District Heating
for Energy Efficient Building Areas

Kari Sipilä, VTT

Timetable

Starting September 1, 2008 and ending October 1, 2010; 25 months

Co-partners

VTT Energy Systems

Kari Sipilä
Miika Rämä

FVB Sverige AB

Ulrika Ottosson
Heimo Zinko

BB Energiteknik

Benny Bøhm

Building Research Establishment

Jonathan Williams
Antonio Rullan

The district heating market faces two strong challenges:

1. **Increasing energy efficiency of buildings decreases the heat demand of the customers. Therefore heat distribution will in turn get more costly and less efficient.**

2. **Furthermore, customers in new areas also wish to use their own heat sources based on renewable energy such as solar energy or heat pumps, which accentuates the difference between summer and winter loads.**

Project objectives

Strategies for securing and widening the district heating market by offering district heating to housing areas with increasingly improved energy efficiencies and use of renewable energy sources (CO_2 neutral).

1. **Summer and winter heat demand analyses in low heat density areas and recommendation for design and operation of the future district heating systems**
   - **Development of loads in different areas of district heating networks**
   - **Low heat load demand examples**
   - **Load scenarios**

2. **Integration of heat sources (RES) in district heating areas and how the system should be designed for such areas**
   - **How to integrate RES in DH areas?**
   - **Successful integration of RES in DH systems**
   - **How should RES, houses and the network be developed for such areas**

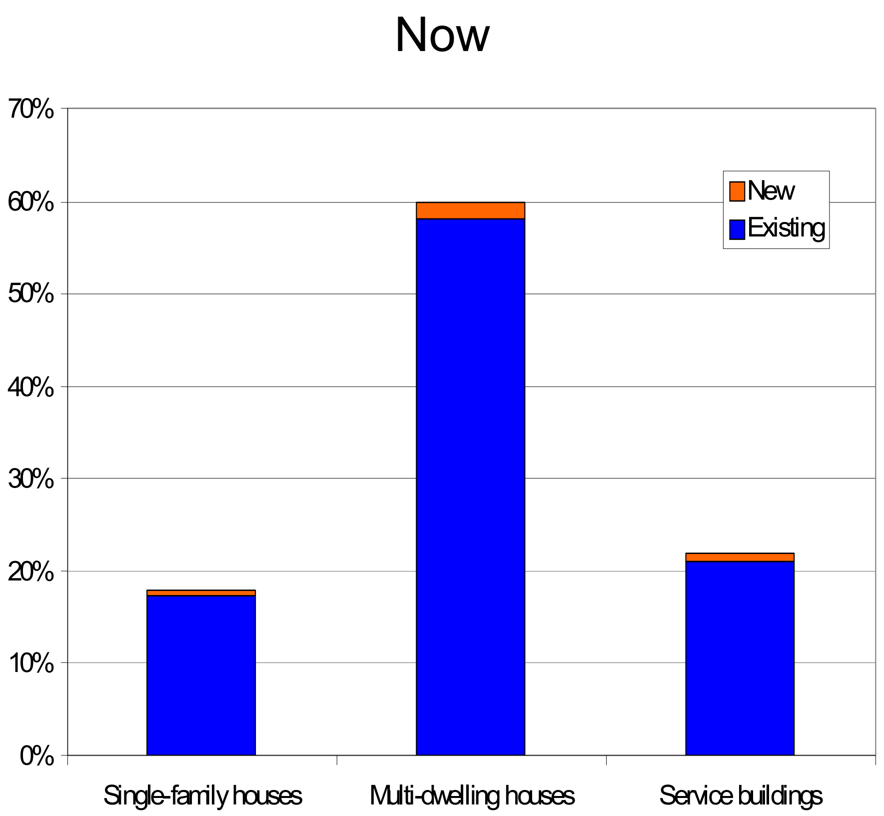
3. **Offering DH to new areas with heat line densities, which so far were not considered interesting for economic district heating supply**
   - **Heat demand density**
   - **Capital and running costs**
   - **Dwelling density for district heating contra distributed heating solutions**

