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Fuel shift for improving urban integrated energy system operation and efficiency

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A large amount of literature has been focusing on low-temperature district heating (LTDH) in order to reduce heat loss reduction and facilitate renewable energy integration. Yet, LTDH alone is insufficient for domestic water heating, which requires 50 °C for circulation and 60 °C as set point temperature for the storage tank due to hygiene concern. Our work from last year's 4dh conference contributed to this research area [1] and this abstract intends to extend our previous effort.

Previous analysis on fuel shift technology shows substantial benefits and the potential to provide more services in an integrated energy system. It was based on a hypothetical district with 23 terraced single-family houses supplied by both a low-temperature district heating (LTDH) network and a low-voltage network (LVN), as shown in Fig 1 to Fig 4. It was shown that district heating network (DHN) losses can be reduced by 35% if the supply temperature is reduced from 70 °C to 50 °C, but the LVN peak power will have to be increased by up to 2% using heat boosting. It further aggregated EHBs to provide a fuel shift (FS) service for the DHN. The results show that while LVN peak power was increased by up to 4.3%, the basic power production and peak boiler usage for DHN could be reduced by as much as 15% and 48%, respectively. In summary, lower supply temperatures and intelligent components can improve system efficiency and turn the DHN into an integrated part of a SES.

We will extend previous analysis and further study fuel-shift solution and investigate the possibility to provide ancillary services to distribution network. We will conclude the research with fuel-shift feasibility and implications for industrial application.

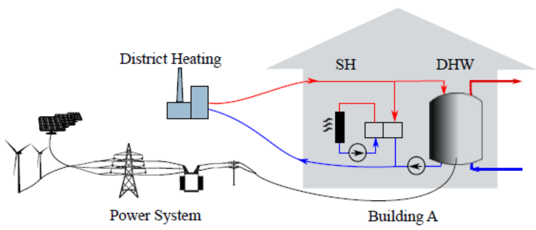

Figure 1. Building's connection to heat and power system

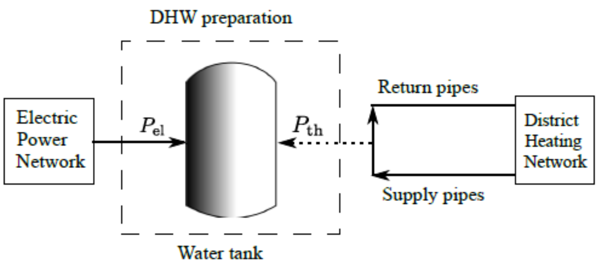

Figure 2. Electric heat booster and its energy sources

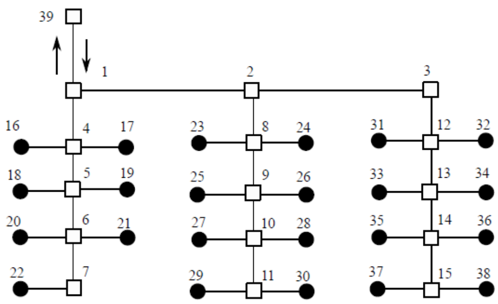

Figure 3.District heating network

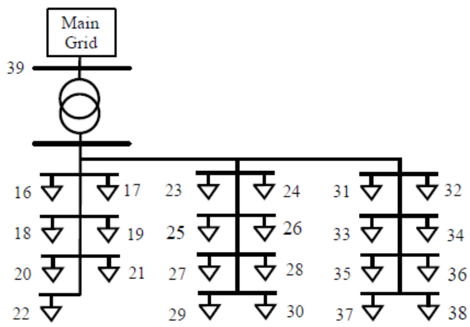

Figure 4. Low voltage distribution network

[1] Cai, H., You, S., Wang, J., Bindner, H.W. and Klyapovskiy, S., 2018. Technical assessment of electric heat boosters in low-temperature district heating based on combined heat and power analysis. *Energy*, *150*, pp.938-949.

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