HVAC in education

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INSIDE THIS SUPPLEMENT

Lessons in retrofit lead to energy efficiency

There can be a temptation to underestimate the returns offered by retrofit technologies on energy efficiency investments, warns **Chris Meir**, of Remeha Commercial. In fact, adopting the appropriate measures could save schools up to £21,500 a year

Three high-efficiency Remeha Quinta Pro 65 replacement boilers on a cascade system helped provide energy-saving heating safely and quickly at Woodlea Primary School in Surrey school with ventilation, location and asbestos problems in its existing basement plant room

Chris Meir is national sales manager at Remeha Commercial

WHEN BUDGETS are tight, it is important to identify efficiency savings wherever possible. Schools are a case in point. With utility bills continuing to rise due to spiralling fuel prices and education resources already stretched thin, adopting energy efficiency measures is a practical, affordable approach for schools and local authorities seeking to lower utility bills and carbon emissions and free up funds for the benefit of their students.

In its work with 3,000 schools over a 10-year period, the Carbon Trust identified that schools could save up to £21,500 a year in energy bills by improving their energy efficiency and cutting energy use – that's the equivalent of the salary of a newly qualified teacher. And with heating accounting for on average 58 per cent of a school's total energy use, it makes sense for this to be the first step towards improved energy efficiency.

> Retrofit can help schools reduce not only their energy bills but the carbon footprint

The UK has a high proportion of old school buildings with old heating systems in place. This means that often the only logistical solution to cutting energy consumption from heating is through retrofitting a modern condensing or super condensing boiler. Retrofit technologies may not have the impact or visibility of renewable technologies, but it is important not to underestimate the returns they offer for energy efficiency investments. Retrofit can help schools reduce not only their energy bills but their carbon footprint, thereby assisting them in meeting their environmental targets. Replacing a 10-15 year old atmospheric boiler with a modern condensing or super condensing boiler, for example, has more than halved energy consumption and bills for some schools. Whilst requiring relatively low initial outlay, they deliver rapid financial payback. Clean burning and low in harmful NOx emissions, they are proven to reduce carbon emissions by up to 90 per cent.

Advances in condensing boiler technology apply not only to their improved efficiencies but also to innovations in their design. One such example is the introduction of condensing boiler models that can be disassembled into sections

A 'super condensing' Quinta Eco Plus 115kW passive flue gas heat recovery system with a Quinta Pro 115kW were specified at Taunton Academy as the favoured solution to meeting the school's requirement for environmentally-friendly, sustainable heating. The Quinta Eco Plus delivers a higher attainable level of efficiency of 107 per cent NCV at all times irrespective of primary circuit temperatures, making it the ultimate 'green' retrofit solution

for ease of installation. This feature is particularly advantageous in old school buildings where access to the plant room is difficult due to its location, typically in the basement, or accessible only through narrow stairways and corridors. Boilers that can be disassembled to facilitate entry into the plant room speed up installation time and therefore reduce labour costs. Any disruption is also minimal as the disassembled boiler can be reassembled and installed with no need for hire of additional equipment such as cranes to lower the boiler in through the window.

Modern heating solutions such as prefabricated heating systems also make boiler replacements easier and more flexible to carry out. With disruption kept to a bare minimum, schools are no longer constrained to restrict such energy-saving improvements to the holiday period. Condensing boilers on a cascade system, for example, are delivered on site in a pre-assembled wheeled unit. Not only does this reduce the installation time, which in turn reduces labour costs, but quality control is also improved as the pre-configured unit is pre-tested and delivered as a whole system, from a single supplier, rather than individual components. Furthermore, installing boilers in a modular design on a cascade system allows the heat output demand to be matched more accurately and more reliably in a fraction of the space.

According to a report by the Committee on Carcinology for the Department of Education, about three-quarters of England's 24,000 schools are estimated to have some buildings with asbestos. The Government's recommendation is to leave the asbestos in place undisturbed. Fortunately for schools wishing to replace ageing boilers, the speed and ease with which prefabricated heating system such as modern condensing boilers on a cascade system can be fitted can help them in the management of their existing asbestos problems and ensure no disruption during the school day.

