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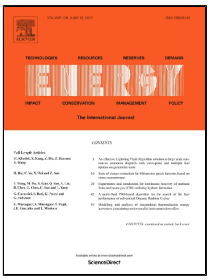

The role of heat storages in facilitating the adaptation of district heating systems to large amount of variable renewable electricity

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The role of heat storages in facilitating the adaptation of district heating systems to large amount of variable renewable electricity

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Abstract:

In the future energy system, it is likely that there is more variation in the electricity prices due to higher share of renewable energy sources in electricity production. In this paper, the effects of more variable electricity prices were analyzed in a district heating (DH) system that includes both combined heat and power (CHP) plant, fired mainly by biomass and heat only boilers. The most cost optimal dimensioning and combination of heat storages, heat pumps and solar collectors are searched in three future electricity price scenarios. When the impacts of different system components were analyzed separately, it was found that especially a larger heat storage (1% of annual DH energy) is economical. In addition, the results indicate that the most economical size for a heat pump is around 20% of peak heat demand. Yet, the most profitable solution was to include both a heat storage and a heat pump in the DH system. According to our results, solar collector was not a profitable investment in the studied DH system.

Keywords:

District Heat, Renewable Energy, Thermal Energy Storage, Heat Pump

Highlights:

- The effects of more variable electricity price were analyzed in one DH system
- The optimal dimensioning of DH components like heat storage was studied
- A rather large heat storage is economical in the studied DH system
- The most economical solution is to include heat storage and heat pump in the system

1 Introduction

In Finland, the most common form of heating is district heating and it accounts for almost half of the total space heating market. In 2014, around 35 TWh of district heat was produced in Finland and approximately 72 % of it was produced with cogeneration. In the same year district heating produced 12.3 TWh of cogenerated electricity. The most common fuels for district heat and CHP were coal (25 %), natural gas (22 %), forest wood (17 %) and peat (14 %) [1].

District heat is economical especially in dense urban areas and the market share can even exceed 90 % in the largest Finnish cities [2]. Report by [3] predicts that district heating will have an important role also in the future and it will continue to be a competitive form of heating. Yet, energy systems