



## Heat pump refrigerant cycle model for generation of lookup tables

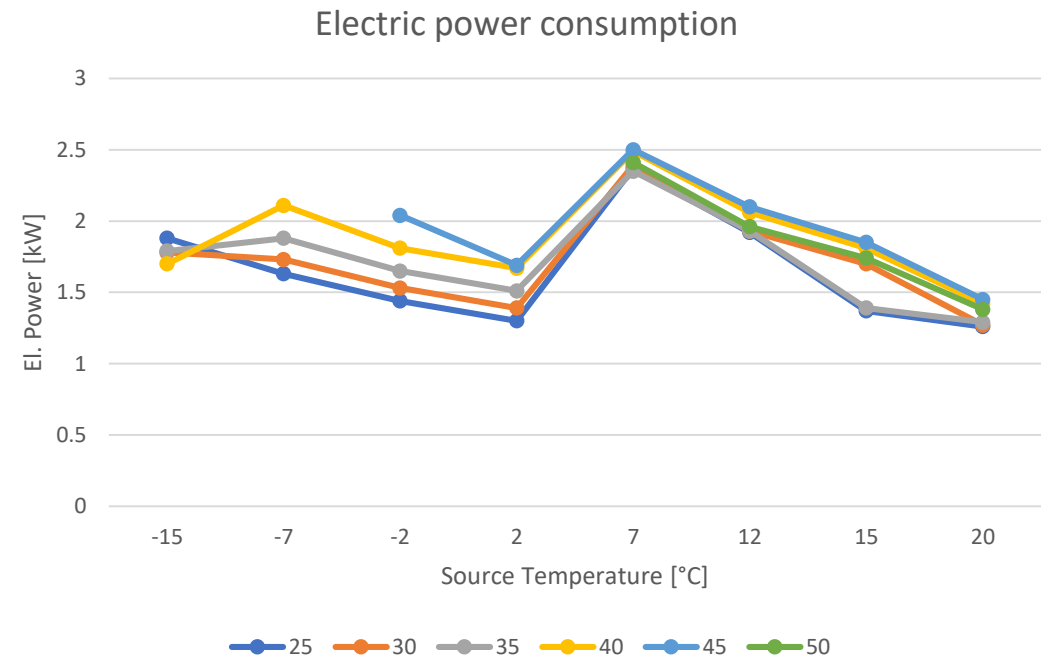
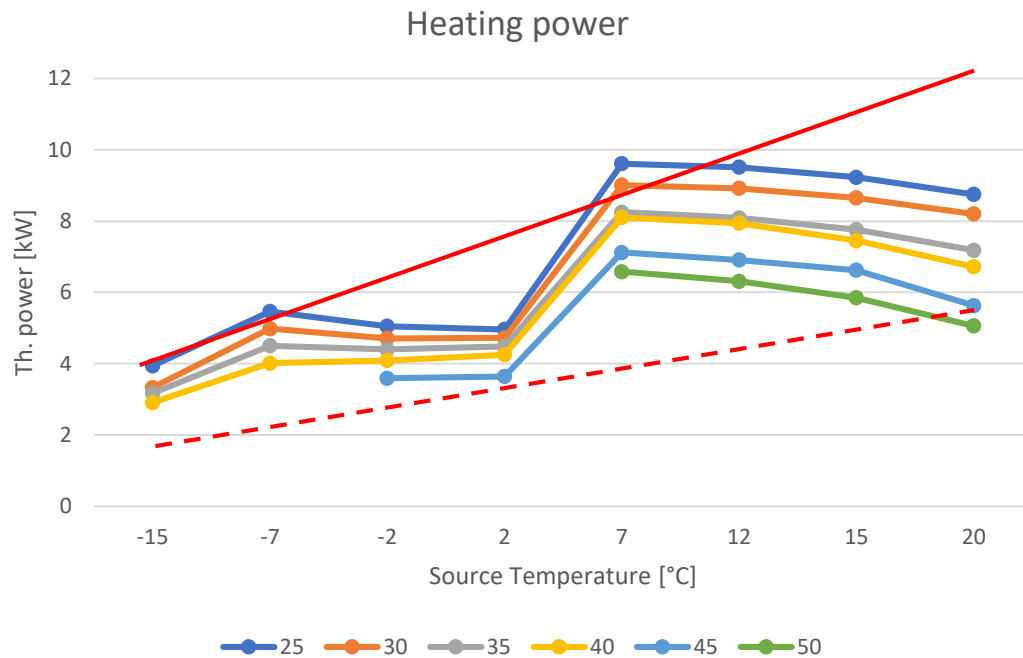
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## Background and motivation

