

The Role of 5th Generation District Heating (5DH) in UK's Path to Net Zero

What is 5th Generation District Heating (5DH) and how can it help the UK decarbonise the heating sector?

5th generation district heating (5DH) systems make use of very low temperature water between 10 °C and 40 °C to provide both heating and cooling. This is enabled by using heat pumps either to extract heat from or to reject heat into the network.

The benefits of such a system are in the flexibility, low cost and low carbon nature of the heat produced (or removed). A single heat pump connected to an ambient network is capable of extracting or rejecting heat as required. It is also capable of achieving a high coefficient of performance (CoP) in the process due to the low temperature of the water.

There is potential in using multi-use systems (for example, residential heat requirements and data centre heat rejection) to achieve a balance between usage. However, shortfalls can be addressed by a top-up from a central ambient resource, such as lakes or groundwater. A rough metric in deciding whether a 5th generation network will be appropriate is that more than 40% of the load must be cooling.

The use of heat pumps with a high CoP is intrinsically low carbon as the UK grid continues to decarbonise. This is also further supported with the storage of heat during periods of high renewable production by using thermal stores.

A potential concern with 5th generation heat networks is the requirement for individual heat pumps and the storage of domestic hot water (DHW) within each dwelling of a residential scheme. This can lead to a high capital cost. Furthermore, requirements to meet Legionella guidance are such that a choice must be made between either compromising the CoP of the residential heat pumps or installing direct electric immersion heaters. Both options are accompanied by an increase in the cost of heat to the resident.

A promising way to avoid this issue is by marrying 4th and 5th generation district heat networks. This involves implementing a 5th generation ambient loop with 4th generation networks, thereby using heat pumps in central plant rooms to extract heat from the ambient loop. This enables the use of individual Heat Interface Units (HIUs) within dwellings to produce instantaneous DHW, thereby removing the requirements associated with Legionella guidance, and enabling a reduction in outlet temperatures.

This combination will enable existing 4th generation communal heat networks to connect to 5th generation district heat networks as and when they become available, thereby providing a reliable path to a net zero future.

The addition of the tried and tested delivery systems associated with 4th generation heat networks is expected to achieve an overall reduction in utility costs to residents. It is also expected to achieve a reduction in capital costs and maintenance requirements for operators. These achievements are expected to occur while maintaining the flexibility and carbon reductions associated with the connecting 5th generation system.

Ryan Harris and Tom Burton, FairHeat, July 2020

Key Points to Consider

- 5th generation networks struggle with the production of DHW to adequate temperatures.
- DHW storage and top-up requirements have a significant impact on the cost of heat.
- Implementation of known 4th generation technology can reduce capital and operating costs.
- Existing 4th generation networks have the potential to connect to new 5th generation networks.
- The combination of technologies provides a clear route to decarbonising UK heating.

Links

- The YEPG webinar on the role of 5DH in the UK's path to net zero is available at: https://youtu.be/s0IFb9E_x7s
- An example of an existing 5th generation network implementing a balance of heating and cooling is available at: <https://www.theguardian.com/sustainable-business/geothermal-heat-pump-london-shopping-centre>
- An example of a large residential 5th generation system is available at: <https://www.kensacontracting.com/englands-largest-district-ground-source-system-breaks-new-ground/>

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