LOW CARBON SOLUTIONS FOR COMMUNAL HEATING SYSTEMS

The Code for Sustainable Homes (CSH) is applying increasing pressure to developers, architects, building services engineers, installers and equipment suppliers to deliver new build residential properties that have a low carbon footprint. The latter is achieved through a combination of building fabric, improved air tightness and the adoption of low and zero carbon (LZC) technologies. Here Yan Evans, Technical Director of Andrews Water Heaters and Potterton Commercial, explains how the use of commercial boilers and mini-Combined Heat & Power (CHP) can be harmonised to deliver low carbon heating and hot water solutions.

Code for Sustainable Homes Level 3 requires the carbon emissions of a residential property to be at least 25% below the levels required as per 2006 Building Regulations. This 25% reduction is referred to as the Target Emission Rate (TER). Code Level 3 has been a mandatory requirement in residential buildings since 2008. In some cases property developers are considering centralised communal heating systems in blocks of flats as the method of providing heating and hot water to the dwellings, and supporting the achievement of the TER. There are a number of other benefits this offers including alleviating the need for gas into each property and the need for access to the dwelling to carry out the annual legal landlord appliance inspection to name but two.

Locally in the dwelling heat interface units are being used to distribute the heat generated from the centrally located boiler plant through the dwelling using a pump or balancing valves. Hot water can be generated locally within the dwelling through the use of a plate heat exchanger for modest hot water loads and indirect cylinders for large demands. The primary source of energy for either method of hot water generation is the central boiler plant. In the case of a plate heat exchanger these are usually located within the heat interface unit, which should not occupy any more space than a traditional domestic combination boiler.

Between the commercial boilers in the central plant room and the heat interface units there should be some form of buffer tank. The capacity of this vessel should be selected on the basis of the peak domestic hot water load, e.g. shower load of around 9 litres/min (6 litres/min of hot water) for a period of, say, 5 minutes, and an allowance for dwelling space heating occurring concurrently. This allows for the lower capacity of boiler plant to be installed as the buffer tank stores water at the same temperature as the flow temperature from the boilers (80^{O}C).

It is with the inclusion of the buffer tank where the complication can arise with regard to the integration of low and zero (LZC) technologies. In the scenario outlined, domestic hot water is being generated locally within the dwelling with the cold water inlet supplied direct into the heat interface unit on the secondary side of the circuit. The heat source is the primary circuit from the communal heating system which is typically at 80^{O}C and 60^{O}C flow and return temperatures respectively. These temperatures are required to generate hot water at around say 50^{O}C to 55^{O}C on the exit of the plate heat exchanger mounted within the heat interface unit.

The buffer tank operating temperatures are the same as those of the primary heating circuit i.e. 80^{O}C flow and 60^{O}C temperature. The latter is the minimum return temperature when heating and hot water is at peak demand. It will be higher than this during lower load periods. This presents an issue for solar thermal solutions and for heat pumps. In the case of a solar thermal solution the operating temperatures are such that even during periods of peak available solar irradiation, it will contribute a minimal amount of renewable energy and therefore offer little contribution in reducing carbon emissions. Heat pumps deliver the best performance on low grade heating circuits such as under-floor heating where flow and return temperatures are typically 35^{O}C and 25^{O}C respectively. At these temperatures an impressive Coefficient of Performance can be achieved in the region of range of 3.0 to 4.0, depending on the appliance chosen.

However with the higher operating temperatures of the buffer tank, the COP of the heat pump, whether this be a ground source or air source heat pump, could be significantly compromised.

If we consider small-scale Combined Heat & Power (CHP) units such as the Baxi-Senertec DACHS, then these low carbon products operate at similar heating circuit temperatures as conventional systems. For example the flow temperature from the DACHS is around $83^{O}C$ and the unit can tolerate return temperatures of up to $70^{O}C$.

CHP units are selected on the basis of the base thermal load in order to maximise the annual running hours. The operating regime is typically 17 hours a day, 365 days of the year accumulating around 5,000 to 6,000 hours. Heat required above the output of the CHP unit is provided by the commercial boilers. As such the CHP unit would act as the lead heating appliance with both the CHP unit and boilers feeding into the buffer tank, which in turn feeds heat in the dwellings via the interface units for heating and hot water. The buffer also prevents the CHP engine cycling on and off during periods of low thermal demand.

In addition to the heat output of the CHP unit which displaces boiler fuel, it also generates electricity. The DACHS generates 5.5kWe of 3-phase electricity and operates in parallel with the grid under Engineering Recommendation G.83/1. As with the thermal output, the CHP unit should be selected on the basis of the base electrical load to minimise the exporting of spilling of electricity to the national grid. Electricity required above the output of the CHP unit is simply imported from the grid through the main incoming supply to the site in the usual manner.