- » Knowledge about heat pump operation under varying boundary conditions necessary when using heat pump models in dynamic simulations
- » Manufacturer datasheets do not always offer complete information (e.g. speed-controlled, de-icing operation)
- » Use of alternative refrigerant mixtures

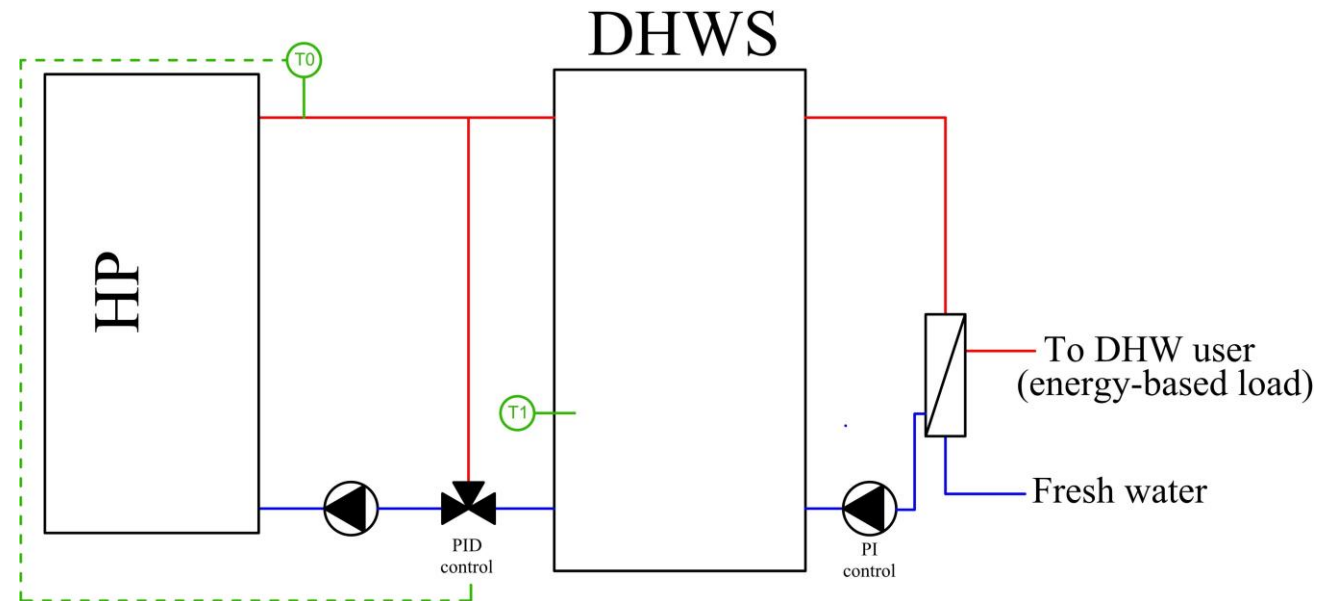
# Why a lookup table generator?



