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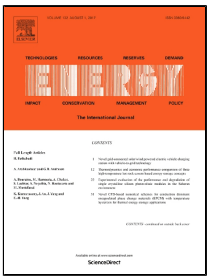

Utilizing data center waste heat in district heating – impacts on energy efficiency and prospects for low-temperature district heating networks

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# Utilizing data center waste heat in district heating – impacts on energy efficiency and prospects for low-temperature district heating networks

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## ABSTRACT

Data centers seek solutions to increase energy efficiency and lower costs by novel methods. Waste heat utilization is considered to be one of the major trends in the near future, especially in the Nordic countries, where heat demand is high. In this paper, waste heat utilization was analyzed from the perspectives of both the data center and district heating network operators. Timing of the data center waste heat production was considered based on an existing data center load profile. For the district heating network operator, the system level effects of increased waste heat utilization were quantified by simulating district heating production in the city of Espoo, Finland, with actual plant and heat demand data for 2013 and 2015. Results showed that with high shares of waste heat in the district heating system, i.e. 20-60 MW, the system level operational cost savings were 0.6-7.3% in the case study. Utilizing waste heat decreased utilization hours of both combined heat and power plants and heat-only boilers. The analysis showed that pricing of the procured waste heat affects the utilization level of waste heat, but operational hours of waste heat utilization were over 95% in all scenarios.

**Keywords - District heating, data center, energy efficiency, waste heat utilization, load profile**

## HIGHLIGHTS

- Data centers can act as a stable source of waste heat
- Increased waste heat utilization decreases operational hours of CHP plants and HOBs
- Waste heat reuse improves energy efficiency on a system level

## NOMENCLATURE

| | |
|---|---|
| *CHP* | *Combined Heat and Power* |
| *COP* | *Coefficient of Performance* |
| *CPU* | *Central Processing Unit* |
| *CRAC* | *Computer Room Air Conditioner* |
| *CUE* | *Carbon Usage Effectiveness* |
| *DC* | *Data Center* |
| *DCE* | *Data Center Efficiency* |
| *DH* | *District Heating* |
| *DHW* | *Domestic Hot Water* |
| *EOC* | *Environmentally Opportunistic Computing* |
| *EPC* | *Energy Proportionality Coefficient* |
| *ERE* | *Energy Reuse Effectiveness* |
| *ESX* | *VMware Elastic Sky X server* |
| *FVER* | *Fixed to Variable Energy Ratio* |
| *HOB* | *Heat Only Boilers* |