In order to achieve maximum 'Blue Efficiency' levels from heating, however, it is important to consider the system design as a whole. For this reason, the boiler should be seen as the first part in the refurbishment project. Adding the appropriate advanced control will ensure that the boiler operates at its optimum efficiency level for maximum energy and carbon savings. Controls are simple to fit and use and, what's more, typically achieve payback in just one to two years.

Adding low temperature radiators is another consideration. This will allow the boilers to operate at reduced temperatures which will help them to achieve higher efficiency and energy savings. Low temperature radiators are particularly suitable for schools as they remove any scald hazard from exposed pipework for the protection of the children.

However, on old heating systems which by their nature take more energy to heat, even the most efficient boilers could struggle to achieve their maximum quoted efficiencies as they are sized on high flow and return temperatures, which prevents the boiler from fully condensing. In such cases, it is worth looking beyond condensing to 'super condensing' passive flue gas heat recovery technology. Such systems use energy input still more effectively and profitably, delivering an outstanding 107 NCV per cent efficiency at all times irrespective of flow and return temperatures. These heat recovery devices are the optimal solution for retrofit and refurbishment projects as they deliver maximum condensing efficiency and maximum use of the energy input, recovering any otherwise wasted energy for the benefit of space heating or cold water preheat.

For schools keen to stretch the strained budgets further and help fight climate change, the good news is that the technology is here now to deliver affordable energy-efficient heating with rapid financial payback. At Remeha Commercial we look forward to helping schools become energy smart with 'Blue Efficiency' level, energy-efficient heating.

Farley Junior School in Luton slashed its energy consumption by more than half from 660,995kWh to 273,148kWh with carbon savings in the region of 53 tonnes following the installation of three Remeha Quinta Pro 115 condensing boilers with low temperature radiators and fan heaters

// The author is the national sales manager at Remeha Commercial //

Good ventilation for today's airtight schools

Mark Quigley discusses the importance of good ventilation in educational buildings

ONE OF the key factors emerging out of trends in contemporary school design has been the creation of a balanced classroom environment, with optimum Indoor Air Quality (IAQ) at its heart. IAQ has grown in prominence with the onset of better-insulated buildings, raising the matter of 'good ventilation' to the top of the agenda.

A move towards zero-leakage, airtight property is now standard across the building industry as the Government strives to achieve its carbon reduction commitments.

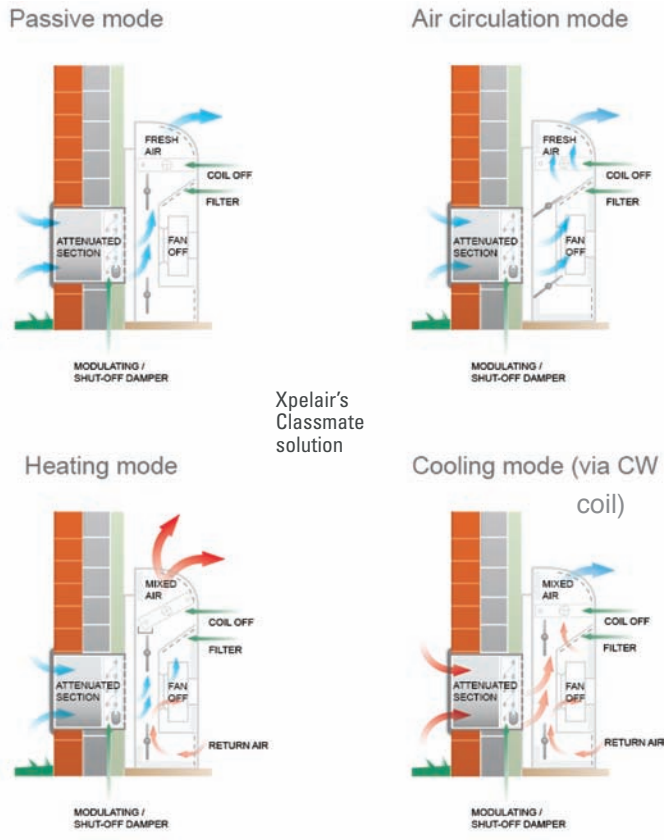
However, whilst carbon savings are key to how buildings are designed, there are a host of vital factors in the build process, and one that is becoming more universally acknowledged is pupil health – achieved through better ventilation.

