Technische Hochschule Ingolstadt
Institute of new Energy Systems

Comparison of Different District Heating Substation-Systems in a Hardware-in-the-Loop-Test Rig

6th International Conference on Smart Energy Systems 2020

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Agenda

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- Introduction
- Approaches for low-investment measures
- Comparison of two District Heating Substations (DHS)
- Outlook

Small existing District Heating Networks (DHN) operate with biomass/-gas **have high heat losses**

- Because DHN were often **too large designed**
  - Heat were only waste from CHP process
  - More consumer wanted to join than did
  - Operator calculated that there will be sometime new construction site
- Because a high proportion of consumers in rural areas **have additional heat supply sources** such as heating stoves, solar thermal heat supply system
- Because district heating **substations are working mostly inefficiently** (low temperature differences)

→ Focus on single-family houses

AIM

- ➢ **With low-investment measures**
- ➢ **To a cost-efficient operation of existing DHN in the future**

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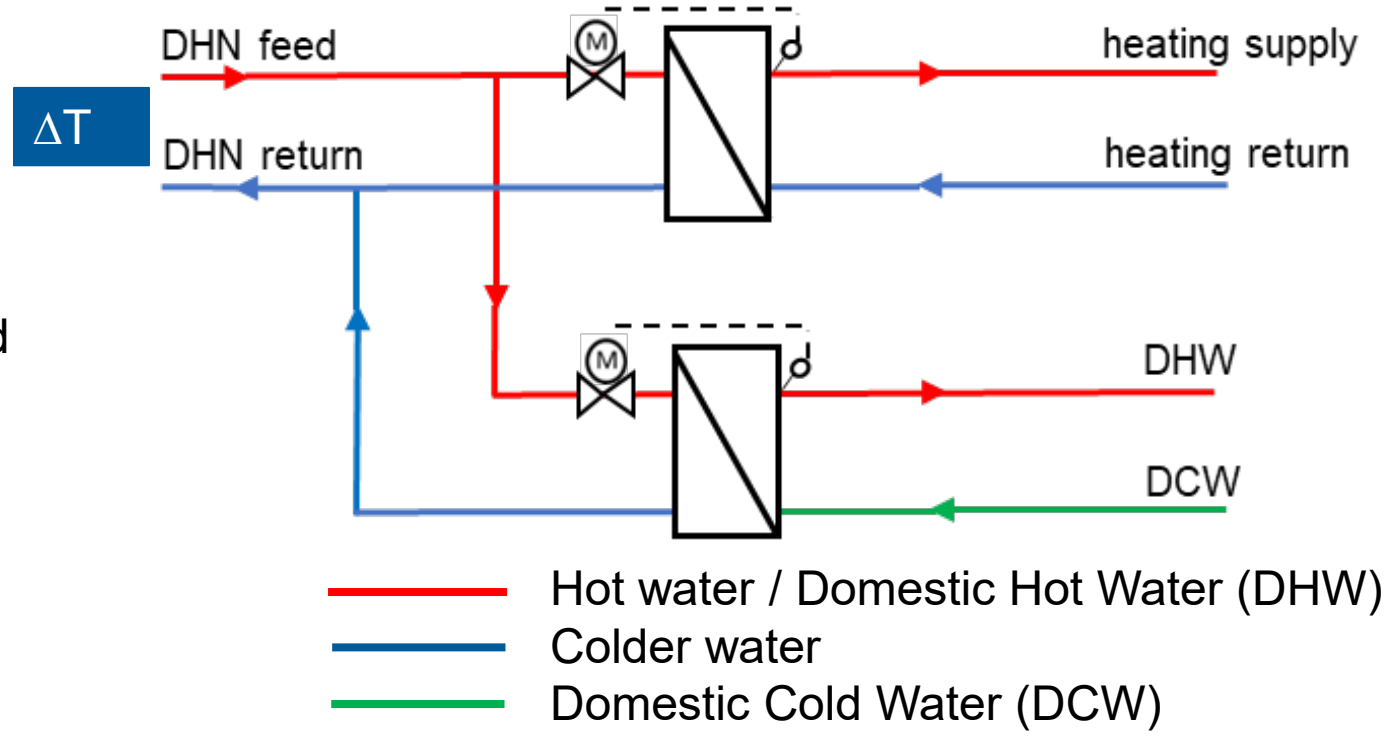
Strategies to reduce thermal losses for a cost-efficient operation in the future