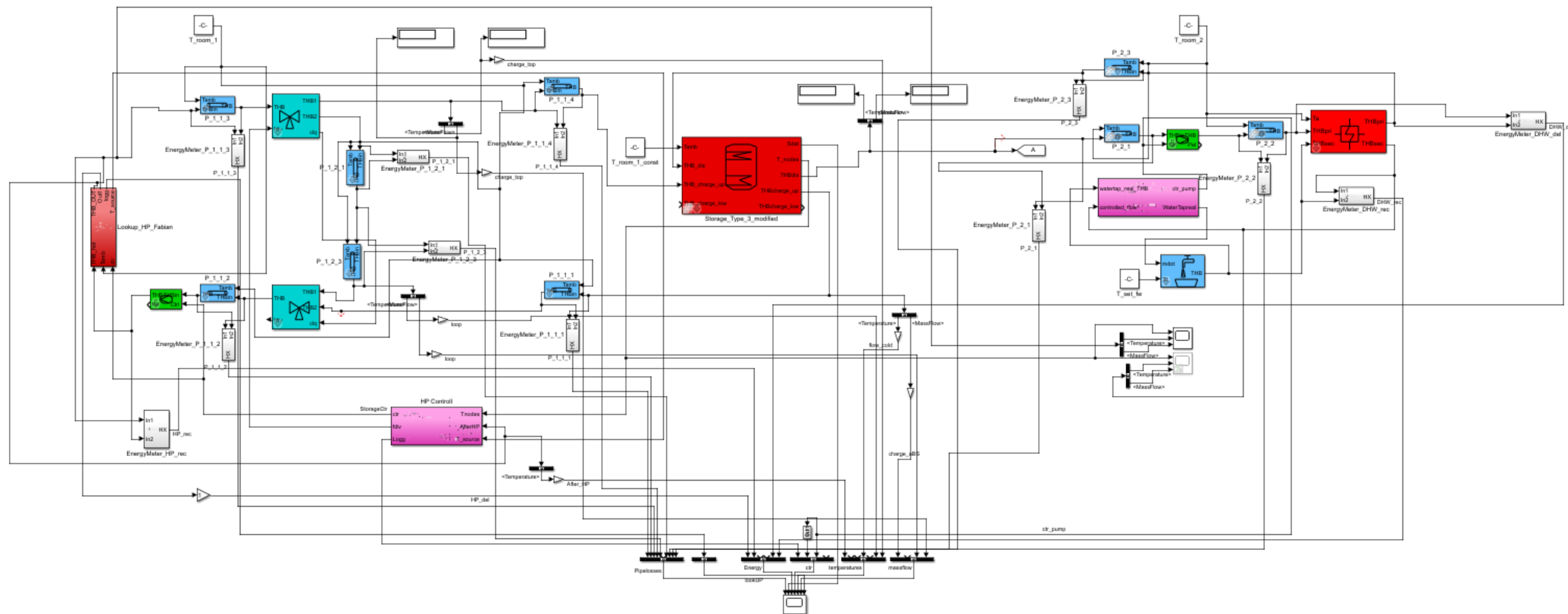
Source: [https://www.daikin.de/de\\_de/produkte/3mxm-a.html](https://www.daikin.de/de_de/produkte/3mxm-a.html)

## Aim of the work

- » Steady-state tool needed to supply reliable heat pump performance maps
- » Results compared against measurements of an air-to-water heat pump and against the simulation results of a commercial software