Poor ventilation is a serious issue. Excessive condensation can cause mould growth, leading to cosmetic and structural damage to the fabric of a building and can create extremely poor IAQ, which can lead to potential health issues for the building's occupants. The level of carbon dioxide in classrooms will also impact pupil concentration.

A correctly designed, specified and installed system will ensure the required performance levels, help reduce carbon emissions and comply with industry regulations. CO2 should never exceed 5,000 ppm, and on average levels should not be in excess of 1,500 ppm. At any occupied time, occupants should be able to lower the concentration of CO2 to 1,000 ppm. When ventilation is supplied at 8 l/s per person, the CO2 concentration will generally stay below 1,000 ppm.

Traditionally, schools have been designed for natural ventilation and good natural light, which resulted in narrow-plan schools with large window space and cross ventilation combined with stack ventilation.

Modern schools will generally be much more air tight, so it's critical that users have control of the ventilation, understand the best system for them and understand how to use it properly.



As trends change, technology evolves to offer a solution, and Xpelair Ventilation Solutions has developed a new technology to meet the demands of school applications. The hybrid, or mixed-mode, low-energy ventilation system is designed specially to enjoy all the benefits of natural ventilation but without the pitfalls.

Unlike its natural or mechanical counterparts, mixed-mode ventilation is, in many instances, the more environmentally and financially sound solution. The underlying principle of a hybrid system is that the school is designed as a naturally ventilated building – without ductwork for air transport, whilst provision is made to assist the airflow through the space when natural driving forces are inadequate.

The Building Regulations Part F and Building Bulletin 101 govern that 'Natural ventilation should be used for standard teaching and learning areas' BB101 2.2. While natural ventilation is an innovative, and sometimes preferable, system it cannot cope with warmer weather, so the assistance of comfort cooling through mixed-mode ventilation is an ideal top-up solution to maintain a comfortable school environment.

Xpelair's Classmate solution controls the learning environment by automatically reacting to CO2 levels, room occupancies and seasonal and daytime temperatures to maintain optimum IAQ. Since its launch in 2008, and its pilot installation at Williamstown Primary School, Rhondda Cynon Taff, South Wales, the technology has continued to prove its effectiveness in a host of local authority and private school applications.

As part of the £9.5 million development, Williamstown sought to secure an A-rating for environmental standards and Classmate was specified to enhance the learning environment.

The control system selected was designed to provide each classroom, nursery and music room with the correct environmental conditions, acoustic and air quality.

The installation was also required to interact with central BMS systems, and in this case, modulating dampers were combined with the operation of high level windows located in the schools central atrium to allow exhaust air from each classroom to exit the building.

Classmate may be the solution to many of the pitfalls to modern zero-leakage building design, but the application has also proved its worth in a host of other applications, too.

Xpelair was specified in early 2011 to provide a bespoke, state-of-the-art ventilation system as part of a £9 million project to transform the prestigious Tonbridge Girls Grammar School in Kent.

The school – a nationally acclaimed centre of educational excellence – was in the process of developing a brand new facility with 39 classrooms, a sports hall and a Learning Guidance and Information Centre. Other key considerations to the installation were the orientation and layout of the building, solar exposure, occupancy periods of each room and acoustic performance to eliminate indoor (crosstalk) and outdoor noise intrusion.

Xpelair's installation of automatic control panels now allows users to select appropriate ventilation options for each individual classroom. As a result, lower carbon emissions are looking likely and the school could enjoy energy cost savings of as much as 40 per cent compared with what would have been gained with conventional system installation. Up to six units are now managed from one controller incorporating: timed function, CO2 control, night cooling function, temperature differential sensing and manual override.

In addition to works on the new facility, the school's original 1905 building was also regenerated to cater for music and art curriculum needs, dining and kitchen facilities and lecture theatres – Classmate was specified in both applications.