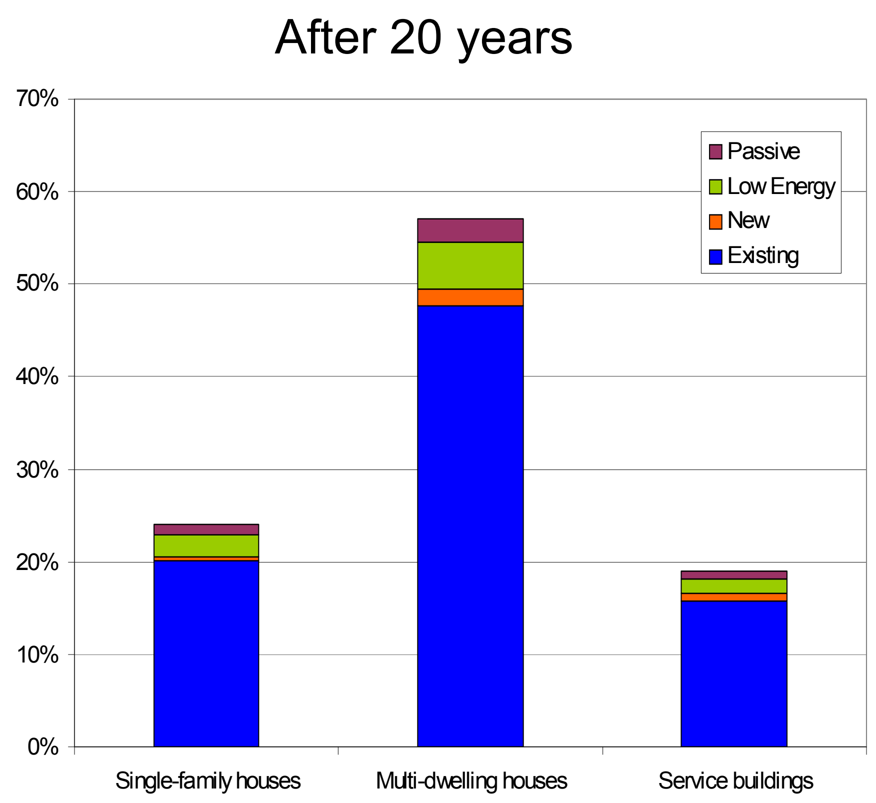
Characteristics in heat density areas

Characteristic	Unit	High	Medium	Low	Obs!
Heat density/ pipeline	MWh/m,a	> 1,0	<1,0	<0,5	
Heat density/area	kWh/ha,a	50	30	10	
Annual energy/dwelling	kWh/a	16 000	12 000	5 000	
heating/ hot tap water	kWh/a	10 000/6000	8000/4000	1000/4000	
DH temperature	°C	90	60	60	
		90	90	90	
Hot water					
-with heat ex.	°C	55	55	55	
- with heat storage		60	60	60	
DH Heating	CHP	plant			
	Gas	boiler			
	Pellets	boiler			
	oil	boiler			
	Heat pump	ground, air			
Individual consumer	gas, pellets, oil boiler				
Prices	EUR/MWh	Electricity, DH, gas, pellets, oil			
Discount	%	3	6	10	
used time	y	25	DH		
	y	12,5	2 gas and pellets boilers during 25 y		
	y	8,5	3 heat pumps during 25 y		

Buiding stock deviation by type and age

Suburban district heating area in Sweden

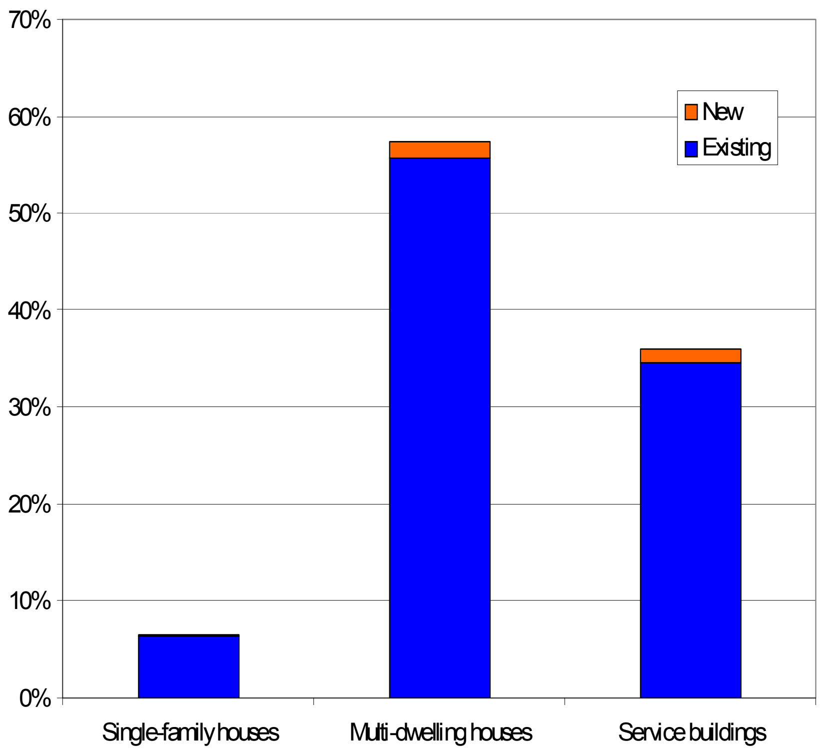




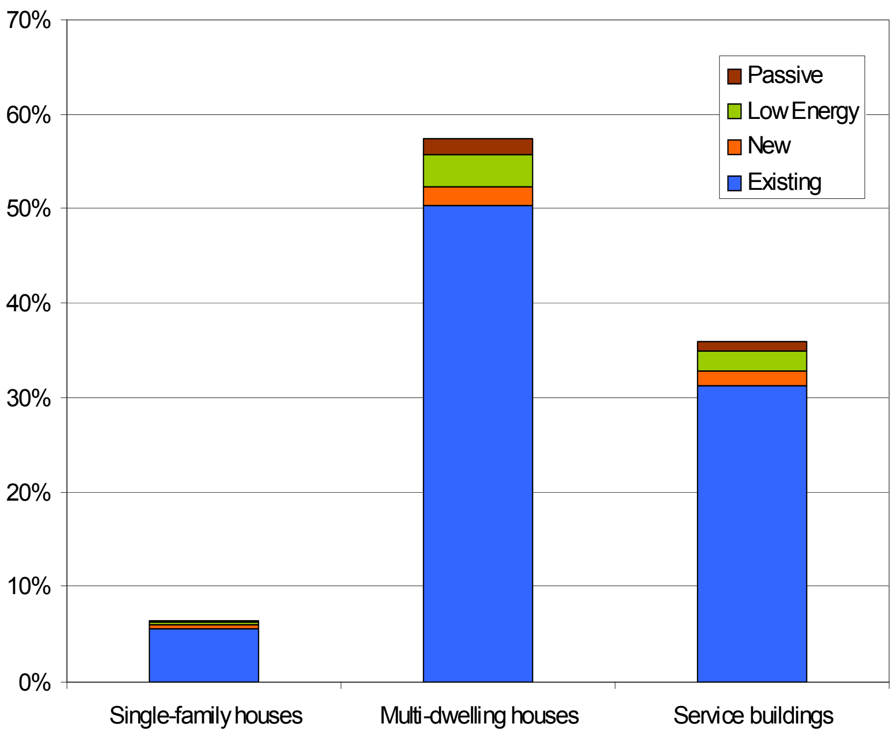
Building stock deviation by type and age