# Dynamic system simulation of a split DHW heat pump (Simulink + Carnot Toolbox)





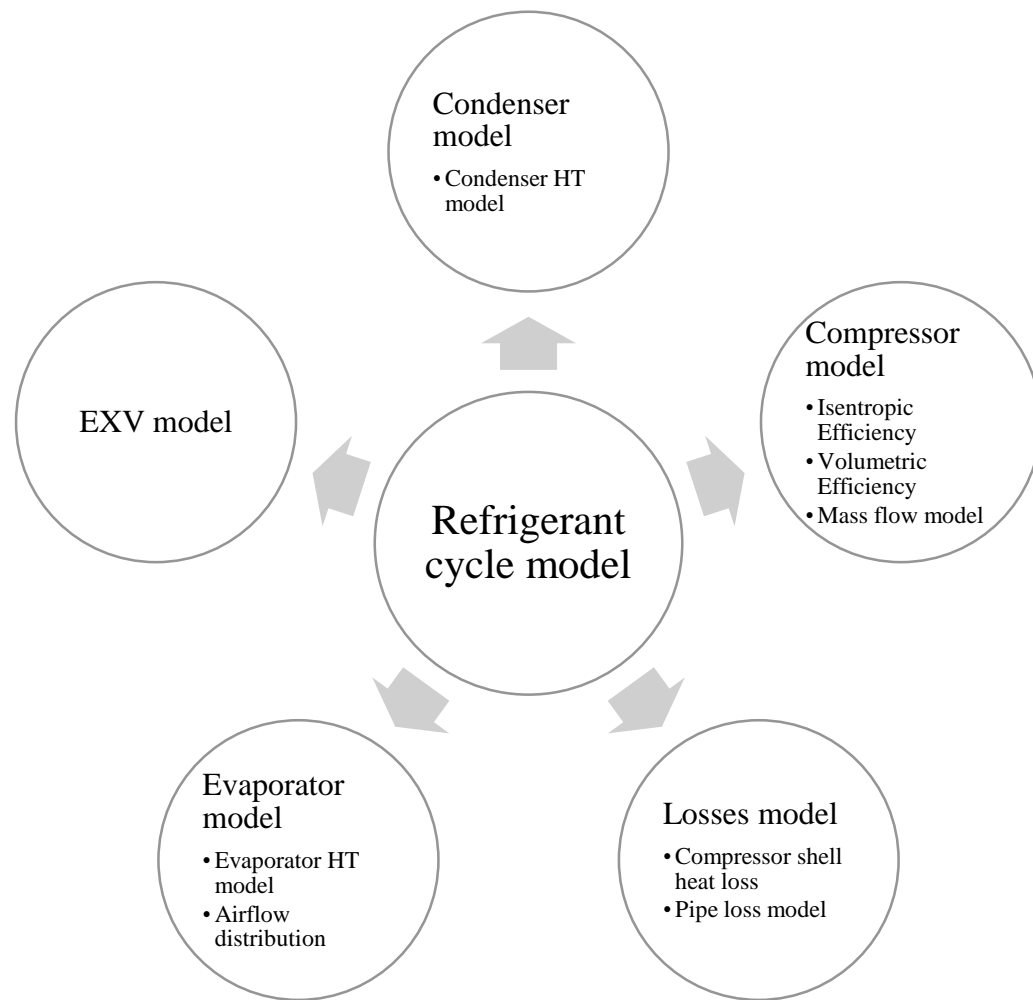
# Methods – Tool description and required inputs



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## Source side:

- $\vartheta_{src,in}$  Source inlet temperature
- $\dot{m}_{src}$  Source mass flow

