

A collaborative project from start to finish

Warrington and Halton Hospitals NHS Foundation Trust has just completed a project that was over two years in the planning and implementation to introduce carbon and energy-saving initiatives and upgrade other facilities and infrastructure at two of its main hospital sites. Keen to address a major priority – its maintenance backlog – it has reduced its carbon footprint, cut its energy bills, and made further reductions in its overall demand for electricity and heat, by entering into a 15-year Energy Performance Contract (EPC) with Cynergin. The company's turnkey solution – it will also maintain the equipment – involved centralising each site's heating systems with energy-efficient, dual fuel low temperature hot water (LTHW) boilers and associated distribution systems, installing a combined heat and power (CHP) unit, and fitting 'considerably more economical' high-efficiency lighting. Philip Jagger reports for *HEJ*.

The Trust needed to simultaneously address its £2 m annual energy bill, £11 m backlog maintenance – including substantial heating-related problems, and its site resilience, to ensure continuity of hospital services. It is also committed to a 30% reduction in carbon emissions by 2015. To address these issues, it entered into the energy procurement framework, the Carbon & Energy Fund, to procure an Energy Performance Contract.

Cynergin was selected as Preferred Bidder after being shortlisted following the Invitation to Tender Stage. The competitive procurement process allows companies to put forward their proposed solutions following a series of site visits and meetings with the Trust. Each bidder's solution is judged against the Trust's evaluation criteria.

Bidder selection

Richard Greaves, Cynergin's director, explained: "Cynergin's solution was compared against the other bidders. The proposals put forward had to show the initial capital spend on itemised equipment, together with calculations showing the predicted savings on gas, electricity, and water. The savings generated in an EPC contract are used to finance the project, typically over a 15-year term. With the savings proposed guaranteed by the bidder, it is essential to undertake sufficient due diligence, surveys, and calculations, to take the risk transfer. The best proposals usually incorporate many added value aspects, such as tackling the Trust's backlog maintenance, reducing demand



Warrington Hospital is a major general hospital that is home to a wide range of NHS services.

from the National Grid, reductions in maintenance costs, and improved reliability and resilience. Another notable aspect of an EPC is that over-performance is rewarded and shared with the Trust. So, for example, if a CHP system outperforms what has been guaranteed, the savings are shared."

Nature of the deal

Richard Greaves says: "The £4.65 m project is structured as a 15-year Operating Lease, with Cynergin responsible for the operation, maintenance, and performance of the plant throughout the contract's

duration. We also helped the Trust to secure a £576,000 grant from the Department of Health's Energy Efficiency Fund. The transaction was mostly off the Trust's balance sheet due to the Operating Lease structure, with the exception of measures funded via the DH capital grant. The guaranteed savings provide funds to pay for the project, with a substantial surplus for the Trust to reinvest into clinical priorities."

Impressive statistics

The project's statistics are impressive, with an upfront capital investment of around

£5 million. Cynergin has guaranteed the Trust a saving of circa £11 m from its revenue budget over the next 15 years, and tackled some £2.4 m of high-risk backlog-maintenance. In addition, the project will achieve a 55,000 tonne carbon reduction, exceeding the Trust's 30% target, and enabling it to reach a significant milestone towards its Carbon Management Plan on carbon emissions by March 2015 and NHS/Government-set targets.

Cynergin carried out a detailed audit of both main hospital sites during the tender process, spending a considerable time on the two sites reviewing documentation, undertaking site and equipment surveys, and attending technical meetings to exchange ideas with the Trust and explore its needs. The first step was to design a comprehensive programme of demand-reduction, including:

- New controls and upgraded building energy management system (BEMS).
- A lighting retrofit, with T5 high-frequency fittings and various lighting control systems.
- Water conservation measures (flow-regulators, dams, WC controls).
- Variable-speed drives on pumps and motors.
- Thermal insulation on pipes and valves.

The supply side

Only once the demand reduction measures were approved did Cynergin turn its focus to the supply side, a priority being to ensure that the heating and CHP system were not oversized, as is evident in many NHS estates.

Cynergin was confident that its proposed design would meet the Trust's



The CHP unit located externally on the Halton General Hospital site.

needs. Once the engineering solution had been agreed, detailed design and installation commenced on the sites at the end of May 2013, and achieved practical completion on 30 June 2015, with any disruption to patients and staff avoided through a collaborative approach to design and planning. An extended installation period was required because of infrastructure changes to the electrical distribution network; typically a 12-month period is needed.

