

# Heat pumps in industrial cleaning applications



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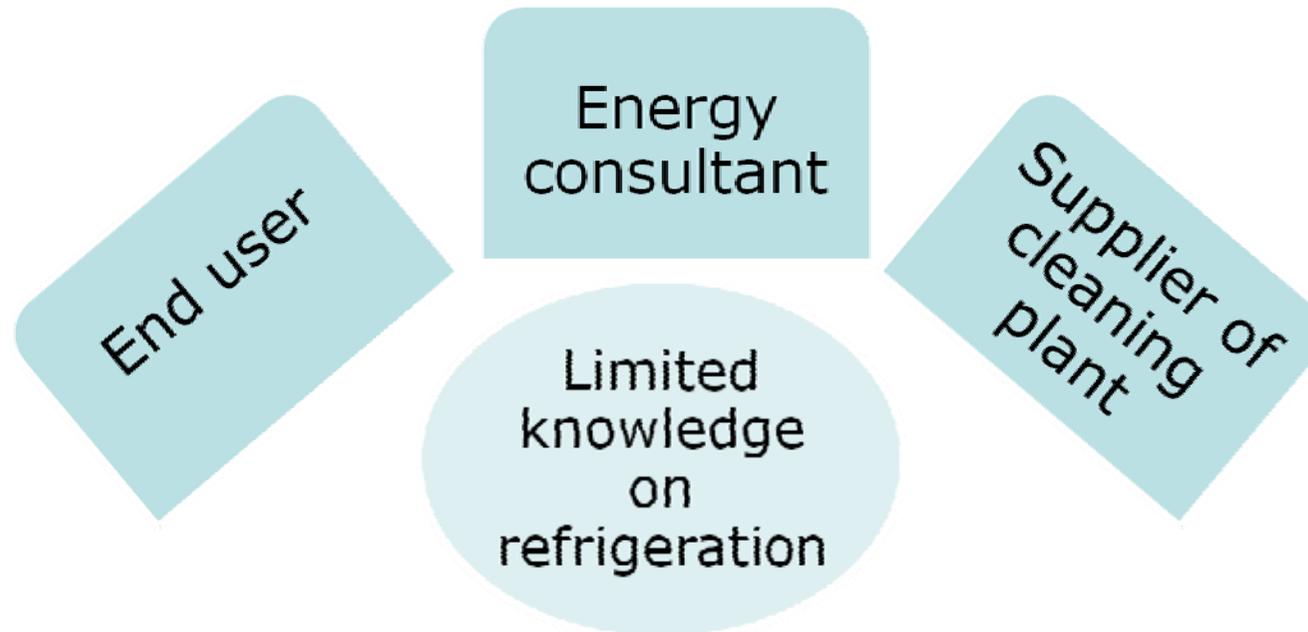
Achema 2012 - Frankfurt



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## Project to promote heat pumps in industrial cleaning apps.

