Energy Central
Bjerringbro District Heating and Grundfos
Re-thinking the energy system
with groundwater aquifer and heat recovery
**Brugsreteaftale**

**Mellemlen**

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8830 Bjerringbro
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og

Grundfos A/S
Paul Due Jepsens Vej 7
8830 Bjerringbro
CVR: 31499913
(heretter kaldt "Grundfos")

er d.d. indgået i følgende aftale:

1. **Forsinket tilbage** til installation af anlæg til opsamling af vand ved grundvand, Grundfos, Bjerringbro – reg.nr. 761-991-0003-00

samt

dispensator fra naturbebygelsestilsvare af placering af boringer indenfor albebeskyttelsesområde langs Gudenåen

**Bjerringbro Fællesvandværk A.m.b.a.**

Brogade 19
8830 Bjerringbro
CVR: 33015372
(heretter kaldt "Vandværket")

og

Grundfos A/S
Paul Due Jepsens Vej 7
8830 Bjerringbro
CVR: 31499913
(heretter kaldt "Grundfos")

er d.d. indgået i følgende aftale:

1. **PwC**

Grundfos – Bjerringbro Varme værk

Notat af 27. september 2011 vedrørende energiefugter i varme- og kælepunkt

Nedenfor er her beskrevet vore vurderinger af energikilderne ved gennemførelse af projektets anbefaledeøkonomimodell i vejledning af Dansk Engenhed.

An resilient cooling solution...

- A solution that reduces the use of fossil fuels
- Provides year round cooling to production equipment
- Provide waste heat from production as a heat energy to local homes and businesses
- Reduce carbon emissions
Take when you need...

- September to April waste heat given off by the energy center is used by the Bjerringbro District Heating system.
- During the summer months Energy Central is on standby.
...replace when you can.

- Grundfos draws water from a re-purposed well in town.
- 9\(^\circ\) Celsius water from 80 meters below the ground is used for cooling.
- Water is immediately returned to aquifer as indirect heat storage for use in winter.
Recovery is the key to resiliency...

- As summer gives way to autumn the Energy Center resumes delivering cooling to Grundfos and waste heat to local homes and businesses.
- The Energy Center also takes care of cooling the aquifer again so it will be ready to cool the production process the following summer...
5 old waterwork boreholes
Rented by Bjerringbro Fællesvandværk

2 x 20 feet containers with exchanger and measurement equipment

140 m² new ENERGY CENTRAL with refrigerating equipment

1.5 km new pipes under rail, roads and private grounds
## Key numbers for the shared energy centre

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Annual cooling output of groundwater cooling for 4 summer months.</td>
<td>3,500</td>
<td>MWh</td>
</tr>
<tr>
<td>Groundwater cooling covers cooling consumption 100% of the affiliated</td>
<td></td>
<td></td>
</tr>
<tr>
<td>factories.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Annual heat production of cooling machines.</td>
<td>13,400</td>
<td>MWh</td>
</tr>
<tr>
<td>13,400 MWh covers heat consumption by approx. 750 households, or 15% of</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bjerringbro Varmeværk's annual heat production.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Annual cooling output of the cooling machines in 8 months.</td>
<td>10,500</td>
<td>MWh</td>
</tr>
<tr>
<td>Covering cooling consumption 100% and cooling of the groundwater aquifer.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total investment</td>
<td>34</td>
<td>mdkk</td>
</tr>
<tr>
<td>Estimated annual savings</td>
<td>3</td>
<td>mdkk</td>
</tr>
<tr>
<td>Total annual reduction in carbon emissions</td>
<td>3,700</td>
<td>Tonnes</td>
</tr>
</tbody>
</table>
Operational expectations

- Cooling water to Grundfos 12 °C (input) 18 °C (outcome)
- Cooling water to groundwater cooling system 12-6 °C (input) and 18 °C (outcome)
- District heating temp. to heating pumps 37 °C
- District heating temp. from heating pumps 67 °C
- Annual cooling production = 10,500 MWh
- Annual production of district heating = 13,589 MWh
- Average COP = 4.4
- Cooling towers, cooling machines and split system must continuously be abolished
- High need of security and backup for cooling systems
Who does what?

- Grundfos invests in a groundwater cooling system and in a new building for heating pumps (a total of 17 million DKK)
- Bjerringbro Varmeværk invests in heating pumps (a total of 17 million DKK) and rents the new Grundfos building
- Each company is responsibility for the operation of own facilities
- Business model for sharing of profits

It has been in the papers for the last 30 years....
# Key numbers for groundwater systems

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of drillings</td>
<td>5</td>
<td>Units</td>
</tr>
<tr>
<td>Amount of circulated water in ground water systems (max)</td>
<td>705</td>
<td>GPM</td>
</tr>
<tr>
<td>Amount of circulated water per. year</td>
<td>400M</td>
<td>gal/year</td>
</tr>
<tr>
<td>Groundwater temperature</td>
<td>48.2/9</td>
<td>°F/°C</td>
</tr>
<tr>
<td>Cooling capacity before exchange</td>
<td>1.5</td>
<td>MW</td>
</tr>
<tr>
<td>Total cooling capacity (4 months of summer operation)</td>
<td>3.500</td>
<td>MWh</td>
</tr>
<tr>
<td>Carbon reduction in the entire system (including Bjerringbro Varmeværk)</td>
<td>3700</td>
<td>tonnes carbon/year</td>
</tr>
<tr>
<td>Estimated COP value for groundwater cooling</td>
<td>46</td>
<td>COP</td>
</tr>
</tbody>
</table>
Thanks for your attention!