Integrating district heating into industrial processes

Practical approaches and design considerations

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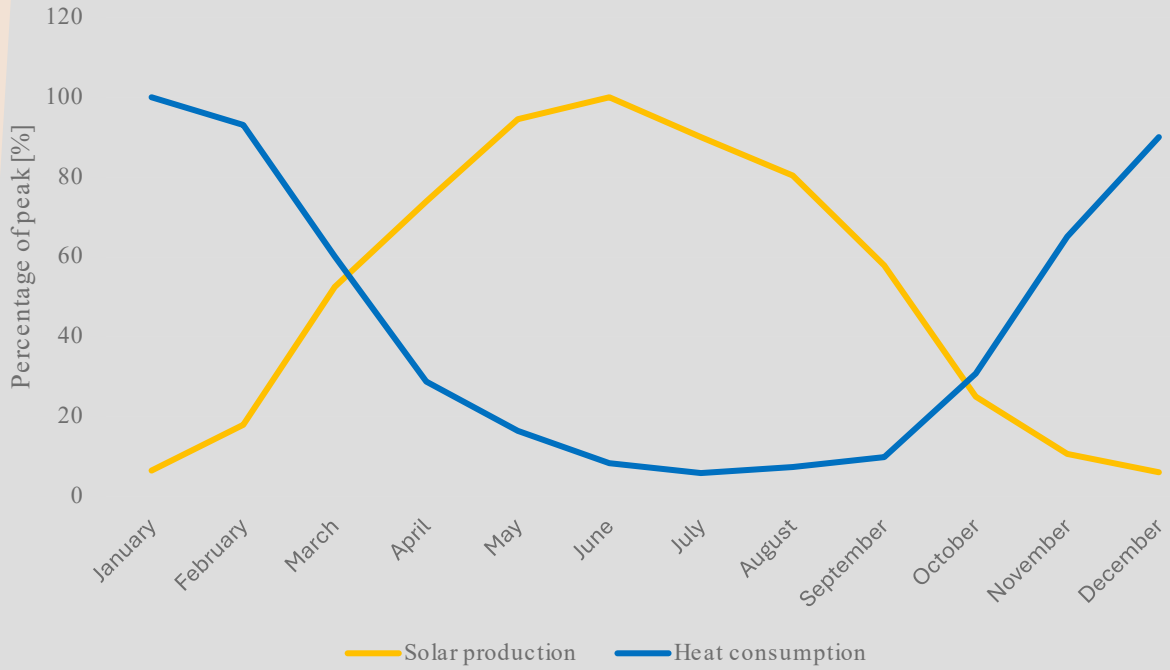
Agenda

1. Use of District Heating in process industry
2. Design considerations
    - District Heat temperature
    - Transient load/temperature on heat pumps
3. Going from gas-fired boiler and steam system to high temperature heat pump, different approaches

