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Low temperature district heating and new energy efficient building blocks

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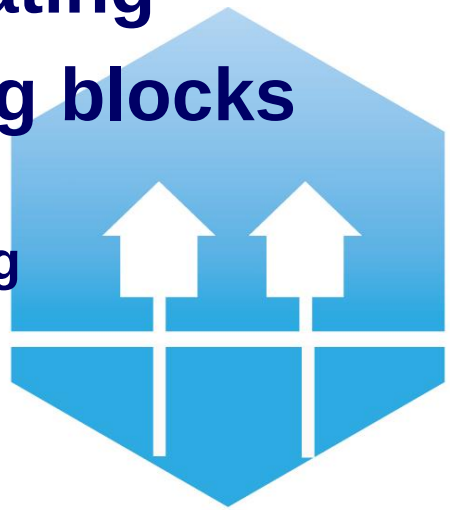

AALBORG UNIVERSITY
DENMARK

4DH
4th Generation District Heating
Technologies and Systems

- This presentation is based on the on-going project:

  Low temperature district heating and new energy efficient building blocks

- The project is funded by Swedish Energy Agency, Växjö Energy AB and Växjö Municipality
- Here we give an overview of the project with some preliminary results

Introduction

- Sweden is less fuel dependent than the global average but still fuels accounted for 87% of Sweden's energy supply
- Building sector consumed 38% of total final energy use
- District heat covered 32% of final energy use in the building sector
- More than 90% of multi-dwelling buildings are district heated
- New buildings can be built with very low heating demands
- The energy supply can be energy-efficient and based on renewable resources
- Such an development contributes to a sustainable development with low natural resource use and climate impact

Aims of the project:

- To facilitate planning and design of new buildings and their energy supply systems
- To formulate strategies and policy measures for the built environment that
  - Reduce the primary energy use and
  - increase the use of renewable energy

  in a cost-efficient way

Project period:

36 months, January 2015 - December 2017

Specific goals

1. To analyze cost, carbon dioxide emissions and primary energy use for heating new building blocks with
   - Low temperature DH (district heating)
   - Conventional DH
   - Heat pumps without a DH-network
2. To analyze the impact of climate change on heat and cooling demands
3. To analyze how future cooling demands may be avoided
4. To analyze how energy-efficient household appliances and lighting influence primary energy use and indoor temperatures
5. To analyze the possibility to use electricity for domestic hot water heating instead of DH during summer months
6. To cost-optimize the space heating demands and compare these demands with demands based on the Swedish building code and passive house criteria

Project site

- Växjö: a city of about 65 thousand inhabitants
- Current district heating system:
  - ~ 185 MW_{peak}
  - ~ 630 GWh_{heat}/year
  - ~ 98% of fuels are based on biomass
  - 2 biomass based CHP plants

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Project site

- A new developing area of Torparängen, Växjö
- Three different levels of exploitation based on:
  - 5 or 6 story-apartment buildings
  - Row houses
  - Villas
- Consideration of different building frames
  - Concrete
  - Wood

