Balanced Energy Networks provide innovative clean heating without combustion

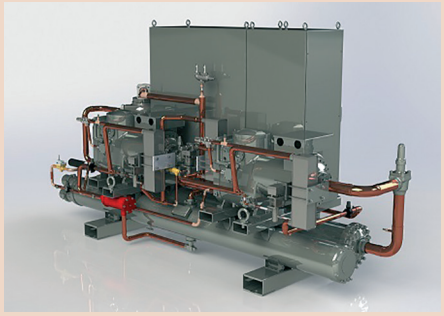
by EDWARD THOMPSON, *director of the Ground Source Heat Pump Association*

A RETROFIT district heating system has recently been installed in the heart of London South Bank University (LSBU) by the Balanced Energy Networks (BEN) consortium.

The BEN project, which is part-funded by Innovate UK, incorporates a number of innovations which highlight the route towards clean heating. That in turn addresses the stated objectives of the Department of Business, Energy and Industrial Strategy (BEIS) in its recent *Clean Growth Strategy* and DEFRA's objectives in its *Clean Air Strategy consultation*.

BEIS believes in district heating as a route to reducing carbon emissions. However, there are formidable obstacles in the way of establishing district heating systems based on combined heat and power (CHP): the enormous cost of establishing and administering a central energy centre, the cost and disruption of installing heavily insulated pipework in the ground, and the legal barriers to signing up tenants for very long-term contracts.

In the case of London South Bank University there was no free space that could have been allocated to installing a central CHP-based energy centre.



A high-temperature heat pump has been installed in each building on the network

There are also increasing concerns about the idea of installing combustion-based engines in the centre of London, which is already breaching air pollution limits. Plus, there is the realisation that, with the rapid decarbonisation of the grid, combined heat and power based on combustion is no longer a valid route to reducing CO_2 emissions.

An alternative approach has been designed and delivered based on an ambient ground temperature: known as the Heat Sharing Network. The network draws water from the London Chalk Aquifer, 112m below the ground. It circulates the water via the plant room of each building on the network, and returns the water to the aquifer via another discharge borehole.

A high-temperature heat pump has been installed in each building on the network in its plant room. The pump extracts heat from the water in the network and transfers it to the existing heat distribution system in each building.

Low diameter plastic pipes have been mounted on the walls of existing buildings to avoid the cost of digging up the roads

This form of heat transfer avoids the use of combustion completely. There are therefore no emissions of CO_2 on site, which answers the Clean Growth Strategy comprehensively. There are also no emissions of NO_x, SO_x or particulates, which also totally answers the Clean Air Strategy.

As well as avoiding CO_2 emissions and air pollution issues, the BEN installation at LSBU has avoided the cost of digging up the roads within the university to install a heavily-insulated metal pipe network. Instead, low diameter plastic pipes have been mounted on the walls of existing buildings to transfer water from the aquifer via plant rooms in each building and back to the aquifer.

The cost and disruption of refurbishing the heat distribution mechanisms in each building have also been avoided, by retaining the existing heat emission systems and using specifically designed high-temperature heat pumps – which can deliver water at up to 82°C when required. That was key to installing the new network into a busy site without the buildings suffering any downtime. The existing gas boilers have been retained on site as a back-up.

In addition to the innovations detailed above, the heat pumps employ 'demand-side response' (DSR). They are linked to the electricity supply companies via a DSR aggregator, which permits them to take advantage of cheaper electricity when this is offered by the grid – and to avoid the use of expensive electricity in peak hours.

The BEN consortium has also designed and installed heavily-insulated thermal energy storage tanks for hot water, which provides additional flexibility and capacity to take advantage of DSR, both for heating and for domestic hot water.

The consortium comprised: London South Bank University; ICAX, who provided the design and project management; Upside Energy, who worked with ICAX to enable DSR for heat pumps and heat storage; Mixergy, who designed and provided thermal energy storage tanks; TFGI, who drilled the boreholes to the London Aquifer; Origen Power and Cranfield University, who have designed and constructed a fuel cell calciner demonstrator, which generates electricity in a combustion-free process that removes CO_2 from the atmosphere.

The result is a network which balances the temperature in the buildings against the thermal mass of the London Aquifer. The BEN is capable of transferring heat into the buildings in winter and out of the buildings to the aquifer in summer. The timing of electricity consumption from the grid is balanced against the fluctuating diurnal demand and supply for electricity, as signalled by demand-side management in real time.

A BEN also provides a mechanism for balancing the budgets of its owners, as it is radically cheaper to install than a CHP-based network and also cheaper – and cleaner – to run than a gas-based network for heating and a chiller-based system for cooling.

The BEN consortium has demonstrated that the future of clean heating that the government has been striving for can be achieved now using ground source heat pumps. The horns of the 'Energy Trilemma' have been blunted. ❑

• Many more details on the project are available at www.BENuk.net