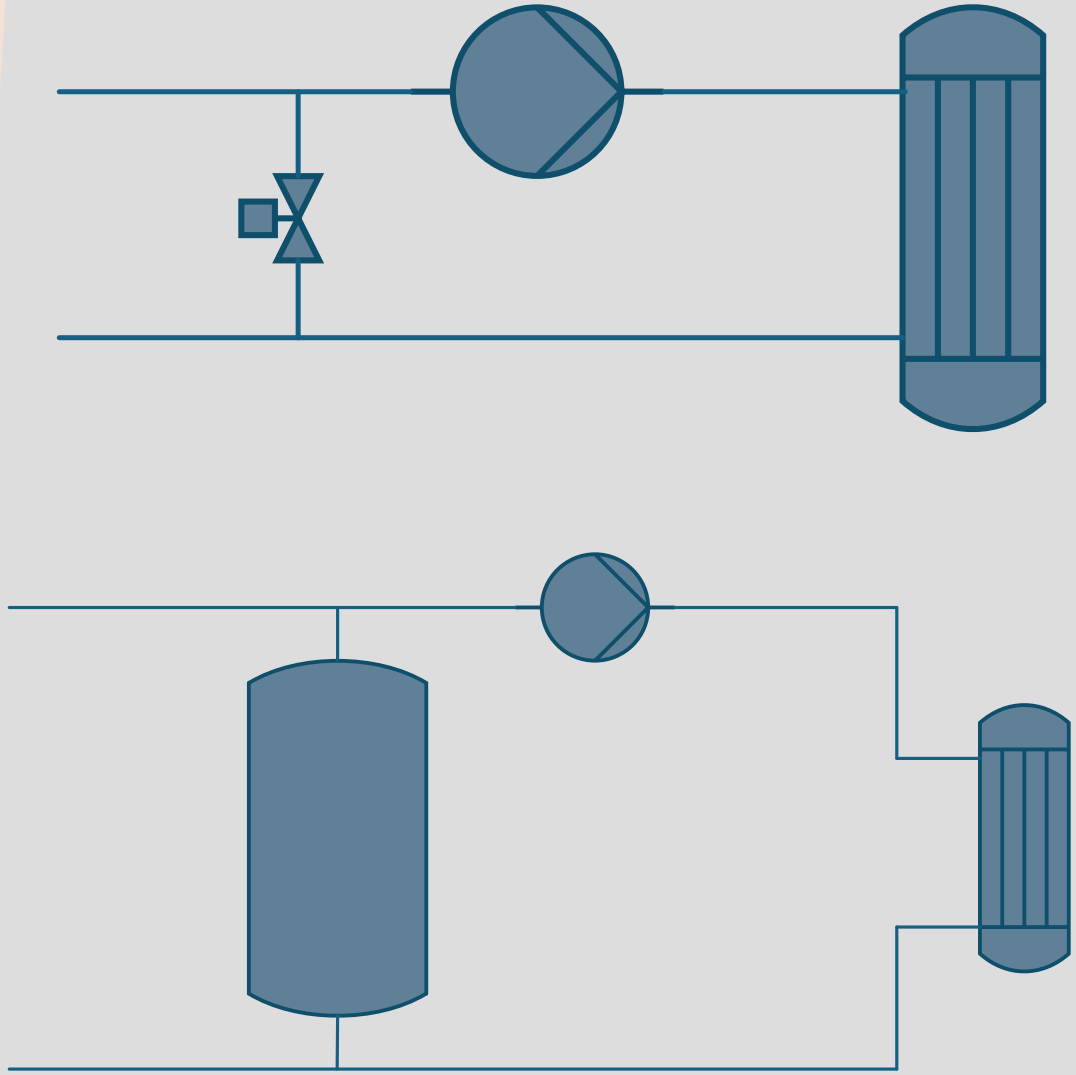
Use of district heating in Process Industry

- District heating is typical hot water between 70 and 90°C
- Can be used either as direct heat source or as low temperature heat source for a high temperature heat pump system
- District heating is an essential part of decarbonisation by implementation of:
  - Electric driven heat via heat pumps and electric boilers
  - Electric grid stabilisation by use of electric boilers and accumulation tanks when increasing solar and wind input on the grid
- Process Industry can increase yearly system utilisation having consumption year round utilising excess solar electricity production in summer periods