Three different exploitation of the development area

Low

Medium

High

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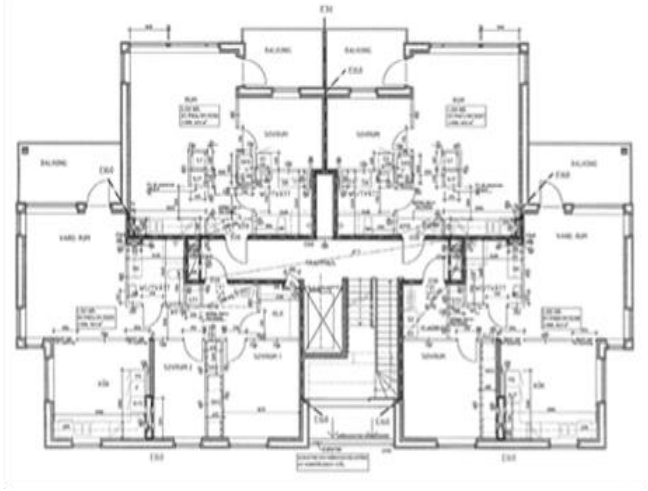
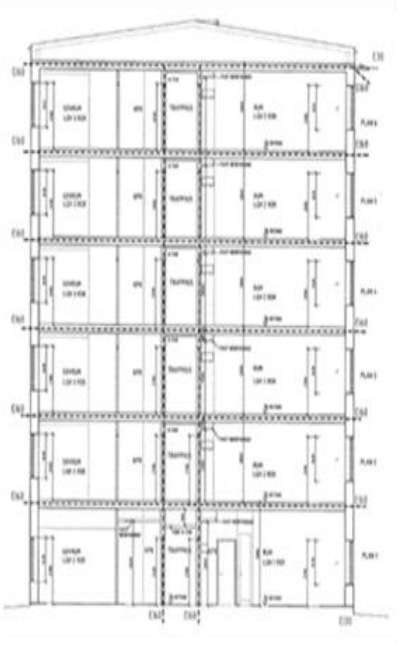
Case study building – Apartment building





- 6 stories (varies between 5-6)
