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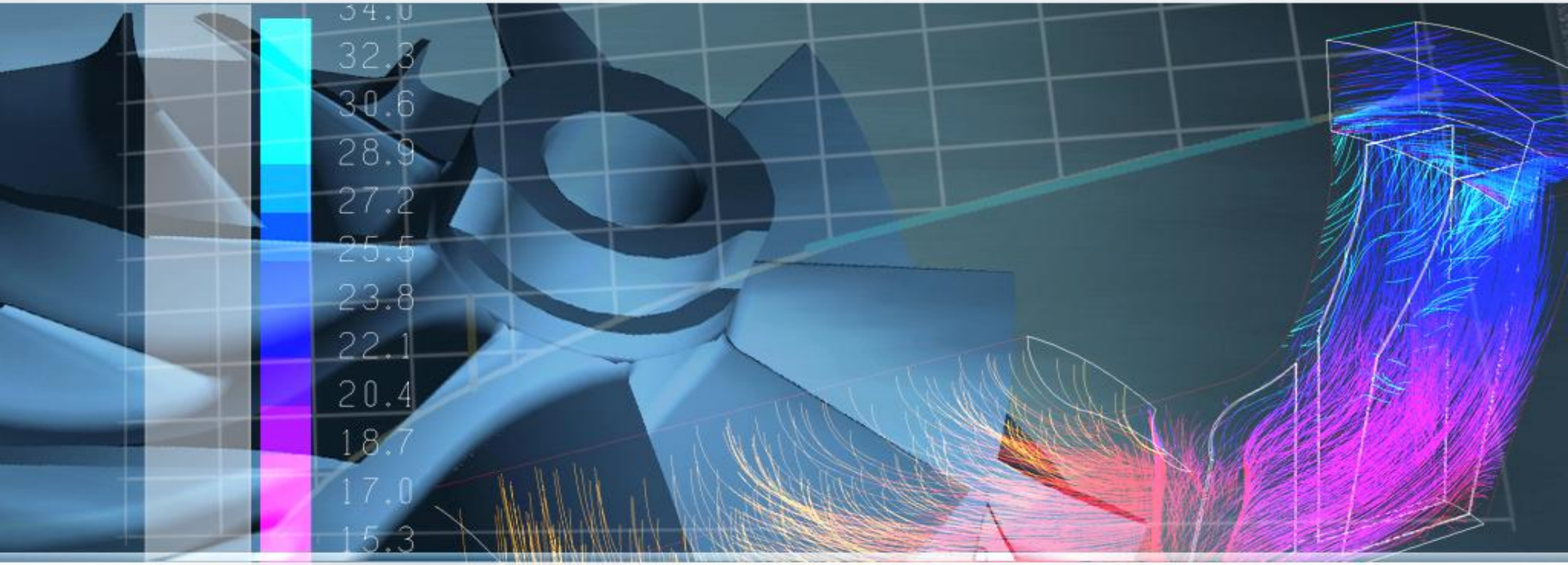


Institute of Air-handling and Refrigeration (ILK Dresden)

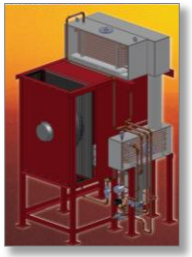
Component development and first test results of a directly air-cooled water/LiBr absorption chiller

Australian Solar Cooling 2013 Conference, Sydney 2013

ILK Dresden – R&D company

- Founded in 1964
- Re-established as independent research institute in 1991

- Employees: 145
- Academics: 72 %
- mean age: ~44
- Laboratory area: ~3000 m²
- Test rigs: ~56
- Phys. / Chem. Laboratories: 25



