Thermo-hydraulic simulation of district heating networks
Outline

• Introduction
• Simulation of networks
• Further steps
• Conclusion
Introduction
Introduction
Simulation of networks

- commercial tools
  - PSS®Sincal
  - Termis
  - PSI Energy
  - Stanet

- URBEM DHS tool
  - GIS-Data
  - incidence matrix
  - hydraulic-steady state
  - thermal-transient
Simulation of networks

Hydraulic calculation

Radial network

Meshed network

Node: Mass balance

String: Pressure loss, pumps, valves
Simulation of networks

hydraulic calculation

String equations $f(w^2)$ lead to nonlinear system of equations

Simple linearization: $f(w^2) \rightarrow f(w_{i-1}w_i)$

Procedure:

1. Define initial values $(p, w)$
2. Set up and solve system of equations
3. Relaxation of $p, w$

iterative process
Simulation of networks

thermal calculation

FVM
implicit or explicit

hydraulic pressure and velocity distribution

thermal
Simulation of networks

analysis:

- pressure losses
- heat losses
- temperature management
- decentralized supply
- energy flow
- exergy flow
- usage of storages
Further steps

- Integration of various heat production technologies
- Application of graph theory
- Planning new or adapting existing networks
- Connection with other supply networks
- Energy Hubs

- Heat pumps
- Solarthermics
- P2H
GIS-based network calculation tool

basis for various analysis

exisiting and future DHN

hydraulic -> steady state

thermal -> transient

conclusion