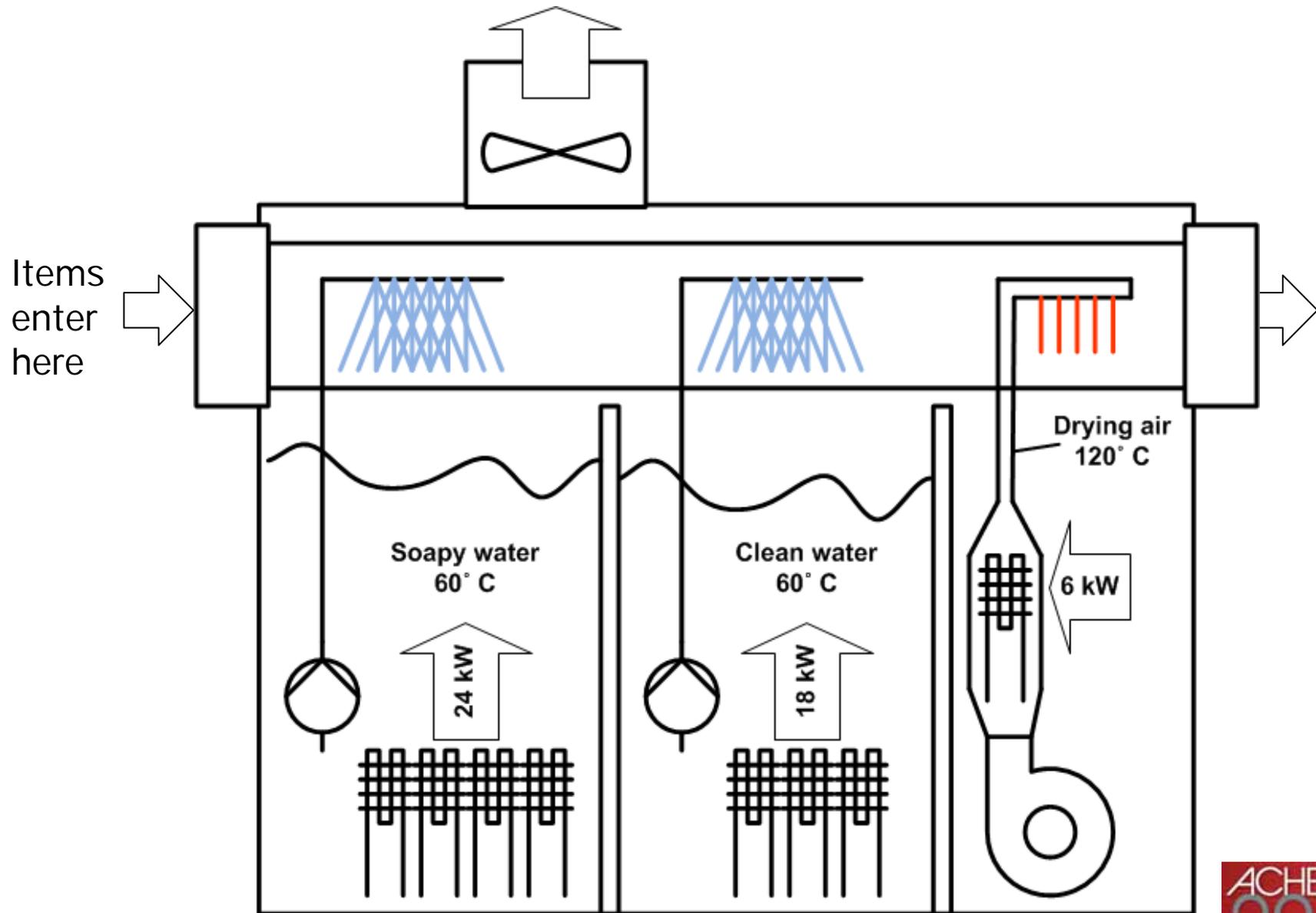
- n Cleaning plants for metal items are energy consuming
- n Plants are often heated by electricity



- n No standard heat pump units available



# Cleaning plant, drum type

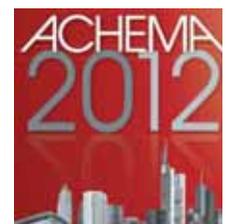




Washing plant and pressing machine



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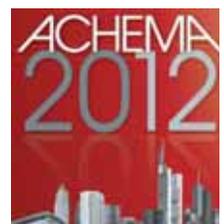




Drum type



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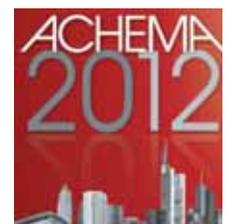




Drum type



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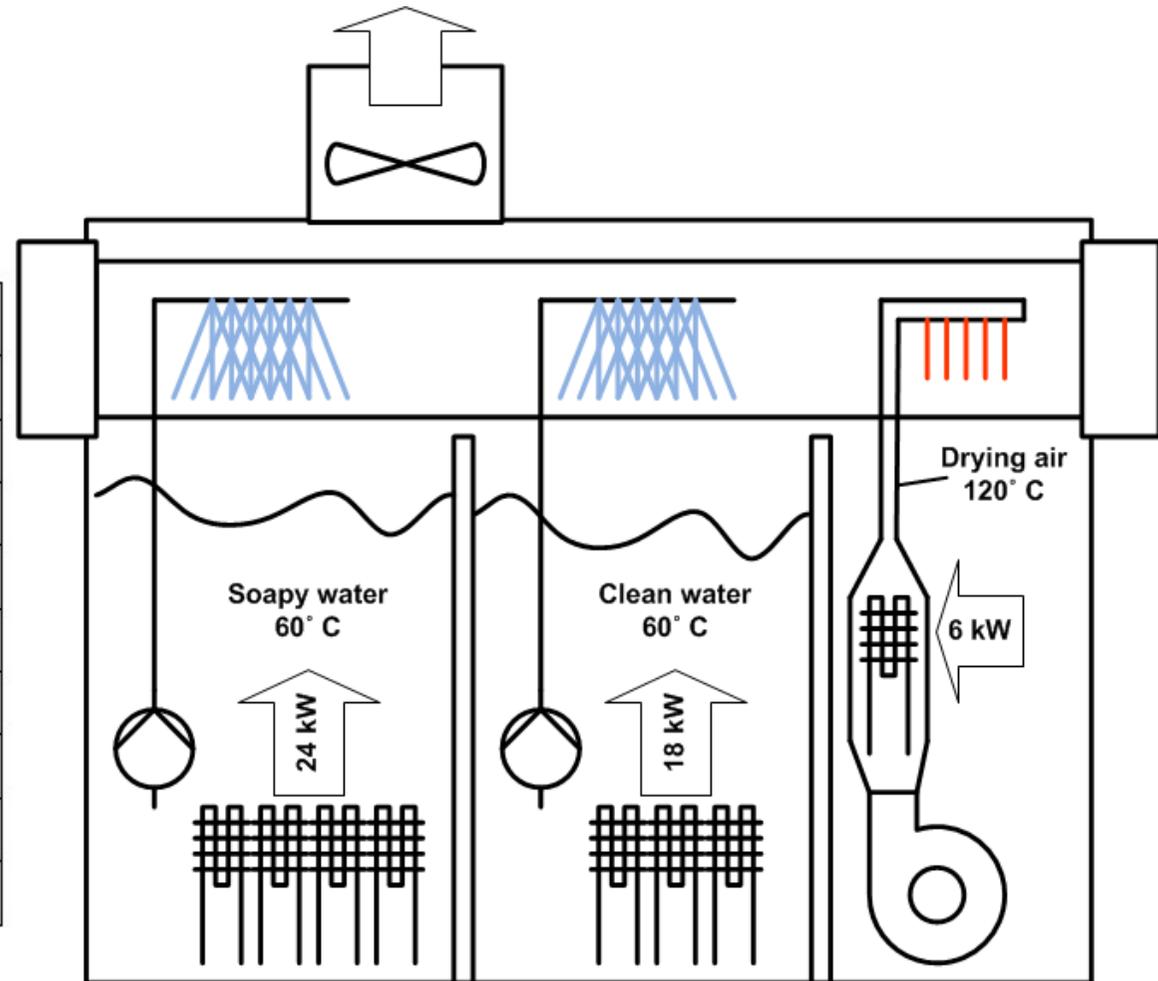
Batch type – Low energy consumption