- 24 apartments (varies between 20-24)
- Total heated floor area 1686 m^2 (varies between 1405-1686)

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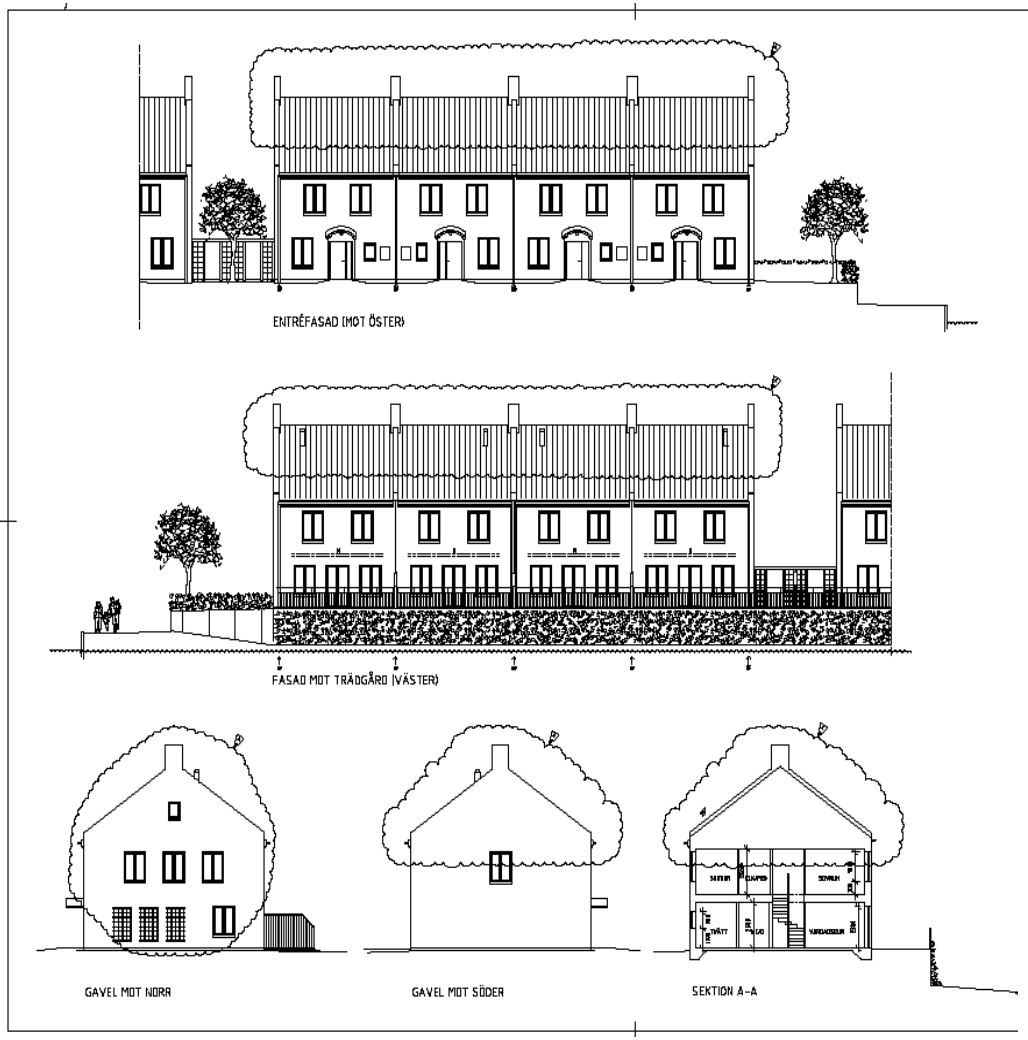
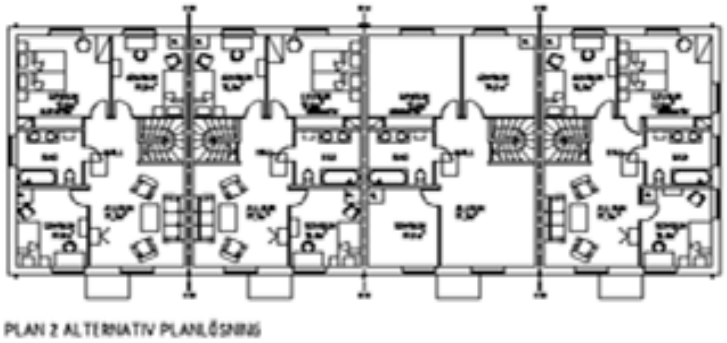
Case study building - Row house



