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# A Theoretical Benchmark for Bypass Controllers in a Residential District Heating Network

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## Abstract

Bypass valves in district heating substations are a compromise between efficiency and quality of service. On the one hand, they are required to ensure that each building (no matter the distance to the heat source) has warm water within an acceptable time. On the other hand, they form a short-circuit between the warm supply and cold return line and their use can increase the return temperature substantially. Therefore, a good control of these bypass valves is critical to limit the drawback of their use. In this context, this paper compares two commonly used control strategies (manual control and thermostat control) to a new theoretical benchmark that provides an upper boundary for the performance of bypass controllers. This theoretical benchmark ensures a just-in-time delivery of warm water by taking into account time delays in the network. In a simulation case study of a small neighbourhood in Genk, Belgium, the benchmark shows that substantial improvement regarding bypass control is possible.

*Keywords:* District Heating, Thermal Networks, Control, Time delays, Bypass Valves

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