof insulation in the flat roof areas; and

(iii) the installation of double-glazing to some areas of the extension blocks.

The Action

The works not being carried out by the Board ie heating controls and low energy lighting, were put out to tender and were carried out in January 1996. The heating controls fitted included the provision of a Trend outstation and zoning controls to optimise heating requirements. The total cost of these works was £14,000, the funding for which was received from the Central Energy Efficiency Fund.

The Board carried out the remaining works, ie roof insulation double-glazing and rewiring, at the same time with a total investment from the Board in the region of £66,000.

The Outcomes

Monitoring was undertaken for a year following the works, showing considerable savings in overall energy consumption.

Electricity consumption was reduced by some 10,102 kWh against a total previous consumption of 68,743 kWh, a saving of approximately 15%. The reduction in oil consumption was, however, not quite as good with savings of only 9574 kWh. This represented a saving of only around 2% against previous years' consumption figures. All in all though total energy savings of 19,676 kWh per annum or 3.5% were achieved. This equated to around £1,050 in cost savings per annum, which gives a simple payback period of 13 years.

Whilst savings in oil consumption may not have been as great as had been hoped, account has to be taken of the very poor heating levels in the school prior to the improvements being carried out. Indeed comments from the staff and pupils in the school now point to much better comfort levels and an overall better working environment throughout the premises.

Added to this there were initial problems with staff and the operation of the new controls. These have now been rectified with training for staff having been carried out. Also the Board has added an automated monitoring system to the school linked to Board headquarters, which should help in the control of the school's energy in future years.

The Lessons

Improvements to controls may not always reduce consumption significantly if heating levels prior to the work have been poor. However, the improved comfort conditions have other knock-on benefits attached such as reduced sickness, reduced management time and improved work outputs.

INSTALLATION OF ROOF INSULATION AND HEATING CONTROLS

CARRICK PRIMARY SCHOOL, WARRENPOINT

The Problem

This original building of this primary school, with an enrolment of around 300 pupils, was built in the 1930s and was a single storey building of standard block/brick construction with a pitched roof. In 1979 a large extension, with a flat roof, was added to the school bringing the total floor area to around 977 sq metres. Unfortunately, both the original building and the extension had very poor or no roof insulation whatsoever. In addition the heating system in the school dated from around 1960 and had very basic controls with no facility to zone the different areas of the school. The meals kitchen also had a very high hot water demand which was served via its own DHW cylinder.

In addition the school also had 2 mobile classrooms both of which were heated electrically with no form of control other than a basic time clock.

As a result of all these problems the school's total energy consumption for both electricity and oil was somewhere in the region of 237,700 kWh per annum. This was considered to be excessive.

The Plan

It was decided that the fabric of the building needed to he improved as did the controls on the heating system.

The Board's Maintenance Department was planning to refurbish an area of the flat roof and it was decided to take the opportunity to improve the insulation in this area at the same time. In addition insulation would also be installed in the pitched roof areas of the school. As regards the heating system a compensator was to be installed in the boilerhouse in piece of the existing ***Spirex*** valve. Added to that set-back temperature controls were to be fitted to the heating systems in the existing mobile classrooms.

It was planned also to carry out other minor measures such as the installation of some insulation panels and some low energy lighting where applicable.

The Action

All of the works were carried out during the period of April 1995 - August 1995, with the controls in the boilerhouse being the last element to be under taken. The total cost for all the work was £6,200, funding for which was received from the Central Energy Efficiency Fund.

The Outcomes

Unfortunately a further 2 mobile classrooms were added to the school in September 1995, which obviously had a direct result on any energy savings going to be achieved through the energy works carried out. This being the case, actual electricity consumption for the full financial year following, was approximately 48,213 kWh as against a figure of 45,579 kWh for the year prior to the works, an increase of some 5.7%. However, as mobiles use on average 4,644 kWh annually had the works not been carried out consumption would have been in the region of 54,855 kWh. Realistically therefore, a saving of some 6,672 kWh or 12% on electricity consumption had been achieved. This would equate to approximately £667 per annum.

Savings on oil consumption were, however, slightly better with a saving of some 38,466 kWh being achieved. This equates to a saving of around 20% against a previous consumption figure of 192,120 kWh. Cost savings here were £546.

