By taking relatively simple steps to reduce otherwise wasted energy, big paybacks, sometimes in well under a single year, can often be achieved. Dr Tom Shelley explains

Spend a little,

Now that we know conventional energy costs aren't likely to fall any time soon, spending what turns out to be relatively little to save a lot has suddenly become much more attractive. All the more so, as engineers and business leaders alike see that – despite solar, wind, wave and revived nuclear power helping long-term – rising energy demand worldwide is bound to fuel price hikes for the foreseeable future.

There are three key solutions for plant engineers: make maximum use of what's available, make serious efforts to reduce waste and invest in technologies – some new, some much less so – able to make a difference. When you hear that payback times for energy improvement schemes are often well under than a year, all three present very viable propositions.

That said, probably the first thing to do is find where exactly energy is being wasted – and how much. One of the most useful tools is an infrared camera, which, in the right hands, readily reveals where heat energy is being lost – from buildings, plant, equipment and wiring. Companies such as Eriks (formerly Wyko), with its thermography department in Tyseley, regularly conduct thermal surveys, using equipment such as Flir's ThermCAM. Similar equipment is now widely available for hire and, of course, purchase.

Eriks recently carried out a two-day survey at the Coors brewery in Burton. It cost less than £1,000, yet showed a potential for cutting up to £60,000 from the firm's annual energy bill. Eriks business development manager Duncan Webb explains: "We assess the integrity of a customer's building. We look at their pipework, heating systems, cooling equipment, windows, roofs, lagging and floors – and spot areas of inefficiency. We then offer hard figures that show the costs of heat losses, and present the customer with recommendations and a budget for repair. We also offer a follow-up survey."

Sometimes, solutions are staring you in the face – and many of these cost very little. One example is ensuring that heating or cooling air only goes where it's wanted. Consider data centres, where the issue is cooling: so often, while some of the conditioned air ducted from the floor is sucked through the computer racks and cabinets, much of it goes straight to exhaust. Equally, some of the hot air from the exit sides of the cabinets invariably mixes with the cold side, reducing cooling efficiency.

Installing what amounts to cold aisles – barriers over the spaces between the electronic cabinets – ensures that all the cooling air is forced through them and cannot mix with warm discharge air. St Ives-based Knurr claims that, by adopting its CAC (cold aisle containment), cabinet cooling and energy efficiency can be improved by a staggering 60%.

Moving on, most plant operations require heat in some form – usually as hot water and steam – and virtually all require electricity. Tackling the latter first, because electricity generation plants are not usually close to population centres, it isn't easy to harness their waste heat. So while energy efficiency in the latest and best plants can rise to 60%, most are down at less than 40%.

However, by generating electricity in a smaller way on-site, and also using

Pointers

- Maximise output of available plant equipment
- Make serious efforts to reduce existing waste
- Invest in low-cost, rapid-return, energy-saving technologies
- Infrared thermography is among the best routes to quantifying losses
- CHP (combined heat and power) can lift 40–60% boiler house efficiencies up to 70–80%
- Micro CHP units can transform some of the smallest energy plants
- Grants and PFI funding can make the apparently unaffordable affordable

the waste heat for heating or as a source of steam, energy efficiency can get up to 70—90%.

That might sound ambitious, but the sums do add up. When Dalkia Utilities Services, for example, was asked to replace six boilers – some of which were more than 40 years old and near the end of their useful lives – at the Royal Victoria Infirmary, the company designed and installed a CHP (combined heat and power) plant. The Newcastle upon Tyne Hospitals Trust invested £7 million under a PFI (private finance initiative) contract over 25 years.

At the start of the project, predicted cost savings were £485,000, which, along with another earlier CHP plant built to serve the Freeman Hospital in the same city, meant £700,000 energy saving per year. However, in 2006, the trust gained an additional £130,000 from energy trading through the then UK Emissions Trading Scheme.

save a lot

And, if you're thinking CHP is not for you, think again: on a much smaller scale, Dalkia announced in January this year that it had successfully installed micro CHP units at three council sites in Neath, Port Talbot: a residential care home, a swimming pool and a leisure centre, between them contributing to cost savings of £5,000 per year, as well as saving 20—30 tonnes of CO_2.

Boiler upgrades

However, if micro CHP isn't for your plant, how about fitting better burners and controllers to existing boilers? Fulton Boiler Works in Bristol claims that typical additional cost per boiler, using an ECA (enhanced capital allowance) approved Nu-way burner, is £2,300, while the estimated annual running cost saving is £2,750. Those figures are based on a steam plant in the North of England equipped with four boilers 2004, and they clearly demonstrate a payback well inside 12 months. That's achieved because modern burner systems save substantial amounts of fuel and power by using modulating control valves and variable speed drives.

Talking of variable speed drives, despite their high capital cost, they can often yield even better payback times – sometimes measurable in a few months. Stryker Orthopaedics, based in Limerick Ireland, which manufactures orthopaedic implants, bone cements and bone substitute materials, installed eight units – in this case Hitachi L300P devices supplied by Silverteam, three at 55kW and five at 37kW – to vary the speed of dust extraction fans. Total installed cost was £22,324 (eur 31,100), but Stryker reports annual energy savings of several times that figure.

The key differences are that each fan is now tuned to local demand, rather than running faster than necessary, while also being varied according to the company's two-shift day. Initially, the drives were configured to provide the fans with three set speeds, but the intention is to upgrade this with full three-term PID (proportional, integral, derivative) control, based on pressure sensor feedback, so that load matching becomes even more precise. In addition, with a Hitachi PLC connected to the company's building management system, the air handling system now closes down when machines are idle during lunch and tea breaks.

Says maintenance manager Robert McKillican: "The biggest unexpected saving – and it is massive – is in the gas bill for space heating. Not only are we pulling in less outside air, but we are now able to recycle half of our heated air. We are saving eur 60,000 on gas, nearly 30%, and there is scope to further increase the recycling." And that's on top of the annual eur 80,000 saving on electricity to run the fans. PE

Pan Peninsula, the UK's largest residential building, will use a CHP installation from Ener-g Combined Power to produce 135kW of electricity and 215kW of heat

Green power solutions

While energy-saving initiatives are laudable, and economically and morally sound, they can only slow the impacts of the inevitable trend, which is the rising cost of fossil fuels as reserves run down, while demand increases.

One green solution is using municipal waste as a fuel, which kills several birds with the same stone – reducing the cost of waste disposal, substituting for fossil fuel and eliminating ozone layer-destroying methane production from rotting waste in landfill.

Analyst Frost and Sullivan predicts that's Europe's waste-to-energy plant capacity will increase by around 13 million tonnes, with almost 100 new plants coming on line by 2012. According to its energy and environment practice director John Raspin: "The move away from landfill is continuing to attract innovation and the current leaning towards waste-to-energy is bringing major capital investment, as opportunities for returns improve. Investors will continue to be drawn to this sustainable growth market."

Innovation is also seen as crucial by the government's Technology Strategy Board (sponsored by the Department for Innovation, Universities and Skills), which is investing £10 million in collaborative research and development around low carbon technologies. The board is working with the EPSRC (Engineering and Physical Science Research Council) and the Energy Technologies Institute, which has now issued details of its complementary programmes covering offshore wind, and marine, tidal and wave technologies.

Information is available at www.technologyprogramme.org.uk