An analysis of heat pumps for industrial applications

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Case study:

Heating capacity = 200 kW

Temperature heat sink = 60 °C

Temperature heat source = 35 °C

Annual operating hours = 7 860 h/a

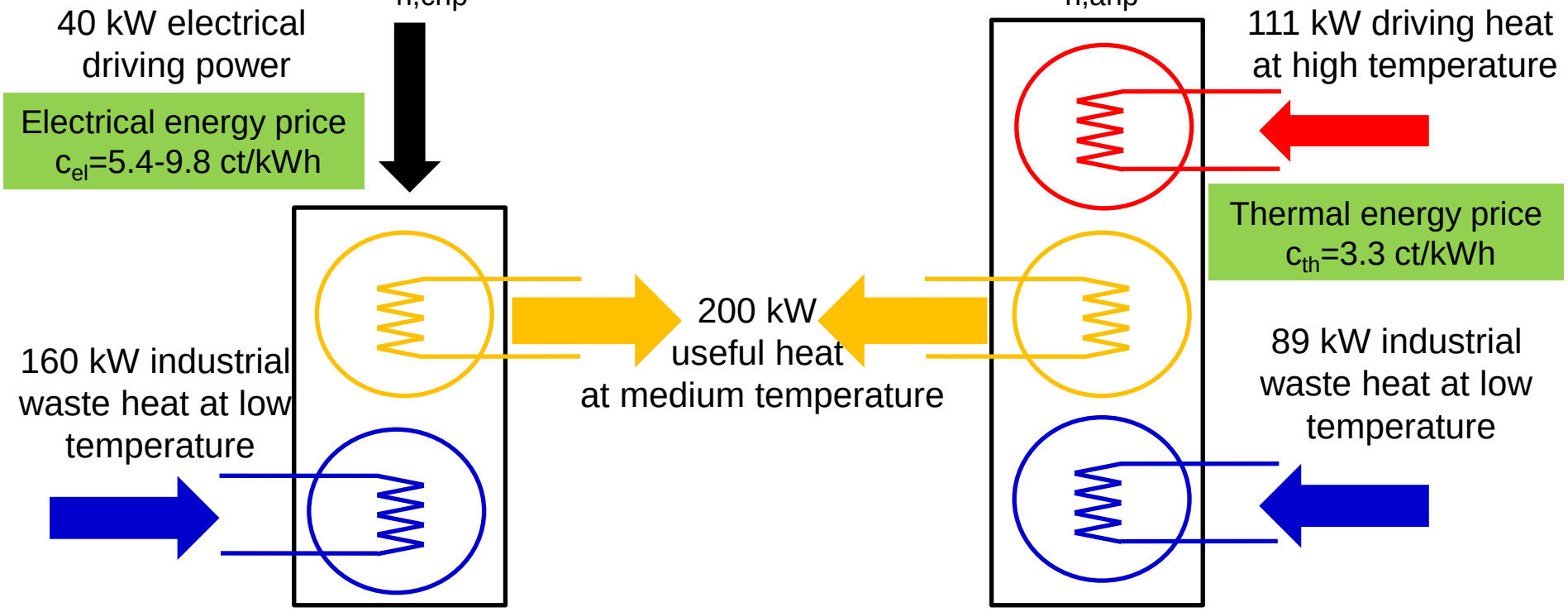
Compression heat pump (chp)

