District heating and cooling in Stockholm
Site visit to the Ropsten plant

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Agenda

- Introduction
- Short overview over the plant
- Intro to District Cooling
- Fortum Heat Pump plants
- Ropsten 1,2
Värtan Plant - a Century of Energy
The Värtan Trigeneration Plant

**Maximum capacity**

- **CHP ("KVV 6")**
  - 145 MW el / 310 MW heat
- **Biooil fired CHP**
  - 190 MW el / 320 MW heat
- **Heat pumps/chillers**
  - 275 MW heat / 150 MW cooling
- **Peak load boilers**
  - 620 MW heat
- **Electric boilers**
  - 230 MW heat
- **Gas turbine 3**
  - 54 MW el
- **Accumulator**
  - 40,000 m³ / 2,000 MWh

**Energy production/2009**

- **Heat**
  - 3,287 GWh/year
- **Power**
  - 930 GWh/year
- **Cooling**
  - 313 GWh/year
Fuel Handling in an Urban Environment

THE NORTH QUAY
1. Cold seawater used to cool the closed water loop of the District Cooling system. The seawater is then returned to the lake.

2. Energy from the district cooling system is recovered and recycled in the district heating system.

3. Nighttime and times when the need for cooling is limited, cold water is stored in the accumulator.

4. The low temperature in the district cooling system is transferred to the building’s closed loop distribution system via a heat exchanger.
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District Cooling in Stockholm city

- 600 buildings
- 204 km piping
- PN 10-16 bar
District cooling value - customer value

**Simpler**
- Minimal maintenance requirements
- Free space in and around the building
- The need of cooling is equal with consumed cooling
- Predictable economy

**Safer**
- High reliability
- Safe cooling supplies
- Long-term and reliable investment
- Proven technology

**Cleaner**
- No noise, local, or to environment
- Better use of energy
- Reducing carbon dioxide emissions and refrigerants
- Better management of Earth's resources

Simpler

Safer

Cleaner
DC in Stockholm today?

- Approx. 135 customers
- Approx. 600 buildings connected
- Connected load ~ 330 MW
- Average customer ~ 500 kW
- Range 8-7,000 kW
Production mix District Cooling 2010

Production 2010
- COP$_c$ = 6.9
- Percentage free-/waste cooling 57%

- Free cooling
- Waste cooling
- HP cooling
- Chillers
"Free cooling"
Waste Cooling from Heat Pump

Heat source 4 °C

Heat exchanger

DC 16 °C

DC 6 °C

DH 80 °C
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Heat Pump in focus

- Fortum has 6 bigger heat pump plants in Stockholm, most of them are designed to produce heat and cooling simultaneously.

<table>
<thead>
<tr>
<th>Site visit</th>
<th>Heating</th>
<th>Cooling</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Ropsten1 &amp; 2</td>
<td>150 MW</td>
<td>0 MW</td>
</tr>
<tr>
<td>- Ropsten 3</td>
<td>100 MW</td>
<td>110 MW</td>
</tr>
<tr>
<td>- Nimrod</td>
<td>36 MW</td>
<td>48 MW</td>
</tr>
<tr>
<td>- Hammarby</td>
<td>230 MW</td>
<td>40 MW</td>
</tr>
<tr>
<td>- Kista/Akalla</td>
<td>25 MW</td>
<td>48 MW</td>
</tr>
<tr>
<td>- Vilunda</td>
<td>44 MW</td>
<td>10 MW</td>
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Our history
– district heating reduces the emissions in Stockholm
District Heating based on renewable and recovered energy

- Biofuel: 31%
- Waste: 13%
- Energy from sea- and treated sewage water: 19%
- Electricity: 16%
- Fossil fuels: 21%
Varaktighetskurva Centrala Södra FV

0 1 2 3 4 5 6 7 8
1000 h/år
MW
Olja
KVV1bio
Bioolja
Pellets
VP
KVV6k kol
reserv 1
KVV returbr
KVV avfall
Div prio

Example of a duaration diagram
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Ropsten 1, 2
a sea water based heat pump plant ~150 MW

6 units
Two stage turbo compressors
Tube in shell condensers
Open spray evaporators, water flow ~3 m$^3$/s per unit
Wooden tube as water intake 170 m long 3 m diameter
Thank you for listening

Some rules for the plant visit (The plant is "Restricted area")

– Please do not smoke
– Unfortunately you are no longer allowed to take pictures inside the plant without special permit
– Use the hard hats (helmets) that we will provide you with
– Please follow the instruction given by the guides
– We are happy to answer any questions you have, to the best of our ability

– There will be three guides at the site. Fredric Wenger, Christer Boberg and my self, Anders Hill.
– Good luck and enjoy the visit