FUTURE DISTRICT HEATING SETUP IN VIBORG WITH 95% RENEWABLE ENERGY

Tom Diget
COO at Viborg District Heating
THE WORLD IS CHANGING
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 at apple to 50 °C, and another boost placed by the current natural gas boilers 4 places in town to 55° C and 60 °C

- Alternatively Large “Air to Water” Heatpump
  - 55 MW electrical heat pumps to boost temperature to 50 °C at the current CHP plant, and another boost placed by the current natural gas boilers 4 places in town to 55° C and 60 °C
  - Lower investment cost, and investment close to city
  - Less efficient because of the lower temperature in outside temperature

- Other surplus energy sources
  - Hospital, supermarket, industrial process

- Existing Gasboilers
4. Generation District Heating

The Datacenter Project (Apple)
Figure 4-8  Duration curve  55 MW from Apple
• DTU report on temperature needs in typical Danish houses
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 ist -12 °C outside

• Small buildings
  • Heat exchanger on hot water and no circulation
SECTIONING THE CITY

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

Blue areas optimized for large older buildings (58-60 °C minimum)
Blå areas is optimized for older multifamily houses (58-60 °C min)

Grønne areas is optimized for 1-family houses (50 °C min)
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
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.
CONSUMER

• Most focus on consumers in the green zones
  - 5990 customers needs a rental unit
  - 90 customers is larger buildings with circulation systems
  - Danish Clean Water model to treat legionella by adding chlorine from kitchen salt seems to be the most effective way.
  - A Heat pump is another solution

![Number of consumers with a given return temperature - 2015/2016](chart.png)
## INVESTMENT AND PRODUCTION PRICES

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Temperature</th>
<th>Mio. kr.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reference – Natural Gas CHP</td>
<td>80/40 °C</td>
<td>29</td>
</tr>
<tr>
<td>0 – Heatpump at Apple – Natural gas boost to transmissions temperature</td>
<td>80/40 °C</td>
<td>275</td>
</tr>
<tr>
<td>1.A – Heatpump at Apple</td>
<td>60/30 °C</td>
<td>318</td>
</tr>
<tr>
<td>2.D – Heatpump at Apple and at gasboilers</td>
<td>55/30 °C</td>
<td>371</td>
</tr>
<tr>
<td>3.D – Air to Water Heatpump</td>
<td>55/30 °C</td>
<td>208</td>
</tr>
</tbody>
</table>

### Produktion prices

<table>
<thead>
<tr>
<th></th>
<th>Ref.</th>
<th>Sc. 0</th>
<th>Sc. 1A</th>
<th>Sc. 2D</th>
<th>Sc. 3D</th>
</tr>
</thead>
<tbody>
<tr>
<td>[kr./MWh]</td>
<td>642</td>
<td>307</td>
<td>274</td>
<td>243</td>
<td>298</td>
</tr>
</tbody>
</table>

- Production price is reduced by 64 Kr./MWh in average compared to running the transmission-network as usually.
- Incl. payback of Investments, it generates (over 25 years) savings of 480 mio. kr.
**CUSTOMER PRICES**

- A standard home 18,1 MWh 130 m²

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<th>Sc. 3D</th>
</tr>
</thead>
<tbody>
<tr>
<td>[kr./year]</td>
<td>18925</td>
<td>11316</td>
<td>10603</td>
<td>9952</td>
<td>11201</td>
</tr>
</tbody>
</table>

- A customer saves 1.364 kr a year or 180 € a year if we do it smart
## Timing and Taxes

![Graph showing average production prices over 25 years for full capacity from Apple VP 2022-2024.](image)

### Table: Average Production Prices (kr./MWh)

<table>
<thead>
<tr>
<th>Year</th>
<th>VP Apple &amp; Multi VP Viborg</th>
<th>Luft-til-vand VP &amp; Multi VP Viborg</th>
<th>Halv VP Apple &amp; Multi VP Viborg</th>
<th>VP Apple &amp; Multi VP Viborg</th>
<th>Luft-til-vand VP &amp; Multi VP Viborg</th>
<th>Halv VP Apple &amp; Multi VP Viborg</th>
</tr>
</thead>
<tbody>
<tr>
<td>2022</td>
<td>285</td>
<td>302</td>
<td>356</td>
<td>269</td>
<td>271</td>
<td>330</td>
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<tr>
<td>2023</td>
<td>297</td>
<td>302</td>
<td>365</td>
<td>283</td>
<td>271</td>
<td>341</td>
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<tr>
<td>2024</td>
<td>310</td>
<td>302</td>
<td>376</td>
<td>299</td>
<td>271</td>
<td>354</td>
</tr>
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