// The author is the commercial director at Xpelair Ventilation Solutions //

Birches Head Academy, Stoke-on-Trent

There are three reasons why ventilation is key in school buildings. Firstly the shift to more airtight school buildings; secondly the trend towards maximising the use of the available floor area in a classroom through design of deep plan spaces; and thirdly, the increased use of ICT as a central teaching tool. All of these have led to concerns about overheating in classrooms, bringing about renewed interest in natural and mechanical ventilation systems.

As part of its phase 3 redevelopment plans, the BSF funded Birches Head Academy, Stoke-on-Trent, was faced with many of the same challenges of new school design, and its centerpiece science building – opened April 2012 – required a system that negated against the problems of overheating and poor ventilation.

The academy invested £3.2m in its new science block, with Xpelair's Classmate solution specified. Like in previous installations, the mixed-mode system offered state-of-the-art natural and low energy ventilation and heating, whilst ensuring the acoustic requirements for the classrooms were maintained in accordance with the Building Bulletin requirements for schools.

Clean air boosts learning

Phil Marris looks at the importance of maintaining good Indoor Air Quality within schools and what to consider in a ventilation system

IT IS HARD for grown adults – let alone schoolchildren – to concentrate in stuffy, humid environments. Teachers are constantly battling with the sometimes short attention spans of their students anyway, so lack of ventilation and poor Indoor Air Quality (IAQ) is another problem that they really don't need.

CO2 is the primary indicator of IAQ, and high levels are a tell-tale sign that stale air is not being replaced quickly enough in relation to the occupancy levels of the room. Studies have proven that excessive build-up of CO2 can result in poor concentration, lethargy, headaches, nausea, and has a significantly detrimental effect on attentiveness too. These ailments demonstrate that the need for good IAQ is particularly crucial in order to keep students performing to the best of their ability.

In addition, high humidity caused by poor air circulation can lead to excessive condensation, thus creating the ideal breeding ground for black mould and dust mites. As these can seriously impact our health, the need for effective ventilation is also crucial in any indoor environment frequented by the vulnerable, such as the elderly or young children, and particularly schools where children will be spending hours on end.

Furthermore, Wim Zeiler and Gert Boxem of University of Technology Eindhovenin, found that natural ventilation in classrooms without any draught prevention is an unacceptable solution to increasing IAQ, and that demand controlled ventilation conditions were required. Unfortunately, all too often teachers think that simply opening a window is sufficient for increasing ventilation. However, this is not the case. Opening a window lets in both freezing air during the winter months and noise pollution from outside all year round – not ideal in a situation where children's concentration can be broken by the slightest distraction.

However, due to national building regulations, more and more educational facilities are moving towards energy-efficient ventilation systems to ensure premium IAQ in their learning environments. Just some of the influential regulations include the Building Bulletin 87 (BB87) – a guide for environmental design in schools, and the Building Bulletin 93 (BB93) – a guide for acoustic design of schools.

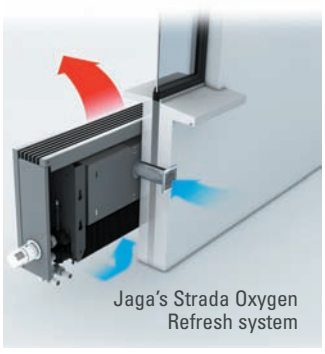
Furthermore, the Building Bulletin 101 (BB101) – a guide for ventilation of school buildings, includes how to prevent overheating and boost Indoor Air Quality through effective use of ventilation systems.

However the need for an effective heating and ventilation solution that optimises IAQ goes beyond mere compliance. A generic, one-size-fits-all approach to ensuring good IAQ is not enough – there are too many variables in play, and ventilation should be managed on a room-by-room basis. With CO2 sensors, IAQ can be constantly monitored; and with a centralised controller, refresh units can be directed to increase or decrease the amount of fresh air being delivered. Direct distribution of filtered air into each room via external air ducts rather than through central supply ducts, ensures a clean, healthy, and pollutant-free indoor environment.