The total energy savings achieved therefore, were approximately 45,138 kWh or 19%, with total cost savings of £1,213.

This gives a simple payback for the scheme of some 5 years.

The Lessons

It is proved that often the best approach may be to carry out a number of improvement measures at one site rather than carrying out an individual measure at a number of sites despite the obvious cost benefits derived from multiplicity.

Later changes on site can often have a detrimental effect on any benefit achieved as a result of the improvements carried out.

UP-GRADING OF HEATING SYSTEM

ST JOSEPH'S HIGH SCHOOL, CROSSMAGLEN

The Problem

This school was built in 1964 and was constructed mainly with a concrete brick outer leaf and plastered block inner leaf. The heating system in the main school was constant low temperature hot water serving fan-assisted heaters and radiators all fed from on oil fired boiler plant.

A major extension was added to the school in 1973 and the heating in this was via constant temperature circuits feeding fan-assisted heaters and radiators. This heating in the new block was provided mainly from a separate boiler which also provided DHW for the new block.

In addition the kitchen/dining hall was also a separate block with the heating provided by the school main boiler by means of a circuit which also provided DHW for the meals kitchen via a calorifier.

There were only 3 time switches controlling the heating systems, DHW and the kitchen/dining hall and unfortunately the pipework configuration only allowed for one zone for the original school heating with no facility for controlling any area separately. In addition to this many classrooms only had one old large convector heater which were well past their best. This contributed to a lack of sufficient heating in a number of the classrooms which was a major cause for concern. Also the DHW calorifier in the main boiler house was infrequently used and had no control mechanism resulting in it heating approx. 2500 litres every day to boiler temperature.

It was against this background that the maintenance and energy sections of the Board were brought together to see what improvements could be made with limited funding.

The Plan

Following an energy efficiency survey carried out at the school it was decided that a major refurbishment of the building services was required. It was then decided that this work would be completed in conjunction with the energy efficiency measures being proposed in respect of the heating system, which were:

(i) installation of an energy management system;

(ii) maximise the opportunities for zoning of heating within the buildings and provide a direct fired water heater to replace the school calorifier; and

(iii) provide a heat exchanger rather than a DHW calorifier in the extension boiler-house.

The refurbishment work to be carried out involved the complete replacement of all boiler plant together with the replacing of the wiring in respect of the lighting in the building, which was in a poor state of repair. Other works to be carried out included the replacement of tungsten lighting with high frequency lighting.

The lack of sufficient heating in classrooms was as stated a major cause for concern. Unfortunately, however, at the time funds were not available to replace the convectors. It was therefore decided that these convectors would be replaced as finance became available.

The Action

Work commenced in August 1995 and was completed by December 1995. The various projects undertaken in the main building included the installation of an energy management system; zoning of heating to the building to allow for the optimisation and temperature control of a number of areas; and the installation of an oil fired water heater to replace the calorifier. In addition, works were carried out relating to the extension boiler house which included zoning of areas covered by this boiler; the provision of high output convectors in the sports hall; and the installation of a heat exchanger to replace a 1500 litre calorifier used to provide DHW in the areas covered by this boiler.

Oil meters were also installed on both boiler houses to enable consumption to be monitored at SELB headquarters.

The total cost for all the works including the maintenance works was £76,000. Of this some £30,760 was estimated to be related to energy conservation measures including the high frequency lighting.

The Outcome

There were a number of initial teething problems during the winter period which did cause wasteful use of fuel. These were generally due to software problems in the Energy Management System and a lack of experience in operating the system. Fortunately, however, these were ironed out quite quickly and no problems have occurred since.

The total consumption for oil in 1995/96 with the new measures installed was 56,000 litres compared to 77,000 litres in 1994/95. This represents an approximate saving in oil consumption of some 27%. However, taking into account the initial difficulties such as the problems with the EMS, now that the system is working properly it is estimated that savings in the region of 35% would be more realistic for future years. This would realise actual annual oil consumption figures of approx. 50,000 litres. Therefore, with oil costing 12.5 pence/litre the resulting actual cost savings for future years are estimated at £3,375 annually.

