Decentralised Energy innovation at the University of Edinburgh

Three Combined Heat & Power (CHP) systems at the University of Edinburgh have substantially reduced carbon dioxide (CO_2) emissions and will help keep energy bills under control for years to come. They represent a sound energy strategy for the future of this 423 year old institution.

With over 25,000 students and more than 250 main buildings, the University is now faced with an annual utilities bill of over £8M. David Somervell, the University's Energy and Sustainability Manager, reports that up to 2003 energy costs had been cut by over 5% in real terms since 1990. The recent rapid rise in global energy costs threatens this achievement.

The University is committed to reduce absolute CO_2 emissions by 40% by 2010, based on 1990 levels and to invest 5-10% of annual utilities spend on energy efficiency improvements. A high proportion of this has been achieved through a £12m investment in three large CHP schemes implemented with significant grant support from the Energy Saving Trust's Community Energy programme.

The first scheme was installed in 2003 at Pollock Halls of Residence. The high domestic hot water demand at Pollock Halls balances the CHP engine's 526kW electrical output, and the existing boilers are hardly used for six months of the year.

In 2004 a 2.7MW electrical output / 2.8MW thermal engine was installed at the King's Buildings. This scheme replaced an old steam system and, along with two 7.5MW boilers, serves the high base load of the research-led College of Science & Engineering.

The third scheme was installed at George Square – formerly a gas fired steam heated system with over 30% heat loss from steam pipework and boilers with associated high maintenance and staff costs. The new low temperature distribution system has reduced pipework losses to less than 6% and the University is saving £500,000 at current prices.

At the core of the George Square energy centre is a 12 cylinder 1.6 MWe GE Jenbacher CHP gas fired engine. Due to the engine design the system produces almost as much electricity as heat (1.7MW thermal) which means the engines run longer in summer. When less heat is required in summer the 95°C primary flow is diverted to a 600kW absorption chiller serving laboratories and specialist equipment requiring cooling. Often refereed to as Trigenration because it produces heat, power and cooling, this approach is now becoming an increasingly popular way of meeting energy needs on large site with significant cooling loads.

The requirement for cooling presents an additional heat load in summer that keeps the CHP running and generating electricity. When there is low site demand for heat it is fed to a massive 75 m3 thermal store. This buffer store acts as the "lead boiler" for morning heating demand. The CHP is around 86% efficient and is very close to this even when the machine is running at half load.

The George Square Energy Centre is the first phase of a planned upgrade to the buildings including the south and east sides of George Square – all built in the 1960s with underfloor electric heating. Over time, the carbon saving and financial benefits of the CHP system will become greater as energy costs rise and more buildings are connected to the district heating and cooling system. Overall carbon savings of 1,254 tonnes/yr are expected from this new system with an estimated financial payback within 7 years.

Hayden Rees of Clarke Energy, who supplied the Jenbacher engines for the Edinburgh projects says "the mix of different building heating and hot water loads along with the summer cooling requirement form a good base load for the engine. This gives good overall heat utilisation and high CHP efficiency."

More at www.eso.ed.ac.uk

1.6MWe Jenbacher CHP plant

600kW absorption chiller