



Long-term monitoring and smart heat pumps for nZEB

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Herzo Base



1. Project Herzo Base
2. Energy concept
3. Control strategy
4. Conclusion and outlook

1. Herzo Base

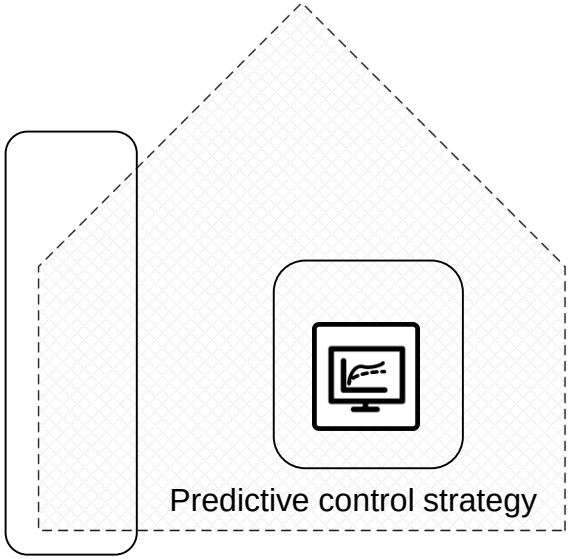
What was the idea?

System integration

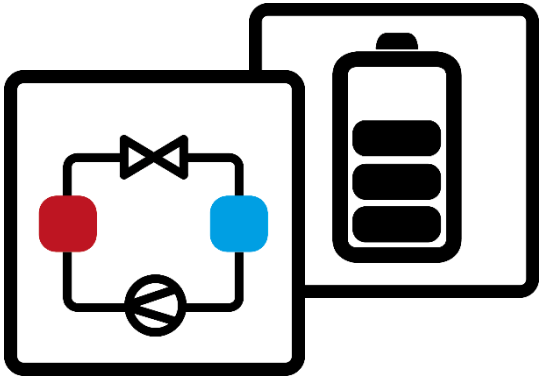
Passive components



Highly heat-insulating building materials



Active components



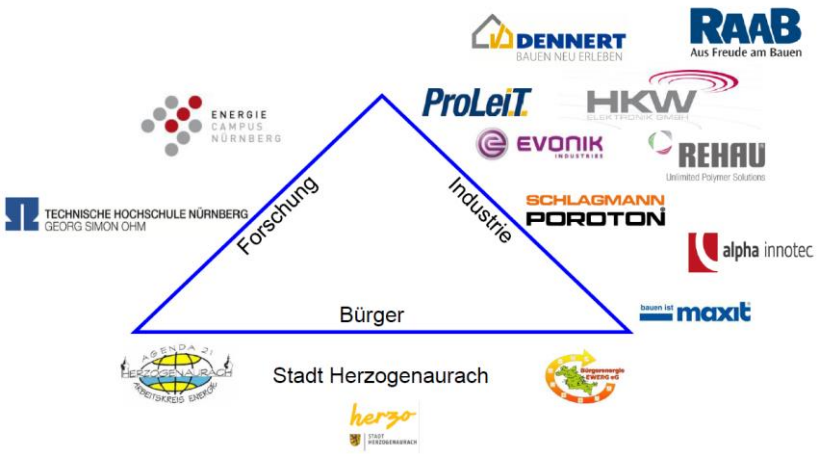
Heat pumps and Battery

- Increasing self-consumption of PV
- Plus Energy Building

1. Herzo Base

Partners and location

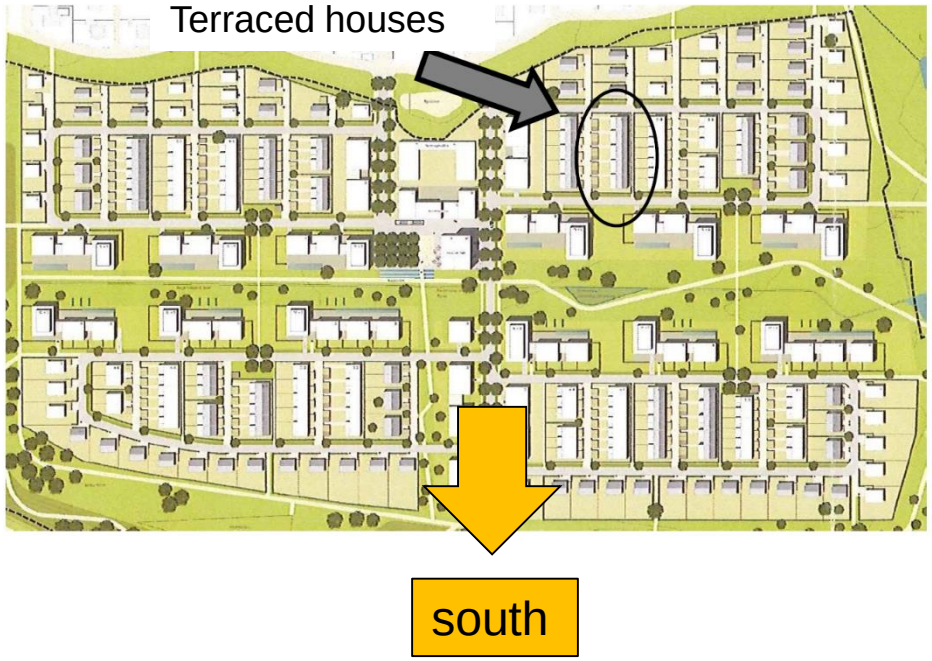
Project partners



- 12 partners
- 3 years

Supported by:
Federal Ministry for Economic Affairs and Energy
on the basis of a decision by the German Bundestag
FK 03ET1364A