District Heating Substation

$\Delta T \uparrow$

- Optimizing through hydraulic construction and digitalization
- Measurement of the actual state and the optimized state in the laboratory



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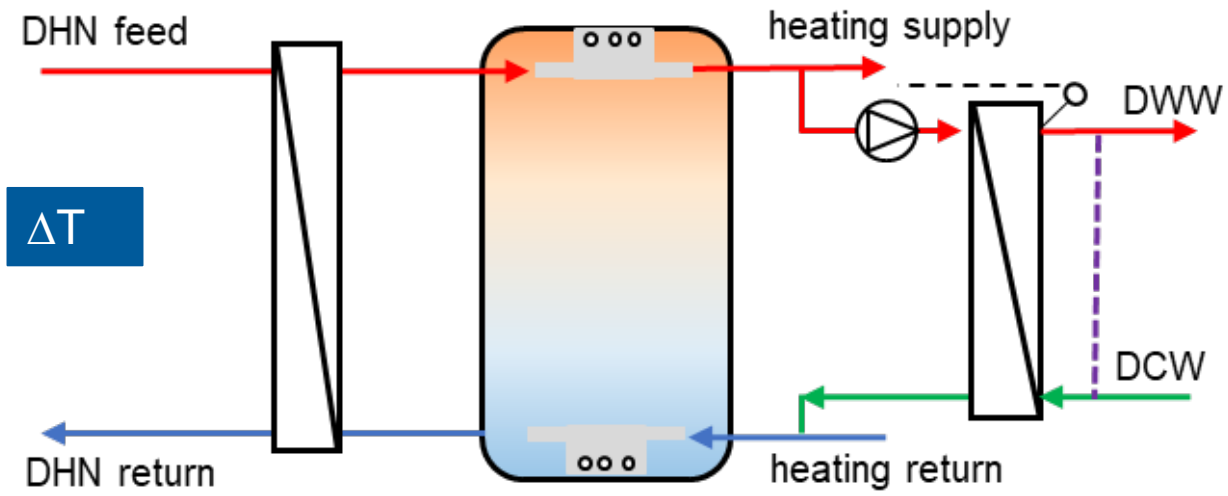
Strategies to reduce thermal losses for a cost-efficient operation in the future

District Heating Substation

ΔT ↑

- Examination of a larger investment: the installation of a storage tank
- Lower average DHN temperature through storages?



Hot water / Domestic Hot Water (DHW)
Colder water
Domestic Cold Water (DCW)

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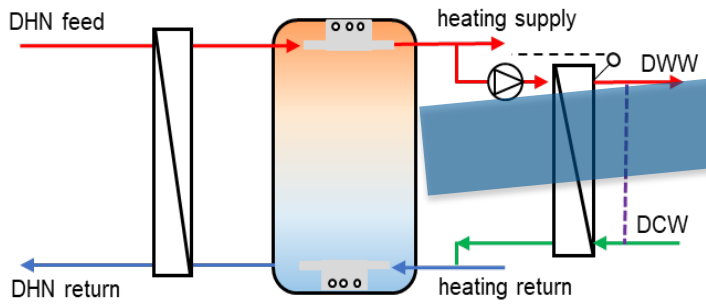
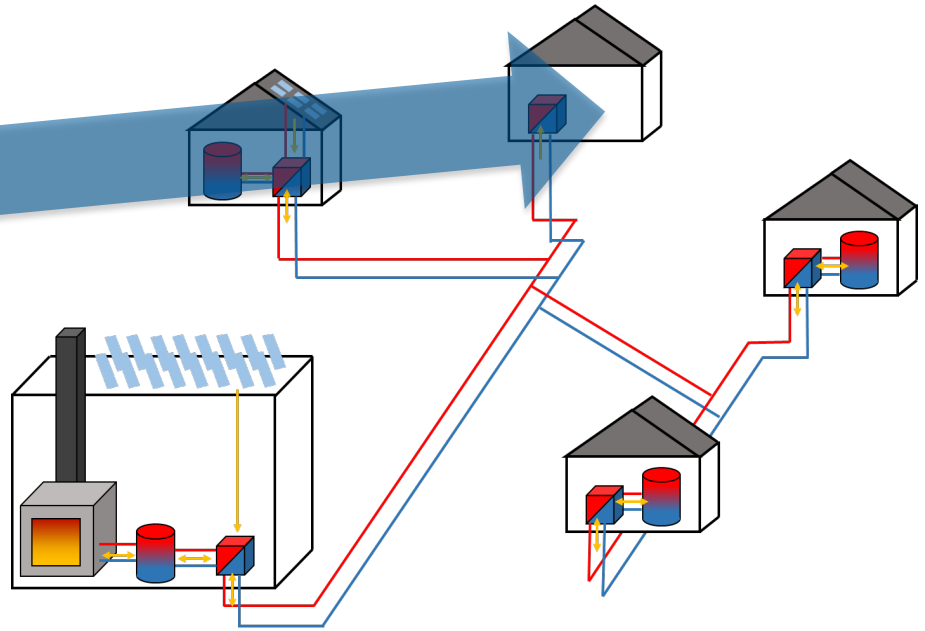
Strategies to reduce thermal losses for a cost-efficient operation in the future