# Specific drum type cleaning plant

n Installed power in specific drum-washer

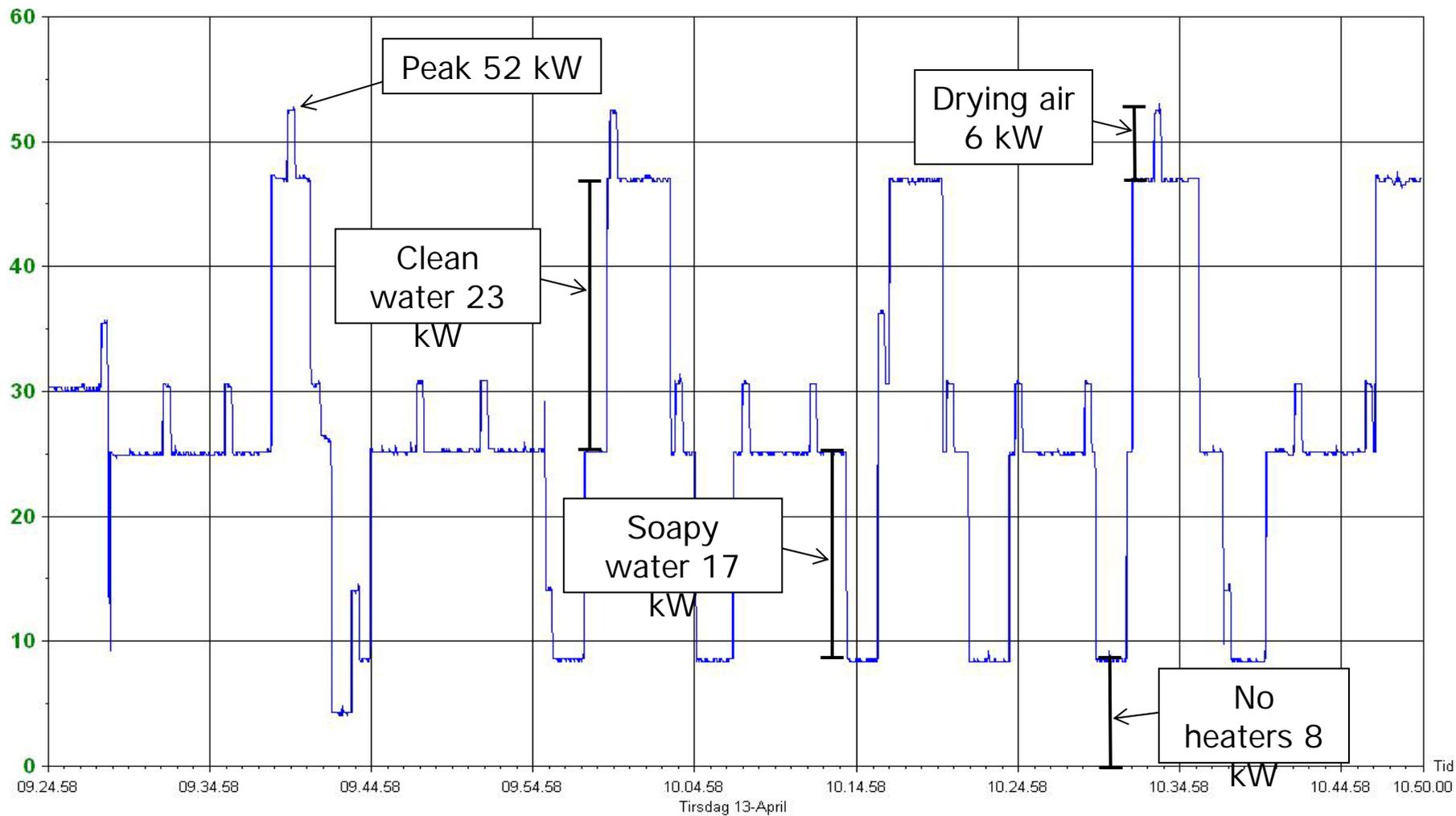
Component	Power
Heaters – soapy water	24 kW
Heaters – clean water	18 kW
Pump – soapy water	1.5 kW
Pump – clean water	0.8 kW
Blower – drying air	2.2 kW
Heater – drying air	6 kW
Motor	0.2 kW
Filter mist	1.5 kW
<b>Total</b>	<b>54.1 kW</b>