The importance of effective ventilation in classrooms, is equalled by the need for efficient space heating, but for education authorities, buying heating and ventilation systems exclusive of each other is not cost effective. The answer? A combination of both – specifically, a Demand Controlled Ventilation (DCV) system with balanced supply and extraction, plus an integrated low-water content heating system.

With a DCV system, the controlled supply of fresh air at low level and extraction of stale air at high level on opposite side of the classroom ensure optimal IAQ for pupils, and offers an energy efficient solution. A low-mass, low-water content heat emitter will also be highly energy efficient by nature of its rapid response times and precise controllability; as well as being highly suited to low water flow temperature heat pump applications.

This two-in-one approach was recently implemented by Stockwell Primary School in South London. Funded by the Government and



Jaga's Strada Oxygen Refresh system

administered by the Lambeth Council, the educational facility underwent a £3.3million expansion to introduce nine new classrooms and a nursery – allowing for an extra class of students to be added to each year group at a time when school places are increasingly under pressure.

While the school has been expanded several times over the last few decades, the most recent extension had an added agenda. This included equipping the new learning spaces with state-of-the-art heating and ventilation systems to help the school reach a BREEAM 'Very Good' standard, and technology to improve the Indoor Air Quality (IAQ) of each classroom.

Located on the busy Stockwell High Street, opening windows was not an option due to the noise pollution and with the facades being primarily constructed from glass – which is a poor heat retainer – effective heating was essential. The project required a system that could not only heat the space, but provide fresh, clean air into the classrooms as well. The answer was the specification of the Jaga Strada Oxygen Refresh system.

Equipped with Jaga's Low-H O technology, 12 Strada Oxygen Refresh radiators were installed throughout the six new classrooms. Jaga worked closely with the architects to come up with a novel way of introducing air into the Jaga heating and ventilating system.

Due to the external façade of the building traditional circular grilles would have looked out of place, so Jaga researched ways of achieving sufficient air volumes. The solution was to provide a "groove" along the length of the building so the air can enter building. The cavity wall of the building was used as a plenum area so that air can enter each of the Jaga Oxygen fans in sufficient volumes. The advanced intelligence of the system also automatically regulates the intake to manage the CO2 in each classroom.

The heating and ventilating industry now offers several types of ventilation systems to choose from. But when designing Oxygen, Jaga chose a unique displacement ventilation system. In order to prevent draughts, fresh filtered air enters the room at low velocity. Furthermore, unlike traditional ventilation systems, unique displacement ventilation enters a room at a low level where it is needed – extracting stale air from higher level.

In recent years, schools across the nation have made substantial efforts to improve their indoor air quality (IAQ). Delivering a controlled supply of filtered, fresh air by ventilation only when and where it is needed – and in the exact quantity required – throughout the nation's classroom environments, will not only improve our children's health, but ensure their learning abilities are not hindered by something as simple as the lack of fresh, clean air.

// The author is the managing director of Jaga Heating Products UK //

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Heat transfer fluids – the little things count

Andrew Murray examines the importance of heating, ventilation and air conditioning (HVAC) systems in the school environment and the benefits of carefully selecting heat transfer fluids to ensure the lifespan and reliability of systems

IT IS IMPORTANT for schools to have a reliable and well maintained HVAC system to ensure a healthy working environment for both pupils and teachers. While classroom temperatures need to be at a comfortable level, there should also be adequate ventilation to limit the concentration of carbon dioxide in all teaching and learning spaces.

The reliability of HVAC systems in schools is paramount as broken heating or cooling systems in the height of winter or summer can lead to pupil discomfort and even illness. This can be extremely damaging to a school's reputation, sometimes creating the need for schools to close while systems are repaired. So, what are the main challenges associated with heating or cooling systems and what is the impact of heat transfer fluids on system longevity and reliability?

Kilfrost's range of heat transfer fluids provides protection against corrosion such as this

The little things count

The importance of the quality and composition of heat transfer fluids should not be underestimated when specifying a fluid for an HVAC system. This is because the reliability and longevity of a system can depend on the heat transfer fluid used.

