

Simulation of bidirectional heat transfer

stations in district heating grids

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/erantwortung für Energie und Umwe











Key data of the research project

Funding program

- Energieforschung 2015 2. call
- Funding sponsor: Climate and Energy Fund Austria
- Settlement Agent: Austrian Research Promotion Agency

Project duration

01.04.2016 until 31.03.2018

Contents

- Investigation of a bidirectional heat transfer station
- Innovative control strategies for the integration of renewable heat sources

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Increasing the efficiency of heating systems

Introduction

Plant

Simulation

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Summary



Initial situation in Austria



Source: Schmidt. R.-R., 2015. Der F&E-Fahrplan – Fernwärme & Fernkälte in Österreich.

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Initial situation in Austria



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Source: FGW, 2015. Erdgas und Fernwärme in Österreich – Zahlenspiegel 2015

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Challenges

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- Decreasing specific heat demand in existing and new buildings → low heat density in a region
- Decentralized integration of (low temperature) heat sources of prosumers
- More flexible structures to enable open and modular heating systems
- Ensuring an all-season heat supply (various types of consumption) through a mix of centralized and decentralized heat sources





Legal requirements

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- Equal rights and fairness for all customers → Who can feed in when and how much and at what conditions?
 - Site and development safety:
 - Connection and feed-in obligations on the part of the municipalities
 - Financial penalties for large potential waste heat suppliers
 - Normative adaptation and simplification of domestic water supply (legionella problem)
 - Change of calibration and standardization of heat meters

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Use cases

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- Solar thermal energy supply on the secondary side
- Waste heat integration from medium (commercial) refrigeration plants on the secondary side
 - Larger heat pump applications on the primary side (return cooling)





Integration options

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- Flow from the return to the forerun
 - high pump performance (small volume flows / high differential pressures)
- Return rise
 - Pressure reducing valve in return or heat exchanger pump
 - Decreasing efficiency of the primary heat source (condensation boiler)
- Forerun rise
 - Pressure reducing valve in forerun or heat exchanger pump

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flow

Solarthermics

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Summar

90% of all collectors are flat plate collectors

$$T \uparrow \rightarrow \eta \downarrow \downarrow$$

- Vacuum tube collectors are advantageous at higher temperatures. However, these are almost not be used because of the high prices
- Operation
 - High-flow (return rise)
 - Low-flow (forerun rise)
 - Matched-flow (Flow from the return to the forerun



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Chiller + heat pump

- Introduction Plant Simulation Results
 - Summary

- Year-round use
- Waste heat from the freezing and standard cooling cells (e.g. supermarket)
- Max. waste heat temperature of 30 to 35° C
- Waste heat potential of a supermarket: ~250 MWh/a



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Hydraulic schema



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Heat absorption from the grid



Flow from the return to the forerun



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Return rise





Forerun rise



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Objectives of the simulation

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Summary

While in a laboratory test, the control of a prosumer is examined, a numerical model is used to examine the effects of several prosumer on the entire grid.



Simulation of the secondary side



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Simulation of a single prosumer

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- The forerun and return temperature of the district heating grid, at the point where the prosumer is located, is feed into the computer
- The influence of other prosumers is not considered





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Simulation of a single prosumer

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Simulation of a single prosumer





Simulation of a line of prosumers

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Summary

- Simulation of a line of prosumers in a reference district heating grid
- Standardized design of a prosumer
- Arbitrary choice of locality





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Simulation of a line of prosumers

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- Simulation of a line of prosumers in a reference district heating grid
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Summary

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- The objective of the research project MULTItransfer is the exploration of a bidirectional heat transfer station for district heating grids
- A simulation model depicts the secondary side
- At present, the control can only be effected by the storage temperature
- A model for investigation the thermo-hydraulic behaviour is planned
- A laboratory test will be carried out in the coming weeks → Validation of the simulation model

