Energy and Water Efficiency

WINNER

Low Carbon and High Efficiency at the University of Southampton

The University's £3.2 million scheme for a combined heat and power (CHP) plant, and associated upgrading and extension of the existing district heating scheme, has many distinctive features. The selected option - two Jenbacher units supplied and installed by Clarke Energy - had a 16% higher capital cost than the cheapest. However, its exceptionally high efficiency - 76% of the energy in the gas it burnt was converted to useful electricity and heat in its first year - meant that its whole life costs were considerably lower than alternatives. This high efficiency results from:

- A very sophisticated control system, which allows the engines to be run with very lean fuel/air mixes without encountering the usual problems of 'engine knock'
- A design based on using natural gas as fuel (rather than, as is more commonly the case, by modifying engines designed to run on oil)
- Use of condensing economisers - these capture an additional 326kW (enough to heat several large office buildings) from the latent energy in the exhaust steam.

To achieve maximum utilisation of the CHP plant, two existing campus district schemes were merged, and other buildings were linked and had their old local boilers retired. One of these is the new Entrance, Education and Engineering Building, which contains a 600kW absorption chiller. This utilises the hot water from the CHP plant (which is otherwise wasted in summer) to provide cooling by generating cold water for circulation through chilled ceilings in the offices, and through a displacement ventilation system in the main lecture theatre.

Mark Turner (right) and visitors admire the CHP engine

Low return temperatures (generally important in maximising CHP efficiency, and especially so when condensing economisers are employed) have been engineered through improved heat exchangers; replacement of existing domestic hot water storage calorifiers with direct provision using plate heat exchangers (thereby eliminating the substantial standing losses associated with hot water storage); and the installation of 'two port' fully variable flow controls. The latter allows the main distribution pumps to be inverter driven - creating large energy savings, particularly at times of low demand.

The scheme also contributes to learning and research. In 2006-7 24 Civil and Environmental Engineering students worked with the Estates Team on CHP-related projects, including a feasibility study of using alternative, carbon neutral, fuels.

According to Mark Turner, the University's Energy Manager, "the scheme is already saving £200,000 a year on heat and electricity costs, and this is set to increase as a result of the summer cooling from the absorption chiller and the addition of a major new building. But the most important thing from my perspective is the reduction in CO_2 emissions of over 2000 tonnes a year compared to the systems that it replaced."

Judges' Comments on Energy Efficiency

There is much scope to reduce energy consumption in universities and colleges, and new incentives to do so in the form of high energy prices, and the need to reduce carbon emissions.

One important means of doing this is through on-site CHP plants, which use the waste energy resulting from electricity generation for heating purposes. Many institutions already have CHP but the University of Southampton's scheme stands out for its whole-life approach and benefits, and the innovativeness of its technology. The developer's willingness to accept higher capital costs for greater efficiency and additional fuel and financial savings is impressive. So too is the systematic planning, and the solid and innovative engineering of its design and implementation. The result is a 'state of the art' installation which is a model for future schemes in the sector.