District Heating Substation

Operation Strategy





ΔT

ΔT ↑

- Optimizing through hydraulic construction and digitalization
- Lower average DHN temperature through storages?

- Reducing power peaks → storages
- Lower DHN temperature (summer)

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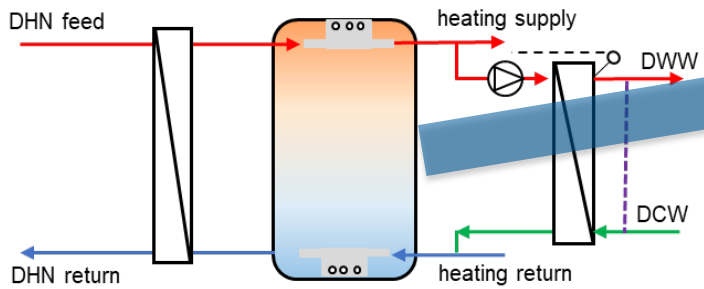
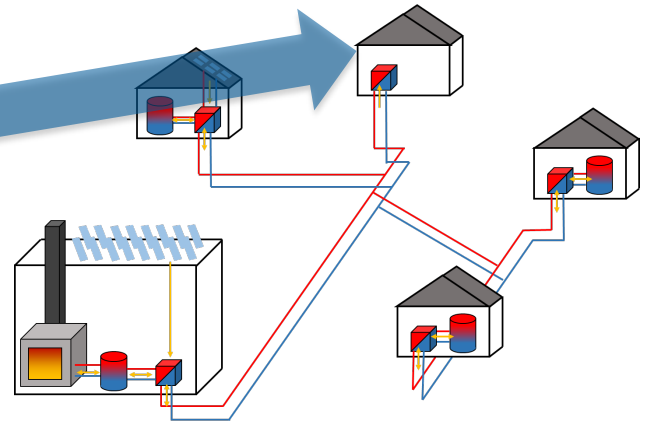
Strategies to reduce thermal losses for a cost-efficient operation in the future

District Heating Substation

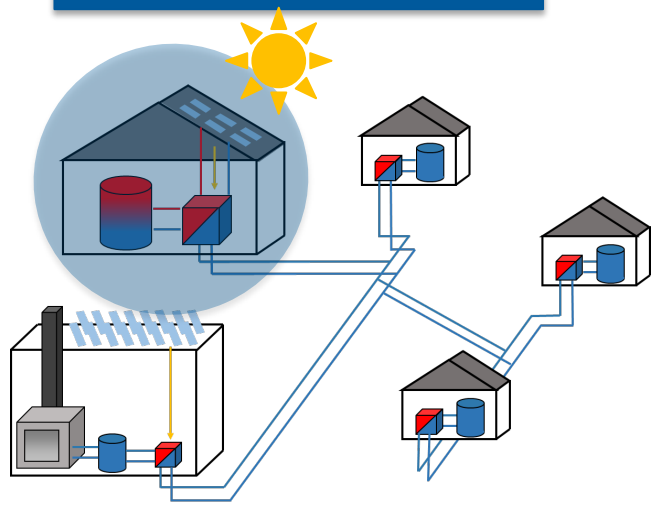


ΔT

Operation Strategy



Optimized Integration of Renewables



$\Delta T \uparrow$

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- Communication of demand between consumer and heat central