This together with approx. cost savings of £2,000 achieved through the lighting project gives a total annual saving of £5,375 for the complete project, with a payback of under 6 years for the energy efficiency works supported from the Central Fund. Though the overall payback is around 14 years, this does not take account of direct savings on water (not previously monitored); on staffing management of time; and on improved working environment for staff and pupils.

The Lessons

The savings in oil consumption being achieved and the ease of control of the heating systems have made the project very worthwhile in the day-to-day management of the school.

Although an energy survey was undertaken in this case, it did not reveal the extent or true costs of all the works necessary to ensure a satisfactory operating system. It would not have been possible to simply undertake one element of the work and leave the remainder until a later stage - it would have been nugatory expenditure.

INSTALLATION OF HEATING CONTROLS

**SOUTHERN EDUCATION AND LIBRARY BOARD -
SCHOOL MEALS KITCHENS**

The Problem

Through the SELB's normal maintenance programme, it became apparent that a number of schools' meals kitchens had very poor ventilation and heating equipment with little or no associated controls.

In relation to the ventilation the main problem was that large amounts of condensation were occurring through the opening of oven doors etc, and the existing small Xpelair fans were insufficient to cope with the problem. In addition most of the dining rooms were heated through old convector heaters which had no form of controls, ie thermostatic or zoning. The problems were much worse in the larger stand-alone meals kitchens which had their own oil heating supply.

In 3 of these larger kitchens alone, the total energy consumption (both electricity and oil) was somewhere in the region of 350,000 kWh.

The Plan

The Board decided to upgrade the heating and ventilation systems in 11 of its larger meals kitchens within a total investment of some £130,000. In addition, the energy officer decided to install appropriate controls to the systems at an additional estimated cost of £7,200, the funding for which was received from the Central Fund for Energy Efficiency. As a result of these controls, cost savings achievable across all 11 kitchens were estimated at £2,400 per annum.

The Action

Consultants were appointed and the work in all 11 kitchens was carried out in October 1995.

Larger fans with canopies were installed in each kitchen with variable speed controls attached to enable large amounts of steam to be extracted quickly and efficiently. New convector heaters were installed in all the kitchen/dining areas and modern thermostatic controls fitted. In some cases zoning was also installed between the kitchen and dining areas. The total cost was £137,200.

The Outcome

From the 3 kitchens mentioned above, which were all stand alone and 1 of which was also all electrically heated, savings in electricity of some 4082 kWh or 2.4% of electricity consumption were achieved. This was in spite of increasing electricity consumption at 1 site due to meals production increasing significantly, as it now produces meals for other schools in its area.

As regards oil consumption, savings were much better with some 33,149 kWh or 18% of consumption saved in the 3 sites. The total cost saving for the 3 sites as result of all the controls installed, was approximately £810 per annum. This gives an average saving per site of £270. If this were taken across all 11 kitchens then the total cost savings achieved would be in the region of £2,970. This would give a simple payback on the controls of 2.4 years.

It should he noted that most if not all of the savings achieved can be attributed to the installation of the various controls. The replacement of the heating and ventilation equipment alone would not have yielded significant savings; indeed in most cases energy consumption would have increased as the new equipment installed required a heavier load to operate effectively.

The Lessons

It is not good enough to simply replace old equipment for new. It is also necessary to ensure that effective controls are also included in any replacement package.

CAVITY WALL INSULATION

**ROYAL GROUP OF HOSPITALS, BELFAST -
BOSTOCK HOUSE**

The Problem

Dating from 1951, Bostock House is an 8-storey accommodation block of red brick cavity wall construction. Heating is by LPHW heated by steam supplied by the main hospital boiler plant. In common with many similar buildings of that era, little insulation was incorporated at the time of construction, so there was scope for significant energy saving.

The Plan

It was decided to fill the wall cavity with Gyproc mineral fibre, injected through holes drilled in the external wall. The estimated capital cost for the project was £14,000.

The Action

As the building is some 25 metres (80 feet) high, built in a **T** - shape on an exposed, sloping site, access for this work necessitated suspending a cradle from the flat roof. Injection holes were drilled in a series of vertical drops, repositioning the cradle laterally round the five facing walls and three gable ends in turn.

