SAV-i Making Central Plant Systems work

Low Carbon Energy Solutions for Building Services Issue 37

Solutions that reduce carbon emissions and energy costs also have the potential to address fuel poverty in social housing.

Tackling fuel poverty with CHP efficiency

Combined Heat and Power (CHP) has the potential to significantly reduce energy consumption, carbon emissions and costs. However, many conventional CHP installations fail to deliver the promised benefits because they lack the flexibility to adapt to changing power and heating loads.

In fact, it is not uncommon for conventional CHP units to be switched off for long periods of time because relatively low site loads mean it is not financially viable to run the CHP.

In addition, traditional CHP frequently delivers variable hot water flow temperatures (as they operate with constant temperature differential ΔT), with inconsistent performance.

With reference to the West Bridge Mill residential project in Kirkcaldy, this newsletter explains how load-tracking, modular CHP is able to modulate to track and match site electrical demand AND maintain a constant flow temperature – making it ideal for multi-residential projects in both the public and private sectors.

Lars Fabricius, Managing Director at SAV Systems

*Data from Consumer Focus

LoadTracker Combined Heat and Power Unit

FACT: Currently around *6 million homes in the UK are in fuel poverty.

FACT: Over *9 million UK homes are expected to be in fuel poverty by 2016.

FACT: Modulating combined heat and power (CHP) will deliver affordable hot water and electricity for multi-residential accommodation.

FACT: CHP and district heating are not confined to new developments, retrofitting to existing multi-residential accommodation is straightforward with a fast return on investment.

Tackling fuel poverty at West Bridge Mill

West Bridge Mill Development, Kirkcaldy.

West Bridge Mill in Kirkcaldy is a multi-residential development by Link Group Housing Association which involved refurbishment of a former B-listed rope mill. It comprises 16 separate flats housing vulnerable young people as well as several office units used by family service charities.

Through the use of CHP and district heating it has reduced carbon emissions by around 70%, compared to the previous heating and hot water system.

Electrical power and hot water for space heating and domestic services are generated by an SAV LoadTracker CHP unit. Heating and domestic hot water in each apartment are managed through Danfoss FlatStation heat interface units (HIUs).

The CHP has been operational since July 2010. Performance data can be read on site and is also monitored by SAV Systems online. Each FlatStation HIU is fitted with an integral energy meter to help monitor energy consumption.

Background

West Bridge Mill was built in 1855 and used as a rope mill until it fell into disuse in the 1980s. It was purchased in 1996 by Link Group and put back into use as supported social housing for vulnerable young people as well as for use by Barnardo's, Fife Disability Network and a number of family services and voluntary organisations.

Until May 2010 the 16 social housing flats were heated by electric storage heaters with hot water from immersion heaters, while the office units were heated with gas-fired boilers. In the flats the combination of inefficient heating and rising energy prices exacerbated problems of fuel poverty while failing to deliver adequate heating.

It was clear the measures needed to be taken to improve comfort levels while reducing energy consumption, while remaining sensitive to the listed status of the building. However, the heavy sandstone construction and vaulted ceilings limited the options for improving the thermal performance of the building envelope.

The solution proposed by James Culbertson of consulting engineers The Keenan Consultancy was to install CHP in a central energy centre linked to a heating system serving the apartments and offices – operating like a small district heating system.

"CHP displaces grid electricity and replaces it with gas, which is about a third more carbon efficient," James Culbertson explained. "In the case of West Bridge Mill, installing CHP was also more cost-efficient than extensive renovation of the building fabric so there are commercial benefits in addition to the sustainability benefits.

"A major challenge with residential applications is that electrical demand fluctuates rapidly and conventional CHP configured to track heat demand is unable to address this efficiently. In contrast, the SAV LoadTracker tracks the electricity demand, responding instantly to variations in demand. The result is that the CHP runs for longer periods, minimising the use of expensive mains electricity," he added.

With financial assistance from the Scottish Fuel Poverty Fund, the project went ahead. Two thermal storage vessels were removed from the plant room and replaced with the CHP unit and plate heat exchangers. Danfoss FlatStation HIUs were installed in the apartments.

Since July 2010 the CHP has run for 20,507 hours and produced 224,609 kWh of electricity and 487,839 kWh of heat, with average electrical power generation of 10.9kW. It has met 67% of the site's electrical demand during this time.

Fully insulated 5 Series DS Danfoss FlatStation

Spectacular results

Under the old heating system, based on SAP assessments undertaken as part of the project design, West Bridge Mill was consuming a total of 189.7 MWh of electricity and around 370 MWh of gas per annum, emitting as much as 50.45 kg CO_2/m^2/yr. In a practical sense it was difficult to maintain a nominal indoor temperature of 18 to 21°C and the cumulative heating bill was averaging above £32,000 per year.