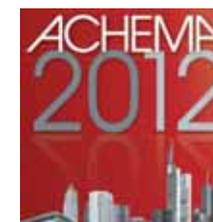
n Heaters are on/off-regulated → actual power consumption ?



# Actual power consumption



n This analysis can not be neglected



## Results from the analysis

Component	Max power [kW]	Average power [kW]
Heaters – soapy water	24	7.6
Heaters – clean water	18	16.7
Pump – soapy water	1.5	1.5
Pump – clean water	0.75	0.75
Blower – drying air	2.2	2.2
Heater – drying air	6	3.5
Motor	0.18	0.18
Ventilation	1.5	1.5
<b>Total</b>	<b>54.1</b>	<b>33.9</b>

- n App. 150 washing plants at project participant
- n Estimated 3.000 plants in Denmark
- n Water temperature typical 55 – 65° C
- n Annual operating time is 4.000 – 8.000 hours
- n Annual power consumption is 135.000 – 270.000 kWh



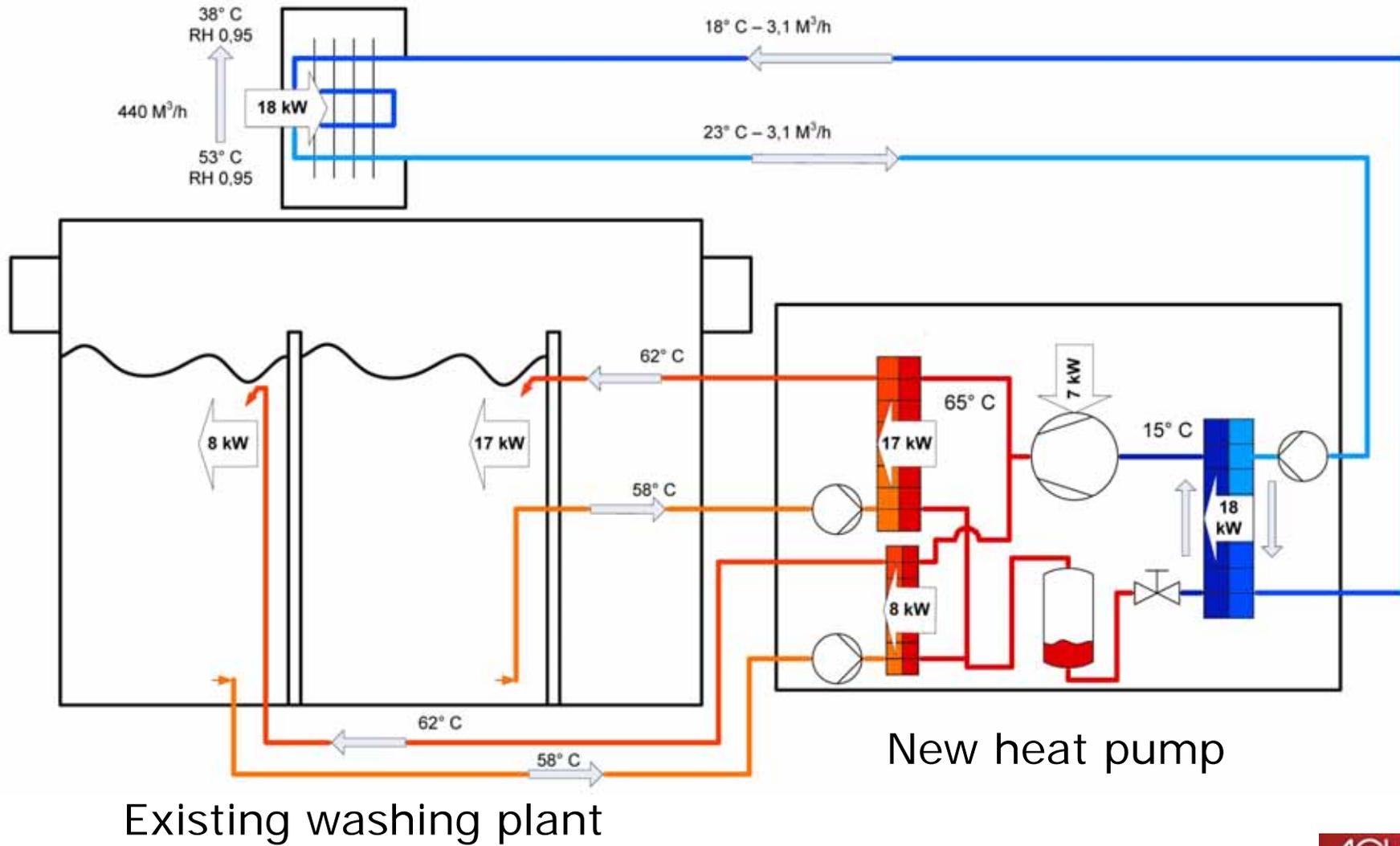
## Applying a heat pump with a COP of 3,5