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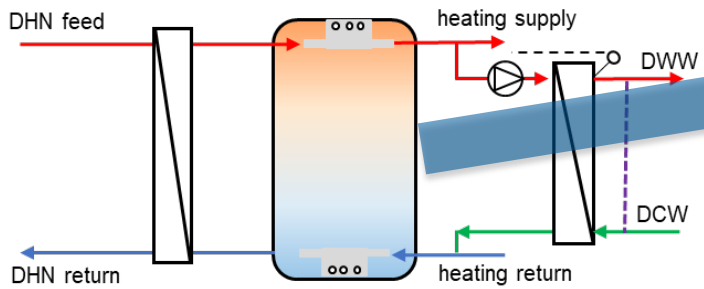
Strategies to reduce thermal losses for a cost-efficient operation in the future

District Heating Substation



ΔT

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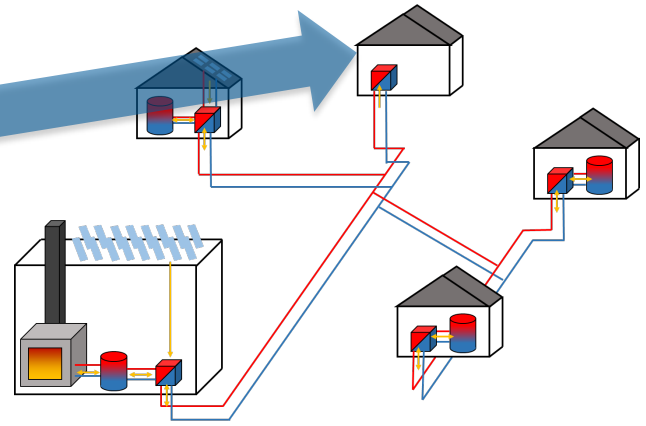
Operation Strategy



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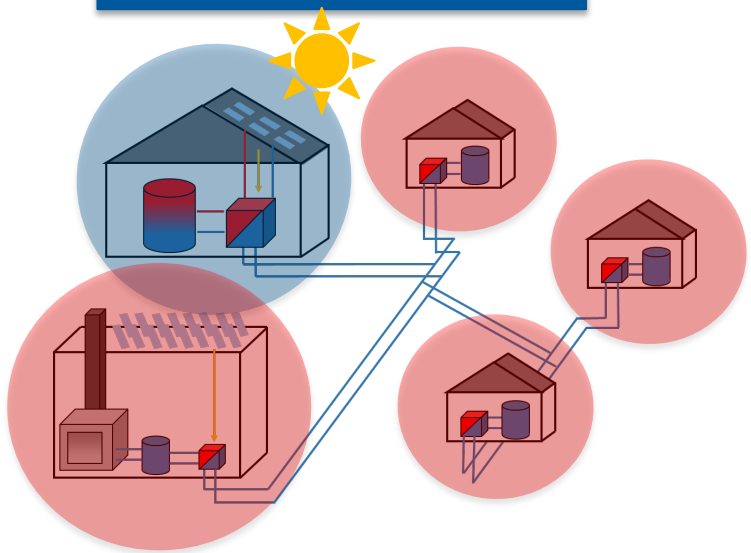
Optimized Integration of Renewables



- Communication of demand between consumer and heat central
- Adjustable heat supply / volume flow