District „Herzo Base“



1. Herzo Base

The terraced houses

Figure of terraced houses



Specific values

Heating and cooling power

- max. heat load: 22.7 kW
- max. cool load: 52 kW

Heating and cooling energy

- Heating energy: 8.9 kWh/m²a
- Cooling energy: 25.6 kWh/m²a
- DHW: 16.9 kWh/m²a

PV Production

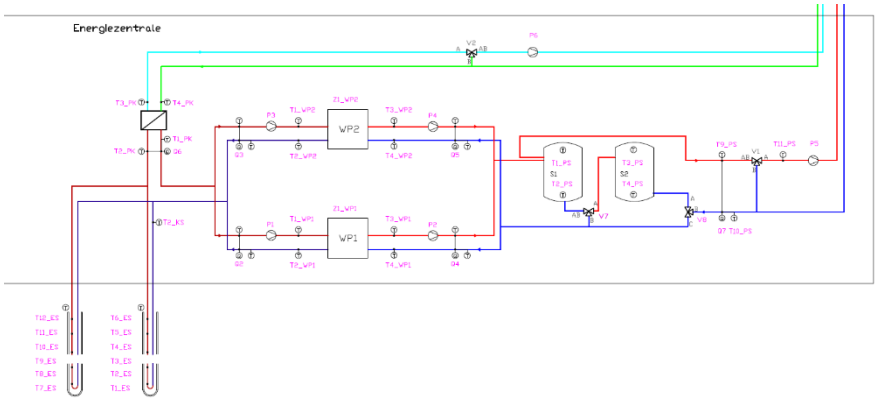
- PV: 66 MWh/a
- Peak: 98 kWp

2. Energy concept

Hydraulic structure

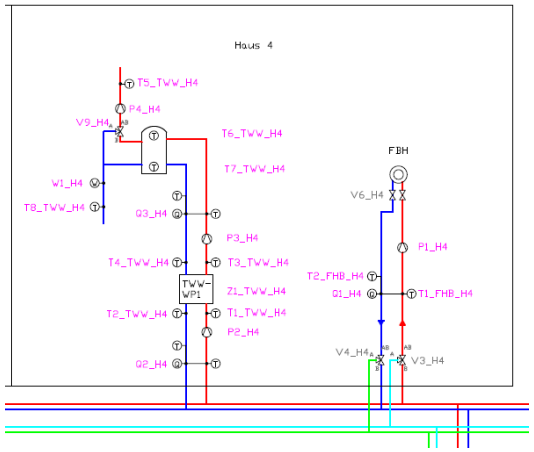
Installation room

- Geothermal source
- 2 modulating HPs
- Storage cascade



DHW

- Thermal source
- 8 DHW-HPs
- 200 liters storage



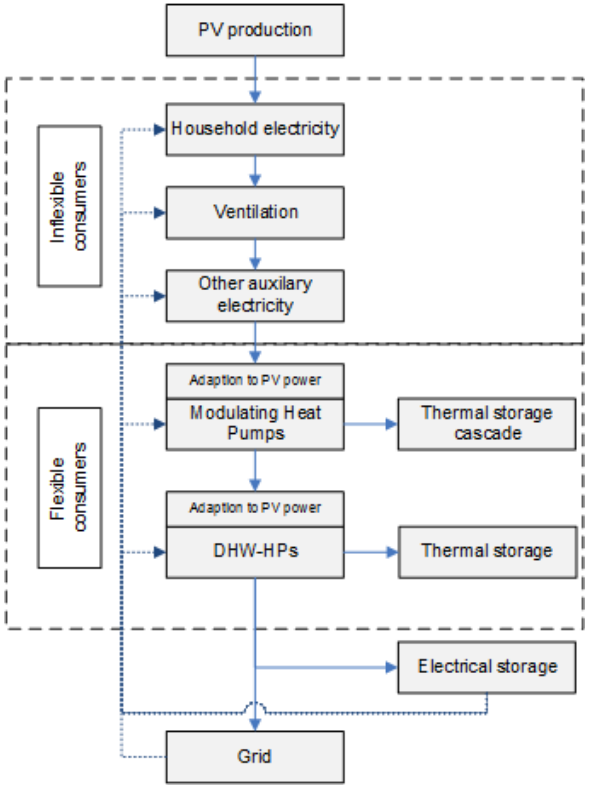
3. Control strategy

PV control

Control method

1. Target
    a. security of supply
    b. Increasing PV self-consumption
2. Method
    a. First: Inflexible consumers consumpt PV
    b. Next: Flexible consumers adapt to PV surplus
    c. Increase thermal storage temperature

