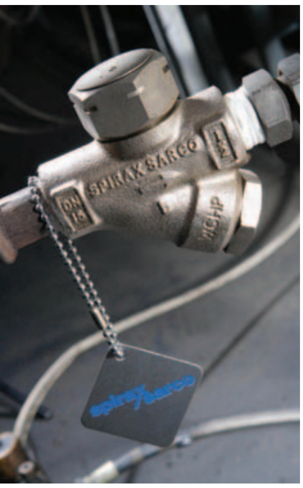
Cool solutions

Most plants would benefit from an energy audit, but where should you focus your efforts? And what kind of technology might yield the best dividends? Brian Tinham reports

However you look at it, whichever your industry and whatever your plant configuration, there are bound still to be significant economies yet to be reaped by reining back on energy consumption. Even a small percentage of a large number is significant – and the figures bandied about for industrial energy usage are nothing short of eye-watering.

The process industries, for example, are estimated to account for 20–25% of energy consumed throughout the EU. At a more detailed level, 10% of electricity used across industry is attributable to compressed air. Steam accounts for up to 40% of many plants' energy bills. And electric motors are responsible for fully two thirds of the UK's entire industrial energy consumption – that's around a quarter of the nation's total electricity output.

So big stuff, yes, but also set against a backdrop of inexorably rising energy costs – and in globally straitened economic times. Additionally, for many plant managers, the drive to save energy and cost goes hand in hand with cutting carbon emissions. And that requirement can only tighten.



Look at the EU's 20 20 20 Climate Change initiative, aimed at reducing CO_2 emissions by 20%, increasing the share of renewables generation to 20% and achieving energy efficiencies of 20%, all by 2020. And consider the Energy Efficiency Directive, too, which is creeping ever closer to national legislation – and almost certainly extending its remit beyond the energy producers and public sector. Responsibility may well fall on the shoulders of plant and facilities managers to carry out audits and make improvements on everything from boilers to pumps and fans. And, if so, they'll also be required to monitor performance through whatever means.

So what are those means? And where should we prioritise? For Steve Offer, Emerson Process Management's European industrial energy business development manager, the lowest hanging fruit today is invariably still in plant power generation. "Energy audits are the starting point, because engineers need to know where energy is being used, the conversion rates etc, so they can better target improvements. However, the biggest single area for improvement is the power house, whether it's a straight steam or cogeneration plant," he asserts.

If it's the latter, that means examining everything from the top-level electricity production/purchase strategy, in line with half-hourly tariffs and daily, weekly and seasonal cycles, right down to the detail. That detail includes: looking at boiler combustion efficiencies (is burner excess oxygen as close to 2% as feasible, are mechanical linkages adequate etc); reviewing water treatment regimes; and checking turbine (and/or heat exchanger) conversion efficiencies. And remember the steam distribution and condensate recovery network.

Meat on the bones

Putting some meat on the bones, Paul Mayoh, UK marketing manager with steam specialist Spirax Sarco, advises engineers to walk the plant. "Start off at the boiler and look at what improvements could be made, in terms of the controls. For example, are the TDS [total dissolved solids] controls modern and automated, so that water quality is accurate, the risk of wet steam getting onto the plant is minimised and you're not wasting energy on blowdowns? Are fuel-to-air ratios controlled properly? And is burner management on track – and maintenance effective?"

As for other aspects, he suggests checking the feed tank installation and ensuring that feed water temperature is near 85°C, to keep oxygen content low, reduce chemical treatment, and maximise thermal efficiency and responsiveness. Similarly, he points to flash steam recovery and the value of closing the loop with that otherwise wasted energy. "Where you see steam plumes, there are almost always opportunities," advises Mayoh.

Then the distribution system, and it's back to basics: check the standard of the installation and

maintenance, including the pipework. Are there enough steam traps? Are they functioning correctly? Maybe some heat exchangers should be upgraded? Again, is much flash steam being lost? And the classic: is that condensate pump still working? If it is not, the site will still be getting its steam, but somewhere you'll find an expensive resource – hot water – pouring down a drain. "Any project that gets condensate recovery working properly will probably pay for itself well within a year," insists Mayoh.

High-level view

All that said, at a higher level, Emerson's Offer makes the point that, with multiple boilers, probably having different efficiency curves, potentially burning different fuel stocks and feeding high-, medium- and low-pressure steam headers, it's important to take an holistic approach. "Engineers need to look at the boiler systems and ensure that performance overall remains optimal as demands change, and as the cost of electricity from the grid varies," observes Offer. "But to do that well, they also need, for example, to be able to determine the calorific value of waste process gas feeds they're mixing in, and vary flow into the boilers automatically to maintain the stability of combustion and steam production."

And it's a similar story with the regulatory controls, managing boiler firing, turbines and/or steam accumulators – and the overarching energy management system. "Typically, operators run the power house in manual mode, setting two or three boilers for base load and one as a swing boiler, or adjusting the turbines. But they can never reach optimal conditions. That has to be done through automation. But payback through this kind of energy efficiency project is typically six to 18 months."

Beyond all that, Offer is one amongst many advising engineers to take advantage of variable speed drives – swapping out mechanical linkages and damper controls, and manipulating forced draft fan speed directly via the electric motors. "If you can take the motor speed down from 100% to 80%, then there's an instant and sustainable 50% saving on energy consumption," he states (see page 14).

Good stuff, but the power house is not the only place to look for energy savings. Finding out what else to prioritise is about extending the energy audit to establish which plant is energy intensive and when. As David Manning Ohrens, plant engineering consultant with maintenance, repair and overhaul specialist Eriks, puts it: "The most effective way to do this is to perform a skim survey across the plant first to find the large kW units."

For him, the most rewarding projects invariably involve large pumps and fans. And the same goes for compressed air, which, contrary to popular belief, is anything but a free commodity. "But if they've done all that, we can be cleverer, and check how much energy particular pumps, say, are consuming, and when, by fitting portable power meters, using mobile phone technology, and looking for spikes." And so the audit continues, with other prime methods for identifying best targets including local energy monitoring of all electrical phases on specific plant units or buildings.

Armed with information about when and where, and the scale of maximum demand – and what that equates to, in terms of production (expressed financially) – it's not difficult to establish potential cost savings. It's also not difficult to relate those to the process change and/or investment required to get there, always bearing in mind the criticality of plant availability (meaning it doesn't always make sense, for example, to downsize a motor, if the result is increased risk of occasional overloading).

Incidentally, Emerson's Offer also suggests that plant engineers would do well to consider modern adaptive tuning technology on process loops in key plant units. That's not only because it tightens regulatory control, and so reduces product variability and maximises quality. It also, in turn, reduces energy consumption and improves a plant's potential to optimise throughput. PE

Energy efficiency projects can have a positive impact on process plant product quality and yield, too