- 2 stories
- 4 row houses
- Total heated floor area 560 m2



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Low exploitation of the development area

- Row houses: 29
- Villas: 39

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Low exploitation

Space heating load (kW) for each individual row houses

Building type	Building No. on layout	Space heating load, kW	
		Building code	Passive houses
Row house	1.1; 2.1 and 3.1	5.78	2.14
	1.6 and 2.10	5.87	2.29
	1.2 – 1.5 and 2.2 – 2.9	3.99	1.80
	3.2 - 3.12	4.34	1.93
	3.13	6.20	2.42

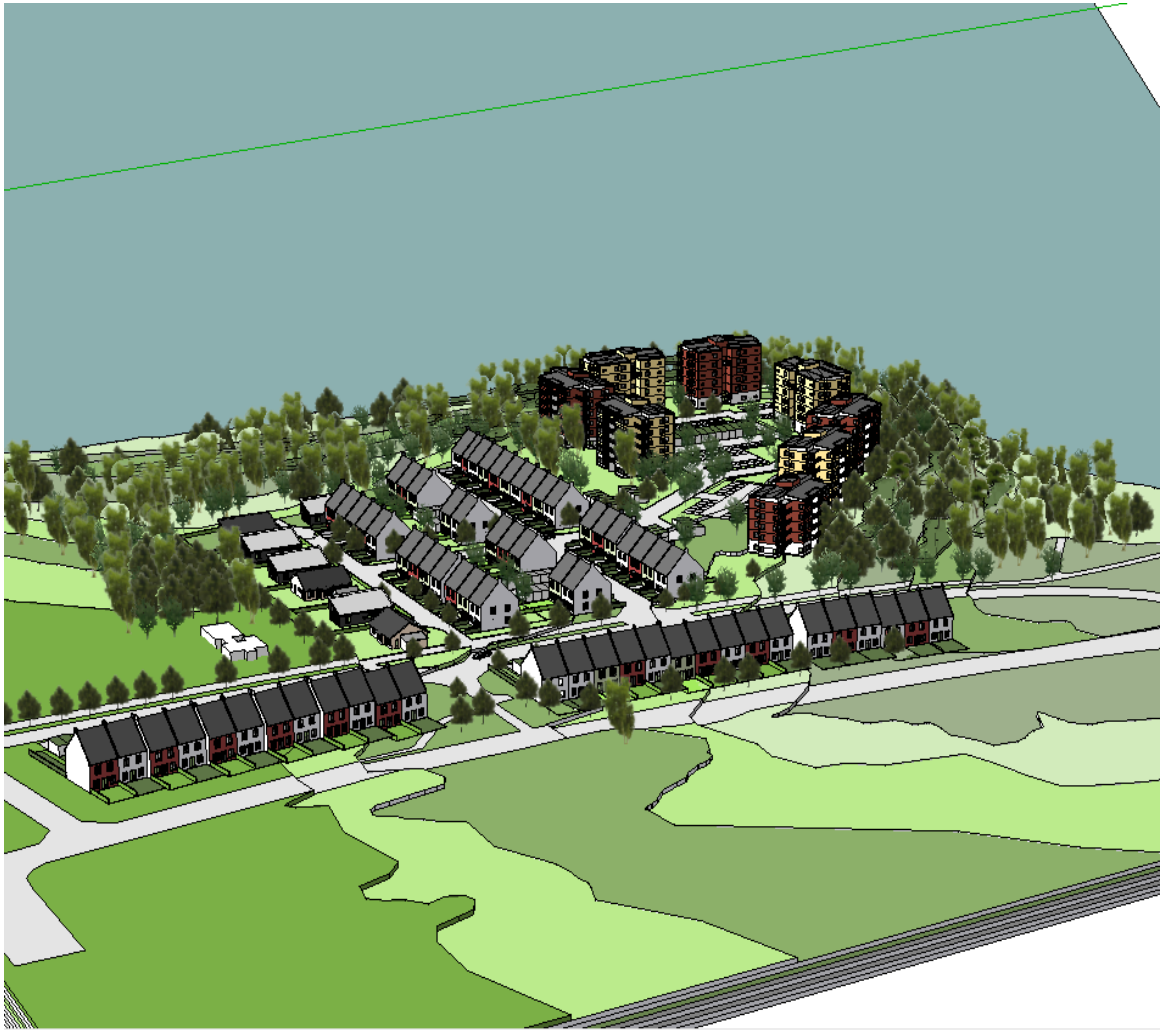
Low exploitation

Space heating load (kW) for each individual villa

Building type	Building No. on layout	Space heating load, kW	
		Building code	Passive houses
Villa – 100 m²	5; 9; 15; 17; 18; 35 and 39	5.68	2.06
Villa – 110 m²	2; 4; 11; 22; 24; 27; 33 and 36	5.81	2.16
Villa – 120 m²	1; 3; 12; 16; 23; 26; 30: 31; 32; 34 and 38	5.94	2.26
Villa – 150 m²	6; 7; 8; 10; 13; 14; 19; 20; 21; 25; 28; 29 and 37	6.32	2.55

Medium exploitation of the developing area

- Apartments: 188
- Row houses: 68
- Villas: 7



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Medium exploitation

Space heating load (kW) for each individual apartment building

Building type	Building No. on layout	Space heating load, kW	
		Building code	Passive houses
6 storeys (24 apartments)	1 – 7	54.47	27.82
5 storeys (20 apartments)	8	46.27	23.63

Medium exploitation

Space heating load (kW) for each individual row house

Building type	Building No. on layout	Space heating load, kW	
		Building code	Passive houses
Row house	1.1; 2.1; 3.1; 4.1; 4.11; 4.18; 4.21; 4.23; 4.28; 4.31; 4.33 and 4.37	5.78	2.14
	1.6; 2.10; 4.10; 4.17; 4.20; 4.22; 4.27; 4.30; 4.32; 4.36 and 4.39	5.87	2.29
	1.2-1.5; 2.2-2.9; 4.2-4.9; 4.12-4.16; 4.19; 4.24 – 4.26; 4.29; 4.34; 4.35 and 4.38	3.99	1.80
	3.2 - 3.12	4.34	1.93
	3.13	6.20	2.42