The Outcome

The work was carried out in December 1996, and steam consumption monitored over the following months. 1997 was a warmer year than 1996, and actual consumption fell by around 20%. When the appropriate weather correction factor was applied, it was found that steam consumption had fallen by 14%, giving an annual saving of around £3,500 and a payback of 4 years.

CAVITY WALL INSULATION

NORTH AND WEST BELFAST HSS TRUST -
MOYLENA VILLA, MUCKAMORE ABBEY HOSPITAL

The Problem

Muckamore Abbey Hospital was designed in the 1930s, but construction was delayed due to the Second World War. The hospital did not open until 1957, with over 30 buildings dispersed across a 95 acre exposed rural site. Due to the hospital's age and a lack of investment in building services over several years, it was not a good energy performer. In particular, staff and residents in Moylena Villa often complained of discomfort due to inadequate heating levels.

The Plan

The buildings at Muckamore are of traditional cavity wall construction. The hospital's management developed a capital programme which included a variety of energy efficiency schemes and applied to the Central Energy Efficiency Fund for support to install cavity fill insulation at Moylena and other villas on the Muckamore site.

The Action

As part of this programme, cavity wall insulation was successfully installed in Moylena in 1996.

The Outcome

Cost savings were originally based on the use of 3500-sec heavy fuel oil, and were estimated to give a payback of almost 4 years. However, since installation of the insulation, the boiler plant has been replaced and now burns 35-sec oil. As a consequence of the higher cost and lower calorific value of the lighter oil, the payback period has been significantly reduced to 2 years.

In addition, the previous complaints have been replaced by requests to reduce the heating levels, demonstrating that an energy efficient building can provide the optimum conditions for comfort.

CAVITY WALL INSULATION

NORTH EASTERN EDUCATION AND LIBRARY BOARD

The Problem

The majority of secondary schools were constructed 25 to 35 years ago when the Building Regulations did not require cavities to be insulated. This resulted in heat losses from buildings and higher energy consumption.

The Plan

Following energy audits carried out by consultants funds were utilised to install cavity wall insulation in 8 secondary schools.

The objective was to reduce waste heat and improve comfort conditions within the schools. One of the schools, namely Larne High School, was selected for monitoring 6 months before and after the cavity wall insulation project was carried out. The new extension was omitted as it had been fully insulated; however the remainder of the school, representing 80% of the school area, was insulated. The estimated capital cost was £10,000 and savings were estimated to be 20% of consumption providing cost savings of £2,500. Larne High School's annual oil consumption was 4,261 GJs costing £13,199.78 in 1997/98. 20% of this consumption is used for domestic hot water leaving 3,551 GJs (0.35 GJs per m^2) for heating the school.

The Action

The contract for the work at Larne High School was tendered and ordered by 6 October 1997 and the work was completed by mid-February 1998.

The Figures

Anticipated Overall Savings

Based on the outcome of Larne High School having had a savings at 20% the overall savings in the 8 schools would be as follows:

Estimated Annual Savings	4,250 GJs
Estimated Annual Cost Savings	£18,000
Capital Cost	£50,000
Payback Period	2.78 years

Actual Estimated Overall Savings

Based on a savings of 16.8% at Larne High School.

Actual estimated annual savings	3,570 GJs
Actual estimated annual cost savings	£15,118.95
Actual Capital Cost	£58,464
Actual Payback Period	3.86 years

The Outcome

The monitored oil consumption showed a reduction in oil used of 14% to 3,048.5 GJs after taking into account reductions of 20% and 80% for DHW use and area insulated during the contract. The savings would have been 16.8% had the complete school been insulated. Hence this saving will be used or the other seven schools included in the insulation programme

Conclusion

The energy savings of 16.8% has proved the cavity wall insulation schemes to be an excellent investment. Comfort conditions have been improved in the schools and harmful atmospheric emissions of CO2 have been reduced. In some schools there are insufficient temperature sensors to control the temperature and take full advantage of the scheme. Hence some schools are slightly overheated on mild days resulting in less than maximum savings being achieved annually.