The engineering solution at Warrington Hospital involved centralising the heat generation within the main boiler house, allowing decommissioning of single fuel boilers in satellite plant rooms.

The existing medium temperature hot

water (MTHW) boilers within the main boiler house had recently been replaced, and were utilised within the project; they are maintained by Cynergin. The project involved the fitting of new LTHW distribution infrastructure and energy-efficient 'smart pumps' across the hospital, the installation of which had to be carefully staged to avoid disruption to staff and patients. A CHP unit was installed in the plant room, supplying 850 kW of electricity and hot water, and meeting the seasonal demand from Spring through to autumn, with peak winter demand being met by the MTHW boilers.

The CHP unit has the benefit of substantially reducing the Trust's electricity demand from the National Grid, which had previously been a problem, due to the site exceeding its capacity.

New BEMS systems

Cynergin also supplied new building energy management systems for primary heating and hot water, and replaced a wide range of existing light fittings in clinical and non-clinical areas with over 3,700 high efficiency fluorescent lights. Water-saving measures, such as 'eco-taps' and sensors, were also included in the project.

Over in Runcorn, Halton General Hospital also benefited from a very similar package of upgrades, in which the works were carefully scheduled to run alongside those at Warrington Hospital so that both jobs could run concurrently with the same start and finish.

Challenges of working in fully operational hospitals

I visited the Warrington and Halton sites a couple of months after the installation projects were completed to find out more about how the energy savings and carbon reductions were achieved from Richard

About Warrington & Halton Hospitals NHS Foundation Trust

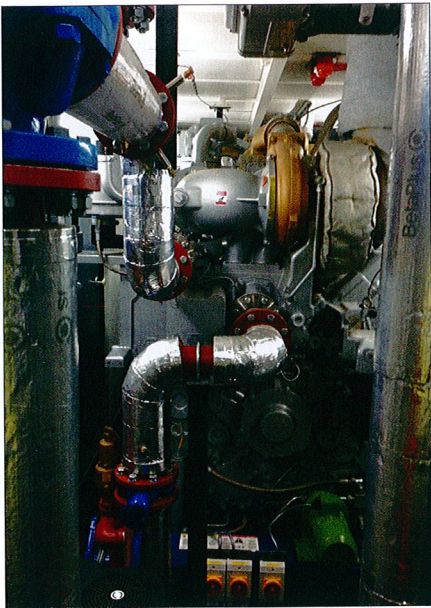
Located to the north of Warrington town centre, Warrington Hospital has around 500 beds, and employs 3,000 staff, with a designated trauma unit and accident and emergency department which sees over 100,000 patients, and a maternity unit that delivers 3,000 babies, every year.

The hospital focuses on emergency and specialist care, and has all the back-up services required to treat patients with a range of complex medical and surgical conditions. Many new departments and facilities have opened at the hospital – which provides a full range of expert inpatient and outpatient services – over the past few years.

Halton General Hospital is located to the south of Runcorn, and provides a range of care for medical and surgical conditions, with a mix of inpatient and

outpatient services. It provides around 50 inpatient beds, has over 1,000 staff, and last year carried out around 225 operations per week. Its minor injuries unit sees around 20,000 patients annually, and there are four specialist operating theatres.

The Trust has invested over £30 million in new facilities and developments across the hospitals over the last few years. At Warrington projects have included a new £1 million specialist Dementia Care ward, a £7 million intensive care unit, a re-designed labour ward, and an investment of some £2 million in redesigning the accident and emergency department. Halton General Hospital has benefited from investment in a new £500,000 endoscopy unit, and a £1 m refurbishment of its Macmillan Delamere Unit.



The CHP unit in the plant room at Warrington Hospital – exterior, and viewed from the inside, showing the generator engine.

Greaves, Cynergis director for the Warrington project. Explaining the challenges faced on each site, he said: "The sites had already had their inefficient steam systems removed some four years before this project. This created the space in the boiler house to centralise the CHP and dual fuel boilers. The challenge was to thread the distribution pipes around a very congested site while avoiding any disruption to patients and staff. More so, we had to somehow separate our works from the normal operation of the hospital. We made an early decision to prohibit any 'hot works' in the hospital buildings, and to maximise opportunities for prefabrication off-site. With careful planning and collaboration with the Trust and staff on site we managed to avoid any unplanned disruption to the clinical site activities."

