Managing energy requirements to best effect

A system to manage the energy requirements of a building can pay for itself in two or three years. Malcolm Clapp, technical director, describes the types of energy management systems and what they can do.

Energy management systems came into their own in the 1970s with the advent of escalating fuel prices. At that time there had been so little effort devoted to energy saving that almost any measures paid off handsomely. Since then, most industrial and commercial buildings have had at least some attention, and in many there is considerable attention to detail, with commensurate savings.

But now the philosophy has changed and systems look after far more than simple energy savings – electrical services, safety and security, water and gas consumption and many more are now commonly part of any comprehensive building management system.

This begs the question: What is an energy management system? At its simplest (and excluding the domestic central heating controllers sold as such from door to door) a timeswitch can be considered as an energy management system. In the true sense of the phrase as used in the building trade, such a system would be an interactive electronic monitor which also controls the settings and state of devices such as valves, dampers, boilers, pumps, fans and coolers.

A CERTAIN CONFUSION

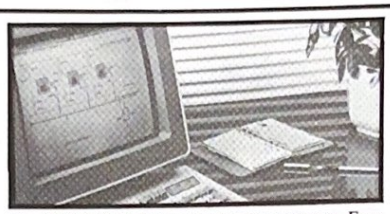
There is a certain confusion as to names: building automation systems (BAS), building energy management systems (BEMS), energy management systems, and most recently the term "integrated building" has swum across the Atlantic.

They are much the same thing, except the last which is currently over-used and refers to the integration (sharing) of the wiring and communications of a building's services, as well as their common control. Generally, the heating and ventilation industry entered the field first (not surprisingly, bearing in mind that fuel – energy – will be 22 per cent of the running cost of even a well designed and well insulated office block), and tends to favour the term "building automation system" since it controls comfort as well as managing energy.

"Energy management" came into more general use when some of the computer companies (principally, because of their expertise in process control) came on the scene with equipment to program lighting and other services. BEMS is rather confusing as it also stands for Building Energy Management Systems Centre, an independent group run within BSRIA (Building Services Research & Information Association) who, with government assistance, promotes building management.

By whatever name, energy management systems are installed to ensure that the use of all utilities is as efficient as possible. 'Efficient' here means more than just minimising use. It also encompasses maintenance, to minimise downtime, and automatic monitoring so that staff can be used for more skilled tasks and not just meter reading.

The philosophy in the use of energy management systems has changed in that, on the whole, the savings which are still to be made are smaller. Also, there is more emphasis on staff comfort than was the case even 10 years ago. In the 70s, buildings were often poorly maintained and the heating systems frequently had only the bare minimum of controls – boilers on, on October 1, for example.



The BAS 2000 building management system. Ease of use is the key to the system, made even simpler by the use of comprehensive colour graphics.

Unfortunately, inadequate maintenance is still common, but there can be few sites, industrial or commercial, where there is not some degree of optimisation, boiler sequencing and temperature compensation.

It is because we are looking for small savings that the role of the energy management system has become more critical. It would be impossible, for example, to maintain the air temperature in even an office block to within 1° without the use of automatic electronic control. Typically, running 2° over set temperature costs 20%. Also, a 2° drift is uncomfortable for sedentary workers who will accept 2° over-temperature but object to 2° under-temperature – the reason why buildings err on the warm side.

Typically a building automation system (BAS) will consist of a number of outstations, each usually situated fairly near the building services plant. The outstations provide the interface between the plant and the monitoring and control centre.

Sensors are connected to them to feed in information, and switched and controlled input/output functions which in turn cause valves to open and close, dampers to move, fans to start and stop, and boilers and pumps to turn on and off.

On the non-heating side, the monitoring and control of electrical demand to keep within the constraints of a maximum demand tariff can be most rewarding. In one factory a Satchwell system was bought just for this task. Since its installation many other uses have been added on, but it would have achieved pay-back in under three years if used solely for electrical control.

Originally, schemes based on a central processor plus outstations were installed to keep costly wiring runs to a minimum, but with the increasing power of microprocessors more and more control is being delegated to the outstations through direct digital control (ddc); outstations can operate independently and have a high degree of intelligence. Quite often one or more outstations are located on sites remote from the head office, communicating by telephone or radio links.

New facilities are continually being added by manufacturers to give users even better control over their buildings. Colour graphics display, for example, help staff to see immediately where an item of plant is located as well as its status. This is especially useful on very large sites where staff cannot be expected to be familiar with the layout in detail. It also helps new staff, and the emergency services if they have to visit the site.

Most recently, the facilities of Satchwell's BAS have been extended by the availability of the Maximo maintenance planning software. This permits full plant inventories to be kept and maintenance scheduling to be done by the BAS with data input being accessed on line. Thus it is possible to provide a life history of each piece of plant, and make replacement decisions based on automatically recorded performance, as well as maintaining an asset register of plant.

The range of uses of a building management system is almost as wide as the user's imagination, but there are some functions which are controlled in most installations.

Optimum start/stop allows the heating to come on before people start work in the morning, altering the switch-on time in order to achieve the desired room temperature just as staff start to arrive. Equally, heating can be turned off before the end of the working day so that the interior is still at a comfortable temperature when staff leave, without being kept warm for a large part of the evening.

SELF-LEARN CHARACTERISTICS

This is achieved with a knowledge of the internal temperature, sometimes the external temperature (especially in extremes of climate), and the characteristics of the building, plus occupancy times and holidays. Modern optimisers can self-learn the building characteristics, thus reducing the on-site commissioning time.

In a small building with its own boiler an optimiser, whether it is a stand-alone instrument or a BAS control point, will normally control the switching of the boiler direct. In more complex installations it may be the water flow temperature to a particular building which is controlled.

If the boiler locks out, ie, fails to fire, an alarm will be raised for manual maintenance.

Boiler sequencing is a frequent application. Not only is water flow temperature more efficiently controlled if several boilers are used sequentially, but automatic rotation of the lead boiler evenly spreads wear and tear and extends plant life.

Load cycling and maximum demand load shedding are the most common parameters applied to electrical systems and considerable (at least 20 per cent) savings have been achieved. Weather compensation of boiler temperature is an important energy and cost saving option frequently controlled by an energy management system.

The most common application of all is of course the maintenance of a comfortable working temperature, at minimum cost, for all the disparate needs of a multi-use building.

Recently Satchwell has monitored the efficiency of plant such as boilers and chillers and applied alarm limits, thus alerting maintenance staff when efficiency falls.

There are a number of ways of calculating the running cost of a building and the savings which can be made by installing energy saving measures of some kind. CIBSE (Chartered Institution of Building Services Engineers) issues comprehensive guidelines. But the most common rule of thumb remains the pay-back period. That is, the length of time which equipment needs to be in use before its capital cost is offset by the actual savings made on energy bills.

Most Satchwell energy management schemes achieve pay-back in under three years and many in less than two years.