City Centre and Inner City District heating area in Sweden

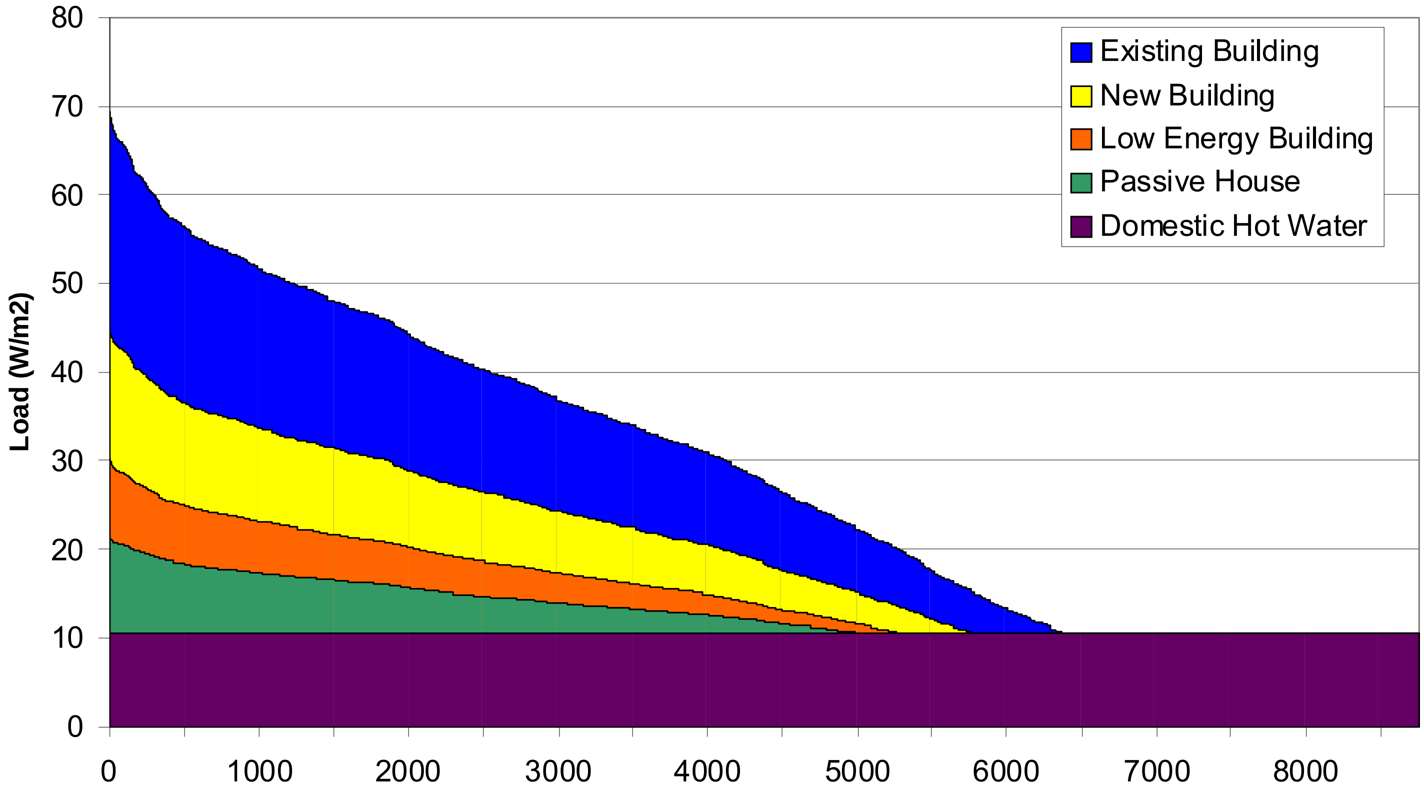
Now



After 20 years



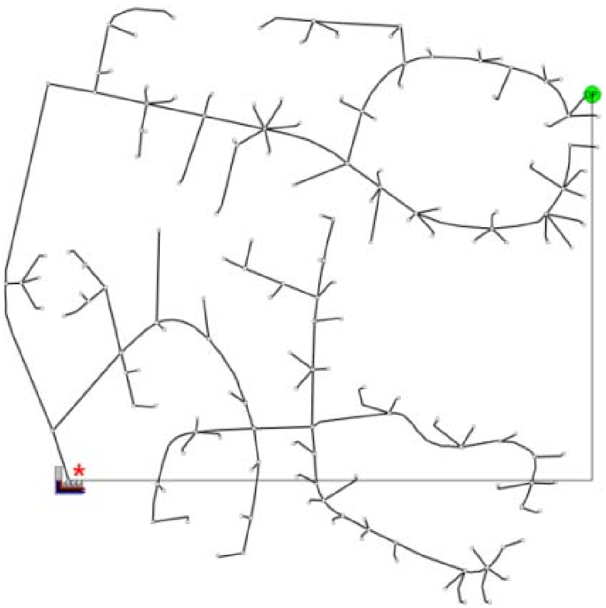
Duration curves for buildings



Examples of individual integration of RES

Concept A: ”Constant” Load System

Theoretical case in Ullerod 30 km NW of CPH

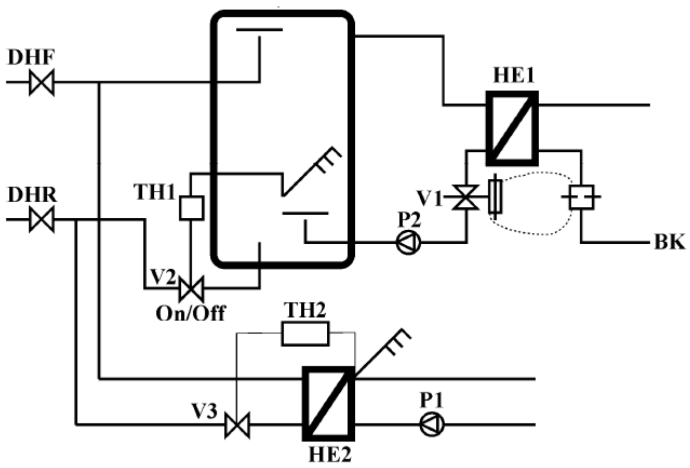


Concept based on the future development of DH supply of 92 class 1 houses of 145 m².
Traditional tracé

- Alupex Twinpipes, class 2 isulation for dimensions Ø14-32 mm
- Steel Twin pipes, class 2 insulation for dimensions DN32-DN 80
- 10 bar system (maximum pressure) – alternatively 6 bar system
