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Harvesting Energy from Buried Infrastructure: current UKCRIC research

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The UK Government has a commitment to reach net-zero emissions by 2050. Because 70% of heating comes from direct burning of natural gas, this target cannot be achieved without decarbonising the gas network. One of the best routes to decarbonise heating is through use of ground thermal energy storage coupled with ground source heat pump systems. However, heat pump systems retain high investments costs, mainly due to the expense of drilling dedicated ground heat exchangers (GHE) such as deep boreholes. One route to reducing these costs is to use buried infrastructure for simultaneous structural function and ground heat exchange. In the past deep foundations, embedded retaining walls and trial tunnels have all been used as GHE. However, there is increasing interest in extending this approach to other shallow buried infrastructure, such as waste and drinking water distribution networks, and green infrastructure such as sustainable urban drainage and swales.

The UK Collabatorium for Research in Infrastructure and Cities (UKCRIC) is a consortium founded by thirteen universities to provide an integrated research capability with a mission to underpin the renewal, sustainment and improvement of infrastructure and cities in the UK and elsewhere. Under the auspices of UKCRIC, a pump priming project called PLEXUS has been carried out. One of the research challenges of PLEXUS has been to consider how much heating and cooling capacity can be obtained from using civil engineering infrastructure as GHE, and whether there are any risks to original structural function from the GHE operation. The project has included trial experiments for (i) soil element thermo-mechanical and thermo-hydraulic behaviour, (ii) the operation of sustainable urban drainage under heat injection, (iii) heat transfer characteristics of a near full scale water pipe segment, (iv) effects of temperature change on the formation of fats, oils and greases in waste water treatment systems. This paper will present a summary of key findings from the project and identify challenges for implementation of this valuable thermal resource.