2nd International Conference on Smart Energy Systems and 4th Generation District Heating
Aalborg, 27-28 September 2016

Towards 4th generation district heating

- A case study of possible solutions in Malmö, Sweden

Sofia Akhlaghi
Sofia Carlson
Lisa Brange
Henrik Landersjö

AALBORG UNIVERSITY
DENMARK

4DH
4th Generation District Heating
Technologies and Systems

Aim

Investigate possible solutions of 4DH in Malmö, with respect to technical, financial and environmental aspects

How?

- Design two models of low temperature DH and a model of conventional DH based on the city area “Varvsstaden” consisting 35 low energy houses
- Compare the solutions regarding heat losses, return temperature and flow velocity
- Compare them regarding economic viability and primary energy use during operational phase

Design of models

DH has two functions and temperature requirement for the consumer:

1. Function: DHW preparation
- Requirement: Swedish legislation, minimum 50 °C at the tap

2. Function: Space heating
- Requirement: 40-60 °C

Design two models where each function determines the grid dimensions of the system

1. Low temperature district heating (LTDH)
- Supply/return 65/35 °C
- Pipes of cross-linked polyethene (PEX)
- Secondary grid

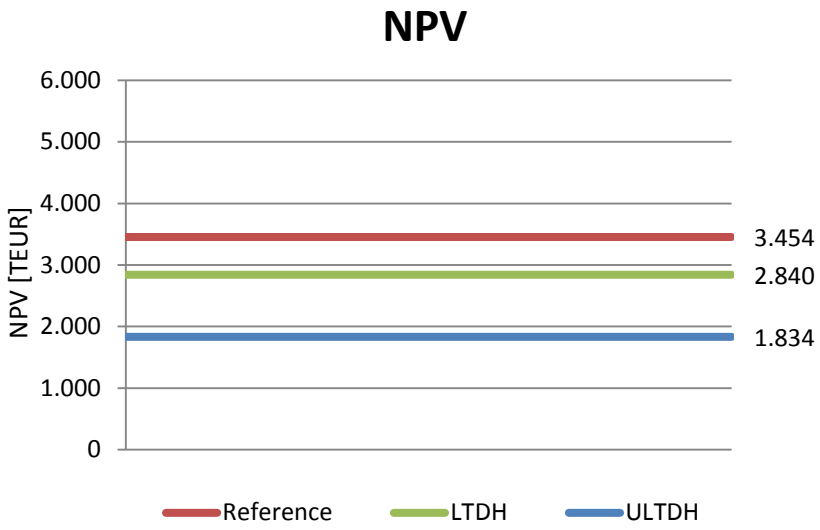
2. Ultra Low temperature district heating (ULTDH)
- Supply/return 41/20 °C
- Microbooster/electrical heater
- Pipes of polyethene (PE)
- Secondary grid

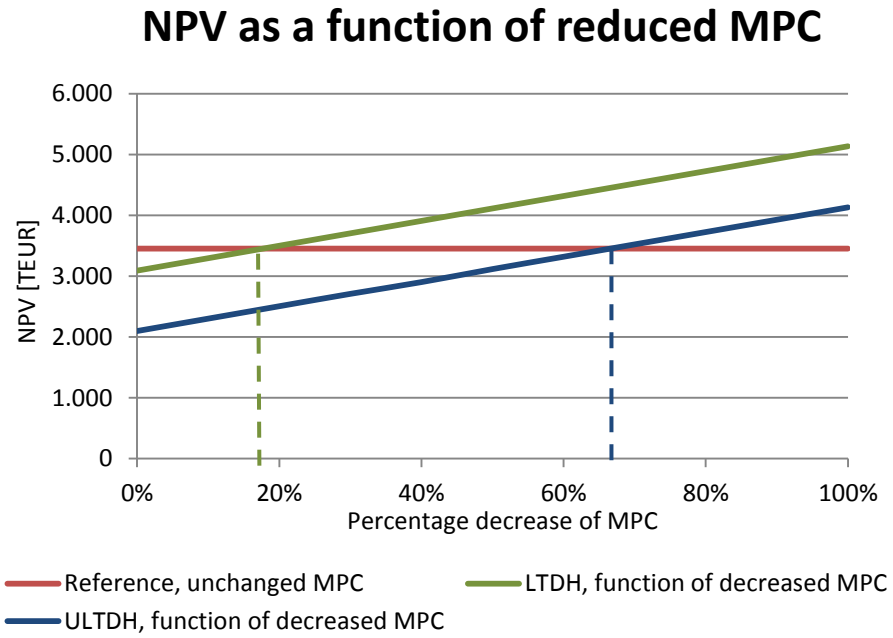
Reference case: Conventional DH, supply/return 112/65 °C
Pipes of steel, extension of Malmö main grid

Result – technical parameters

Parameter		LTDH	ULTDH	Reference
Comparison to Reference: *Decrease* in heat losses	[MWh/y]	440	610	-
Comparison to Reference: *Incease* in electricity demand	[MWh/y]	480	720	-
Mass flow at -16 °C	[kg/s]	73	119	38

Result– economy





AALBORG UNIVERSITY
DENMARK

Result – primary energy

Primary energy		LTDH	ULTDH	Reference
Malmö DH fuel mix + marginal el.	[GWh/y]	4,0	5,6	3,9
100 % excess heat (4DH) + marginal el.	[GWh/y]	0,12	1,9	3,9
100 % excess heat (4DH) + wind el.	[GWh/y]	<0,1	<0,1	3,7

Break-even	LTDH	ULTDH
Marginal el.	3,1%	48,0%
Wind el.	0,1%	0,0%

Conclusions

- **Limitation: Legionella restrictions**
- **Good cooling is crucial**
- **Economic viability depends on MPC**
- **Primary energy depends on electricity and excess heat**

Excess heat determines a 4DH-system economic viability and environmental benefits

4DH
4th Generation District Heating Technologies and Systems

Thank you!

AALBORG UNIVERSITY
DENMARK