Background and goal of the development

Problems in systems with small scale chillers

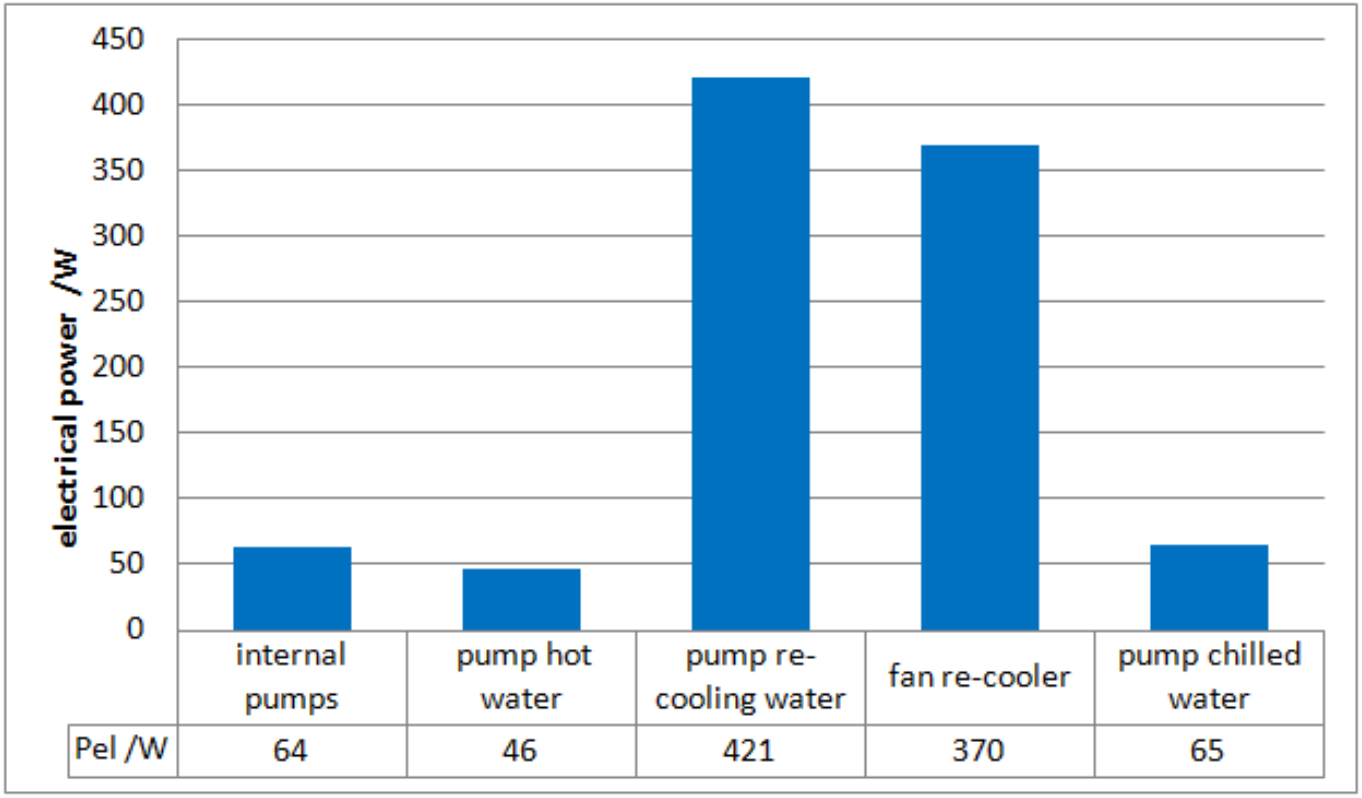
- Complexity of the systems
- Interface problems because of different crafts (might be) involved
- Possibly high error rate during installation
- Auxiliary energy demand of the system
- Limited applicability of evaporative systems but high re-cooling sensibility of the cycle

Challenges

- Avoiding of an intermediate circuit:
  - to minimize the auxiliary energy demand (as re-cooling circuit pump usually consumes a lot)
  - for a better approach of external and internal temperatures since temperature lift is limited
- Air-cooled absorber needed
- Water as refrigerant -> big free section needed