- Low supply **temperature with 50 °C** at end consumer (minimum)
- District heating **buffer tank DHW**
- Floor heating for constant space heating load – alternatively radiators

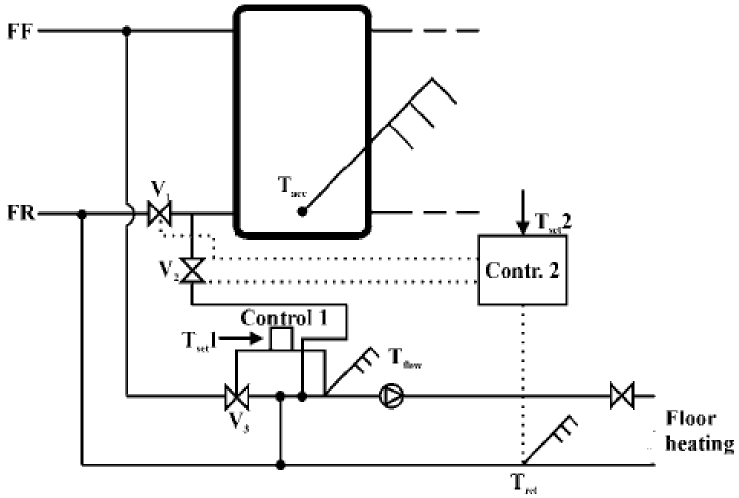
Solution A.1

A tank with DH water is loaded continously by a low flow (≈ 20 l/h). The low flow is controlled by a valve which will maintain a good stratification in the tank and a low return temperature. DHW is produced in an efficient heat exchanger.



Solution A.2

In this solution the tank supplies water to the floor heating system, if the temperature is high enough.



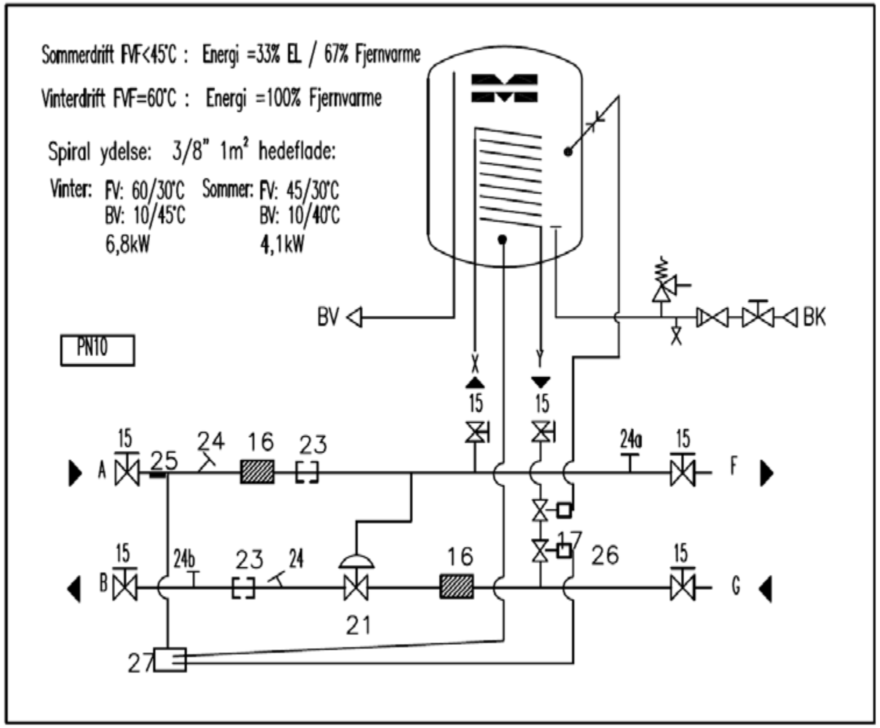
Concept B: Tullebølle Cold District Heating in DK