INSTALLATION OF SWIMMING POOL COVERS

UNIVERSITY OF ULSTER, JORDANSTOWN

Summary

The University of Ulster energy policy aims to control costs, maintain comfort, protect the environment and conserve fossil fuels. Reducing the heat loss and humidity from heated swimming and diving pools would support this policy.

The increasing use of motorised pool covers to insulate heated water from evaporation encouraged the University to consider this application. With the recent installation of VSD on pool fans, ventilation outside opening times will automatically reduce, thus saving electricity. Fuel used to heat the pool water should also be significantly reduced.

Although annual savings were less than expected, due to cover operating problems, a total annual saving of 1518 GJ of energy and a reduced cost of £6,711 were achieved. The benefit to the environment was lower carbon dioxide (CO_2) emissions of 149 Tonnes. The overall payback was 3.21 years.

The Energy Problem

The University of Ulster at Jordanstown Sports Centre includes a swimming pool and a diving pool. The swimming pool is an unusual size being 25 metres long and 17.5 metres wide. This enables the Sports Centre to host swimming competitions which standard 25m x 10m pools cannot. The diving pool is 10 metres long and 10 metres wide.

Jordanstown pool facility is heated from centralised boiler plant supplying medium temperature hot water (MTHW). Prior to 1997, all boilers operated on heavy fuel oil (HFO). Since 1997 the boilers are also capable of running on natural gas.

The pool water is heated via a calorifier to 28 - 29^{o}C. The pool air temperature is maintained at 22 - 24 ^{o}C by the pool water and an air-handling unit. The fans kept the relative humidity below 60%.

The pools are open 60 hours per week, but the heating and ventilation plant operates continuously. A high evaporation rate from the water means ventilation must always operate to keep relative humidity in the air space to a level that maintains comfort and protects the building fabric. However if ventilation rates are too high, evaporation losses will increase. In 1996 relative humidity was too low, often below 50%. To improve control of the relative humidity and ventilation, the fans have since been fitted with variable speed drives. Relative humidity is now kept very close to 59%.

An uncovered pool generates substantial heat loss which can be determined, if the air temperature, water temperature and relative humidity are known. For the above conditions the average heat loss is 172 W/m2/hour. Given the total pool area is 537.5 m2 the following statistics have been calculated.

Pool Heating
Maximum consumption = 0.172 x 537.5 x 24 x 7 x 52 = 807,643 KWh or 2,908 GJ.
Using HFO at £2.65/GJ, annual cost = 2.65 x 2908 = £7706
CO_2 emissions = 0.08236 x 2908 = 240 Tonnes

Pool Fans - rated at 15 KW
Maximum consumption = 15 x 24 x 7 x 52 = 131,040 kWh or 471 GJ.
Using electricity at £I9.64/GJ, annual cost = 19.64 x 471 = £9,180
CO_2 emissions = 0.238 x 471 =112 Tonnes,

The Planned Solution

A pool cover is the simplest way of reducing evaporation and heat loss from the pool surface. With the cover in place overnight, and at other unused periods (5856 hours/year) pool heating can be cut dramatically from 172 W/m^2 to 12 W/m^2. In addition the ventilation could be reduced by at least 10 KW/h.

The Department of the Environment Energy Efficiency Office carried out a series of good practice case studies on sports and recreation buildings, which included swimming pools. Case study 76 - swimming pool covers - demonstrated a payback period of up to 1.6 years. Given this information, the University decided that covers on the swimming and diving pools at Jordanstown would offer potential savings.

Due to the size of the swimming pool and limited staff availability, motorised cover rollers would be required. As a cover can only produce savings when it is in place, ease of use is important. The estimated capital cost for supply and installation of pool was £17,750.

Three sites were visited to investigate the types of covers used, their operation, reliability and staff experiences. The three sites were Queen's University, Olympic LC and Whiterock LC. The findings supported the need for a motorised system with the roller mounted high to preserve limited space around the poolside. Also it was recommended that, if possible, a supplier with a local service agent would be more responsive to breakdowns and avoid expensive travel costs.

Expected Outcome

The application of swimming pool covers, when in use, would lower heat loss from the pools due to virtual elimination of water evaporation. The cover would also limit relative humidity, thus minimising ventilation demand and damage to the building fabric through condensation. Further, it would offer savings in electricity and boiler fuel, reducing the University's impact on the environment.

