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Improving urban energy system operation with flexible heat and power coupling

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Low-temperature district heating (LTDH) has been proposed to reduce heat loss 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. The engineering solution to address this is to complement existing system with heat booster. It is expected to be a widespread coupling across power system and district heating system and represents the flexibility to support integrated energy system operation. Our work is based on this paradigm shift in the research of integrated energy system and this abstract presents partly the results from reference [1]. We based our work on real system in Copenhagen's Nordhavn area, as a part of the large demonstration project - EnergyLab Nordhavn.

The 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 district terraced single-family houses supplied by both a low-temperature district heating (LTDH) network and a low-voltage network (LVN). A real example is illustrated in Fig. 1. It was shown that district heating network (DHN) losses could 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.

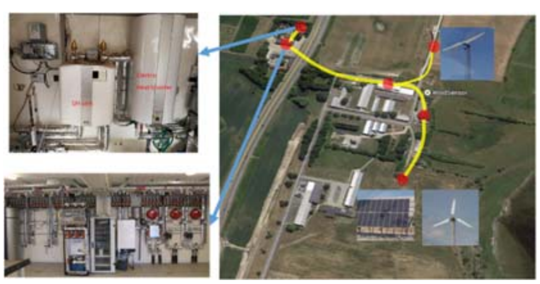

Fig 1. Building's connection to heat and power system

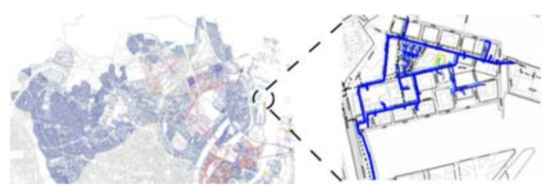

Fig 2. Field demonstration

[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.