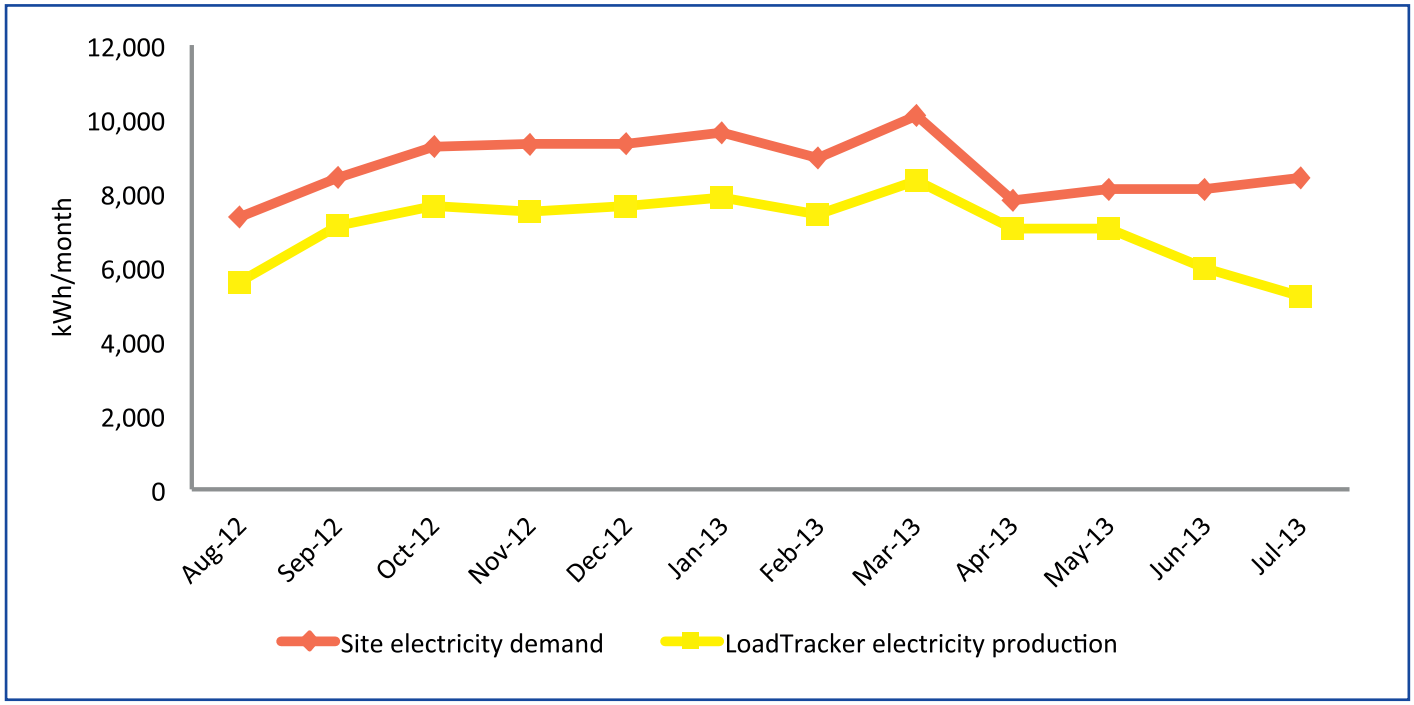
The new CHP system is calculated to save 123.53 tonnes of CO_2 per annum (circa 70%), whilst first year energy bills showed an annual reduction in energy costs of £10,303.73 (around 30%).

In addition to the CHP, additional measures by Link Group to combat fuel poverty included low energy lighting and supplementary loft insulation. Furthermore staff have undertaken City and Guild courses in Energy Awareness with training disseminated to residents.

Efficient control of hot water

Another challenge for the design team was to ensure effective control of domestic hot water (DHW) in the apartments. Many heat interface units lack effective control of hot water temperature, resulting in temperature variation by as much as +/- 15°C. To avoid this unacceptable situation The Keenan Consultancy specified Danfoss FlatStation heat interface units, which incorporate pressure and temperature control valves to ensure correct DHW and heating control.

The result is that DHW temperature is controlled to within +/- 2°C. Also, an integral idle temperature controller in the control valve will ensure that water in the supply pipe remains warm. This enables the DHW to be highly responsive – even at times when space heating loads are low.



LoadTracker CHPs monitor site electrical load and modulates CHP electrical output to minimize high carbon grid electricity import.

Rising to the challenge

At the risk of stating the obvious, the main challenge with CHP is that when it's running it is generating both heat and electrical power – you can't have one without the other.

Therefore the key to making CHP sufficiently flexible to cater for a wider range of projects is to ensure it manages both of these efficiently.

Tackling variable site loads

The inherent inflexibility of conventional fixed-output, non-modulating CHP often results in the CHP being turned off for long periods of time, so that the potential benefits of this technology are not realised.

For example, if West Bridge Mill had used a fixed-output 15kW CHP unit, the CHP would have been switched off when demand was less than 15kW. The modulating functionality of the LoadTracker 15kW CHP unit ensures that the CHP runs even when loads are as low as 6kWe.

Tackling variable temperature differentials

Traditional CHP operates with a constant temperature differential, resulting in variable flow temperature and inconsistent performance of the system.

SAV LoadTracker incorporates a patented heat distributor that maintains a constant flow temperature, irrespective of the return water temperature. As a result, LoadTracker always produces high grade heat that can be used on site without 'topping up' from boilers. In fact, as long as the heat loads are within the CHP's capacity, there will be no need to use the boilers.

Modular flexibility

Traditional CHP is not suitable for many smaller projects, but the heating and hot water demands of these projects means they would benefit from CHP. Or, in larger projects, the fixed outputs of traditional CHP need to be carefully matched to the anticipated electricity and heating base loads – thus imposing constraints on the contribution of the CHP to the building's operation.

The modular design of LoadTracker CHP enables multiple units (just like modular boilers) to be used to suit the requirements of many small and large projects. Up to five units can be combined to provide a range from 15kWe/30kWth to 100kWe/200kWth.

Awards recognition for West Bridge Mill

- Finalist, Time-Proven M&E Installation, H&V News Awards 2013
- Finalist, Excellence in Environmental Sustainability Design, Chartered Institute of Housing Awards 2011
- Joint runner up in the Energy Action Scotland Energy Savers Award 2010
- Finalist, Low Energy Social Housing Project of the Year, Sustainable Housing Awards 2010

Useful links

www.sav-systems.com

www.linkhousing.org.uk

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