Pool Heating
Estimated consumption savings = (.172 -.012) x 537.5 x 5856 x .0036 = 1,813 GJ.
Using HFO at £2.65/GJ, annual savings = 2.65 x1813 = £4804
CO_2 emissions = 0.08236 x 1813 = 149 Tonnes

Pool Fans
Estimated consumption savings = 10 x5856 = 58,560 KWh or 211 GJ.
Using electricity at £19.64/GJ, annual cost = 19.64 x 211 =£4144.
CO_2 emissions = 0.238 x 211 = 50 Tonnes.

Estimated simple payback = 17750 / (4804+4144) = 1.98 years

The Savings Achieved

Tenders were sought from five suppliers of pool covers in November 1996 and the least expensive tender was selected at £21,56I. The installation of the pool covers at Jordanstown was completed in August 1997.

Monitoring of the heating and ventilation plant was performed through the University Building Management System. Swimming pool staff were also trained in the operation of the covers and rollers.

Since August 1997, several problems emerged which caused the covers to be out of use for around 20% of the time. Supplier faults have related to cover splits and the breaking of cover guide ropes. The pool supervisor felt the cover widths were too tight for the rollers and therefore difficult to guide properly. 100mm were taken off each cover width to improve their ease of operation. Despite this modification, several breakdowns have occurred due to incorrect operation of fitting and removal of the covers by pool staff. Further modifications to the covers are proposed to reduce the risk of failures in the future.

When the covers are in use the savings in heating and ventilation was similar to the estimated data. For its first year in operation the covers have saved I5I8 GJ and reduced costs by £6,711. CO_2 emissions have been reduced by 149 Tonnes. Given the actual cost was higher than estimated, the revised financial payback was 3.21 years.

Conclusion

The benefits of pool covers in terms of energy conservation and protection of the building fabric are significant. However it is important that staff using the covers on a daily basis need to be made aware of these benefits. The University was unable to select a supplier who had a local agent. Therefore travel from the mainland becomes necessary and this slows maintenance response.

Review / Follow Up Action

Closer monitoring of the pool cover use is required. To achieve this, a heat meter is being installed on the water circuit. This will highlight a cover problem immediately and ensure action to fix is taken quickly. Liaison between management, maintenance and pool staff to remedy cover problems will also increase cover utilisation. An ongoing study of the pool covers and their contribution to energy conservation will continue.

HEATING CONTROLS AND SWIMMING POOL COVER

DUNDONALD HIGH SCHOOL

The Problem

The swimming pool, measuring 25m x 7m and containing 160 cubic metres of water, was uncovered. The warm-up times were becoming longer and boosting the heating caused increased condensation.

In addition, the heating system design was such that the radiators in the pool area could not be controlled separately from the rest of the school. Controls, such as timeclocks and thermostats, were ineffective.

The Plan

The installation of a pool cover would immediately prevent evaporation and heat loss. Upgrading of controls would enable better management of the heating system.

The Action

A 7mm foam manually operated pool cover was installed and the water temperature reduced to 27/28^{o}C. This resulted in initial complaints indicating that the previous set temperature had been in excess of the norm.

Zone controls were added to the heating circuits and with an optimum stop/start facility ensured the necessary pre-heat time of the pool building. Timeclocks controlling hot water and thermostat settings were regulated.

The total estimated cost of the project was £18,000.

The Outcome

A temperature drop of 1^{o}C on 160 cubic metres of pool water is equivalent to saving 184 kWh. Over a 40-week school year, the saving would amount to 156,768 kWh and with oil costing 2p/kWh, cash savings would be £3,135.

In conjunction with the adjustment to the heating system and associated controls, the project showed an overall saving of 33,747 litres of oil in the period April-November 1995 compared to the same period in the previous year.

Projected savings for a 12-month period are £6,000 giving a simple payback of 3 years.

AUTOMATIC LIGHTING CONTROLS

GREEN PARK HEALTHCARE HSS TRUST -
MUSGRAVE PARK HOSPITAL

The Problem

The Musgrave Park Hospital site consists of buildings erected between 1880 and 1996. Many are connected to one another by corridors ranging in length from 10 metres to 100 metres and illuminated by over 500 fluorescent tubes of varying sizes. There is no central responsibility for corridor lighting, making management difficult. This results in lights being left on for 24 hours a day irrespective of corridor use or lighting requirement.