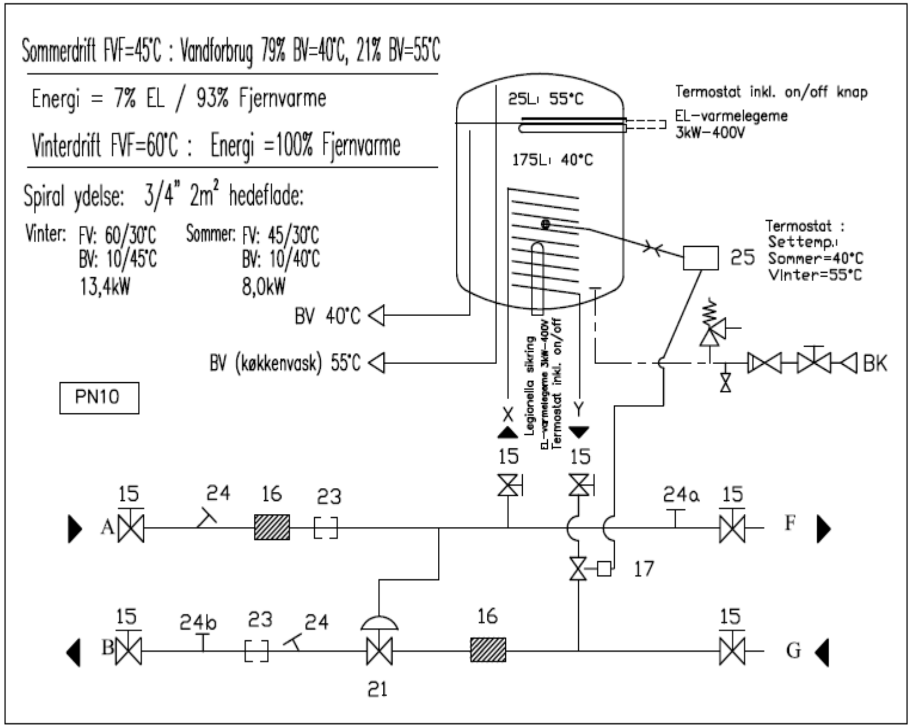
In **Cold District Heating** very low supply temperatures (< 50 °C) are used and a DH unit in each house can increase the supply temperature by use of electricity or solar heating

The DH company produces this ”cold” district heating in the summer period.
In the winter period a ”normal” supply temperature is used.

