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On the benefits of demand side management in Water Supply System

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ABSTRACT

Traditionally, water supply and power systems have been designed and operated, in general, as two uncoupled systems. However, these systems are intrinsically linked through a co-dependent and complex relation of mutual exchange of resources often referred to as the Water-Energy Nexus [1][2]. On the one hand, water supply systems (WSS) can contribute to a more decarbonized power sector by improving power system operations and enhancing grid stability. These can also act as a cost-effective balancing resource for coping with intermittent renewable energy sources (RES), thus reducing GHG emissions from the power sector. On the other hand, the energy transition based on smart grids brought opportunities for water utilities to reduce their energy costs by implementing demand response (DR) programs through dynamic energy pricing and load management strategies [3]. Being a highly energy-intensive consumer and having some degree of demand flexibility due to storage elements such as water tanks, WSS become excellent candidates to implement demand side management such as DR [4][5]. Water can be pumped and stored in less critical periods for the power system, such as when energy is cheaper or there is plenty of local renewable energy generation. However, the operation and management complexity of WSS increases with the available resources to control. A major challenge is to find operation strategies that can reduce energy costs in WSS while satisfying the consumers' demand in terms of water flow and pressure. Therefore, the use of optimization approaches to plan WSS pumping operation is paramount given the complexity of operational constraints, available resources and water quantity and quality requirements. Optimizing the water pumping schedule in the context of DR events or using available energy provided from RES can reduce energy costs in WSS. This work aims to explore the benefits to the daily operation of WSS by promoting an optimized integrated resources management, encompassing the application of DR events and local RES in pumping schedule. Using a benchmark network and some hypothetical scenarios for DR events and local renewable generation, these benefits are evaluated in terms of WSS energy costs reduction. This work aims to demonstrate the impact of external resources in WSS operational management and its financial benefits for water utilities.

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