

Energy efficiency

Better use of existing facilities delivers significant energy savings

Syngenta at Jealott's Hill has successfully reduced its energy profile through a review of its building services operations as well as implementing cost-effective operating principles and engaging with the site occupants. Owen Overall explains.

Syngenta is a world-leading agri-business committed to sustainable agriculture through innovative research and technology, with research and development sites located in India, the USA, Switzerland and in the UK at Jealott's Hill in Berkshire. The Jealott's Hill site has transformed its approach to energy and water use and has benefited from significant environmental and financial savings. The site is located in the heart of the Berkshire countryside between Maidenhead and Bracknell and celebrates its 80th anniversary this year. Over the 80 years Jealott's Hill has developed to encompass nearly 80,000 m² of building stock including laboratories, offices, glasshouses, controlled environment (CE) rooms and restaurant facilities.

Laboratories, glasshouses and CE rooms, in particular, are high energy users and in 2004 the site consumed 72 GWh of energy (40 GWh of gas and 32 GWh of electricity) and 171mn litres of water. The utility bill was £1.78mn and made up a significant proportion of the site operations budget.

The change programme initiated at Jealott's Hill has more than returned the investment of time and cost by improving its environmental performance, saving money and engaging the site community to contribute to the overall objective of saving energy. These savings have been achieved through identifying the opportunity for savings and establishing the right environment to enable change through people, technology and good engineering practice.

The philosophy has been to manage the assets already installed to improve performance through the building management system (BMS) rather than make wholesale changes through the application of capital expenditure. More recently the way space is used is becoming a feature of the site operating strategy to ensure that best value is obtained from the building stock (the space occupancy has been reduced from 79,000 m² to 76,000 m² (4%) in 3.5 years).

Savings in electricity and gas

Since 2004, the site has embarked on an energy management programme and has successfully reduced utility consumption every year, resulting in a more efficient operation. Effective management of the building services has reduced the consumption of electricity and gas by 35% and water by 57%. The site

has delivered year-on-year savings and continues to redefine its energy requirements through a structured approach of continuous improvement. The financial contribution made by the energy savings averages £57,000 per month for the last 42 months (approaching £2.4mn in total).

The investment required to achieve these savings has been acquired by redirecting resources rather than spending more. For example the maintenance contract with the BMS service provider was changed from one of preventative maintenance routines to one of strategically reviewing the building services controls to ensure they are current and relevant. As a result of this work the maintenance budget has been reduced by 35%.

The primary driver to reduce the site energy consumption was the rising cost of energy and the impact this had on the operating budget. However, it soon became apparent that there were ancillary benefits to managing energy such as improved environmental conditions for occupants, reduced maintenance costs and an informed, motivated maintenance team.

Metering and asset management

It was important to establish a baseline figure from which to compare future performance and then to generate data which could be used to track progress. Historically, all meter readings had been taken at the end of a calendar month for fiscal purposes. This made analysis and comparisons difficult and weekly readings of gas, water and electricity meters were introduced to overcome this. This data capture frequency has now been increased for the main electricity and water meters to be read daily and the gas meters to be read three times per week. The data analysis has also been improved with the BMS recording some of the utility meters and local site degree day data to enable monthly predictions of gas consumption to be calculated.

As with any energy management programme, it is important to understand where and when the energy is being used. From experience and calculation it became clear that the site had too much installed boiler capacity which was a function of the historical site development and different operating philosophies employed to deliver heating services. The site had 32 MW of installed capacity from steam boilers, a medium temperature hot water district heating scheme (130°C) and low temperature hot water systems. These systems have now been rationalised to reduce the installed capacity to 21 MW, and common operating strategies applied wherever possible to simplify operations and improve efficiencies. Employing



The updated fully modulating boiler system at Jealott's Hill

common operating strategies enable quick comparisons to be made to systems and identify where there are differences in performance. Another benefit of having less plant is a reduced maintenance burden in terms of insurance inspections and operational checks.

A review of the water pumping infrastructure resulted in the replacement of two fixed speed pumps which caused pressure fluctuations in the distribution system with a pressure controlled variable speed pump, thus providing a much smoother service delivery and a significant reduction in electrical costs with a simple payback of less than two years.

Similarly, reviewing the waste operation led to the closure and ultimate removal of the site incinerator reducing the complexity of the site operation and reducing disposal costs. The plant was a significant user of electrical energy running auxiliary systems such as air compressors.

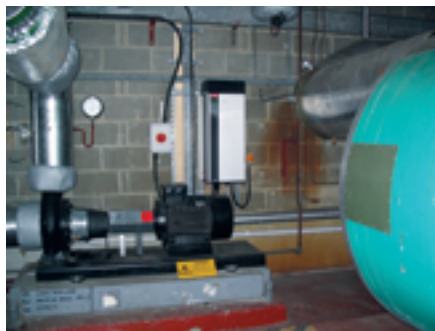
As a result of the direct approach to managing energy the site no longer needs to update the electrical feed to the site from 5 MVA to 7.5 MVA, costing £500,000. The load is now managed, monitored and kept well below the 5 MVA supply capacity agreement.