Solution B.1

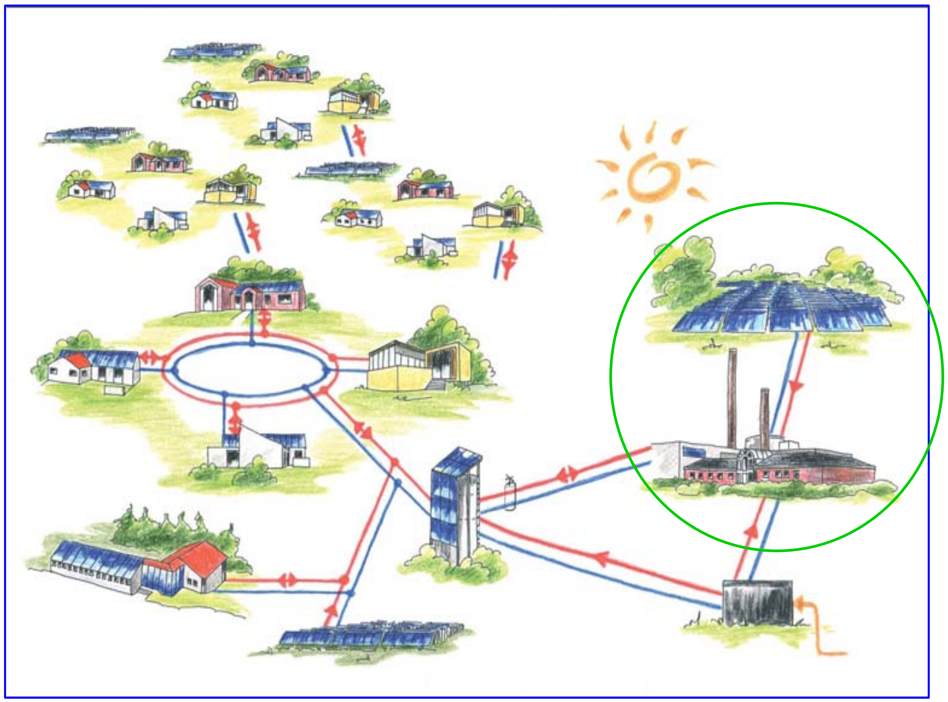
Solution B.2

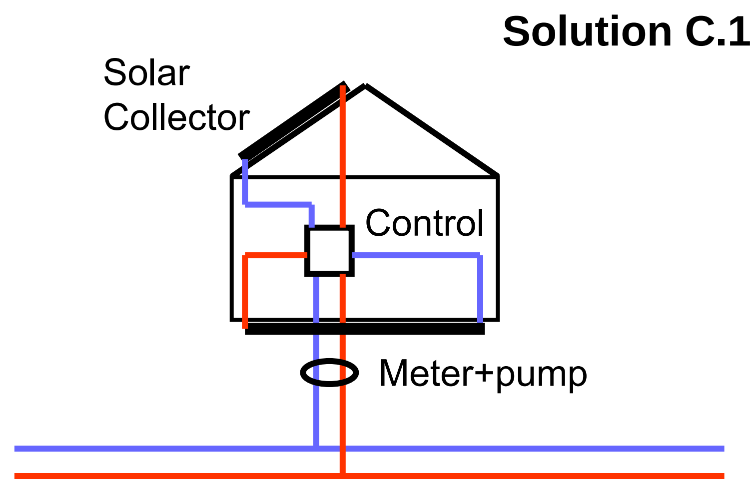


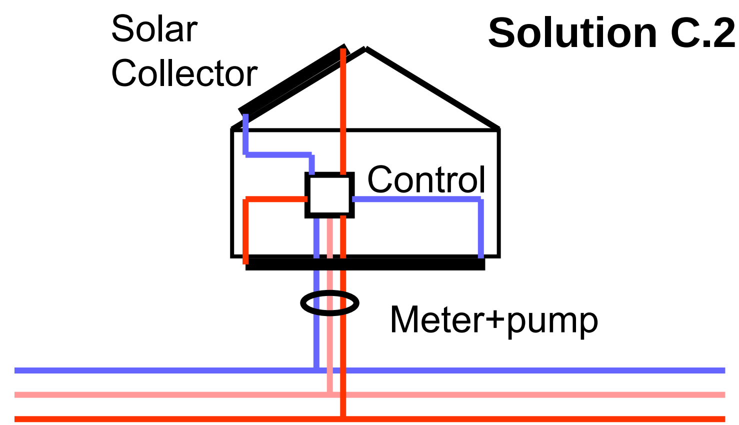


Consept C: BRÆDSTRUP case

Solar heating + Heat pump

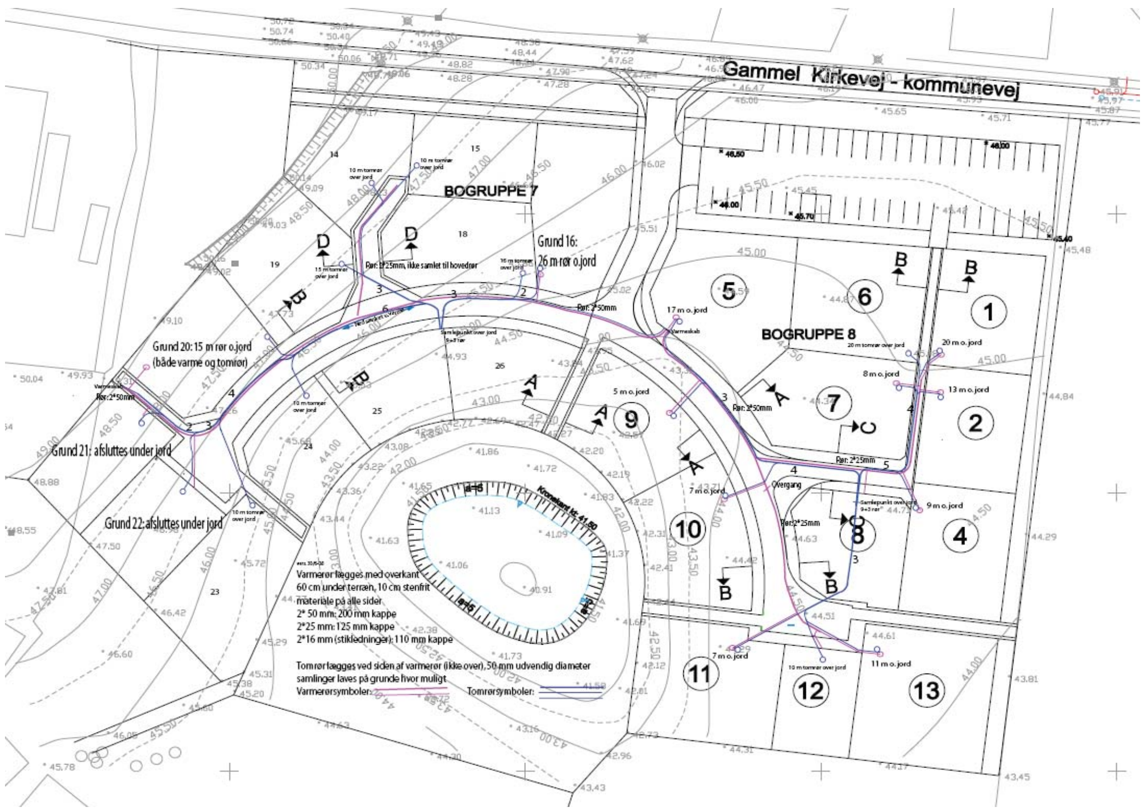






Concept D: HJORTSHØJ, Århus

Pulse operation and summer stop



Case studies looked at in UK

Brooke End

42 detached houses
2.7 ha, 15 dw/ha

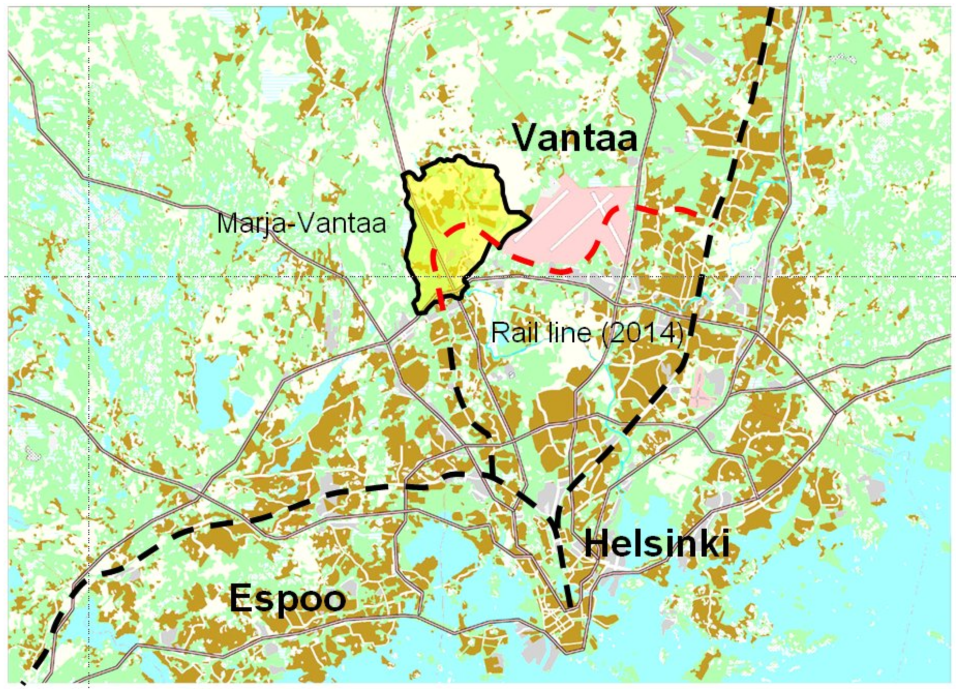
