Sector coupling (heating, cooling, electricity) - cold district heating networks with intelligent control as key technology

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Example:
Small scale cold water district heating system in Wüstenrot

Details:
- 25 single family houses
- Heat pumps for domestic hot water and space heating
- Hot water storages
- Direct cooling in summer
- Agrothermal collector
- Low temperature heat source
- Direct cooling of buildings in summer

Main waste water channel

Waste water heat exchanger

Planned: Heat rejection of supermarket chillers (2 x 110 kW air coolers)
Example:
Small scale cold water district heating system in Wüstenrot

Installation of the 'Agro-thermal Collector'

Source: Doppelacker
Example:
Small scale cold water district heating system in Wüstenrot

Installation of the 'Agro-thermal Collector'

Starting trench
Ploughing in of tubes
Cutting area

Source: Doppelacker
Example:
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Example:
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Example
Intelligent Control – Local optimization and sector coupling

Development
- Setup of the cloud based master energy and data management system
- Connection to a the Virtual Power Plant of grid operator for clustered DSM
- Monitoring of all energy flows of the settlement in detail at building and system level
Example

Intelligent Control – Local optimization and sector coupling - Intelligent control modes

Local optimization per building by MPC

Load and generation profiles from MPC
- Weather forecast data
- Predicted PV - generation
- Statistical electrical loads
- User profiles
- Predicted heat demand

Schedule HP + Battery

Optimization

Charge schedule battery

Operation schedule heat pump

Operation schedule variable load (WM, E-Mobil)

Available electricity sinks for DSM

Grid based optimization (Grid operator)
Part A
Cold water district heating system in Wüstenrot

Practical problems

Hydraulic station

→ More icing at supply tube than at return tube!
Part A
Cold water district heating system in Wüstenrot

Practical problems → Simple reasons – strong effect!

Missing return flow blocker

Pump installed in the wrong direction

Local circuit
HP1
HP2
The intelligent interaction and control of multiple consumers, prosumers and suppliers in cold district heating networks
The transition of thermal Networks

Classical one dimensional system

Flexible bi-directional energy exchange system
Part B FLEXYNETS CONTROL
Multi-level control and optimization problem
FLEXYNETS CONTROL - Concept

Management Level
Strategic control

- Data Management
- Optimization
- Simulation / Load forecast

High Level Control → enisyst
Energy flow control

Supply System Control
LC1, LC2, LC3, LC4, LC5

Load Control
LC7

Storage Control
LC6, LC7

Low Level Control
FLEXYNETS CONTROL – Predictive control optimization

Optimization domain

Layer 1

- Forecasts
- Current state

Planning (12 hrs horizon)

Targets

Layer 2

Real-time control

Control signals

System (5 minutes)

State update (5 minutes)

State update (1 hour)
FLEXYNETS CONTROL - Implementation
Laboratory test system at EURAC Bolzano

Whole network control (EURAC and enisyst)

- Substations hardware and software development
- Low- and High-level controls tests
- Metering practices elaboration and assessment
FLEXYNETS CONTROL - Implementation

Modular TCP/IP based control structure

supervisory / strategic control

Local server or cloud service

high level control

consumer / prosumer

Substation

heat pump 1

Substation

heat rejection

Substation

generation 2

Substation

heat pump 2

Substation

generation 1

substation thermal network

Supplier

consumer / prosumer

substation heat pump 1

substation heat pump 2
THANKS FOR YOUR ATTENTION!

WWW.FLEXYNETS.EU

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