Component	Max power [kW]	Average power [kW]	Average power HP [kW]
Heaters – soapy water	24	7.6	2.2
Heaters – clean water	18	16.7	4.7
Pump – soapy water	1.5	1.5	1.5
Pump – clean water	0.75	0.75	0.75
Blower – drying air	2.2	2.2	2.2
Heater – drying air	6	3.5	3.5
Motor	0.18	0.18	0.18
Filter mist	1.5	1.5	1.5
<b>Total</b>	<b>54.1</b>	<b>33.9</b>	<b>16.5</b>

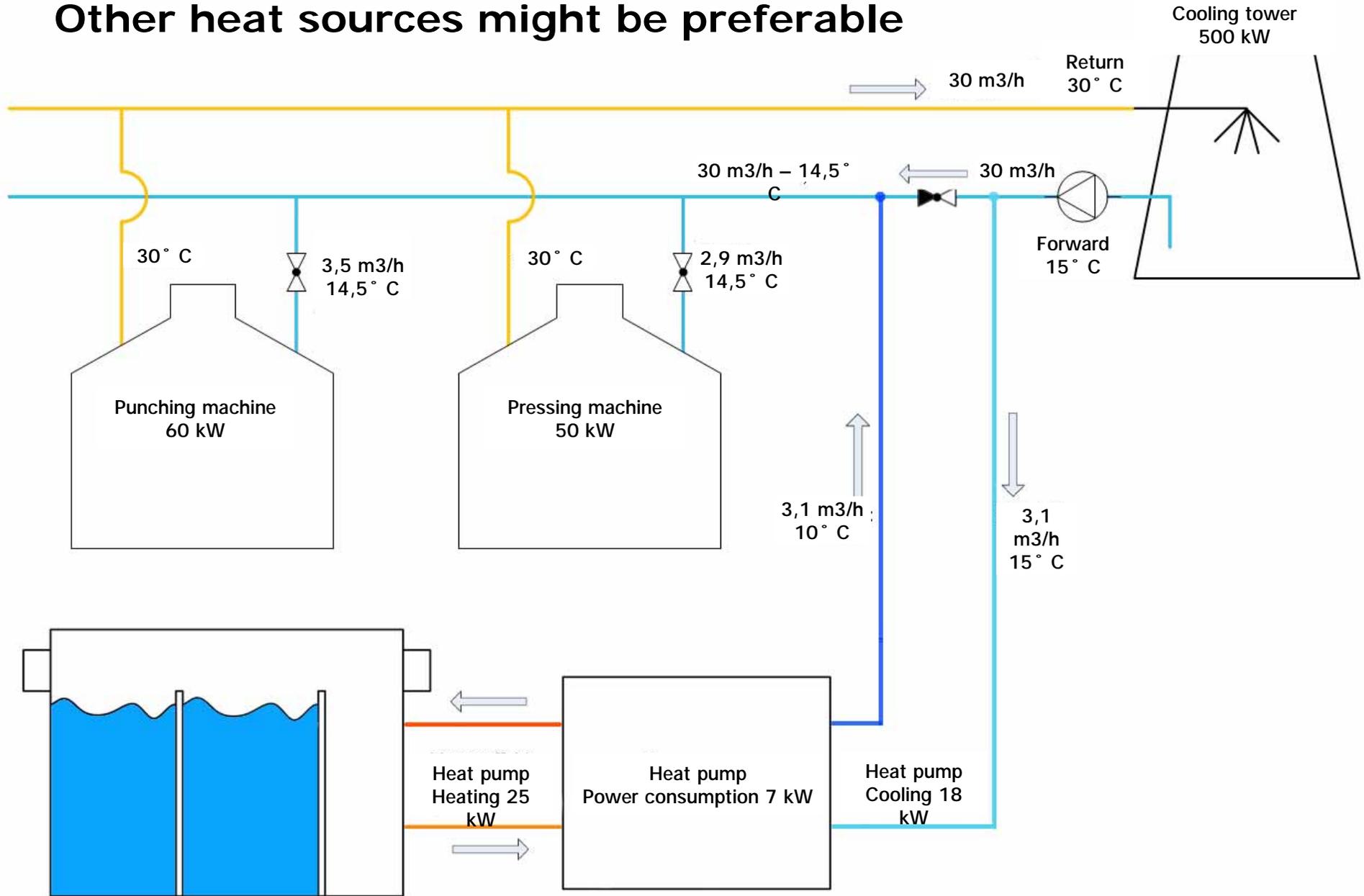
n 50 % reduction in total energy consumption is expected