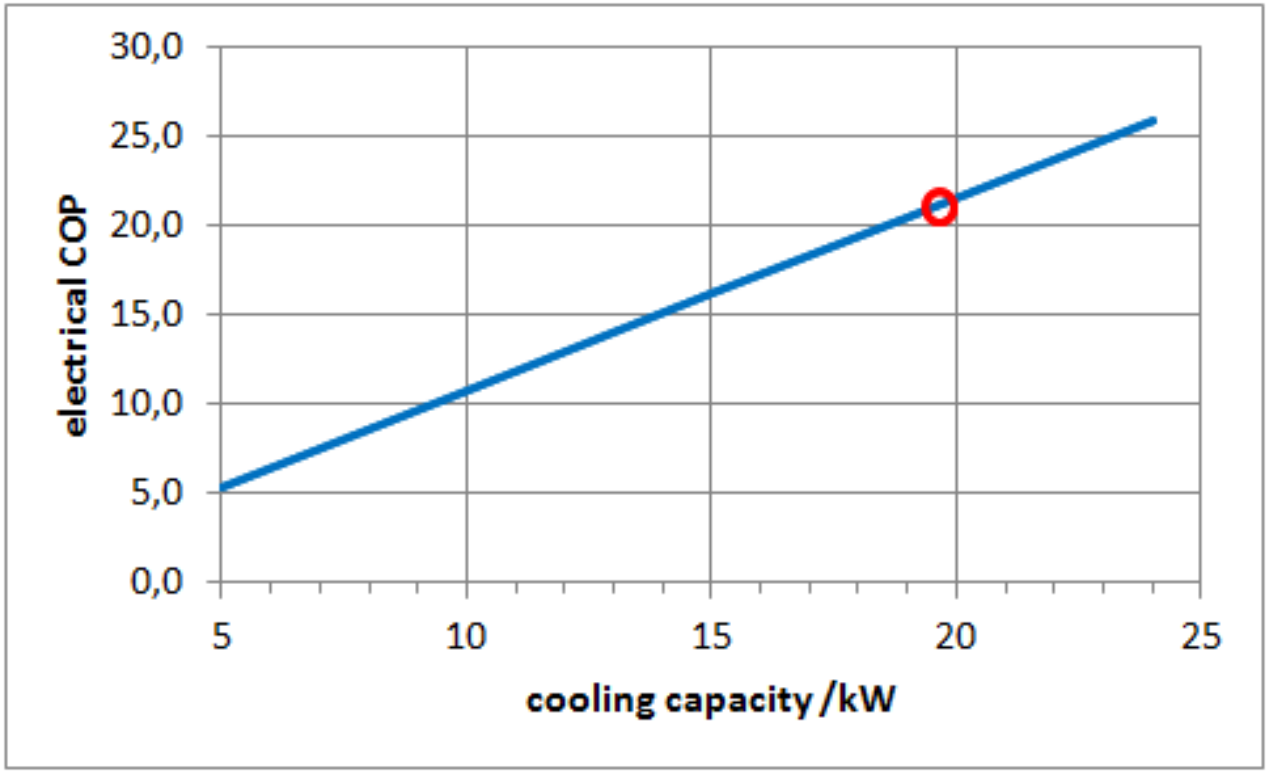
- Air as heat transfer media -> big free section needed

Distribution of the auxiliary energy demand of a small scale water cooled absorption chiller