Many heat transfer fluids are glycol-based. While they are not particularly corrosive in concentrate form, corrosion challenges arise when they are diluted with water to achieve the required frost protection.

> The reliability of HVAC systems in schools is paramount as broken systems could lead to pupil discomfort or illness

Another important consideration is the quality of the water used as the corrosive effect of water can vary considerably depending on its chemical composition. Hard or inferior water can cause bacterial growth and scaling within the system, as chemicals such as calcium and magnesium are introduced. This has the potential to reduce the system's lifespan and increase the need for maintenance and repairs.

As a result, mixing an inhibited glycol-based heat transfer fluid, with water of a sufficient quality, enables the system to last longer by reducing corrosion, bacteria and scaling. This results in cleaner circuits, efficient heat transfer and long-term cost benefits. The need for system repairs and to replace expensive equipment is reduced, saving both time and money for the installer and school.

But how can the installer really know the quality of the heat transfer fluid in operation? As the industry recognises the importance of corrosion prevention, an international standard, known as the ASTM D 1384 corrosion test standard is playing an increasingly important role. During the test, metals such as aluminium, iron, steel, brass, solder and copper, which are commonly used in heat transfer systems, are immersed in a glycol/water mixture. After this procedure, they are analysed in laboratory conditions for signs of corrosion.

This is an effective way to demonstrate the ability of the fluid to protect sufficiently against corrosion. However, as the standard remains voluntary, there is still a need for a greater focus in the industry on the importance of corrosion prevention and the quality of heat transfer fluids.

System maintenance

While selecting a fluid with the ASTM corrosion test standard can help to reduce the need for maintenance and repairs, regular quality checks remain important in the school environment. They are needed not only to confirm that the HVAC system is performing correctly, but that it is in good condition, with no signs of degradation or indications that it will fail. During maintenance, the glycol content within the system should also be monitored to maintain sufficient frost protection.

In addition, the various conditions under which heat transfer fluids are transferred, stored, heated and applied can all have an impact on their performance. As a result, regular quality checks should be performed in order to ensure that fluids are in an adequate condition for use all year round.

The perfect combination

In summary, the right combination of regular maintenance and carefully selected heat transfer fluids, can help installers to ensure that their systems remain operational and in good condition throughout the year. This is particularly vital in the school environment where failing or unreliable systems can lead to school closures, pupil illness, disrupted education and complaints. While heat transfer fluids may seem a small part of a system, poor quality fluids can potentially be very expensive and damaging.

// The author is the senior manager at Kilfrost's speciality fluids division //

Cutting carbon in the classroom

Lisa Gingell explains why proactive energy management is just as important in the school environment as the office and highlights why interactive energy management dashboards are great for giving schools an energy boost and ideal for showing children how they can cut carbon

IT'S A well-known fact that behaviours learnt at a young age will stand you in good stead in your adult life and the same goes for energy management and carbon cutting.

Good habits are hard to quit. By showing young people about the importance of saving energy at schools, the hope is these routines are then followed through into homes and communities.

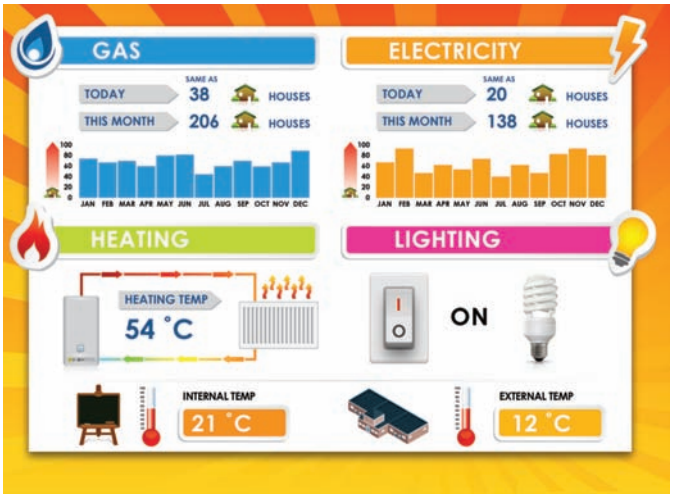
Today, many schools are not only teaching children about the importance of sustainability and energy management by including it in the curriculum but also showing them. From recycling in the classroom to learning about the effects of the climate change, schools are tackling eco-initiatives head on.