CHP delivering benefits

Much had been said about the CHP engines installed under the project, and I was keen to see the plant for myself. Richard Greaves was keen to show me around the site, so, after signing in at the estates office, we began our tour of the Warrington site, where the first stop was the main plant room to see the CHP. He explained: "The CHP unit was delivered to site on a low loader, and craned into position outside the main access doors. It was then slid into position using heavy duty skids." Richard Greaves went on to say: "The CHP unit is currently supplying the majority of the hospital's electricity demand. The unit is capable of producing 850 kWe, which meets the electrical demand in all but peak hours during the day. The electricity generated is distributed around the site via a high voltage (HV) ring



main, and then stepped down to low voltage via transformers."

In order to deliver the guaranteed savings under the EPC, the CHP and boilers must meet the specified performance and availability criteria. Richard Greaves said: "The CHP must be available around 90% of the year, while the boilers provide N+1 resilience. In line with best practice within the NHS, we have sized and selected plant on an N+1 basis, and assume from a design perspective no contribution from CHP (to either thermal or electrical resilience), ensuring that there is always suitable capacity available in the event of one unit failure. However, in practice the boilers are cycled with the CHP via the new building management system, which controls their operation."

Collaborative working with the Trust

On such a complex EPC I was interested to know how relationships fared with all the differing Trust team members throughout the project. Richard Greaves responded: "We find that an open, collaborative approach from bid stage helps to found a good relationship, as we had with the Trust on this project. We had an issue with connection of the CHP units to the electricity network, and this relationship helped to find a solution that

minimised the impact to both parties. I was especially pleased to be working on this project personally, as it is my local hospital, where my children were born. It is good to be supporting an institution that plays such a vital role in the community."

Mobilisation and staging

On further inspection of the Warrington plant room, Richard Greaves pointed out the new building services elements, explaining that the new LTHW distribution pipework connects the three boilers and the new CHP unit. The hot water produced is carried by a network of pipework across the plant room and across the site. A new section of MTHW distribution pipework had to be installed across the roof of the main Appleton Wing.

I asked Richard Greaves if the project plan allowed for the installation in parallel with existing service delivery, and how disruption was avoided. "Yes," he replied, "we developed plans for each proposal, together with a scope of works and methodology document. This identified how we intended to undertake the construction while the hospital continued its existing service delivery."

He talked me through the sequencing of the works with the aid of a diagram, starting with the siting of temporary site cabins adjacent to the plant room, and

going on to discuss the installation of temporary enabling works and key access points. He said: "Edge protection had to be fitted to the roof of the Appleton Wing to protect the workers while the work was in progress, along with scissor lift, towers scaffolds, and crane, to allow access for materials to this restricted area."

New and old systems working together

I asked if any shutdowns or restricted running were required. Richard Greaves explained: "At Warrington, we needed to connect to the existing gas and oil service, MTHW system, satellite plant room heating systems, and the electrical infrastructure and the oil supply. We successfully connected to the systems without impacting upon hospital operations. With the satellite plant rooms we were able to operate the new and old systems together until everyone was satisfied and the old system could be switched off. All the work was agreed in advance, with detailed method statements produced."

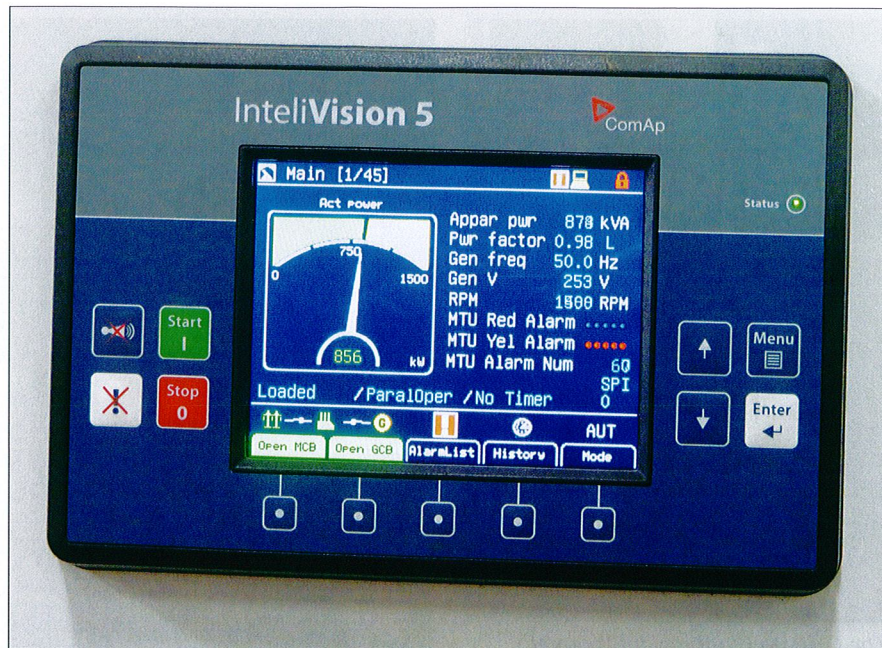
I next asked him how Cynergin would demonstrate the savings? He said: "We agreed with the Trust how we would demonstrate the savings, and these methodologies were incorporated into the contract. We then captured the data to enable the savings to be measured and calculated. Many of the energy-saving measures are directly metered, allowing direct measurement of savings. Where savings cannot be directly measured, these are agreed with the Trust and technical advisers through engineering calculations."