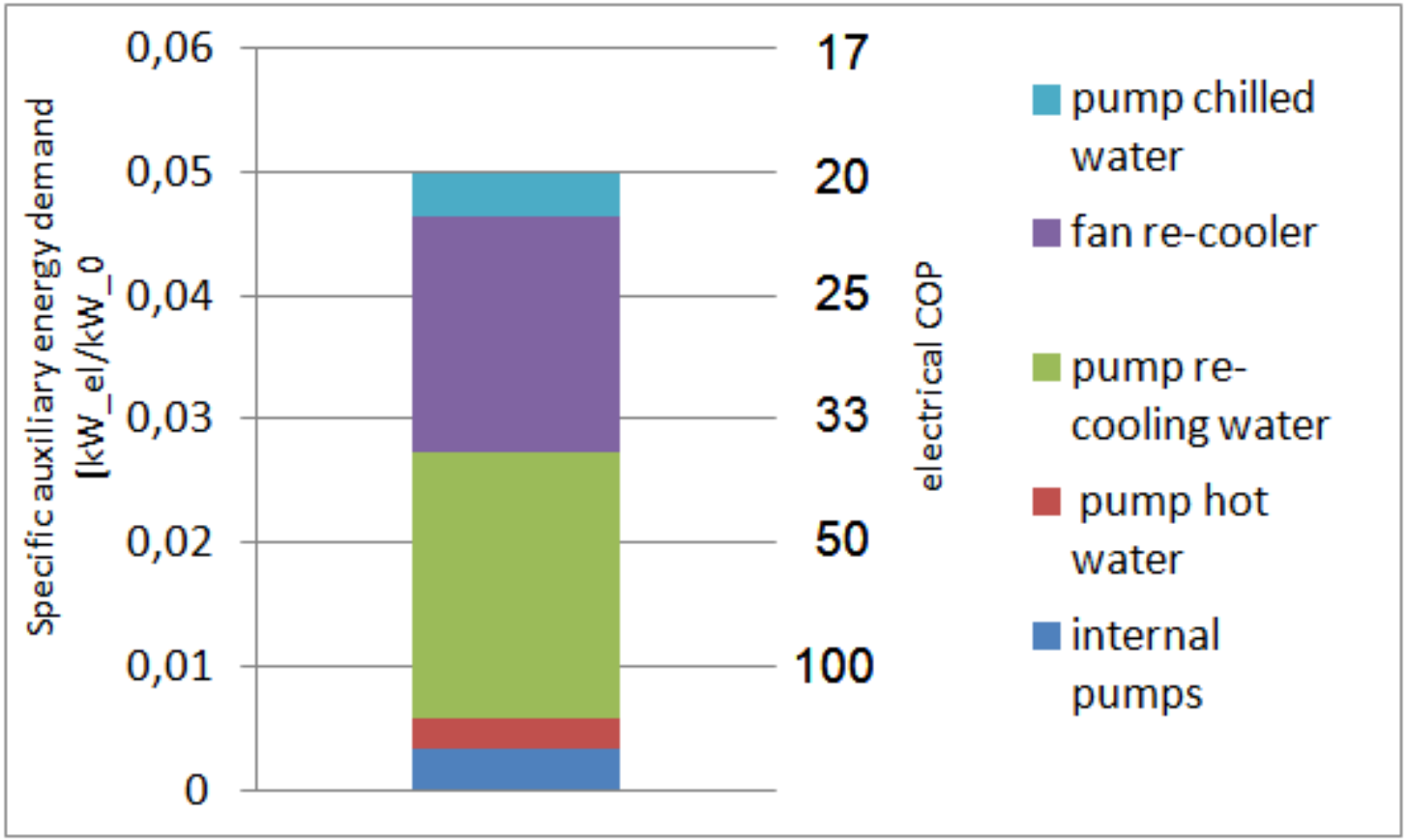
Nominal cooling capacity: 19,4 kW %-numbers: pump efficiency

Auxiliary energy demand of the system



Auxiliary energy demand of the system with constant speed pumps/fans as a function the cooling capacity

Distribution of auxiliary energy demand



Examples of air-cooled absorption chillers

Source: Rotartica

H_2O/LiBr, rotating HX, intermediate circuit

Source Helioplus

NH_3/H_2O -> high working pressure!