Flow Chart of PV control



3. Control strategy

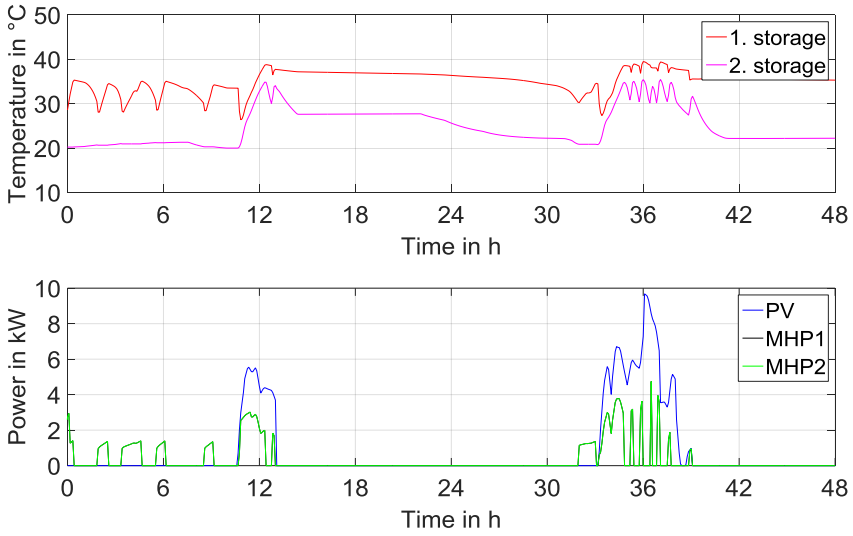
Adaption of modulating HPs to PV power

Operation modes

1. Grid and battery operation
    a. Consumpting as less energy as possible
    b. 40 % Modulation (high COP)

2. PV operation
    a. Using maximal PV power by adapting the speed
    b. Charging storages to maximal capacity

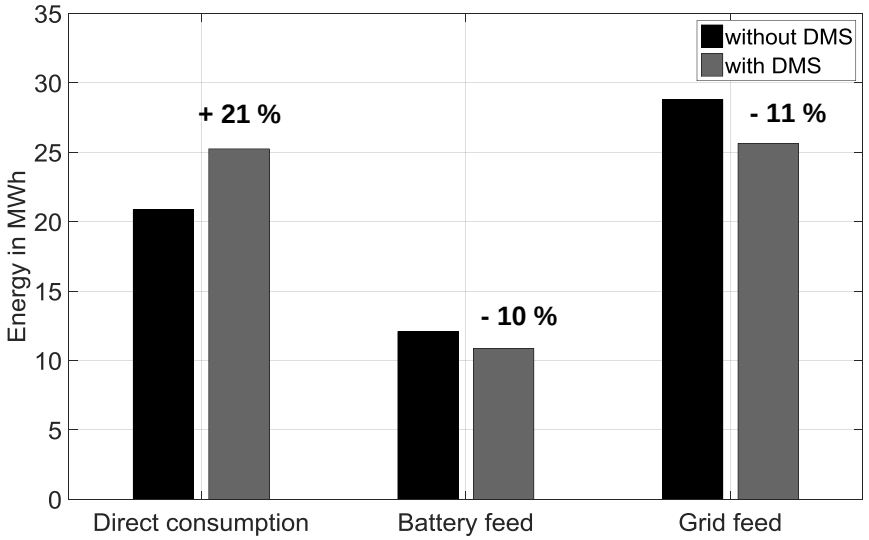
PV adaption



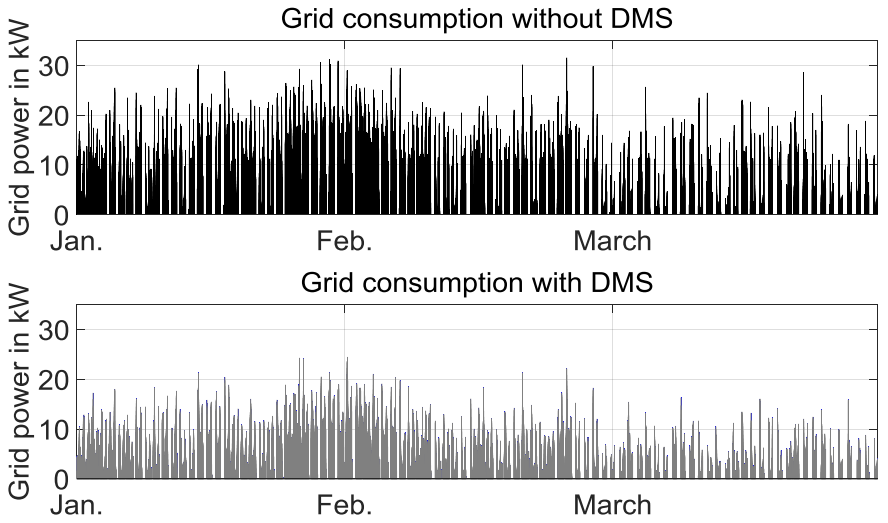
3. Control strategy

PV control

PV self-consumption



Grid consumption



Load peak reduction of 24 %

3. Control strategy

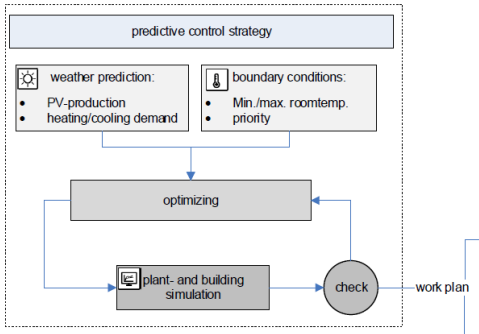
MPC control (ongoing work…)