$COP_{h,chp}$=5

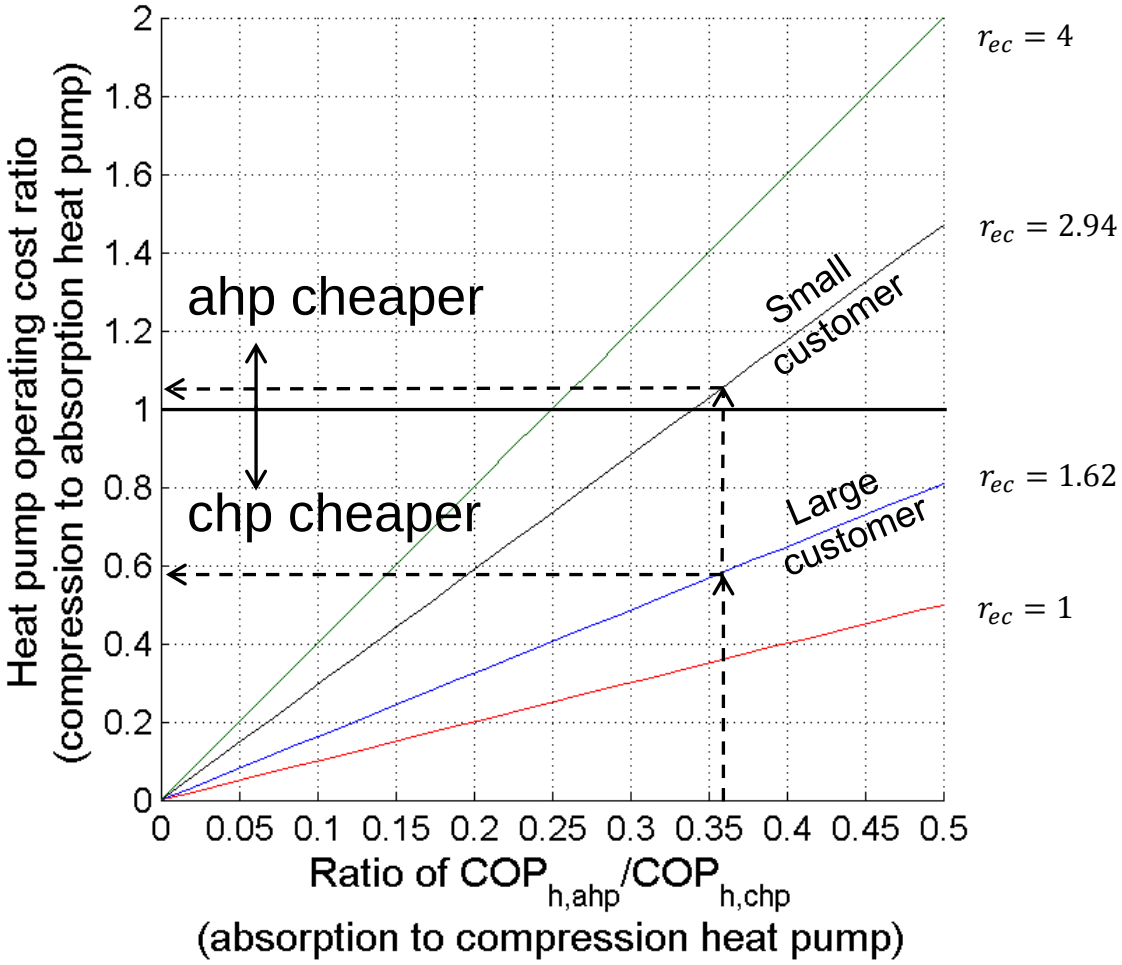
or

Absorption heat pump (ahp)

$COP_{h,ahp}$=1.8



Estimation of the operating costs



Operating cost ratio

$$r_{op} = \frac{c_{op,chp}}{c_{op,ahp}} = r_{ec} \cdot r_{COP_h}$$

Ratio of $COP_{h,ahp}$ / $COP_{h,chp}$

$$r_{COP_h} = \frac{COP_{h,ahp}}{COP_{h,chp}} = \frac{1.8}{5} = 0.36$$

Ratio of energy prices

$$r_{ec,large} = \frac{c_{el}}{c_{th}} = \frac{5.4}{3.33} = 1.62$$

$$r_{ec,small} = \frac{c_{el}}{c_{th}} = \frac{9.8}{3.33} = 2.94$$

Acknowledgment

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Federal Ministry
Republic of Austria
Transport, Innovation
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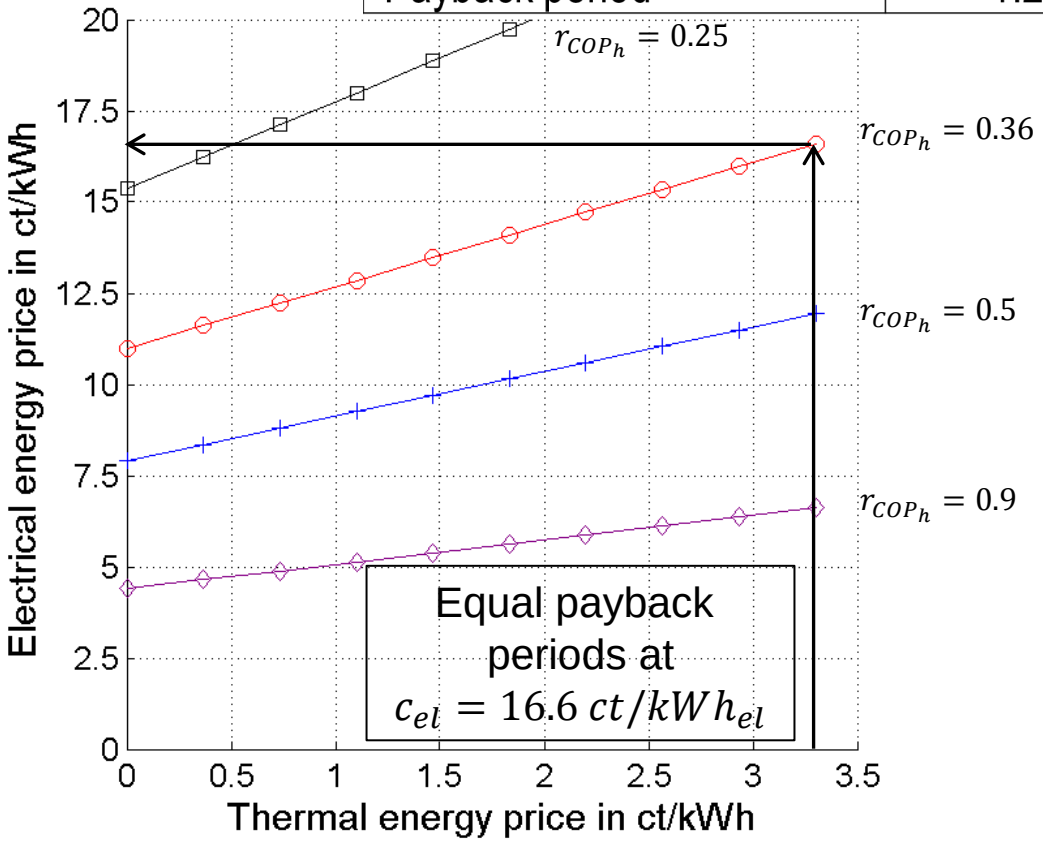
Payback period for a replacement of a natural gas boiler

$$\tau_{pb} = \frac{C_{ic}}{\Delta C_{op}}$$

$$c_{gas} = 5.1\ ct/kWh$$

	ahp	chp	Unit
Price of driving energy	3.3	7.6	ct/kWh
Investment costs	72 593	44 451	EUR
Payback period	1.2	0.68	a



Industrial heat pumps

Utilization of 100 % waste heat at low temperature

Compression heat pump (chp)
$COP_{h,chp}=5$

or

Absorption heat pump (ahp)
$COP_{h,ahp}=1.8$