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Development of an Innovative Low Temperature Heat Supply Concept for a New Housing Area

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Abstract

The domestic energy demand of buildings is responsible for one third of the world's final energy consumption. To increase the sustainability of new housing areas, the identification of innovative heat supply concepts based on renewable energy sources (RES) is required. For the new housing area "Zum Feldlager" (Kassel, Germany), various supply concepts are studied. Main objective is the development of an innovative and efficient supply concept based on RES and low temperature district heating (LTDH) for practical implementation. In the course of different studies, centralised and decentralised supply strategies are analysed. The most promising supply concept is based on a central ground source heat pump in combination with LTDH and decentralised solar thermal systems. In comparison to a reference concept the annual heating costs and the CO₂-emissions are lower. This project is a cooperative activity and of the Fraunhofer IBP, Institute for decentralized Energy Technologies (IdE), Kassel University, City of Kassel and Staedtische Werke Kassel AG. The paper covers a topic from IEA DHC Annex TS1.

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1. Introduction

During the planning phase of new residential areas, the investigation of suitable energy sources and supply strategies is crucial. The use of renewable energy sources (e.g. solar energy and geothermal energy) offers great potential for a sustainable and efficient supply of heat. However for optimized usage of these resources it is necessary to identify appropriate technologies to ensure efficient supply of the new housing area. In order to identify the best possible system solution, different supply strategies have been investigated and compared. Main objective is the development of an innovative heat supply concept based on renewable energies and an optimised supply concept. Central challenges in achieving these objectives is the identification of the most promising and efficient technical solutions for practical implementation. Furthermore aspects of future network management as well as business models for distribution and operation are considered. As a result, the focus of this project is on investigations on suitable centralised or decentralised supply concepts for a new residential area using renewable energy sources in a cost efficient way.

The project is carried out in two project phases. The first project phase consists of a study in order to identify the most efficient and economical heat supply concept. In the course of the second project phase a detailed concept will be elaborated which includes selecting, dimensioning and detailed cost determination of the various components. This paper presents the results of the first project phase.

Nomenclature

Symbols

Q Heat energy (kWh/a)

Subscripts

hd Heat demand

cd Cooling demand

DHW Domestic hot water

el Electrical

th Thermal

Abbreviations

BHE Borehole heat exchanger

CHP Combined heat and power

COP Coefficient of performance

DHW Domestic hot water

EGRT Enhanced geothermal response test

HP Heat pump

MFH Multi-family houses

RES Renewable energy sources

SDH Semi-detached houses

SFH Single family houses

SPF Seasonal performance factor

TH Terraced houses

2. Description of the new housing area

The planning area "Zum Feldlager" is located in the city of Kassel (Germany). The area is surrounded by existing buildings and is located in an urban ventilation path. For that reason the combustion of oil or wood (fine dust

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