Gas driven -> high temperature

Examples of air-cooled absorption chillers

Source: Broad

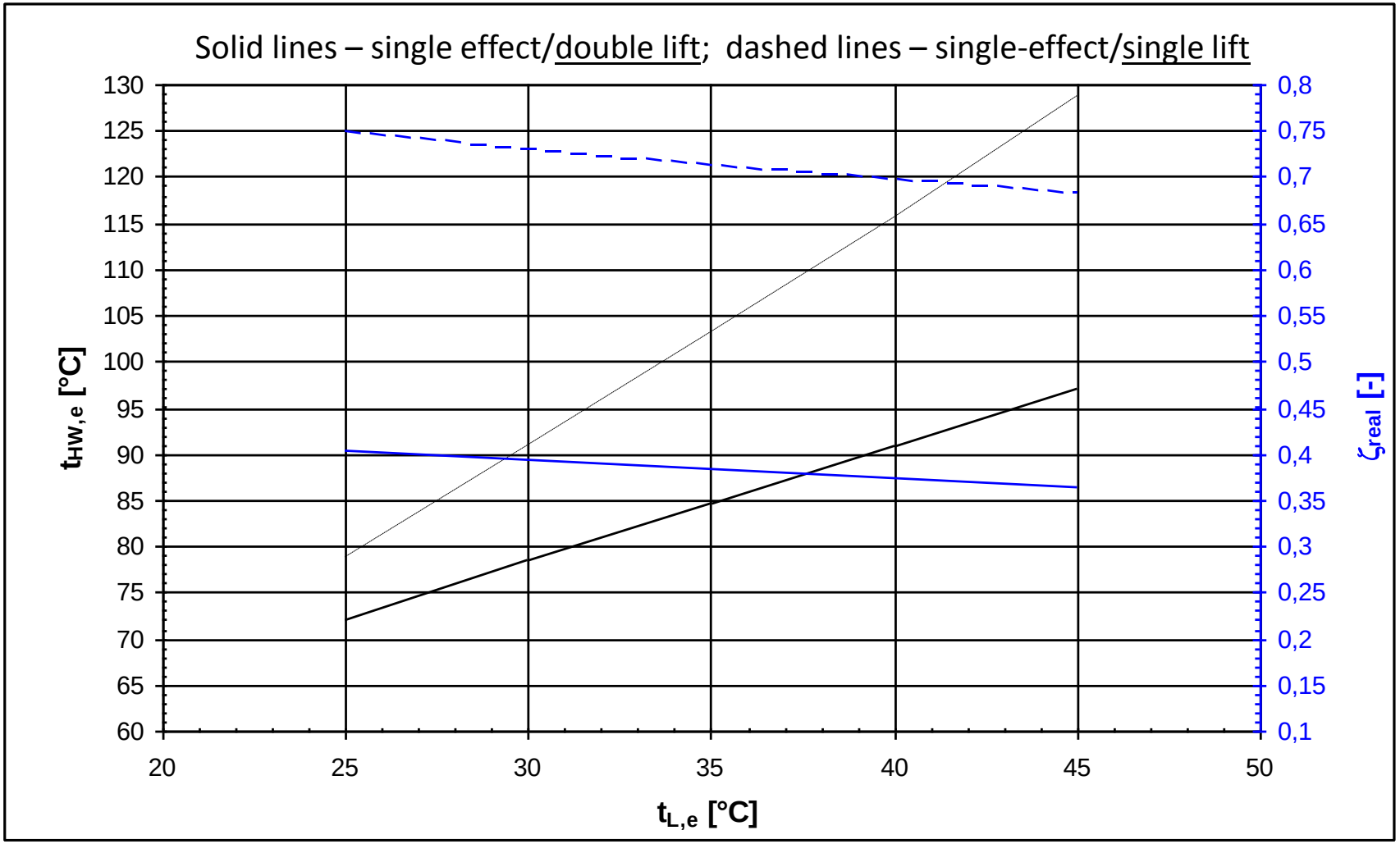
Source: Broad

H_2O/LiBr, gas driven, intermediate circuit

Q_0=23 kW; zetta=1,1, P_{el}=1,8kW

(COP_{el}=12,7)