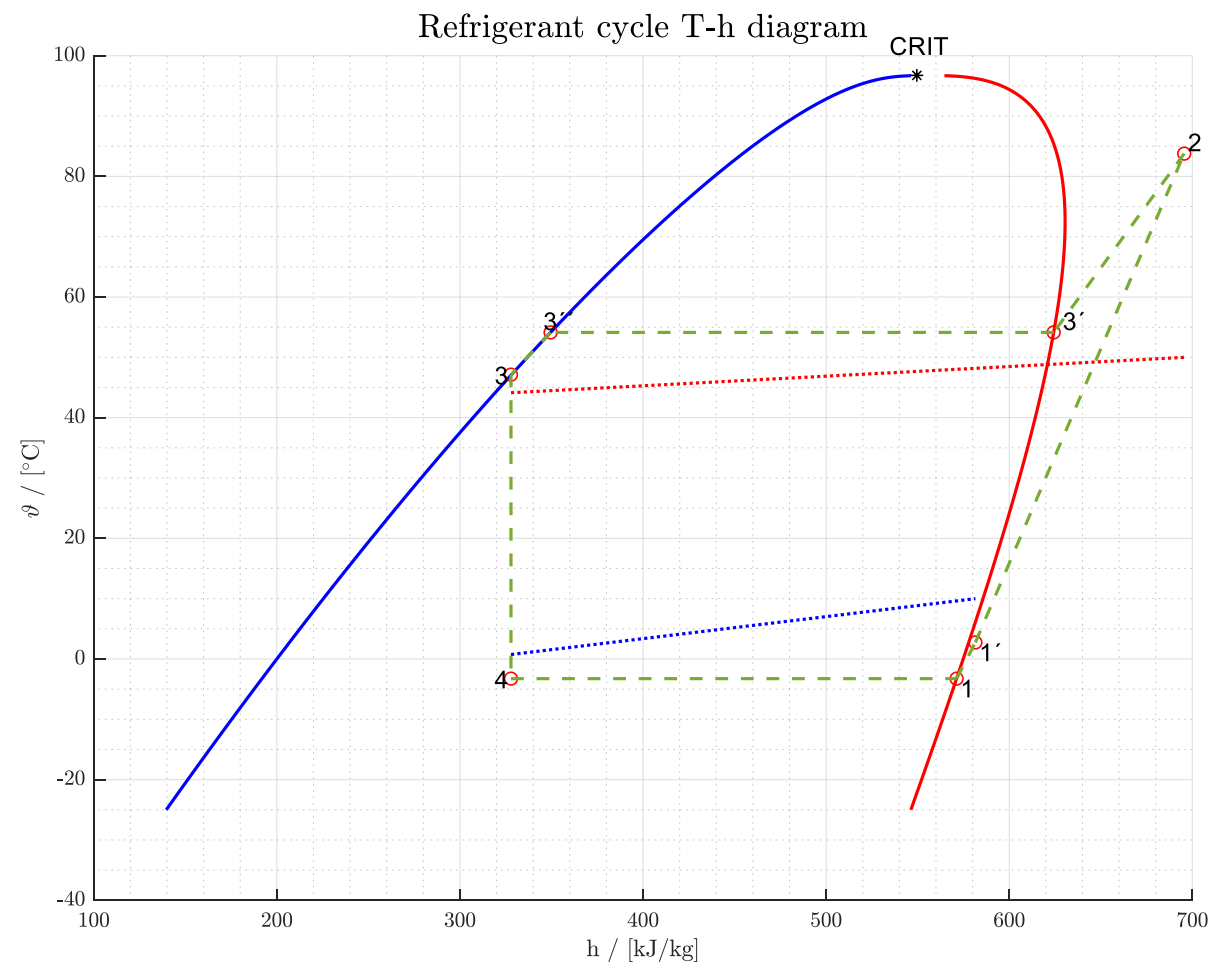