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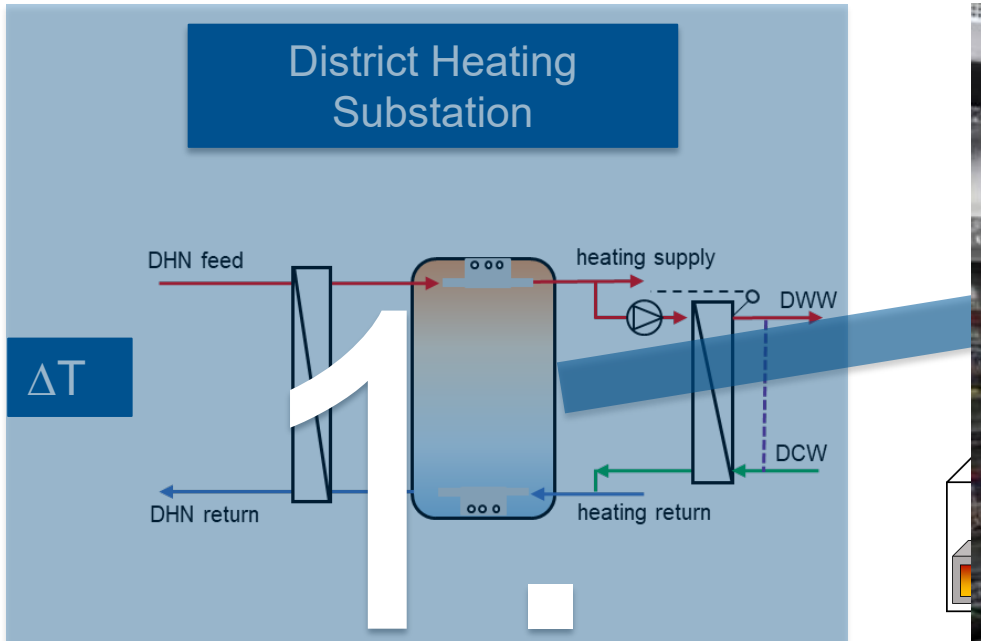
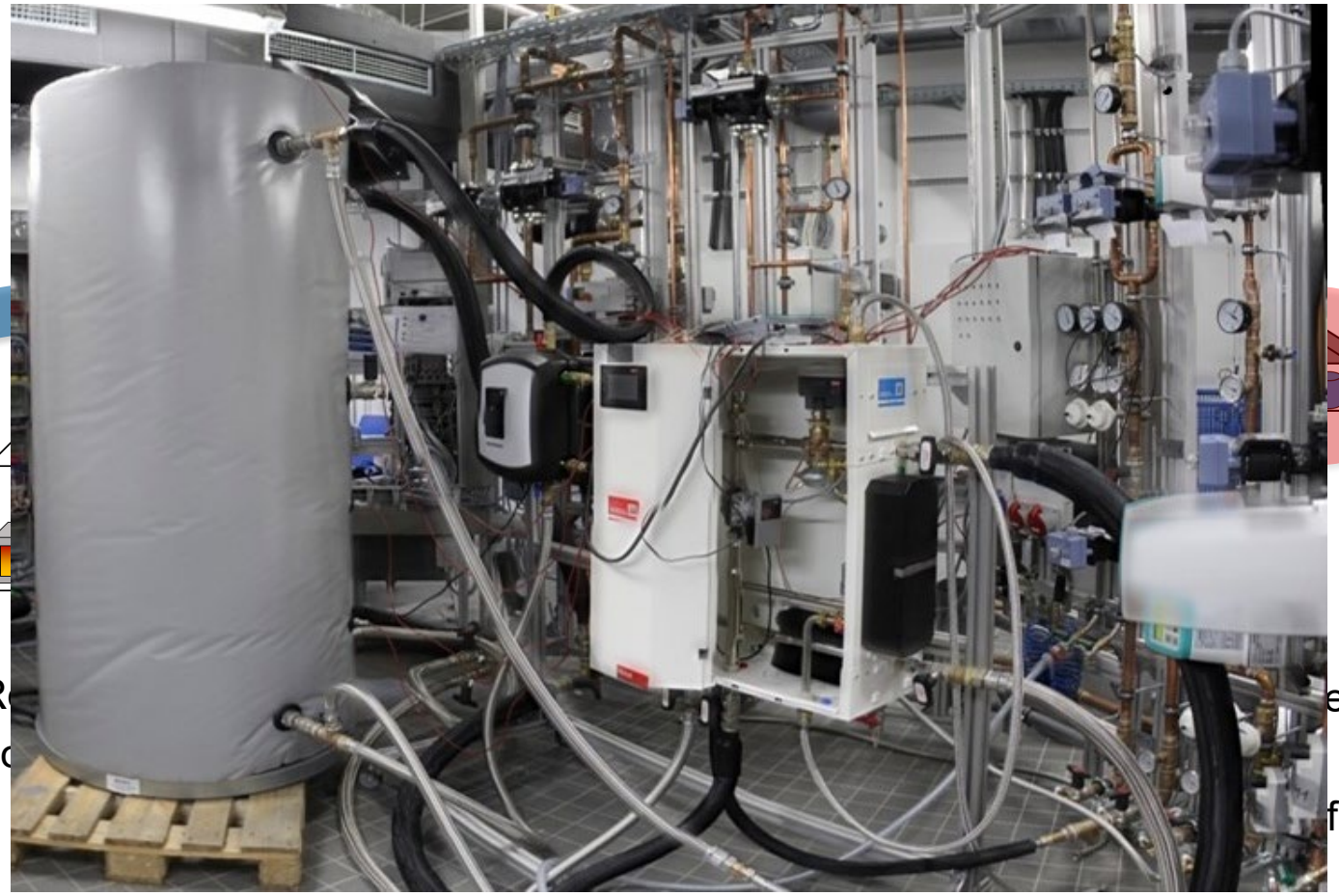
Strategies to reduce thermal losses for a cost-efficient operation in the future