The Plan

It was calculated that corridors with natural light needed artificial lighting for only 8 hours a day in winter and 4 hours in summer. Those without windows would need lighting for 8 to 12 hours a day depending on usage. These assumptions would permit a reduction in lighting demands of approximately 60% if proper control were introduced.

The Action

The solution was to fit automatic lighting controls in the form of movement and light level detectors. Automatic controls were also installed in plant rooms, the staff restaurant and large offices.

The Outcome

Considerable savings have been achieved, especially in summer when the light level sensors are most effective. This has produced a reduction in electricity consumption in these areas of up to 60%. Energy savings in the first year amounted to 17090 kWh, giving a cost saving of £11,968. This provides a simple payback of 4.51 years.

There is an additional benefit of reduced maintenance costs due to the less frequent replacement of fluorescent tubes.

CONVERSION OF TWIN FLUORESCENT LAMPS TO SINGLE FITTINGS

DEPARTMENT OF AGRICULTURE
FORESTRY SCHOOL, POMEROY

The Problem

The existing fluorescent lighting in the Dining Room, Recreation Room and Lecture Room was the original installation using standard T12 tubes and fittings. The high electricity consumption was unacceptable.

The Plan

To replace the fluorescent lighting in these areas with modern high frequency equivalent, offering greater efficiency.

The Action

Central Fund approval was obtained to the estimated capital cost of £ 2,145, tenders invited and the installation completed without difficulty, maintaining the required design lighting levels.

The Figures

As the electricity supply to the lighting in these rooms is not separately metered, consumption was calculated by reference to stated ratings and hours of use. On this basis, the project secured electricity savings of 23.04 GJ/year (compared to an estimate of 25 GJ/year) and CO_2 saving of 5.5 tonnes annually. The annual cost savings of £ 557 (£ 512 estimated) and a final capital cost of £ 2,235 (4% overspend) provide a payback of about 4 years – easily within the Central Fund maximum.

The Outcome

The project was monitored following completion. This is a simple project offering good savings in energy cost and CO_2. All lights were still functioning 3 years after installation. Staff were very satisfied with the outcome.

REPLACEMENT OF TUNGSTEN LIGHTING

WESTERN EDUCATION AND LIBRARY BOARD

The Energy Problem

A significant number of schools are still using the original tungsten lighting installed when they were built. This form of lighting is energy inefficient and would not meet today's lighting level standards.

A lot of these schools have fitted 150 watt or 200 watt tungsten lamps into the existing lamp holders in classroom areas to try to increase lighting levels. This leads not only to increased energy consumption, but also to excessive heat build-up in the lampholders causing continual insulation and lampholder breakdown.

Corridors and storage areas of these schools were generally lit with 100-watt tungsten lamps. Assembly and Sports Halls were generally lit using 300 watt recessed tungsten fittings.

The Planned Solution

Using energy efficient lighting products now available, it was planned to replace the existing tungsten lighting with more energy efficient luminaires. This would entail installing high frequency fluorescent luminaires in classroom areas, compact fluorescent luminaires in corridors and storage areas, and the most appropriate form of discharge lighting as required in Assembly and Sports Hall areas.

The Expected Outcome

Based on previous projects and energy efficiency best practice guidance the estimated savings would be as set out below -

Estimated Annual Energy Savings	985GJ
Estimated Annual Cost Savings	£21,300
Estimated CO2 savings	221 tonnes

The Savings Achieved

Savings achieved on six sites were measured as 162GJ per annum. This equated to an annual cost saving of £4,053 per annum on an investment of £14,950. If these results were extrapolated across 20 sites then the annual savings would be -

Actual Capita1 Cost	£80,000
Annual Cost Savings achieved	£22,516
Annual Energy Savings achieved	1035GJ
Annual CO2 Savings achieved	233 tonnes
Payback Period	3.55 years

Conclusion

Replacing tungsten lighting with energy efficient high frequency and compact fluorescent lighting is generally accepted as being a worthwhile medium cost energy saving measure

This project broadly meets the expected savings and payback targets.

