

# District Heating Integration of a River Water Heat Pump at a CHP Plant in Germany

Feasibility Study and Techno-Economic Evaluation

U. Trabert, I. Best, W. Bergstraesser, O. Kusyy, J. Orozaliev, K. Vajen

University of Kassel, Institute of Thermal Engineering

#### Status quo of urban district heating systems in Germany





6-7 October 2020

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# Integration of a river water heat pump at a CHP plant



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#### **Techno-economic evaluation of two concepts**



• Simulation of hourly heat production for the years 2024 to 2038 with the software energyPRO

VS

> Minimum dimensioning Concept ()

- River water heat pump:  $\dot{Q} = 4.7 \text{ MW}_{\text{th}}$
- Tank storage:

V = 600 m<sup>3</sup>

Flexibility Concept (II)

• River water heat pump:

$$\dot{Q} = 6.2 \text{ MW}_{\text{th}}$$

- CHP unit:  $\dot{Q} = 7.1 \text{ MW}_{\text{th}}$  $P_{\text{el}} = 7.2 \text{ MW}_{\text{el}}$
- Power-to-heat (PtH):

 $\dot{\underline{Q}}$  = 2.2 MW<sub>th</sub>

• Tank storage:

Backup: Primary district heating network

#### Mean annual heat pump operation (15-year average)



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\*Monthly 15-year average (2024 to 2038)



Mean\* electricity market price and heat load in **July** 

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\*Monthly 15-year average (2024 to 2038)

**Concept** (*Heat Pump*)



Mean\* daily operation in July

Heat pump operates during market price dip caused by solar PV electricity feed-in ٠

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\*Monthly 15-year average (2024 to 2038)





Mean<sup>\*</sup> daily operation in **July** 

- Heat pump operates during market price dip caused by solar PV electricity feed-in ۲
- More flexibility potential for electricity market with a high thermal output of the heat pump

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\*Monthly 15-year average (2024 to 2038)



Mean\* electricity market price and heat load in **October** 

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\*Monthly 15-year average (2024 to 2038)

#### **Concept** (II) (Heat Pump + CHP unit + PtH + large storage)



Mean<sup>\*</sup> daily operation in **October** 

- Heat production is a good flexibility option for the electricity market from April until October ۲
- More flexible production in winter would require further over-dimensioning of components

#### **Economic comparison**





- Low LCoH possible with self-generated electricity from CHP plant.
- Flexible heat production in Concept II not cost-efficient yet.

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#### Ulrich Trabert

www.solar.uni-kassel.de

solar@uni-kassel.de

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### Summary

- Excellent and transferable opportunity for river water heat pumps at existing CHP plants.
- Heat production is a **good flexibility option** for the electricity sector during summer and transitional periods.
- River water heat pumps can achieve **competitive LCoH** to conventional heat supply by CHP plants when using self-generated electricity.
- Very **flexible electricity tariffs** (i.e. flexible grid charges) required for economic efficiency of flexible systems.

#### Thank you for your kind attention!