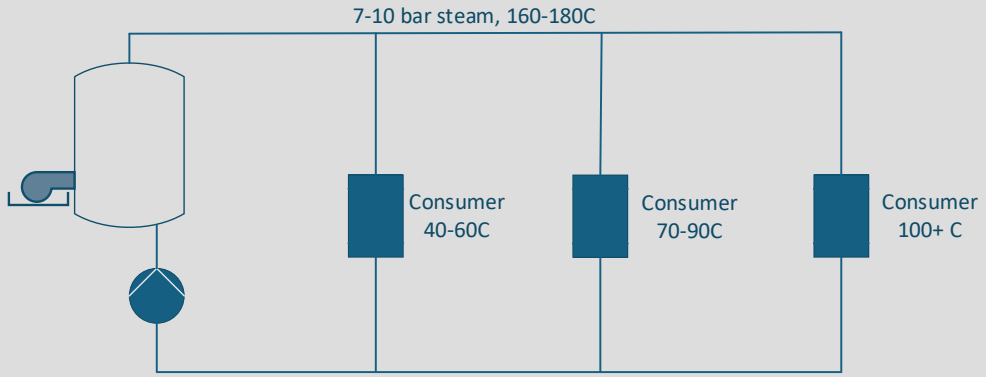
Design considerations

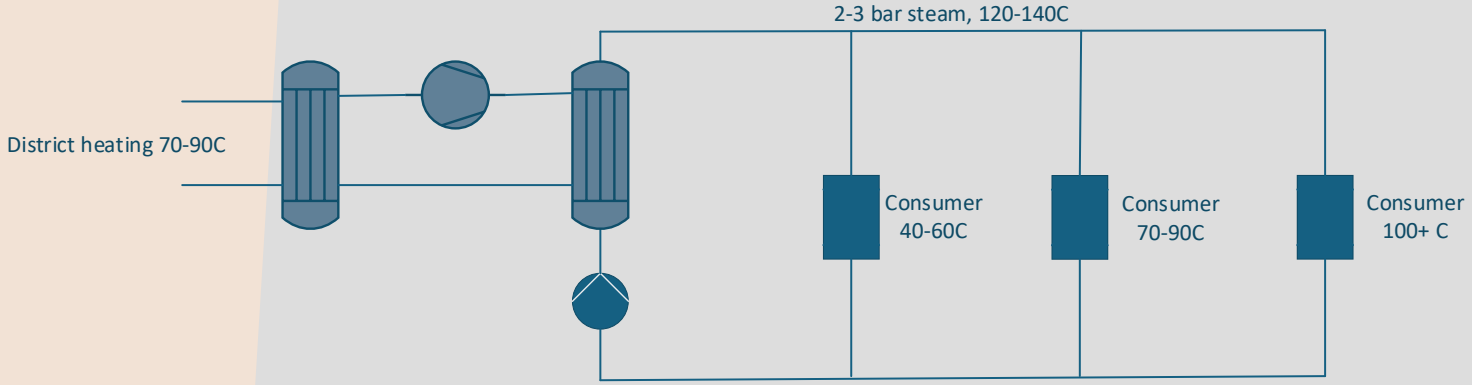
- Move towards district heating heat pump solutions will trend supply temperature down as a 70°C supply temperature vs. 90°C will reduce electrical consumption by 25-30%
- Supply temperature will be limited by potable water heating, meaning a supply temperature limit around 65°C
- Compared to a boiler, a heat pump is more sensitive to transient temperature fluctuations, so the cold and hot side must be designed with this in mind
- Shunt and buffer volumes can reduce temperature fluctuations and selection can be based on:
  - Initial cost
  - Impact on efficiency (COP)

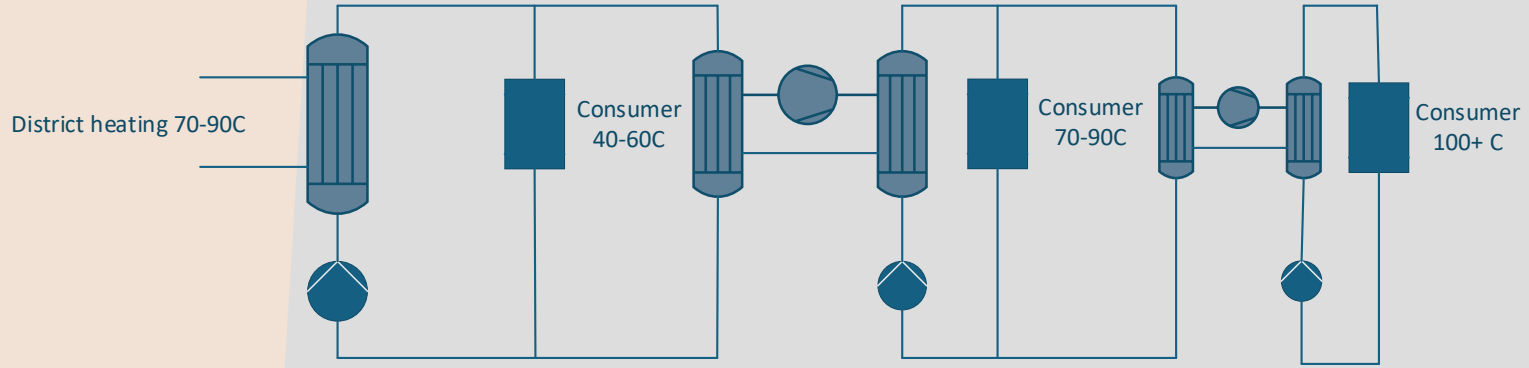


An holistic approach for a high temperature heat pump installation

- Approaches replacing a gas fired boiler providing heat to a steam system
  - Replace boiler one to one with a heat pump
  - Review consumer temperature requirements and refine system to meet these demands