A structured approach

Further efficiency improvements have been made through making the boiler burners fully modulating rather than merely two-position (high and low fire) as well as taking direct control of the burner modulation through the BMS. This enables the BMS to determine exactly what the firing rate needs to be to match the demand of the whole system and prevents sequenced boilers from coming on unnecessarily with wasteful purging cycles which cool the boiler. Other key advantages are better temperature control and complete visibility of burner activity rather than merely knowing that the boiler has been enabled by the BMS and then handing over control to the boilers' own burner management system.

All boiler control systems now control the boiler output from the flow temperature sensor rather than the return temperature sensor as in many cases the set point on the return was too high for the boilers to actually achieve and resulted in boilers reaching their own internal control thermostat which shut the boiler down. This in turn was observed by the BMS as a drop in temperature and so it would enable the next boiler in sequence. This would continue until all the boilers in a system were enabled and the whole system was effectively controlling on individual boilers' control thermostats.

In order to maximise the energy saving opportunity it has been necessary to alter a boiler system configuration by modifying the pumping arrangement to create primary and secondary circuits with a low loss header. Included in the upgrade were new secondary pressure controlled pumps which now only deliver water that is required for heating rather than pumping all of the water all of the time around the system, regardless of the demand. This improvement plan included shutting the bypasses on all of the air handling unit batteries thereby effectively mak-



A secondary pressure controlled pump

ing them two port valves.

The end result is a boiler system that can alter its output temperature to respond to outside conditions (no overheating the water), deliver exactly the right volume of water to the right part of the building (no distribution waste) and maintain a relatively steady temperature differential between the flow and return temperatures (matching supply to demand).

System simplification

Simplifying the plant operations is a key component to reducing costs. Initiatives such as installing immersion heaters to provide domestic and process hot water services for the summer has had dramatic results. This simple application has enabled (for example) the steam boilers (5 MW capacity) to be turned off for three months in the summer saving gas, water, and chemicals as well as improving safe maintenance access to the plant and steam distribution system for an extended period.

This initiative is now being rolled out to other large buildings on site. The savings come about from not having to run large (5 MW) boiler systems to heat up relatively small amounts of water for domestic and process requirements.

Demand-led strategies

Many of the energy improvements have been achieved by driving better value from the BMS and establishing demand-led strategies for heating and ventilation systems rather than merely time-enabled operations. Coupled with the demand-led strategy significant effort has gone into the tuning of control loops, resulting in improved conditions for the occupants and the prevention of heating and cooling systems competing with each other.

Inspection of the BMS controls highlighted that over time buildings change, occupants change and maintenance is carried out. Where a short-term change to the running time of an air handling system is made to overcome an issue very often it is left and not revisited. The same can be said of other building service plant like boilers to overcome heat-up times. The net result is a drift in the plant performance which shows itself in increased energy consumption and costs. If there is no regime to review and control these changes then they will go unchallenged.

At Jealott's Hill the BMS contract has been re-scoped to allow a review of all the control parameters that should be operating in any particular building, ensuring the plant operates optimally. In conjunction with this review initiative demand-led strategies have been developed to improve the control of plant.

A typical demand-led strategy would be to establish the drivers for enabling a heating system, such as outside air temperature, inside air temperature, the position of a heating valve and the times of occupancy. These parameters are then used to determine when the boilers ran, for how long and at what output, rather than merely running the boiler plant on a time enabled strategy.

The electrical savings have come about as a result of the above activities (boiler pump control, comfort cooling) as well as installing lighting controls for occupancy and taking control of plant which was hitherto left running 24/7, such as air compressors and ventilation systems. Management of this uncontrolled plant has reduced the night load from 2.4 MVA to 1.6 MVA. Further savings have come from user inspired changes to the way glasshouse lights are used.

Water savings have been made by following the same principles for energy management. Reducing site leakage, improving tank maintenance (overflows) and a review of water consuming plant, such as the steam boilers have all contributed to the huge reductions in usage.

Customer awareness

Working with the site community to raise awareness of energy programmes and enlisting their help to understand the impact of their activities, as well as regularly publicising updates on progress, is an essential part of the change process and has raised awareness of the contribution they can make. This has not only added to the overall energy savings but has also extended the useful life of their equipment.

The site has established an Energy Cost Saving working group with members from all areas of the site to engage and form ideas to reduce energy consumption and thereby save cost.

Summary

Saving energy at Jealott's Hill is a continuing journey of learning, engagement and sharing. Whilst some capital has been deployed to effect some small projects, the bulk of the savings have come from managing assets, having consistent operating philosophies for plant and simplifying operations. Engaging the customers in the change programme has also been important to this success story. However, effective management of the BMS is probably the single most effective tool in achieving such energy saving results. ●

Owen Everall is the Site Engineering and Facilities Manager at Jealott's Hill International Research Centre.
e: owen.everall@sygenta.com