

Smart district Karlsruhe-Durlach, Ersinger Straße 4 «HEAVEN»

The building forms part of a cluster of five large renovated multi-family buildings from the 1960s within the Karlsruhe district Durlach, where an integrated energy system is demonstrated combining heat pumps, PV and CHP units in multi-family houses.

The demonstrated heat pump system is developed within «HEAVEN» project of Fa. Viessmann and Fraunhofer ISE: the innovative heat source hydraulics utilize the synergies of air (availability, costs) and ground sources (performance) and allow regeneration and defrosting by intelligent control.

Key facts

Building

Location	Karlsruhe-Durlach, Germany
Construction	1965
Heat distribution	radiator heating
Heated area	2112 m ² living
Level of insulation	good (renovation in 1995)

Heat pump and source

Number of	2
Installed power	27 + 43 kW _{th}
Operation mode	bivalent
Heat source	Air (Outdoor unit) + Ground (

Heating system

Heat demand	ca. 60 kWh/m ² a
Heating temperature	55/45 °C

Domestic hot water

Type of system	central
Max. temperature	62 °C
Circulation system	yes

Other information

Investments costs	unknown
PV installation	yes (PV)

Lessons learned

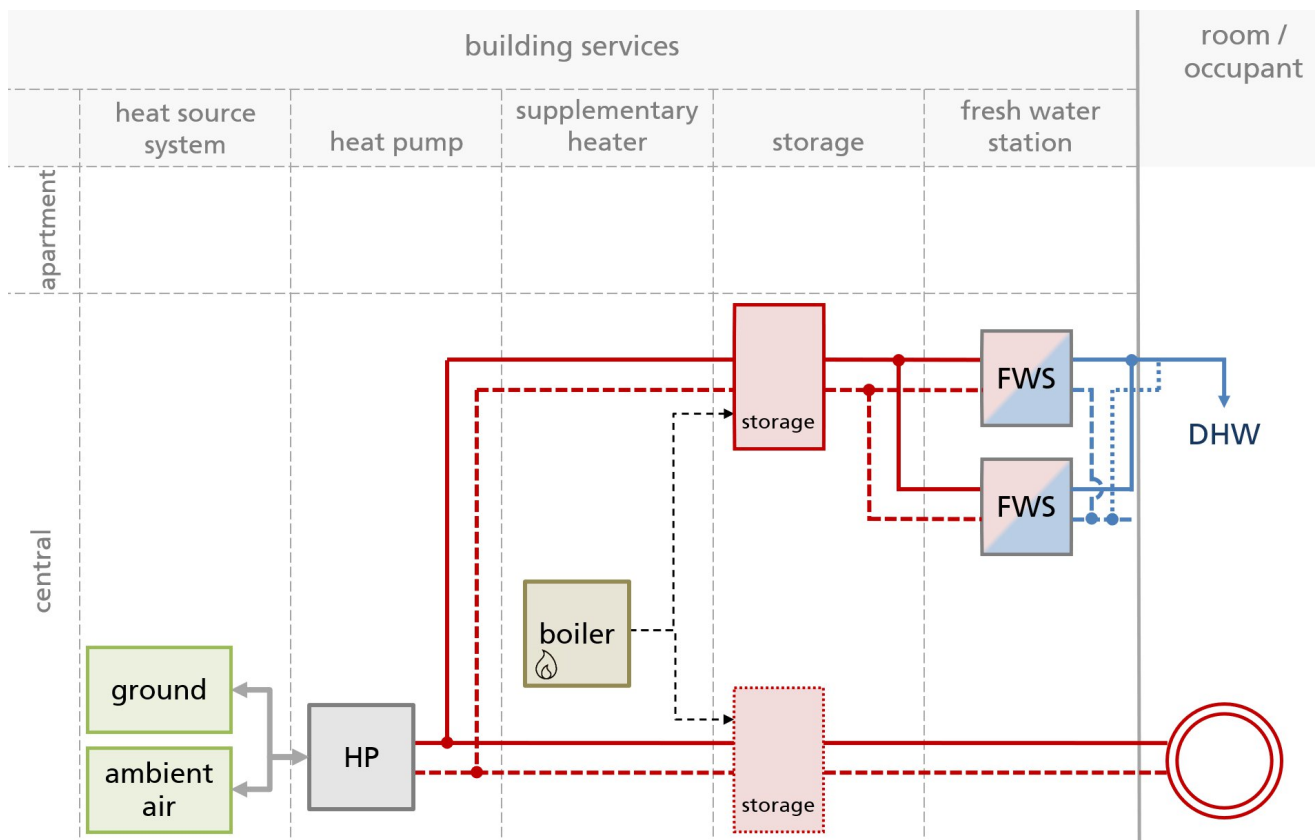
Scientific monitoring has just started recently



The building was originally built in 1963 and renovated in 1995. The building features a heated floor area of 2112 m² on 5 floors with a total of 30 apartments. The building was renovated exchanging the windows with insulating glazing ($U_{win} = 1.7 \text{ W/m}^2\text{K}$), and adding layers of thermal insulation (styrofoam, $d = 60 \text{ mm}$, $\lambda = 0.035 \text{ W/mK}$) to the façade, cellar and to ceiling, thus reducing the overall U-value of the opaque envelope from $U_{envelope} = 1.71 \text{ W/m}^2\text{K}$ to $0.323 \text{ W/m}^2\text{K}$.



Smartes Quartier Karlsruhe-Durlach, Ersinger Straße 4



Description of the technical concept

Heat pump system

- Heat pump technology
 - o Cascade of two heat pumps with $27 \text{ kW}_{th} + 43 \text{ kW}_{th}$
 - o Viessmann 351.B27 and 351.B43
- Heat source:
 - o Outdoor air unit: 40 kW_{th} nominal power
 - o Ground source heat exchanger: 18 probes à 18 m length, double U tube, 30 kW_{th}
 - o Hydraulic source system developed within research project «HEAVEN» by Fraunhofer ISE and Fa. Viessmann.
- Bivalent system with condensing gas boiler as back up (bivalent parallel operation)
- Two drinking water storages (2x 850 l)
- One heating buffer storage (850 l)
- Heat pump integrated into district energy systems via SG ready to allow optimization of self-consumption of PV and CHP electricity

Low Ex Measures:

- Heat distribution system:
 - o Original radiators are mostly sufficient to allow a reduction of nominal heating temperatures
 - o 13 of 150 radiators were identified as “bottleneck” radiators. These radiators are exchanged with radiators of larger heating power
 - o Reduction of heating temperatures to $55/45^\circ\text{C}$
 - o Hydronic balance
- Drinking water distribution:
 - o Two external freshwater stations
 - o Circulation