Hunter Oak

96 dwellings in detached, semi detached, and terraced houses; 3 ha, 32 dw/ha,

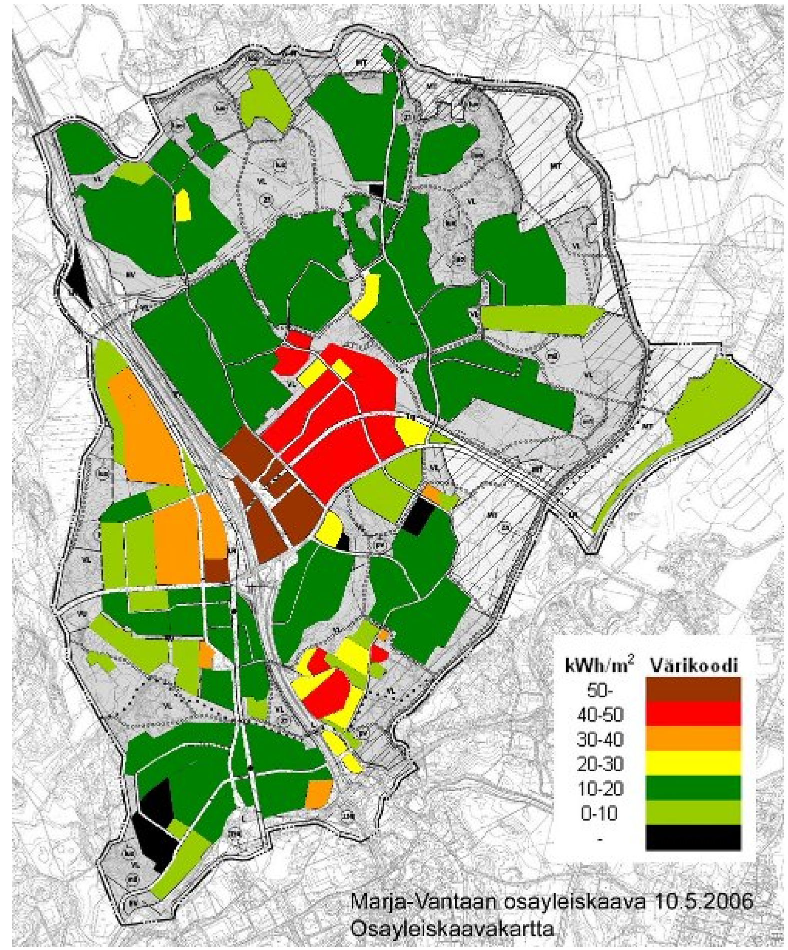
Heat densities

large new build detached dwellings - 42 dwellings		Brooke End	Hunters Oak	Jamestown Way
density	dw/ha	15	31	40
2006 Compliant Building				
heat density	kWh/m^2	14	23	23
linear heat density	MWh/m	0.44	0.58	0.44
Passive house				
heat density	kWh/m^2	7	13	14
linear heat density	MWh/m	0.24	0.34	0.26