Reducing demand for grid electricity

One of the issues faced by the Trust at Warrington Hospital was the fact that the site was up to its capacity for electrical load from the grid. The new CHP unit now takes the hospital's base load of circa 700 kW. Richard Greaves explained: "Our strategy for electrical supply at Warrington was to provide a CHP selected for just

About Cynergin

Cynergin was founded in 2000 to provide consultancy and guaranteed project-delivery services to large organisations wishing to reduce energy consumption and carbon emissions, and to improve the operational and financial performance of their estates. Its senior directors have over 80 years' combined experience in delivering large-scale EPCs to the public and private sectors. In March 2010 Cynergin became part of the Brook Henderson Group (BHG), 'an established leader in providing performance-based service contracts to the public sector'.



The CHP control panel at Warrington, showing an output of 850 kW.

under peak site electrical load. The CHP installed displaces the majority of imported electricity, reducing the Trust's financial exposure to market fluctuations. It operates 24 hours a day throughout the year. We set up a connection agreement for some export to the grid, allowing the CHP to operate at 100% load all the time – which is its most efficient state – and provide some export revenue. The CHP generates at 415 V, stepping up to HV (11kV) through a new transformer, and connecting to the existing HV ring main which goes around the site by adding to existing switchgear or introducing a new ring main unit. This allows unfettered distribution around the site buildings, and optimal displacement of grid electricity."

Lighting replacement

Cynergin's project also involved replacing ~3,700 light fittings across both sites with new high efficiency fluorescent lights in clinical and non-clinical areas. This amounted to about 10% of the capital cost, and saves around 100 kW in electricity, which is guaranteed by Cynergin under the EPC agreement. Richard Greaves pointed out: "Most of the work we do is behind the scenes, and is never seen by the public, who are mostly unaware of the impact on long-term reliability and comfort in the hospital. However the lighting works make a noticeable difference to the look of the internal spaces, making them brighter and more welcoming, significantly improving the patient and visitor experience."

Key benefits to The Trust

Among the key benefits of the project to the Trust are:

- Energy savings guaranteed by Cynergin.
- £2.4 m in backlog maintenance (absorbed into the project cost) tackled.

- 3,610 tonnes of CO₂ saved per annum – a 36% reduction (exceeding the Trust's 30% target).

Nick Ray, Cynergin's MD, added: "The Trust is getting substantial benefit from a completely new, more efficient, reliable, and flexible primary heating system, and making savings at the same time. Cynergin takes the full risk in delivering the financial and carbon savings."

The Trust's perspective

The Trust's operational estates manager, Darren Wardley, said of the project: "Connecting the CHP and boilers to the existing infrastructure within the Trust sites was a real challenge, and working together with Cynergin meant we were able to keep any downtime to a minimum, and have very little impact on patient services and the Trust's operations. The new plant will be maintained by Cynergin, and a close working relationship has been formed with the company so that planned and reactive maintenance is completed appropriately and in a timely manner."

Ron Patterson, the Trust's capital projects manager, said: "The nature of the CHP and lighting installation works involved significant potential disruption to patient services; hence close collaboration between the Trust, Cynergin, and its sub-contractors, was essential. I am pleased to say that Cynergin and its sub-contractors had a positive approach to health and safety, and worked in partnership with the Trust to risk assess and produce method statements for all aspects of the works."

This partnership approach ensured that any problems were identified and addressed at an early stage without any negative impact upon the contract programme, thereby ensuring that the project objectives were not compromised." +