Tendering and contracting HP’s

Bjarke Paaske, PlanEnergi

HPC 2017 - Rotterdam
PlanEnergi:

• Non profit consultancy company
• 30 years with renewable energy

Implementation ↔ Research & Development

• Renewable energy solutions
  • Energy planning
  • Wind turbines
  • Solar heating
  • Seasonal storages
  • Heat pumps
DH in Denmark

- 2/3 of all households
- Around 450 plants
- 16 central plants
- Around 250 decentral gas-based

Current:
- Gas boiler
- Gas engine

Alternatives:
- Heat pump
- Solar thermal
- Wood pellets
- Wood chips
- Straw

Practical experience for tendering and contracting heat pumps for district heating • Rotterdam, May 17th 2017 • Bjarke Paaske
Share of wind power increases

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250 decentralized plants

Natural gas

CHP Unit

Heat pump

Power

Heat

Heat source

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New initiatives

- PSO-tarif is removed (cheaper electricity)
- Subsidies for energy efficiency (less investment cost)

Heat pump

Power

Heat source

Cheap heat production

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Tendering and contracting

• Functional tender
  • The supplier designs the system, components etc.

• Selection criterias
  • Feasibility (15 year period)
  • Safety of operation (design, O&M, service organisation etc.)
  • Optimization process

• Performance test
  • Bonus or compensation
Feasibility

• 15 year period, 3.5 % interest rate

![Total cost of heat production graph]

\[ \text{COP: 79 \%} \]

\[ \text{Initial cost: 16 \%} \]

\[ 38 \text{ €/MWh} \]
### Feasibility Spread

**Nutidsværdi, gennemsnit**

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**NPV**

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<td>Nutidsværdi, driftspunkt</td>
<td>€ MWh-varme i gennemsnit over 50.000 fulldast driftstimer</td>
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**NPV**

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<td>--- Denne nutidsværdi kan bruges ifm. design og dimensionering af varmepumpen.</td>
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<tr>
<td></td>
<td>--- Denne nutidsværdi bruges ifm. vurdering af tilbuddets totaløkonomi.</td>
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</table>
Heat pump design (bespoke)

Total capacity = 3.8 MW
Total COP = 4.16

Hi stage – 2.0 MW
  $te=0.3 \, ^\circ C$, $tc=67 \, ^\circ C$

Lo stage – 1.8 MW
  $te=3.8 \, ^\circ C$, $tc=52 \, ^\circ C$

Groundwater outlet 2 °C
Groundwater inlet 9 °C
DH Forward 70 °C
DH return 35 °C

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Heat pump design (bespoke)

- Very high COP-value
- Site built
Heat pump design (standard)

- As single stage chiller (25 bar)
- As single stage heat pump (40, 50 or 60 bar)
Heat pump design (standard)

- Single stage chiller
- Single stage heat pump
- Two stage heat pump

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2 stage heat pumps (standard)

1st two-stage – 0.7 MW
  te=3.0 °C , tc=55.4 °C

2nd two-stage – 0.8 MW
  te=12.2 °C , tc=70 °C

Total capacity = 1.5 MW
Total COP = 4.6

Waste water outlet 5 °C
Waste water inlet 22 °C
DH Return 38 °C
DH Forward 70 °C
2 stage heat pumps (standard)

- High COP-value
- Factory built
- Simple installation – less complex
Conclusions

• Suppliers understand DH-applications
  • High COP-values are key to feasibility
  • Analyse and improve the final design
  • Accept strict performance testing
• Ranges of available components/units increases
• Performance match the specifications
• Running-in and commissioning is time consuming
COP vs Investment cost

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<th>€/MWh</th>
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Total cost of heat production

- COP 3: 48 €/MWh
- COP 4: 38 €/MWh
- COP 5: 32 €/MWh

1.7 Heat pumps

1 Heat pump
Thank you

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