# Heat pump as stand alone unit



# Other heat sources might be preferable



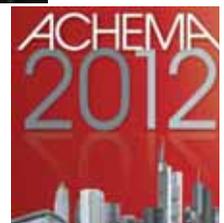


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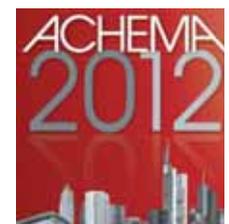


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## Custom build heat pump

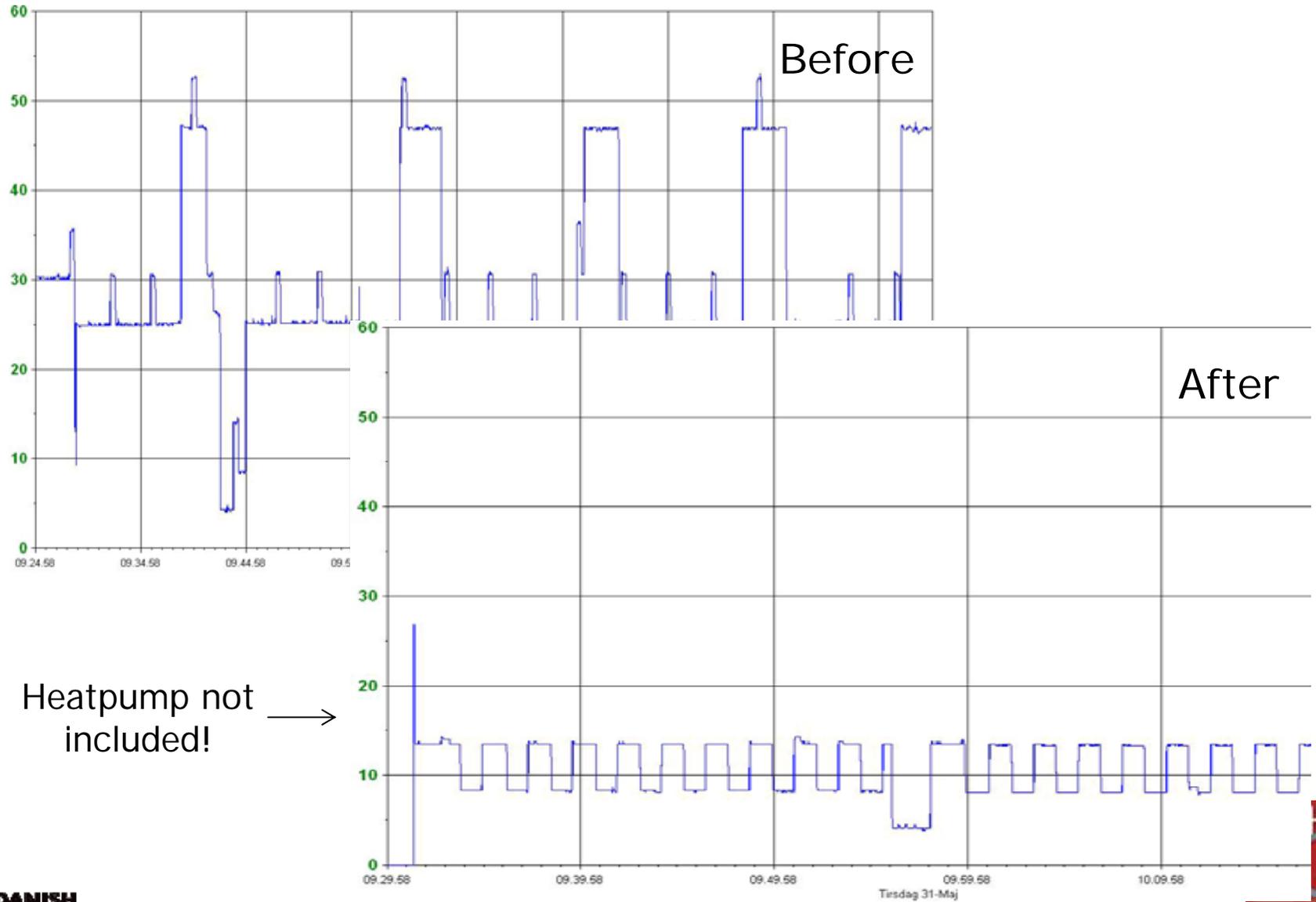
- n R134a system (5,5 kg – HC's not possible at this site)
- n COP of 3,5 @  $t_e = 15^\circ \text{C}$  and  $t_c$  of  $65^\circ \text{C}$
- n Variable speed Scroll compressor – Capacity of 20-32 kW
- n Maximum  $t_c = 75^\circ \text{C}$