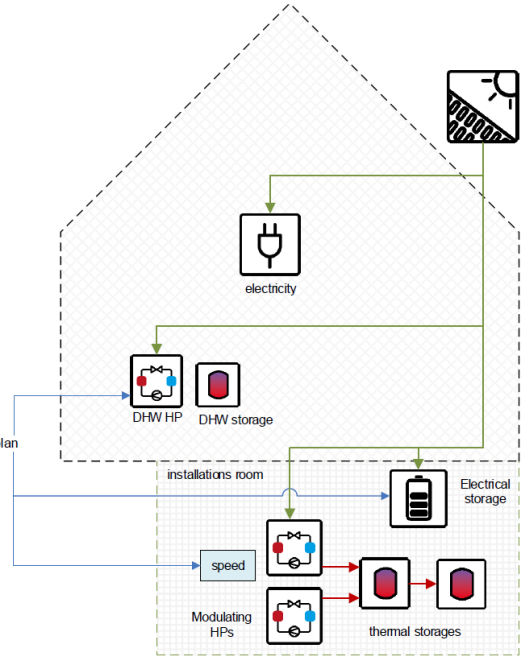
Prediction control

1. Targets
    a. Cost efficiency
    b. Energy efficiency
    c. Load management
2. Method
    a. MPC model
    b. Weather prediction
    c. Optimal modulation for 24 hours

Monitored by PV control to secure the energy supply

Model structure





4. Conclusion and outlook

Impact of smart heat pumps

Impact of modulating heat pumps on nZEBs:

- Modulating HP increase efficiency
- PV Adaption increase the PV self-consumption

Impact of control strategies for modulating heat pumps on nZEBs:

- *PV controlled strategy increase PV self-consumption*
- *MPC control can find optimum between efficiency and costs*