Displacing grid supply electricity and a degree of boiler fuel (CHP heat output/boiler efficiency) can offer significant energy cost savings depending on the tariff structure. It also offers significant environmental benefits largely attributable to the fact that the CHP unit is displacing grid supplied electricity with an emission factor of around 0.58 $kgCO_2/kWh$. With a DACHS unit operating for around 5,600 hours a year the reduction in carbon emissions would be around 5 tonnes per annum. This would contribute significantly towards the achievement of CSH Level 3.

The common message that comes up time and time again, whatever the technology, is that the selection of the appropriate LZC solution has to be application driven.
The temperatures of the hydronic circuit play a huge part in the technology selection. Having a deep understanding of these technologies, their benefits and their limitations, and how they can be applied can lead to commercial heating solutions that offer significant benefits in reducing carbon emissions. \ENDS

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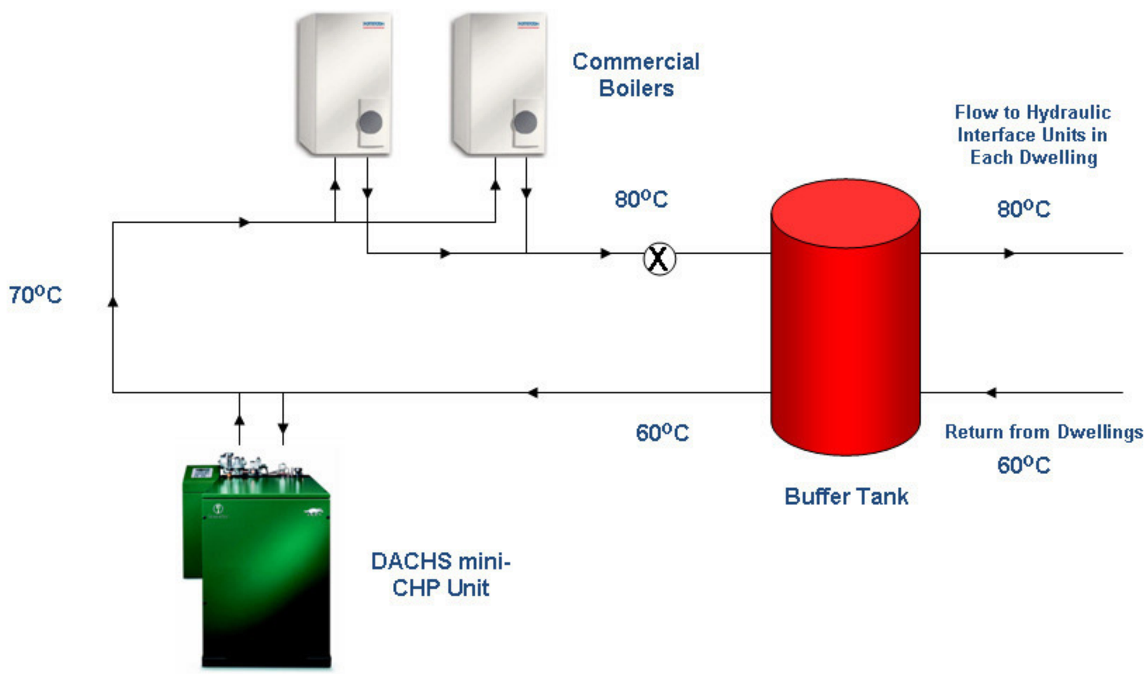

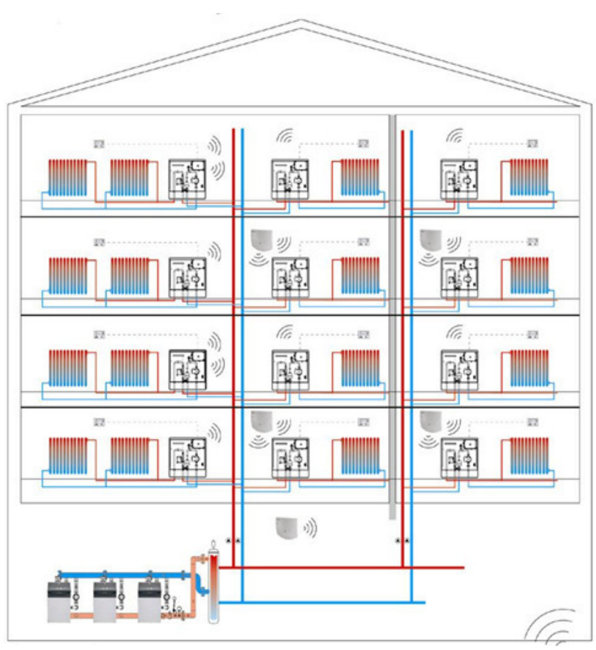

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