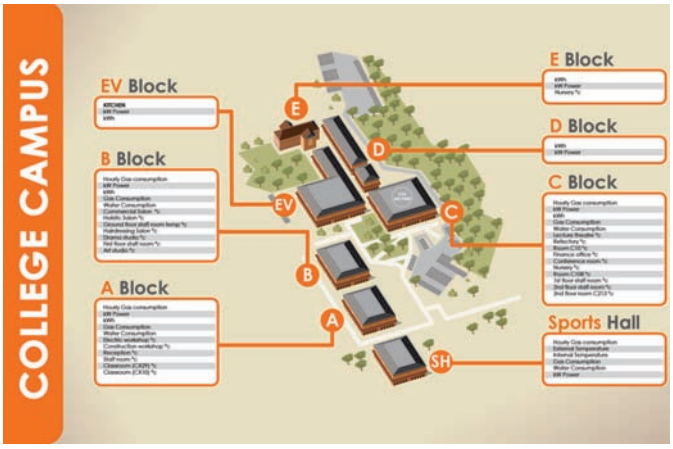
By our very nature we are all visual beings and children are even more so than adults – by physically showing them how they are saving energy they can see in bright colours and easy to understand graphics what this means. It's also been proven by psychologist Ronald Brittle's study of eco-visualisation that real-time display of energy data increases conservation behaviours and that regular feedback can result in 10 per cent energy savings by people.

At t-mac we have worked with a number of schools across the UK to provide them with an energy saving and learning framework to enable teaching staff to embed these principles into the heart of school life. How we do this is via our energy management system and our custom built energy dashboards – visual energy saving displays that can be shown in real-time on laptops, ipads, tv screens or mobile phones to pupils.

We recently installed our Building energy Management System (BeMS) into a school's vast campus for real-time metering of a number of the building's HVAC equipment. t-mac was set to monitor and meter a number of the school's areas such as the swimming pool and leisure centre, a number of accommodation blocks, a student recreation centre and the kitchens.

We enabled the school to internally analyse and quantify its energy consumption and understand the amount that each building is costing in energy expense and carbon output.





The school was also keen for students and staff to get involved and carry out energy analysis of the findings but also to look at how energy can be saved and consumption reduced through behaviour.

The way in which we helped demonstrate the energy savings and energy costs was via a custom designed 'energy makeover' dashboard – which shows pupils how the school is saving energy and carbon. This highly visual interactive screen features educational graphics and calculations demonstrating energy savings from HVAC equipment plus it provides an interactive tool for pro-active maintenance and management equipment by site staff.

All energy dashboards can be single or multi-page, showing data from single or multiple sites, and can be interactive and/or touch-screen versions. Alternatively a dashboard can scroll through screens to view on a plasma screen. The dashboards are accessible online and can be linked from a corporate internet site or running in a reception on a PC with internet access. Suitable for showing the pupils daily what savings are being made – they can visually see how their efforts to cut the use of HVAC equipment is saving energy and cost for the school.

From our research we know that a one off approach to energy management won't reap returns but a long-term approach coupled with getting people – as well as software – on board can make significant reductions. It's all about changing the mind-set behind the everyday actions of pupils and staff and letting them see the benefits of energy savings.

t-mac Technologies is made up of dedicated experts in the field of electronics engineering and web application bringing its associated systems and products to life; providing the next generation of energy management solutions. t-mac Technologies' t-mac BeMS device and energy software can reap savings of up to 30 per cent and offers a return on investment of 12 to 18 months.

The company's products are used globally enabling clients to monitor and reduce their energy consumption, make savings and comply with Government legislation. Using wireless and web-based technology, the company provides intelligent systems for remote, Internet monitoring and control of assets such as heating, ventilation, air conditioning and refrigeration as well as consumables such as water, air, gas and electricity.

// The author is a director at t-mac Technologies //