Balancing Single Lift vs. Double Dift



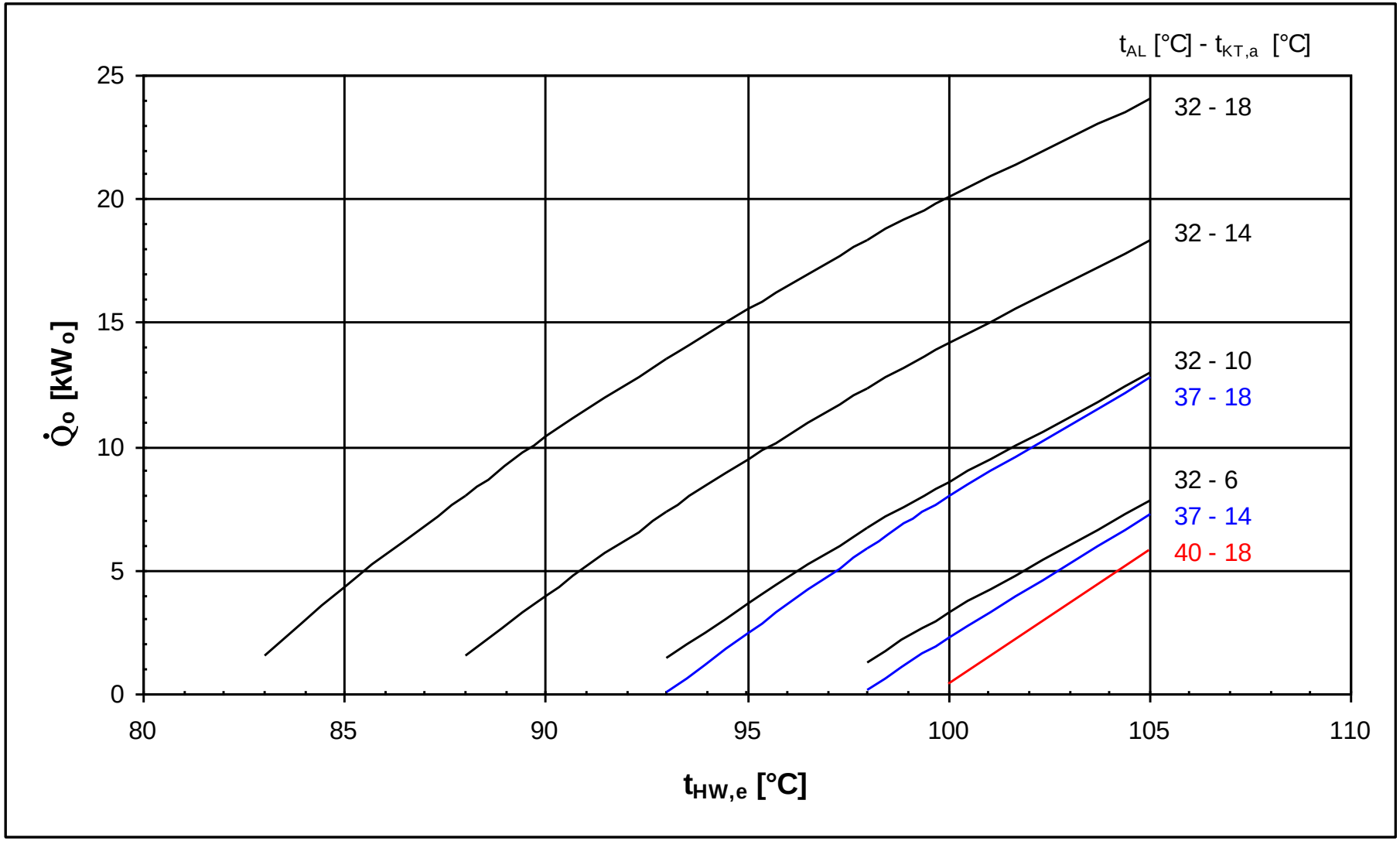
For chilled water out: 13 °C

Aimed specifications for the component development

External Fluid	Nominal Condition	Operating Range
Chilled water temperature (water w. 20 % Glycol)	18 °C / 13 °C (in/out)	6 °C … 20 °C (out)
Heating water temperature (water w. 20 % Glycol)	95 °C / 87 °C (in/out)	75 °C … 105 °C (in)
Ambient air (for re-cooling)	32 °C / 42 °C (in/out)	10 °C … 32°C (in)
Cooling capacity	8 kW	

- Condenser and Absorber directly air-cooled
- Outdoor installation, frost save
- Auxiliary energy consumption at nominal conditions < 60 W_{el}/kW_0 („EER“ > 16)
- Single effect / single lift

Calculated cooling capacities for different temperatures

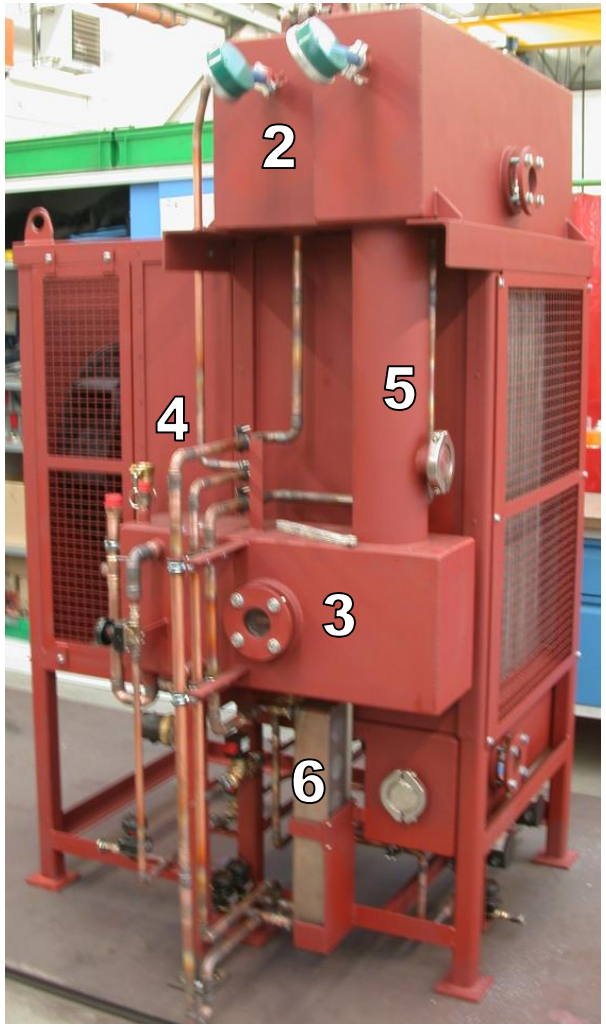


Design and testing of components (Samples)