This type of energy saving measure proves extremely popular with schools as not only has energy and costs been reduced but lighting levels have been greatly improved.

LIGHTING CONTROLS AND REPLACEMENT LIGHTING

SOUTHERN EDUCATION AND LIBRARY BOARD –
BANBRIDGE LIBRARY

The Problem

Banbridge Library is a relatively modern building of standard brick construction with a high amount of perimeter glazing. The original lighting consisted of standard 8' fluorescent fittings with reflective louvres mounted on recessed trunking. These were of the switch start type with control gear which had high losses. The fittings were not well positioned in relation to the shelving, and switching arrangements were inappropriate. Maintenance was becoming difficult due to frequent lamp failure and unavailability of suitable replacements. The library operated long hours during which the lighting was generally left switched on.

The Plan

Following a survey, it was decided to replace the 8' tubes with modern equivalents fitted with high frequency control gear, and to improve the switching arrangements to give the Library Supervisor greater control. It was estimated that the light output would be 10% greater, reducing power consumption by the same amount. Combined with a reduction of power losses in the electronic ballasts, it was estimated that the new system should result in a 25% reduction in the electrical load, and that the longer lamp life would reduce maintenance costs.

The Action

Tenders were sought, a contractor appointed and the work carried out at a total cost of £3,976.

The Outcome

Operation of the system was monitored over a 12-month period. Electricity consumption fell by almost 38% and costs were reduced by £985 in the year, giving a payback of 4 years on electricity costs alone. In addition, the lighting levels were considerably improved and maintenance costs reduced.

POINT-OF-USE WATER HEATERS FOR CLEANING PURPOSES

SOUTH EASTERN EDUCATION AND LIBRARY BOARD

The Problem

The economical provision of hot water in schools in suitable quantities for cleaning outside normal hours of occupation is a problem for most schools. Smaller primary schools have only one central boiler plant with an immersion heater, and as much as 1,000 litres of water may be heated for general use. In larger schools, there may be a separate boiler for domestic hot water which operates only outside the heating season.

This can result in too much water being heated and circulated throughout the system, with associated heat loss and water wastage. Boiler plant is operating inefficiently at low load and, depending on the particular installation, both electricity and oil may be used in the heating process.

The Plan

The Department of Education learned of an initiative by Bedfordshire County Council to install point-of-use electric water heaters for the cleaning of schools during holidays. Bedfordshire CC found the capital cost of installation was recouped in 3 - 4 years. The higher price of electricity in Northern Ireland made the scheme even more attractive, with a likely payback of 2 – 3 years. The SEELB decided to invest £ 60,000 in a programme of installing some 120 point-of-use water heaters in 90 schools (both primary and secondary) in the SEELB area.

The Action

A 3 kW heater of 25-litre capacity was considered sufficient for cleaning purposes. Control through a run-back timer ensured that heaters were only ON for a maximum of 2 hours, and guarded against them being left ON after hours or at weekends. Key switches were fitted to ensure the heaters are not used when the schools' heating system is in operation. Competitive tendering allowed the installation of 130 units within the available budget.

The Outcome

Groomsport PS was selected at random for monitoring and assessment of the project. Here the practice had been to heat, on a daily basis, a 1,000 litre cylinder with high cost electricity during holidays and at other times when cleaning was being undertaken. It was calculated that this cost a minimum of £ 360 over the year.

The 3kW heater was installed at a cost of £ 800 (higher than expected due to a long cable run). The demand for hot water was met by one ON period of two hours, costing approximately £ 15 for a full year. The payback period was therefore about 2.5 years. Installation costs on other sites were generally £ 500 - £ 600, although this does not necessarily mean a shorter payback as average savings may not always be as high as at Groomsport. However, it is confidently expected that the overall payback should be in the region of 2 - 3 years, with a total saving over the lifetime of the units of approximately £ 40,000 at today's electricity prices.

Additionally, installation of the point-of-use water heaters has created an "ownership" culture among cleaning staff, who now have their "own" supply of hot water to use and manage. The overall reaction from school caretakers and cleaners has been very favourable.