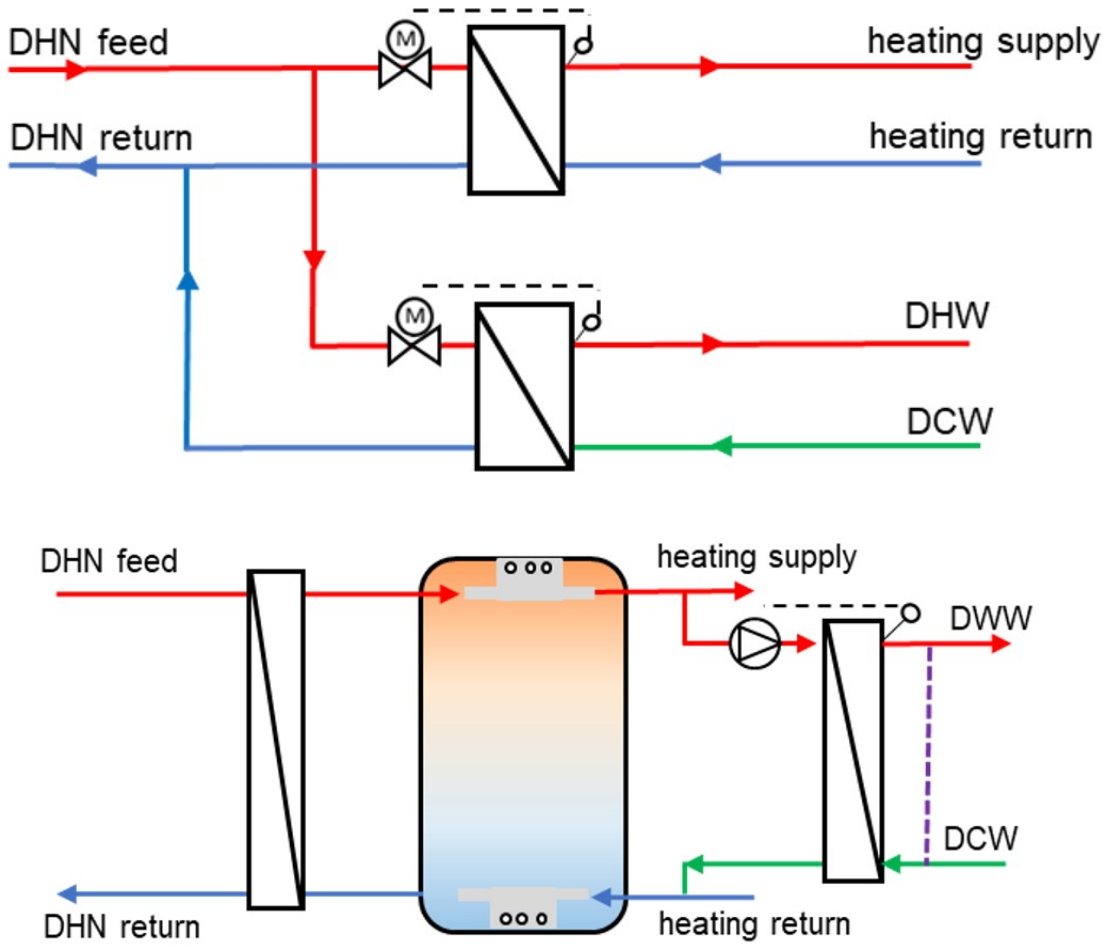
ΔT ↑

- Optimizing through hydraulic construction and digitalization
- Lower average DHN temperature through storages?