- Even and permanent distribution of the solution onto vertical absorber tubes
- Good wetting inside the tubes over the whole lenght
- Increase of HX area on air side
- Efficiency of the fan vs. cost

Model	η_{Fan} [-]	cost [€]
Arial 1	0,354	752
Axial 2	0,375	817
Axial 3	0,395	826
Radial 1	0,480	995
Radial 2	0,570	1222

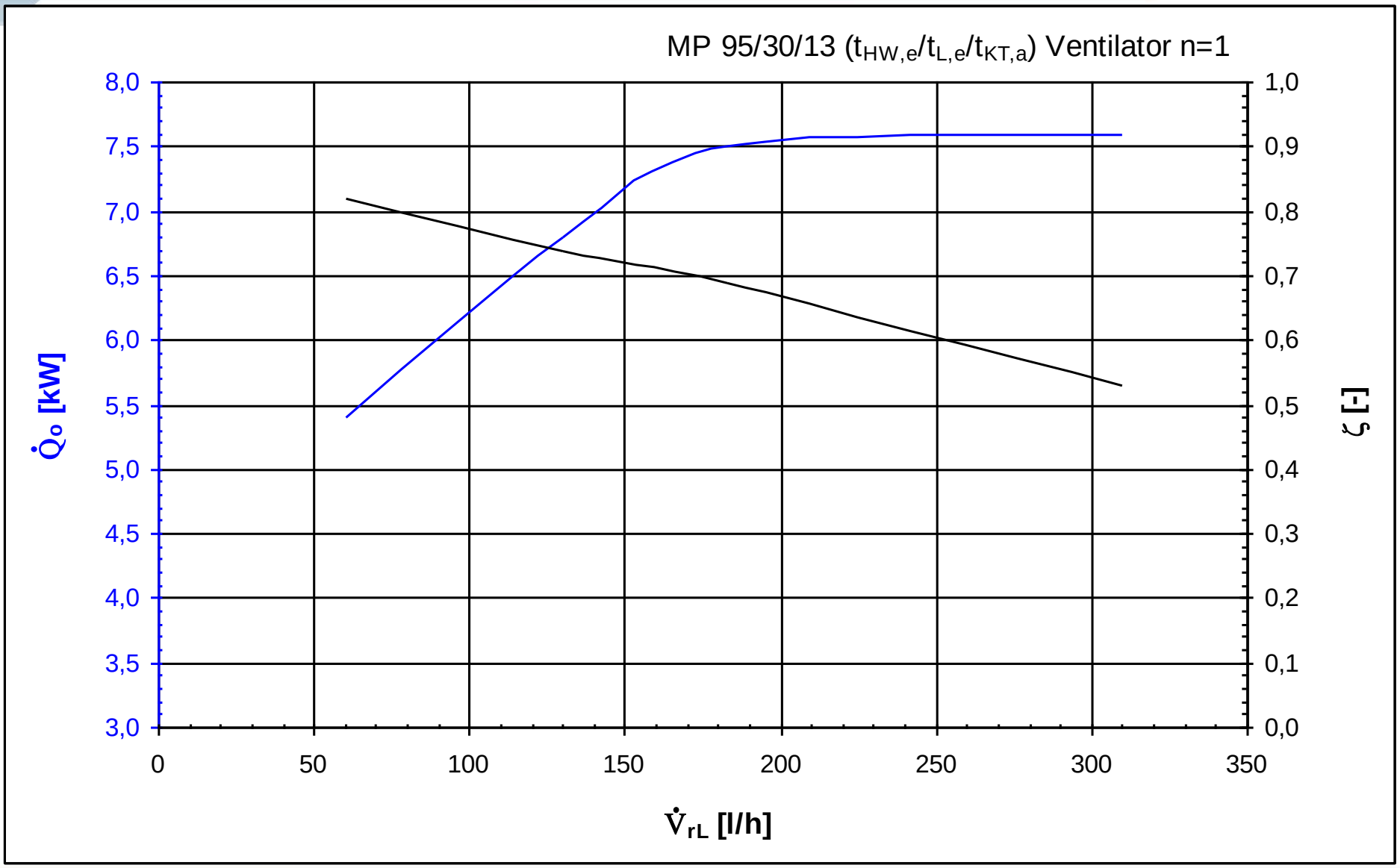
Test of components within functional model



