

What role will heat pumps play in a decarbonised future

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refrigerants delivered by mother nature

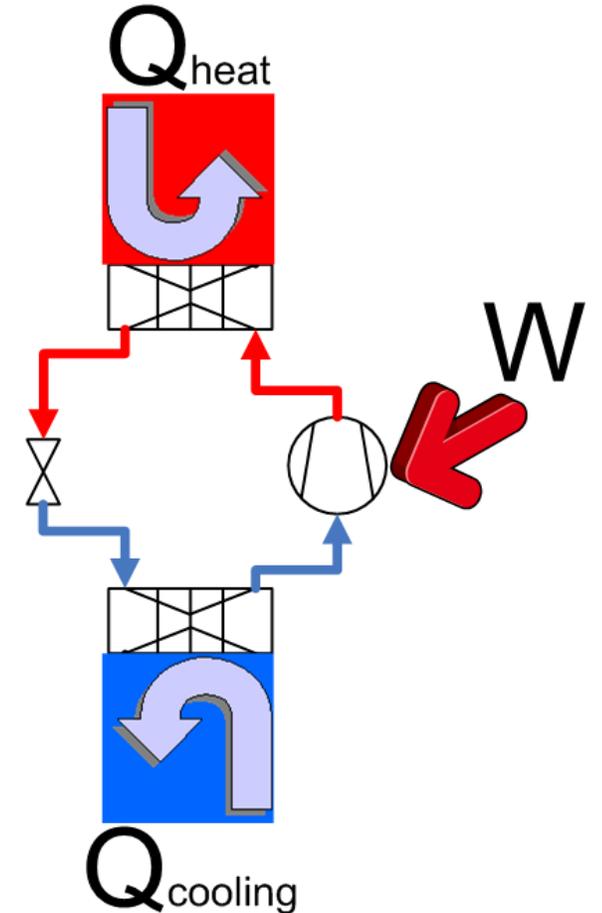
Decarbonising energy consumption

- Industry has understood the message from the customers
- More focus from consumer groups and investors are pushing the agenda in board rooms and in public
- Big oil companies (Exxon and Chevron) are forced by investor groups to take on a green agenda
- Major players will push for heat pumps to avoid boilers
- Latest IEA report say if we are to meet the Paris agreement by 2050, then we need to install 500MW heat pump capacity every month for years to come
- Industrial heat pumps reaching temperature levels of 250°C or higher will be a viable way to go
- For very high temperatures green hydrogen or green electricity will be the energy source
- High Temperature Heat Pumps will be based on natural refrigerants



Heat pumps will be part of the backbone

- Heat pumps will be essential for achieving the goal of becoming carbon neutral anytime in the future
- District heating is only a start and good to learn from
- Industrial production can make a better business case because here we can think the system in to being one energy system
- The ability to link more temperature levels will optimise the use of heat pumps in the future industry site
- Also mixing different sizes of equipment for a better capacity adoption to the actual capacity needed will be essential
- Heat storage is a discipline the heat pump suppliers should master
- Optimisation on both the warm and cold side is essential for flexibility and adoptability



Blue skies

- A very important side effect of decarbonising the way of life is a cleaner environment
- A new future will also demand less emissions of all substances that are harmful to nature and humans
- The change to green and CO₂ energy is good also for the economy of society and companies and not least the citizens of tomorrow's world
- Hydrogen and ammonia as fuel will also play a role in the transport sector
- For years to come the infra structure and logistic net need to be updated to meet tomorrows demands
- Heat pumps will be applied more widely than we imagined before – the mantra being all heat can be recovered



Calculation and comparisons

- Does it still make sense with the decisions made to phase out boilers using fossil fuels?
- Still we have to strive to increase the efficiency
- IEA indicates that 30% or more of the reductions should come by increasing energy efficiency – plenty to do in the years to come
- Focus will also be on increasing efficiency on already installed systems with an expected service life of 25 or 50 years
- Lots of work – Lots of research and development is waiting to show what the industry is capable of when it is at its best

Cordin Arpagaus: Hochtemperatur Wärmepumpen, VDE verlag, page 113		Annual saving
K_wp Annual cost with heat pump	62.278	<u>122.980</u>
K_GK: annual cost with gas boiler	185.258 €	
KA,wp: Annual annuity costs with the heat pump (40,46 €/kW)	40,46 €/kW	
KA,GK: Annual annuity costs with gas boiler (5,78 €/kW)	5,78 €/kW	
Based on assumptions:		
Kinvest,WP: specific investment costs with HP (420 €/kW)	560 €/kW	
Kinvest,GK: specific investment costs with gas boiler (60 €/kW)	201 €/kW	
I: Interests on investment (5%)	5 %	
N: Service life (15 years); Change the value in ROI sheet	30 Years	
A: Annuity (0,096)	0,065 (-)	
Kw,wp: Maintenance costs of the WP related to the investment (2,5%)	2,5 %	
kw,GK: Maintenance costs of the GK related to the investment (3%)	3 %	
Kgas: Gasprice	0,0264 €/kW	
Kel/Kgas: El/gas price relationship (-)	3,36 (-)	
T: annual use time (40% of the year means 3504 h/year)	60,0 %	
EtaGK: Degree of utilization of the GK (80%)	80 %	
Eta_wp: Quality grade of the WP (45%)	55 %	
CCOPH	3,60 (-)	
Source	60 C	
Sink	120 C	
DeltaThub	60 K	
Capacity	1000 KW	
Country	Germany	2019S1
Electricity	0,0887 €/kW	
Gas	0,0264 €/kW	
Kel/Kgas relation ship	3,359848485 (-)	
Prices excluded recoverable fees and taxes		
Return on extra cost of investment	2,9 years	
Return on full cost of invetment	4,6 years	



Thank you for your kind attention

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eurammon e. V. is always available as a sparring partner for questions on refrigeration with natural refrigerants.

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