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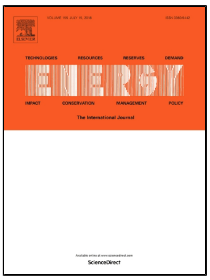

Multi-criteria analysis of storages integration and operation solutions into the district heating network of Aarhus – a Simulation Case Study

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Multi-criteria analysis of storages integration and operation solutions into the district heating network of Aarhus – a Simulation Case Study

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ABSTRACT

This paper assesses possibilities of integration of centralised and decentralised storages in the district heating network (DHN) of Aarhus, Denmark and their operation strategy, with the objective to smooth the heat demand during peak hours (Peak-based strategy) or to reduce the operational costs of the DHN (Price-based strategy). The analysis is carried out using a dynamic plant scheduling optimisation algorithm implemented in MATLAB to simulate and optimise the network behaviour. The results show that both strategies present similar costs reduction when applied to centralised storages. With the Peak-based strategy applied to the decentralised storages, the system runs with the cheapest costs. Additionally decentralised storages lead to different network performances depending on the scenario, from -2% to +1% of CO2 emissions and primary energy consumption. In this analysis where the performances indicators are very close, the investment costs and payback time are key criteria in order to choose the most convenient storage solution.

KEYWORDS

Storages; operation strategies; optimisation; district heating network.

1. Introduction

Due to a growing population in cities, urban challenges must be addressed in order to increase the quality of life along with the competitiveness and sustainability of cities. This is possible by integrating key sectors such as the build environment, mobility, energy and ICT solutions by means of smart energy systems that are optimally planned and operated. In order to satisfy increasing energy needs together with energy regulations and long term security of supply, the integration of more renewable energy sources is necessary. The objective to drastically increase the share of renewable energy sources, most of which are fluctuating and non-controllable, is realistic within the next years, but only with an optimal use and management of storages.

The importance of the use of storages, when fluctuating heat sources, such as solar thermal, are considered, or when the system requires flexibility for energy production, for instance when a Combined Heat and Power (CHP) plant is operating, has already been demonstrated. For instance, in [1] where the authors explain how low-temperature heat production from industrial excess heat, solar collectors, and heat pumps requires the implementation of storages. Another example is also given in [2], which presents a study where the integration of large-scale storages