### Results so far:

- n More than 12 months of operating – no problems so far
- n COP measured is 3,5-4,0
- n Maximum temperature of water is app.  $70^\circ \text{C}$



# Energy consumption "before and after"



Heatpump not included! →

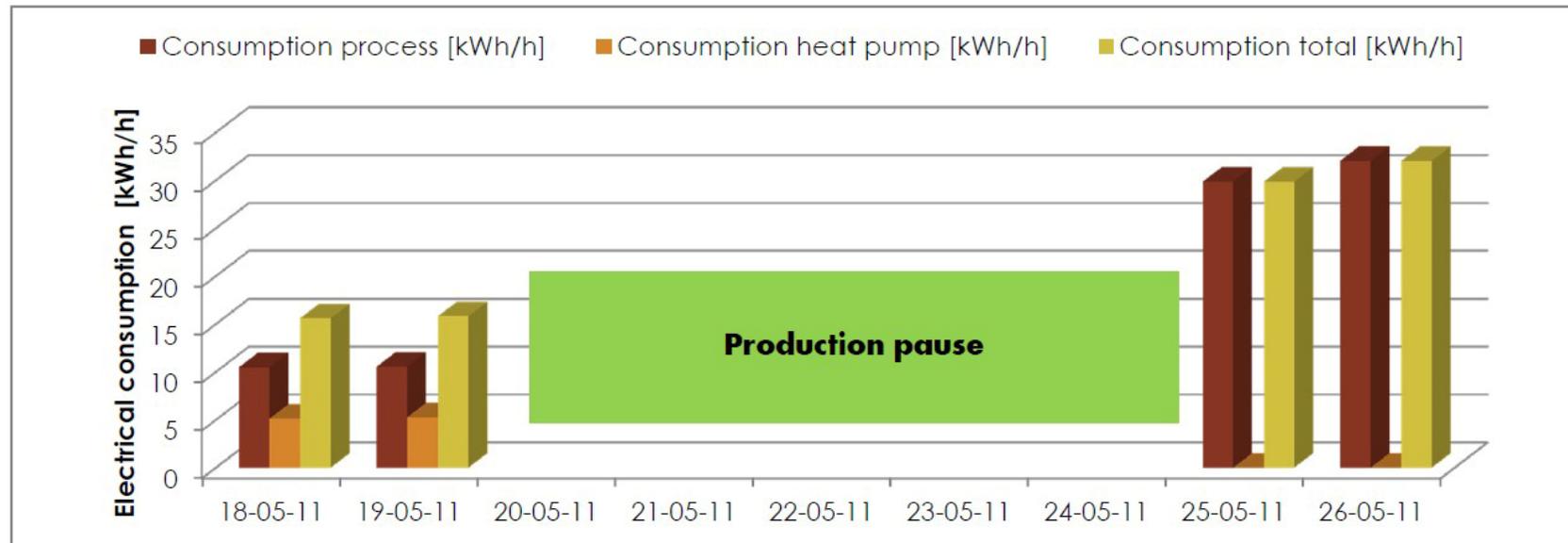


# Comparing the results

Registration date	Runtime [hours]	Consumption process [kWh/h]	Consumption heat pump [kWh/h]	Consumption total [kWh/h]	Water consumption
17-05-11 11:22					
18-05-11 11:11	23,62	10,49	5,12	15,61	1,15
19-05-11 09:18	21,08	10,55	5,27	15,81	1,25
25-05-11 09:18	19,50	29,85	0,00	29,85	1,51
26-05-11 13:14	14,00	32,02	0,00	32,02	1,14