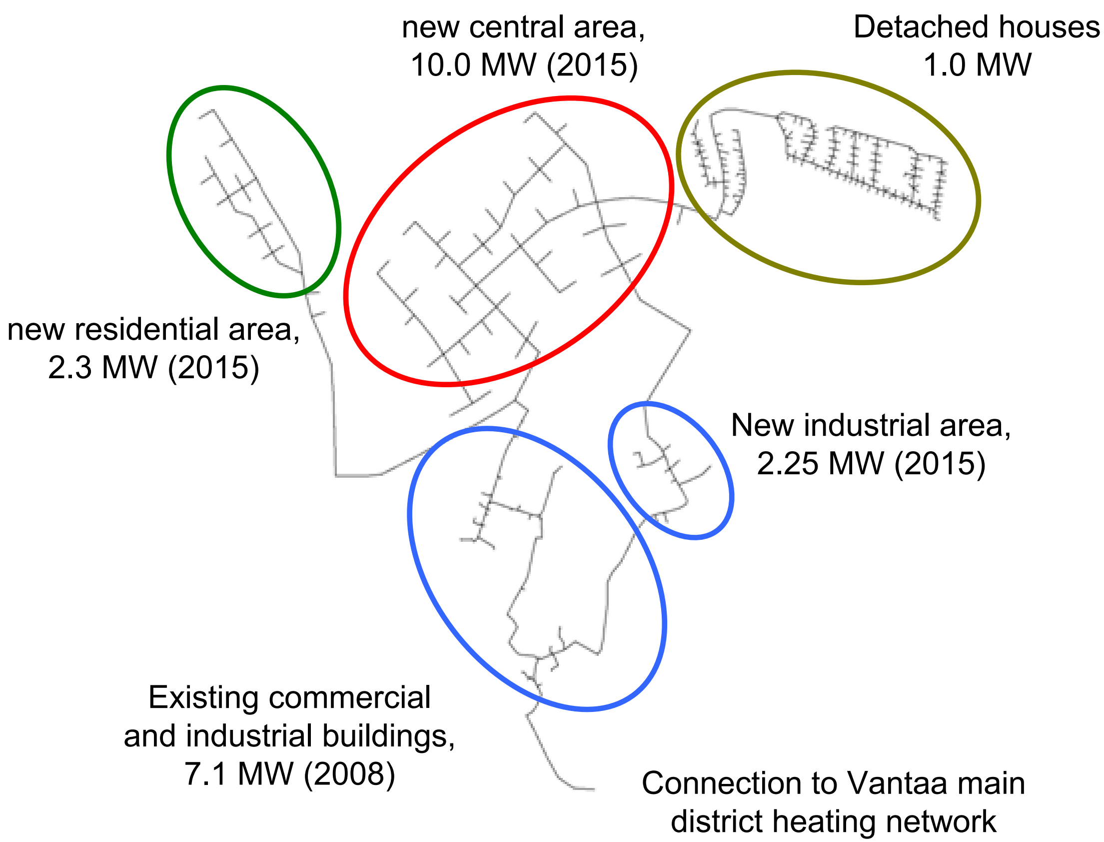
Marja - Vantaa, FI



calculated energy densities (kWh/m^2) in 2030.



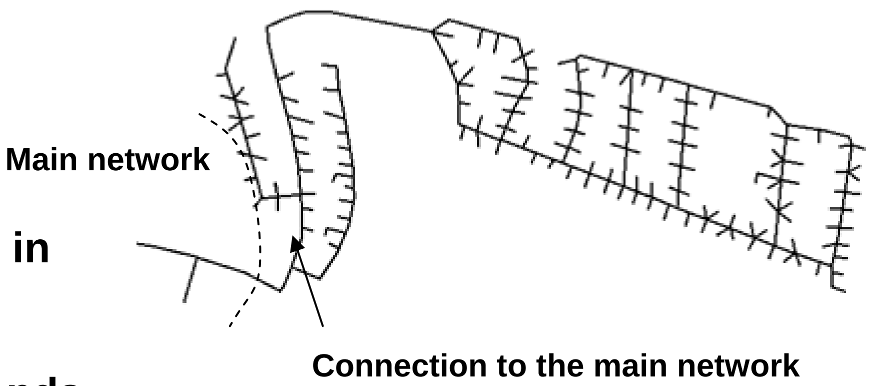
Marja - Vantaa area



Attaching a small house area to DH network

The economy of connecting small house areas to main district heating network will be investigated by calculating costs and

- **varying the lenght of the pipe connection between the area and the main network**
- **varying the district heating connection rate in the area (20% / 60% / 100%)**
- **setting the energy consumptions and demands according to different building types (normal, low energy, passive)**
- **alternative connections of the houses**
- **lowering the temperature level**



Comparing the costs

DH company point of view

- Choosing a reasonable repayment period and interest rate
- Pipe costs (investment), yearly running costs (pumping, heat losses) and energy consumption in the area (costs and revenues discounted)
- Investigating different scenarios (connection rate, specific consumpition, distance from the main network)

What is the price (€/MWh) needed to reach the decided repayment period?

Consumer point of view

- Comparing the costs of district heating to alternative heating methods
- Investment costs needed for different components such as substations, piping and water radiators, electric radiators and house specific boilers (oil, pellet)
- Information on price of electricity, heat and selected fuels needed

What is the most affordable alternative?


The work will be continued
Thank you for your attention !