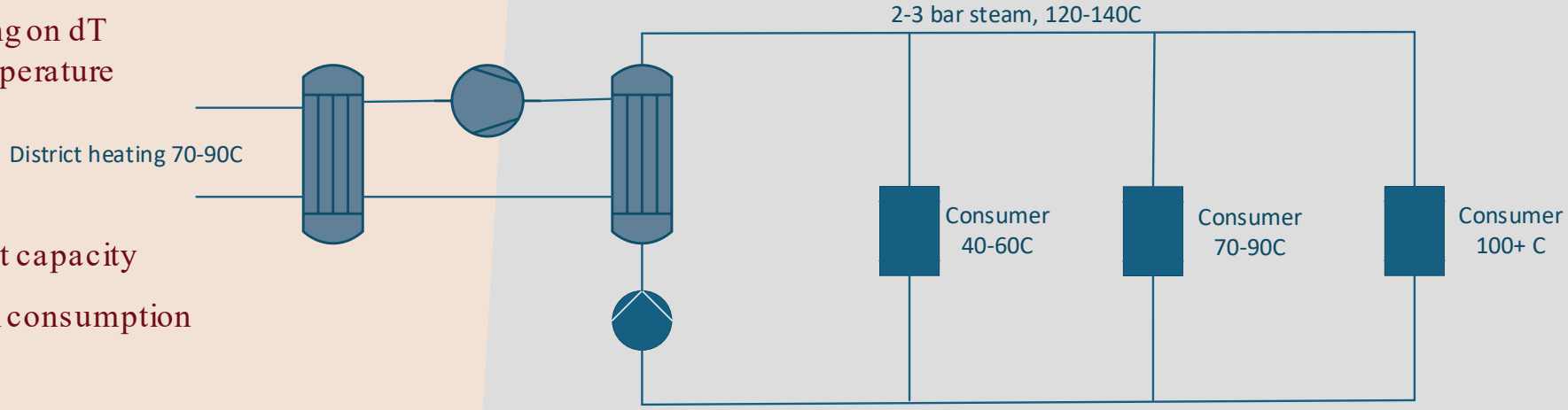


One to One replacement

- Gas burns at approx. 1.950°C meaning enough temperature for a 7-10 bar steam system
- District heating typical 70-90°C with a downwards trend with more heat pump solutions on the district heating system
- High temperature heat pump for 120-130°C low pressure steam
- Obtainable COP around 2.5-3 depending on dT between district heating and steam temperature

Impact

- Large heat pump installation for full heat capacity
- Relative low COP giving a high electrical consumption
- Increase in electric grid connection

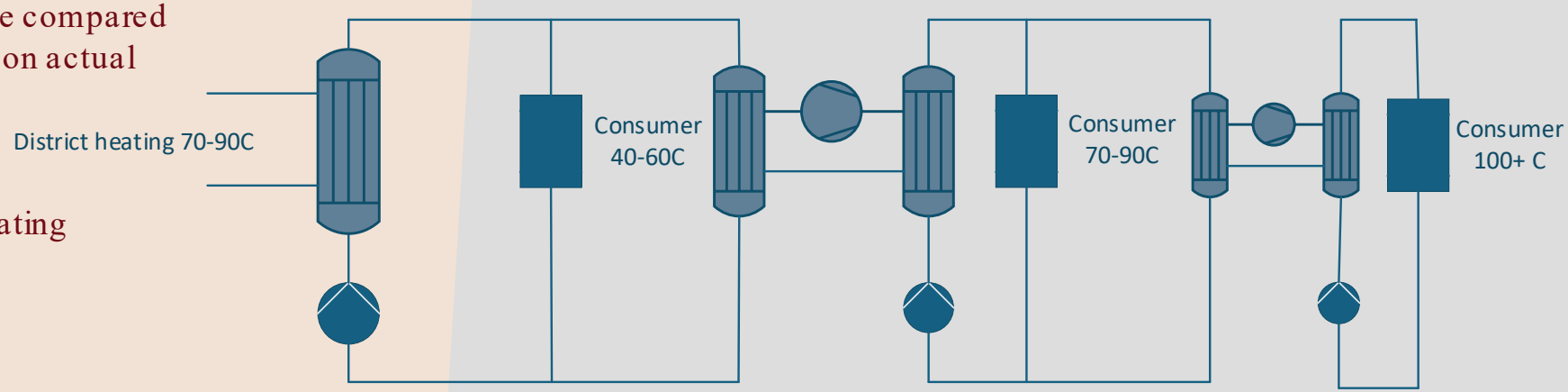


Holistic approach

- Typical some consumers require 40-60°C, some 70-90°C and some 100-130°C, all heated by the steam system
- Changing heating system from a common steam system to a distributed heating system having direct district heating, a 90°C heat pump and 130°C booster system
- Obtainable combined COP could be double compared with a one to one replacement (Depending on actual distribution of consumers)

Impact

- Some heating could be direct by district heating
- Smaller heat pump installations
- High combined COP
- Smaller impact on electric grid connection
- More pipe installation work and new consumer heat exchanger installations
- Less maintenance work given smaller heat pumps with more static installations such as pipe-work and heat exchangers



Thank you

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