First Results

Criteria	Design target	Reached so far
Cooling capacity	8 kW with inlet temperatures: 95 °C; 32 °C; 18 °C	7,7 kW with inlet temperatures: 95 °C; 29,5 °C; 18 °C
Thermal EER	0,71	0,72
Auxiliary energy demand (“electrical EER”)	0,50 kW 62,5 Wel/kW0 EERel: > 16	0,64 kW 85 Wel/kW0 EERel: > 12

First Results



Outlook

Optimisation

- Decrease of air side pressure drop
- Prevention of air bypass
- Improvement of design and alignment of components
- Avoidance of solution displacement

=> Design and construction of an optimised prototype

- Build-up of an adapted testing infrastructure
- More detailed laboratory testing
- Monitoring and evaluation of two prototypes in field tests

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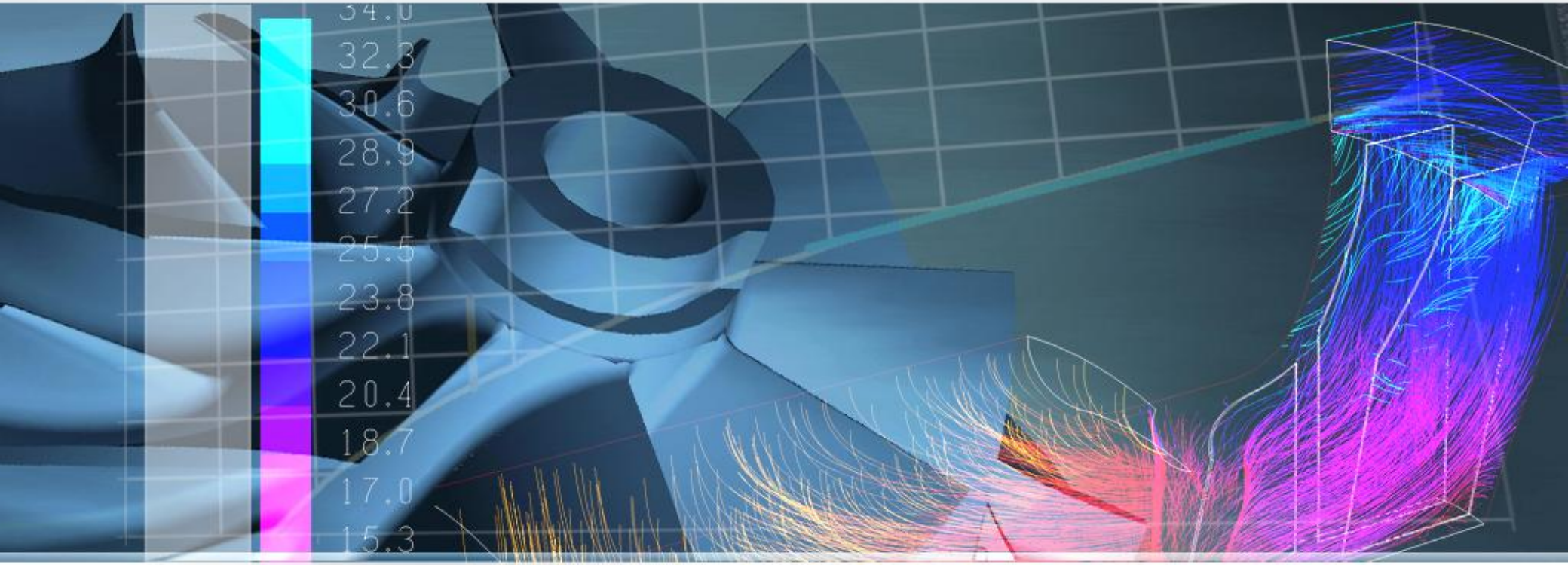

Thanks for your attention!

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