- R… …een
- Lo… …flow

Comparison of two District Heating Substations (DHS)

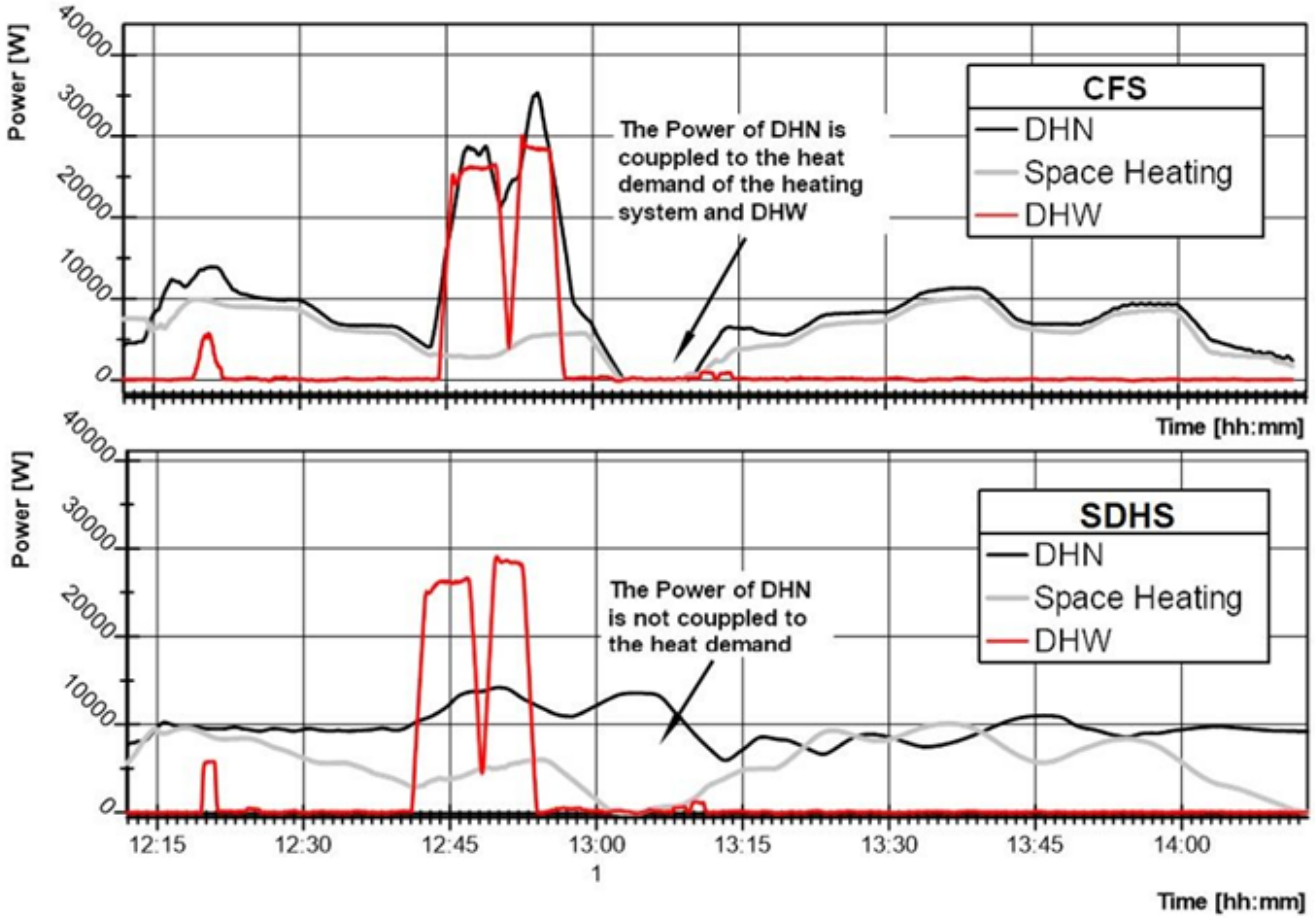
Parameters



Indicator	Temperatures
DHN feed temperature	80 °C
Design temperature of heating system	70/50 °C
DHW temperature	45 °C
Storage System	
Hysteresis switch on temperature T_{on}	55 °C
Hysteresis switch off temperature T_{off}	75 °C
Storage temperature (start of measurement)	50 °C

