Zukunft Bau

STRUKTUR / GLIEDERUNG KURZBERICHT

Title

Langfassung Titel: „Increasing the Share of Renewables in City Districts through the Potential of Low Temperature District Heating Networks“

Anlass/ Ausgangslage

kurze Beschreibung des Problems und des Lösungsansatzes
max. 450 Zeichen (mit Leerzeichen)

Newly developed as well as refurbished city quarters are structures with comparatively low heat demands and decreasing supply temperature levels. These can be met by innovative Low Temperature District Heating Networks supplied by waste heat or renewables. The feasibility of the system and the recoverability of low-grade heat are examined by a co-simulation approach.

Gegenstand des Forschungsvorhabens

Beschreibung der Arbeitsschritte und des Lösungswegs
max. 4.300 Zeichen (mit Leerzeichen)

The research project is subdivided into the steps

- fundamentals,
- modeling,
- scenario definition,
- evaluation and analysis of the simulation results and
- recommendations and outlook.

The section fundamentals introduces the exemplary city district which is the basis of the project, the functional principle of low temperature district heating networks in general, practical examples of low temperature district heating networks as well as the legal boundaries.
On this basis, the definition of the system boundary and the selection of the tools needed for system modeling and simulation follows. The section modeling outlines the framework (Picture 1), which was developed during this project, as well as the partial models of the framework. These are

- Heat Demand Models
- Building Services Model
- Interlink Zone
- Hydraulic Network and Storage Model

Every Heat Demand Model feeds the associated Building Services Model with minute-based domestic hot water and heating loads. These loads as well as the weather data are processed in the Building Services Models. In turn every Building Services Model communicates trough the Interlink Zone with the Hydraulic Network and Storage Model and exchanges with the associated connection point in the Hydraulic Network and Storage Model the values of the current time step.

The framework enables the co-simulation of 13 Heat Demand and Building Services Models, the Interlink Zone and the Hydraulic Network and Storage Model. Since the Building Services Models operate autonomously without superordinated control and ”decide” independently when to feed in or take up heat from the network, the resulting flow conditions in the network are undirected and bidirectional.

The section scenario definition establishes for each scenario which parameters to keep constant and which to vary. Following the definition of a reference scenario, the scenarios are subsequent variations of this reference scenario varying the parameters

- building standard
- domestic hot water demand
- domestic hot water temperature
- type of seasonal storage
- and local storage capacity

The variation of the Building Standard aims to determine the system performance at low and high heat demands. Through varying the domestic hot water demands, the influence on the system of different types of occupants is examined. Further scenarios look at the influence of raising the domestic hot water temperature or the local storage capacities on the system efficiency and the demand of non-renewable energy.

Table 1 provides an overview of all scenarios and illustrates the parameters varied in each of them making it easy to determine and follow the influence of the parameter variation on system efficiency and system performance (e.g. changing temperature levels in the network, changing amounts of fluid transported).

For comparability reasons the variation of some parameters can lead to an under- or overdesign of single system components for particular scenarios. An example could be a solar thermal overdesign by keeping the collector area constant and reducing the domestic hot water demand.
Empty spaces in Table 1 mark parameters which are identical to the reference scenario. The values in the column “Local Storage Capacity” correspond to the cumulated storage capacities of the Buffer storage and the Stand-by-Storage per m² floor space.

Tabelle-1: Scenario Overview

	Building Standard	DHW Demand	DHW Temperature	Type of Seasonal Storage	Local Storage Capacity
Reference scenario	EnEV New Construction	30 l/Pers/Day	45°C	Borefield Heat Exchanger	11 l/m² floor sp.
Scenario 1	Passive House Components				7 l/m² floor sp.
Scenario 2	Existing Construction (modernized)				25 l/m² floor sp.
Scenario 3		22 l/Pers/Day			
Scenario 4		35 l/Pers/Day			
Scenario 5			60°C		
Scenario 6				Hot Water Storage	
Scenario 7					22 l/m² floor sp.
Scenario 8				Hot Water Buffer Storage	3 m³/building

Subsequently the evaluation and analysis of the simulation results is followed by the section recommendations and outlook which provides planning recommendations and further guidance on simplifying the implementation of Low Temperature District Heating Networks.

Fazit

Beschreibung der geplanten Ziele und der erreichten Ergebnisse
max. 700 Zeichen (mit Leerzeichen)

The investigation shows Low Temperature District Heating Networks are able to fully supply districts of EnEV New Construction buildings or of higher standards in our latitudes through solar thermal heat. Under these conditions up to 85 % of thermal losses and 65 % of CO_2 emissions, compared to a traditional district heating network at identical load conditions, can be avoided.
The implementation of such systems is prevented or heavily impeded by the current legal situation put into effect to regulate the traditional producer-consumer structure, which does neither stipulate an energy exchange between buildings within a district nor a change of part of the market players from consumer to producer or vice versa.

Eckdaten

Short title: Low Temperature District Heating Networks in Urban Quarters

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Total cost: 87.883,44 €

Federal funding: 52.730,00 €

Project duration: 23 months

BILDER/ ABBILDUNGEN:

5 - 7 Druckbare Bilddaten als eigene Datei (*.tif, *.bmp, ...) mit der Auflösung von mind. 300 dpi in der Abbildungsgröße (z.B. Breite 10 - 20cm). Bilder frei von Rechten Dritter.
Bildnachweis jeweils:

Picture 1: 01_Framework_Construction.png
Framework construction and relationship of the partial models

Picture 2: 02_LTDHN.png
Low Temperature District Heating Network with local heat pumps and borefield heat exchanger

Picture 3: 03_Energy_flow_schematic.bmp
Energy Flow of an individual building

Picture 4: 04_Hydronic_setup.png
Hydronic Setup of Low Temperature District Heating Networks

Picture 5: 05_ LTDHN.png
Low Temperature District Heating Network with local heat pumps and borefield heat exchanger