Medium exploitation

Space heating load (kW) for each individual villa

Building type	Building No. on layout	Space heating load, kW	
		Building code	Passive houses
Villa – 100 m²	5 and 7	5.68	2.06
Villa – 110 m²	2 and 4	5.81	2.16
Villa – 120 m²	1 and 3	5.94	2.26
Villa – 150 m²	6	6.32	2.55

High exploitation of the developing area

- Apartments: 360
- Row houses: 29

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High exploitation

Space heating load (kW) for each individual apartment building

Building type	Building No.	Space heating load, kW	
		Building code	Passive houses
6 storeys (24 apartments)	1 - 15	54.47	27.82

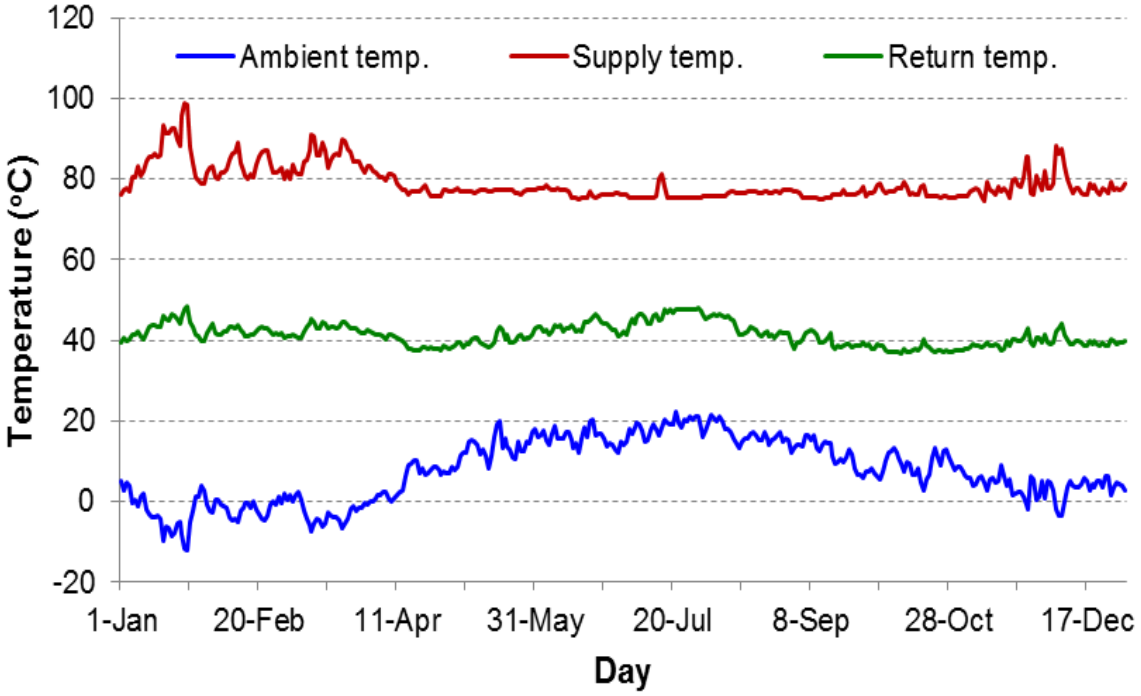
High exploitation

Space heating load (kW) for each individual row house

Building type	House No.	Space heating load, kW	
		Building code	Passive houses
Row house	1.1; 2.1 and 3.1	5.78	2.14
	1.6 and 2.10	5.87	2.29
	1.2 – 1.5 and 2.2 – 2.9	3.99	1.80
	3.2 - 3.12	4.34	1.93
	3.13	6.20	2.42

Examples of current on-going activities

- Design of DH-networks and substations and calculation of investment costs and heat losses for
  - Conventional district heating
  - Low temperature district heating



Operation of the Växjö DHS in 2013

We will be able to present much more results next year

Thank you!