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An assessment of climate change impacts on micro-hydropower energy recovery in water supply networks

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Continuity of service of a high quality water supply is vital in sustaining economic and social development. However, water supply and wastewater treatment are highly energy intensive processes and the overall cost of water provision is rising rapidly due to increased energy costs, higher capital investment requirements, and more stringent regulatory compliance in terms of both national and EU legislation. Under the EU Directive 2009/28/EC, both Ireland and the UK are required to have 16% and 15% respectively of their electricity generated by renewable sources by 2020. The projected impacts of climate change, population growth and urbanisation will place additional pressures on resources, further increasing future water demand which in turn will lead to higher energy consumption. Therefore, there is a need to achieve greater efficiencies across the water industry.

The implementation of micro-hydropower turbines within the water supply network has shown considerable viability for energy recovery. This is achieved by harnessing energy at points of high flow or pressure along the network which can then be utilised on site or alternatively sold to the national grid. Micro-hydropower can provide greater energy security for utilities together with a reduction in greenhouse gas emissions. However, potential climate change impacts on water resources in the medium-to-long term currently act as a key barrier to industry confidence as changes in flow and pressure within the network can significantly alter the available energy for recovery.

The present study aims to address these uncertainties and quantify the regional and local impacts of climate change on the viability of energy recovery across water infrastructure in Ireland and the UK. Specifically, the research focuses on assessing the potential future effects of climate change on flow rates at multiple pressure reducing valve sites along the water supply network and also in terms of flow at a number of wastewater treatment works. This analysis is achieved through development of an empirical model utilising historical climatic data in conjunction with low, medium and high emission IPCC climate scenarios using the HADCM3 global climate model across a baseline condition and two further time steps. Results highlight projected alterations in flow rates together with the potential for increases in the frequency and persistence of drought/flooding events and the resulting impacts on future energy recovery. Critical climate change limits are also identified indicating the tolerable ranges within which hydropower recovery is financially viable, thus allowing for more informed decision making across potential sites.