Green without eco-bling

As energy saving climbs up plant engineers' agendas, Dr Tom Shelley reviews some of the good and not so good technologies for heating, ventilating and air conditioning

Below: Ener-G's Vision screen gives plant engineers access to invaluable management information

There are many cost-effective ways to reduce energy consumptions in buildings, but don't expect a reasonable return from, for example, a wind turbine on a factory end gable in a commercial estate. This is an example of what is coming to be known as 'eco bling' – adornments that have more to do with being seen to be green than serving any useful purpose.

That's not to say all novel ideas concerning wind energy, photovoltaics etc don't work: many do. Sorting the wheat from the chaff is about applying a good dose of engineering circumspection. However, it is also worth noting that some of the best energy-saving ideas for buildings and for plant are simple, and can also be relatively invisible.

Take thermal insulation. Most plant engineers are aware of the requirement to insulate walls and roofs, but fewer understand the importance of insulating cold pipes in refrigeration and air conditioning systems. German-headquartered Armacell, which makes Armaflex foam, recommends 15.5 to 25mm insulation for chilled water pipes and 32 to 50mm for refrigeration. Installation costs are claimed to be recoverable after five to seven months and the company also calculates that, for every cubic metre of its product, CO_2 savings amount to1,150kg for air conditioning systems and 1,900kg for refrigeration with a line temperature of -5°C or 2,550kg for -36°C.

Another high impact way of improving the thermal behaviour of buildings with windows is to introduce blinds, whose performance can be greatly enhanced by coatings. Swedish Hammerglass EnergyBlinds use sputtered aluminium, which makes them highly reflective. Conventionally, when light strikes inner surfaces, it is converted to infrared, which heats the room – the greenhouse effect.

EnergyBlinds, however, transmit 10%, 15% or 40% of incoming light, according to type, but reflect the rest back through the glass unchanged. At night, they also reflect infrared radiation back into the room, reducing heat losses through windows by up to 30%.

On a different note, HVAC running costs can also be greatly reduced by employing variable speed drives, so that fans only run as required, not at full speed. Schneider Electric's ATV212 Altivar drive, for example, was designed for HVAC. It's 'C-Less', meaning it does without large energy storage capacitors on the internal dc link, because it doesn't need to handle high over-torques. As a result, it produces 30% less harmonics than some drives. It also monitors flux within the motor and adjusts drive output to meet needs, further reducing energy consumption.

These drives are available from 0.75 to 75kW, are IP21 or IP55 rated, and come embedded with Modbus, BacNET, Apogee and Metasys digital plant communications. A fire mode function works with motors, for smoke extraction, and a damper control ensures that the motor won't start unless dampers are in the correct position.

Optimised in a very similar way for the HVAC market are CFW700 and CFW701 drives from Weg. These, too, are less expensive than general-purpose drives, because of reduced capacitance on the dc bus and less complex software – although they still include auto-configuration, PID control, overload and over-temperature protection.

Managing energy down

Meanwhile, at the Hannover Fair in April, Econ Solutions demonstrated an energy monitoring and analysis system, which, according to project manager Marc Rostock, was developed for its parent company. Based on brick-sized electronic units that interface with sensors and are connected by Ethernet, it uses a web browser interface. He claims that, on average, installation of its system saves 25% energy costs within the first year.

A similar figure is cited by Ener-G Controls for its E-Magine building management system. Managing director Dr Cedric Rodrigues says the firm has tackled "two major system flaws" that prevent many BEMS from delivering projected cost and carbon savings. First, the software is pre-configured to recognised CIBSE (Chartered Institute of Building Services) control strategy standards – so it avoids problems caused by inconsistent programming.

Secondly, the system prevents the flaw of users adjusting settings and gradually eroding designed-in energy efficiency benefits. “E-Magine locks in optimal settings, so that the BEMS achieves peak performance throughout its lifetime,” says Rodrigues.

These are serious points. Lisa Wilkinson of energy logging specialist t-mac says: “Working with a couple of retailers, we have seen energy costs reduce phenomenally by limiting air conditioning setpoints, so staff cannot abuse the system.” Her company’s systems also link air conditioning and heating to ensure they “don’t fight each other”.

Wilkinson describes switching HVAC equipment on and off according to time of day and hours as Step One. Step Two, she says, is managing BEMS’ performance, and adding in remote diagnostics and maintenance. “Finally, we look to educate staff to ensure they are aware of the impact a change in system performance can have on the cost and carbon emissions of their business,” she states.

Fleshing out the kinds of improvements that can be made, Cleeve Park School in Sidcup, Kent, is expecting £10,000 savings per annum, thanks to a Dedicated Engines (DEL) eFM Internet-based BEMS. The school has two plant rooms: Zone 1, the main boiler room, with three boilers; and Zone 2, with two boilers. Prior to installation of the new system, there was no centralised BEMS, and the boilers were operated independently, using timers and controls.

With eFM installed, boiler run times in Zone 1 have been reduced from 96.5h to 40.75h per week, while Zone 2 went from 168h to 40.75h. “We are delighted with the results,” states Don Blaylock, assistant head teacher. “We were looking for ways of reducing our energy costs, but were restricted by lack of funds. The NESS (National Energy Saving Service) Share programme not only solved the funding issue, but also recommended technologies.”

But there is still more to solving building energy management. David Hudson, senior product engineer with couplings manufacturer Victaulic, makes the point that HVAC system flows change over a 24-hour period. “Because of heat gain from the sun and changes in building occupancy, the demand for heating and cooling varies,” he reflects.

For him, one solution is balancing valves to ensure that heating and chilled water systems deliver correct flows to all terminal units in an HVAC circuit. In an unbalanced system, he explains, some building sectors will experience underflow or overflow conditions that impact indoor climate. For instance, areas closest to energy production and delivery might receive excess heating or cooling flow.

Problems can result from poor design, improperly adjusted balancing valves or clogged strainers and coils, he warns – and these can be expensive. Hudson claims that, for every unnecessary single degree temperature above 20°C, there is an 8% increase in heating costs, while for every single degree cooling below 23°C, there is a 15% increase in cooling costs.

Focuses the mind, doesn’t it? PE

Above: Armacell insulation in action and, inset, Cleeve Park School’s Dedicated Engines’ BEMS
Below: Schneider Electric’s ATV212 Altivar drive, designed specifically for HVAC operations