DATA CENTERS AND 4GDH IN PRACTICE
- THE CASE OF VIBORG

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AGENDA

1. Viborg District Heating in figures
2. Historic focus on low temperature
3. Enabling surplus heat
The company’s main goal is to give our customers more value for less money.

The strategy consists of four main areas:

- **Competitiveness of product** to gain more customers.

- Customer support to **reduce customers consumption** of energy.

- More efficient **low temperature district heating system** to reduce heat loss.

- A **more efficient administration** to be able to include more customers.
DISTRIBUTION
FOCUS ON 50% REDUCTION OF HEAT LOSS

The ideas of the employees is now a part of the investment plan.
TOP 5

• Online hydraulic program (Termis) to set the temperature
  • Reduces temperature 5 degree from 68 to 63 degree annual avg.

• Insulation before meter at consumer and service of consumers installation
  • Savings in heat loss and reduced return temperature

• Prioritized consumer support on return temperature
  • 300 consumers – 3 degree better overall return temperature

• New consumer installation – rental model
  • Makes it possible to reduce supply temperature 10 degree and gives a return temperature 5-10 degree lower and gives consumer internal savings that pays the rent.

• Cut-off network circles that's found unnecessary
  • 40 network circles within the distribution grid
4. Generation District Heating

The Datacenter Project (Apple)
FUTURE ENERGY SOURCES

• Apples new Data Facility
  • Situated 10 km outside Viborg
  • 55 MW surplus energy at 30 degree is planned to be used in Viborg District heating.
  • Electrical heat pumps to boost temperature

• Other surplus energy sources
  • Local hospital, Supermarkets, industrial process

• Existing Gas boilers backup
Figure 4-8  Duration curve for scenario 2.D including 55 MW from Apple
HEAT PUMPS IN 2 PLACES

• Heat pumps both at the Datacenter and at the gasboilers in Viborg

• Reduces installations outside Viborg
• Makes it possible to use other surplus sources in Viborg
• Can differentiate the temperature in different sections
SECTIONING THE CITY

Green areas
optimized for small buildings
(50 °C minimum)

Blue areas
optimized for large older buildings
(58-60 °C minimum)
TEMPERATURE NEEDS

• Older larger buildings
  • Circulation systems on the hot water
  • According to age a heat demand for the radiator from 60 to 75 °C when it’s -12 °C outside

• Small buildings
  • Heat exchanger on hot water and no circulation
SECTIONING ON MAIN STATIONS

- Heatpump
- Pump
- Valve

Surplus Heat

Gas Boiler
• Temperature still high when it's cold
• Temperature in midseason's is lower than the summer temperature
INVESTMENT IN DISTRIBUTION GRID

• To be able to section the distribution net, a few changes is needed:
  • 4 km distribution net needs to be upgraded
  • 2 new pump stations needs to be established

• Investments 14 mio. kr.
• Pipes from 1980-95
• Annual renovation budget in pipes 8 mio. kr.
• Most focus on consumers in the green zones
  • 5990 customers
  • 90 customers is larger buildings with circulation systems
  • The others is small buildings with heat exchanger for hot water
UNIT TO RENT

- New project – helps consumers to a new efficient house installations.
- Low monthly rent which pays back in internal savings
- Makes hot water (45°C) at 50 °C supply temperature
- Online access to data at settings

178 kr. per month
LARGER BUILDINGS

- Two systems to free circulation systems from legionella
  - Heat pump to produce heat to circulation losses
  - Chemical treatment to get rid of biofilms in system

- A heat pump is a cost for the consumer

- Chemical treatment have the possibility to lower the temperature in circulations systems and thereby give an energy reduction and will be paid back
ECONOMICAL AND ENVIROMENTAL CONCLUSIONS
<table>
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<tr>
<th>Scenario</th>
<th>Temperature</th>
<th>Mio. kr.</th>
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<tbody>
<tr>
<td>Reference – Natural Gas CHP</td>
<td>80/40 °C</td>
<td>29</td>
</tr>
<tr>
<td>0 – Heat Pumps at Apple</td>
<td>80/40 °C</td>
<td>312</td>
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<tr>
<td>1.A – Heat Pumps at Apple</td>
<td>60/30 °C</td>
<td>270</td>
</tr>
<tr>
<td>2.D – Heat Pumps at Apple and at Peak Load Plants in Viborg</td>
<td>55/30 °C</td>
<td>316</td>
</tr>
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</table>

Figure 5-12  Investment costs for 55 MW Heat Pumps
Total Cost of Ownership (25 years) for 45 and 55 MW from Apple

- Total Cost of Ownership (25 years) for 45 and 55 MW from Apple.
- The chart shows the cost for different configurations and capacities.
- For 45 MW:
  - Ngas: 4.36 Mia. kr.
  - HP at Apple: 2.64 Mia. kr.
  - HP at Apple & multi HP Viborg: 2.22 Mia. kr.
  - HP Apple & multi HP Viborg: 2.03 Mia. kr.
- For 55 MW:
  - Ngas: 4.36 Mia. kr.
  - HP at Apple: 2.50 Mia. kr.
  - HP at Apple & multi HP Viborg: 2.05 Mia. kr.
  - HP Apple & multi HP Viborg: 1.86 Mia. kr.
### CONSUMER PRICES

#### Standard House savings versus VF tariffs 2017

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<th>45 MW</th>
<th>55 MW</th>
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<tr>
<td><strong>Ngas</strong></td>
<td>-4,147</td>
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<td>80/40 Ref.</td>
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<td>557</td>
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<td><strong>HP at Apple</strong></td>
<td>1,097</td>
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<tr>
<td>60/30 Sc. 1.A</td>
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<td><strong>HP Apple &amp; multi HP</strong></td>
<td>1,392</td>
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Figure 9-2 Standard House savings versus VF tariffs 2017 for 45 and 55 MW
### CO2 Emissions Year 1 (from Natural Gas Consumption)

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*Figure 11-3: CO2 emissions from natural gas consumption for 45 and 55 MW from Apple*
Conclusions

- We can build and operate a district heating grid based on low temperature - thereby enabling surplus heat from Apple in a cost efficient and competitive way.

- Having all costs and investments included we are able to do a significant reduction in CO2 emissions - at the same time lowering the cost of heat to the end consumer...

- When implemented, this shows, that 4DH is not only a study but a proven model how to built, convert and operate district heating in the future.