Comparison of two District Heating Substations (DHS)

Results for section of a winterday



Comparison of thermal power needed from DHN

CFS	SDHS
Correspond to the current demand of heating and DHW	Independent of current demand → nearly constant

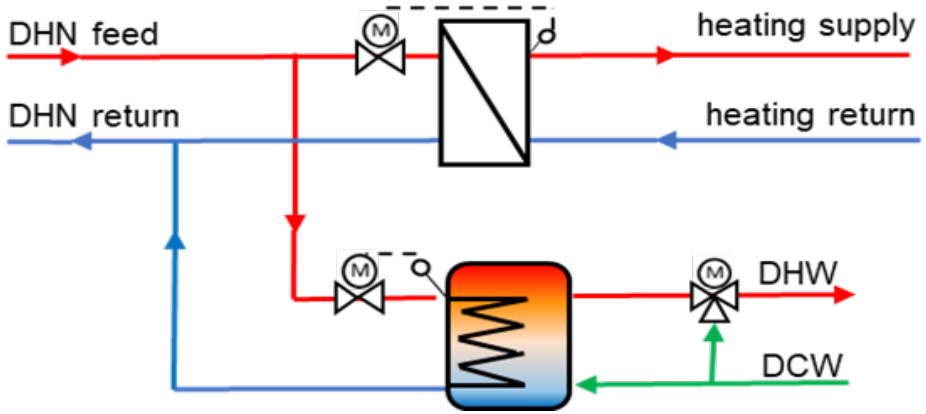
- In case of CFS the max. requested thermal power is about three times as high as that of the SDHS
- If mainly heating power is drawn, the withdrawal rates of both systems are similarly high

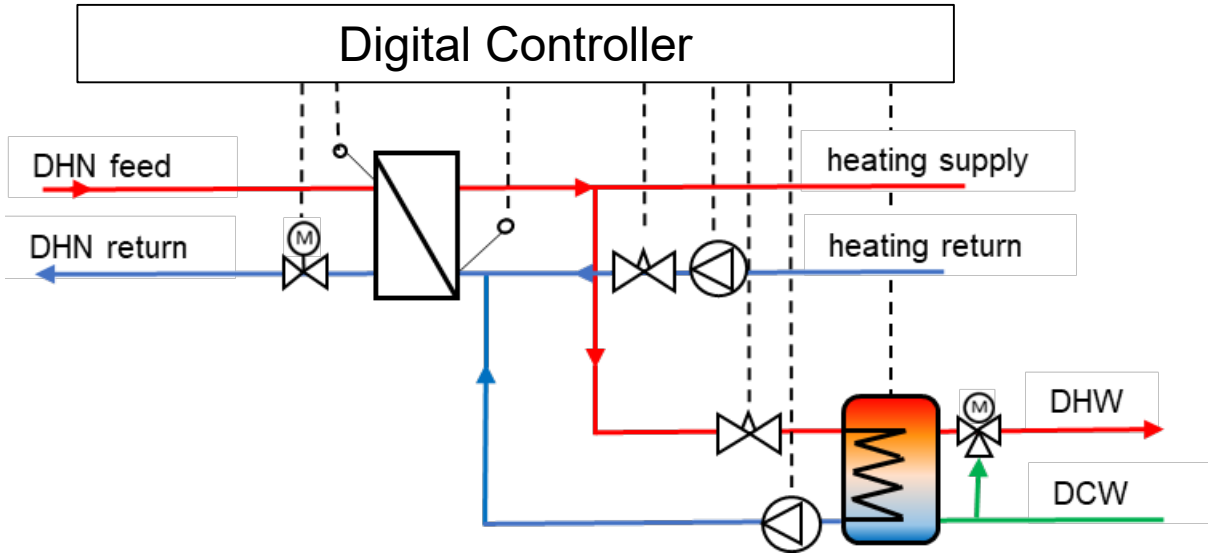
The average of the return temperatures are both at about 50 °C.

Outlook

Next steps

- Comparison of an analog controlled DHS with a digital controlled one on the HiL Test rig
- The analog controlled DHS will be upgraded with a controller that can communicate with the central control of the DHN





Thank you for your attention.

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