Average saving on the electrical consumption

**-49%**



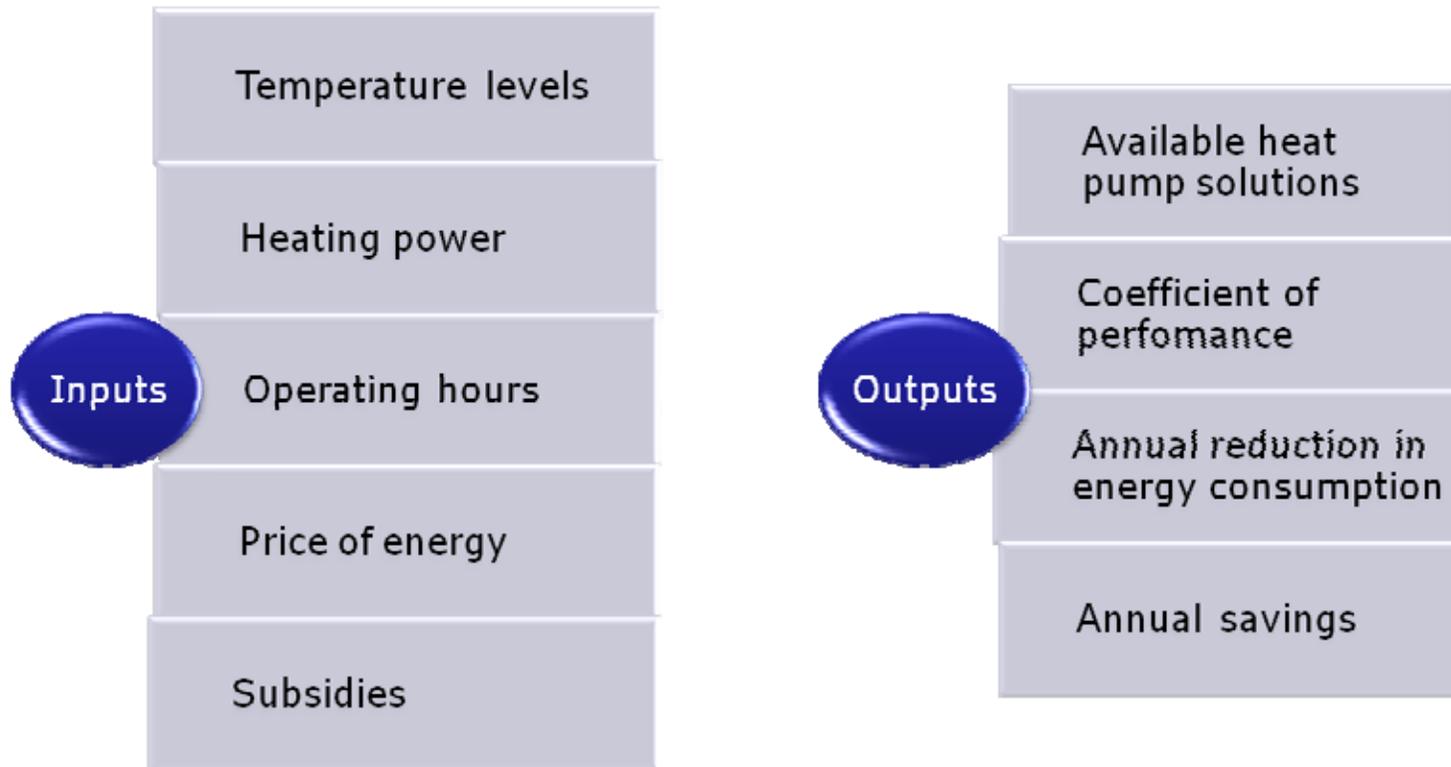
## Feasibility

- n Annual savings is 70–140 MWh (4.000–8.000 hours)
- n Energy saving subsidies 4-6 Cents/kWh (first year)
  
- n Investment app. 30.000 EUR
- n Annual savings – 7.000-14.000 EUR
- n Subsidies – 3.000 - 6.000 EUR (5 Cents/kWh)
  
- n **Simple payback time 1,7 – 4,0 years**



## A simple software tool is developed

- n Will enable manufacturers, suppliers and energy consultant to make quick assessments on heat pumps



## Conclusions

- n No technical issues
  - Easy implementation
  - Simple system using industrial components
  - No risk if failure should occur (existing heaters for backup)
  - Plenty of available heat sources
- n Power analysis in specific plants is necessary
- n Acceptable payback periods
- n Additional benefits:
  - Reduce moist level in ventilation air
  - Reduce water consumption
  - Provide free cooling



# Heat pumps in industrial washing applications



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A large graphic featuring a globe with a grid of latitude and longitude lines. Overlaid on the globe is a solid red map of the world. The text "Thank you!" is written in large, bold, grey letters across the center of the globe.

Thank you!

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