Industrial Waste Heat Utilization for Low Temperature District Heating
Who are we?

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Agenda

• Background
• What has been investigated?
• Results from models
• Economy
• Conclusion
• Questions
Background of project

- Present district heating in Viborg: natural gas
- Apple Data Centre
  - 166,000 m²
  - Enough heat to cover Viborg's demands
  - Finished in 2026
  - First part finished in 2018
- Supply water at 25°C
Background of project

• **Past and present district heating in Viborg**
  – 2002 – 75°C
  – 2013 – 65°C

• The future...

• How can we utilize the heat from Apple?
What has been investigated?

- Energi Viborg and Viborg Fjernvarme
- “Which type of heat pump is best suited for district heating in Viborg?”

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Apple data centre  25 °C  Heat pump  55 °C  Consumer
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Mechanical heat pump

Absorption heat pump
Results from heat pump models

• Two scenarios

<table>
<thead>
<tr>
<th>District heating temperature</th>
<th>65°C (3. gen)</th>
<th>55°C (4. gen)</th>
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</thead>
<tbody>
<tr>
<td>Mechanical heat pump (COP)</td>
<td>4.2</td>
<td>5.4</td>
</tr>
<tr>
<td>Absorption heat pump (COP)</td>
<td>1.5</td>
<td>1.6</td>
</tr>
</tbody>
</table>

• Assumption: Return temp. to Apple is 25°C
Economy

• Fuel costs
  – Electricity
  – Biomass (Straw)
  – Taxes (WHT: 180 DKK/MWh)

• Installation costs

• Operating and maintenance costs

• Inflation
Overall results (no WHT)

Accumulated Expenses in 25 Years (3. gen)

- Natural gas
- Absorption heat pump
- Mechanical heat pump

Time [Years]

Accumulated costs [DKK]

0  5  10  15  20  25

0  500,000,000  1,000,000,000  1,500,000,000  2,000,000,000  2,500,000,000  3,000,000,000  3,500,000,000  4,000,000,000

Overall results (no WHT)

Accumulated Expenses in 25 Years (4. gen)

- Natural gas
- Absorption heat pump
- Mechanical heat pump

Accumulated costs [DKK]

Time [Years]

0 5 10 15 20 25

Conclusion

• Mechanical heat pump proved cheapest
• But...
  – Future fuel and tax prices have great impact
  – Big differences since the project was made
    • PSO tariff removed
    • Natural gas price calculated has proven to be too high
Questions?