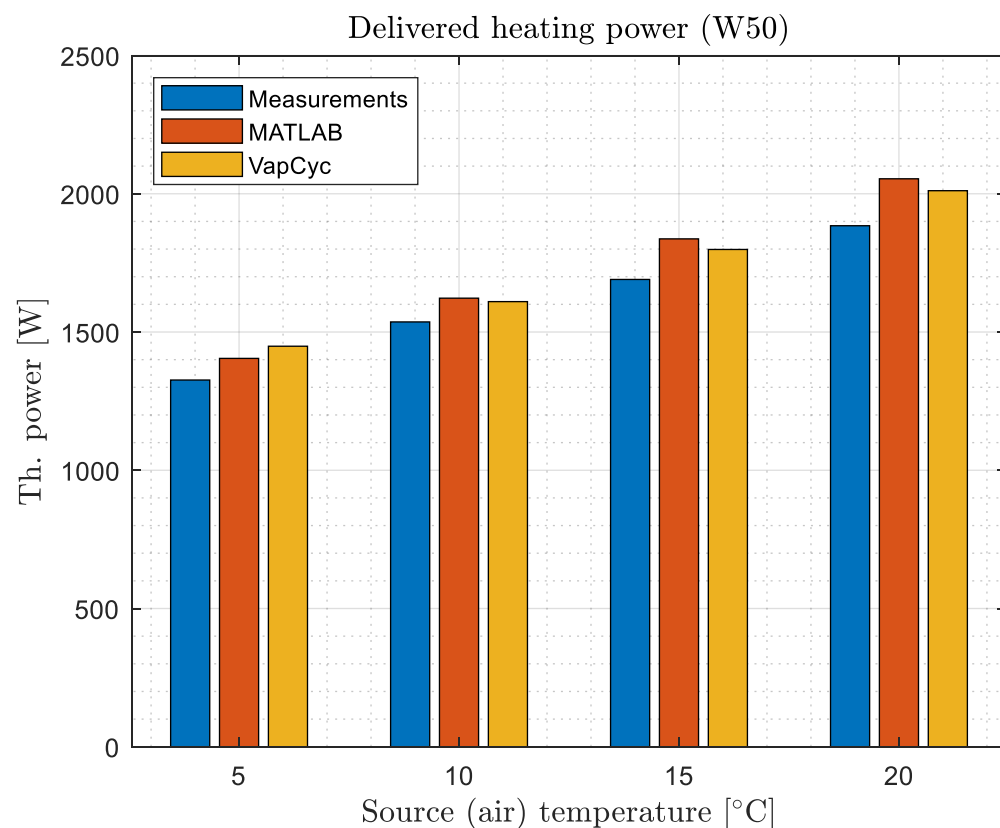
## Sink side:

- $\vartheta_{sink,out}$  Sink outlet temperature
- $\dot{m}_{sink}$  Sink mass flow

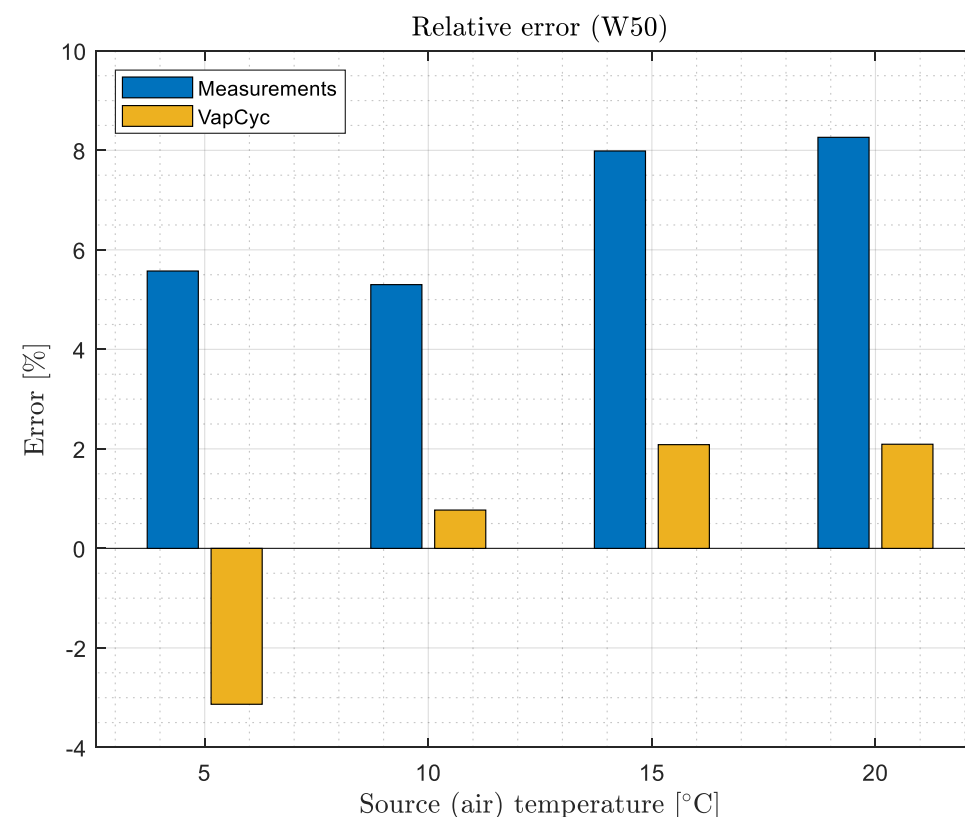
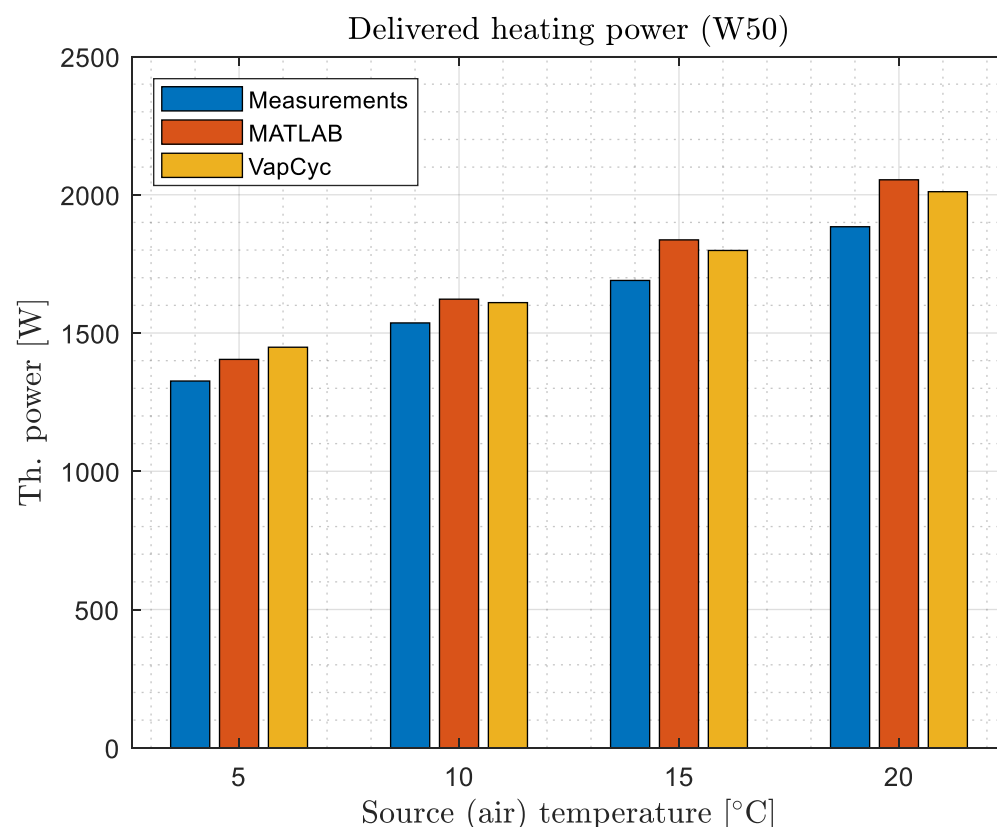
## Refrigerant cycle:

- $\Delta T_{super}$  Superheating
- $\Delta T_{sub}$  Subcooling
- $\Delta T_{pinch,cond}$  Pinch point condenser
- $\Delta T_{pinch,evap}$  Pinch point evaporator

# Results – Comparison of measurements and simulation data for a mini-split air-to water HP



# Results – Comparison of measurements and simulation data for a mini-split air-to water HP





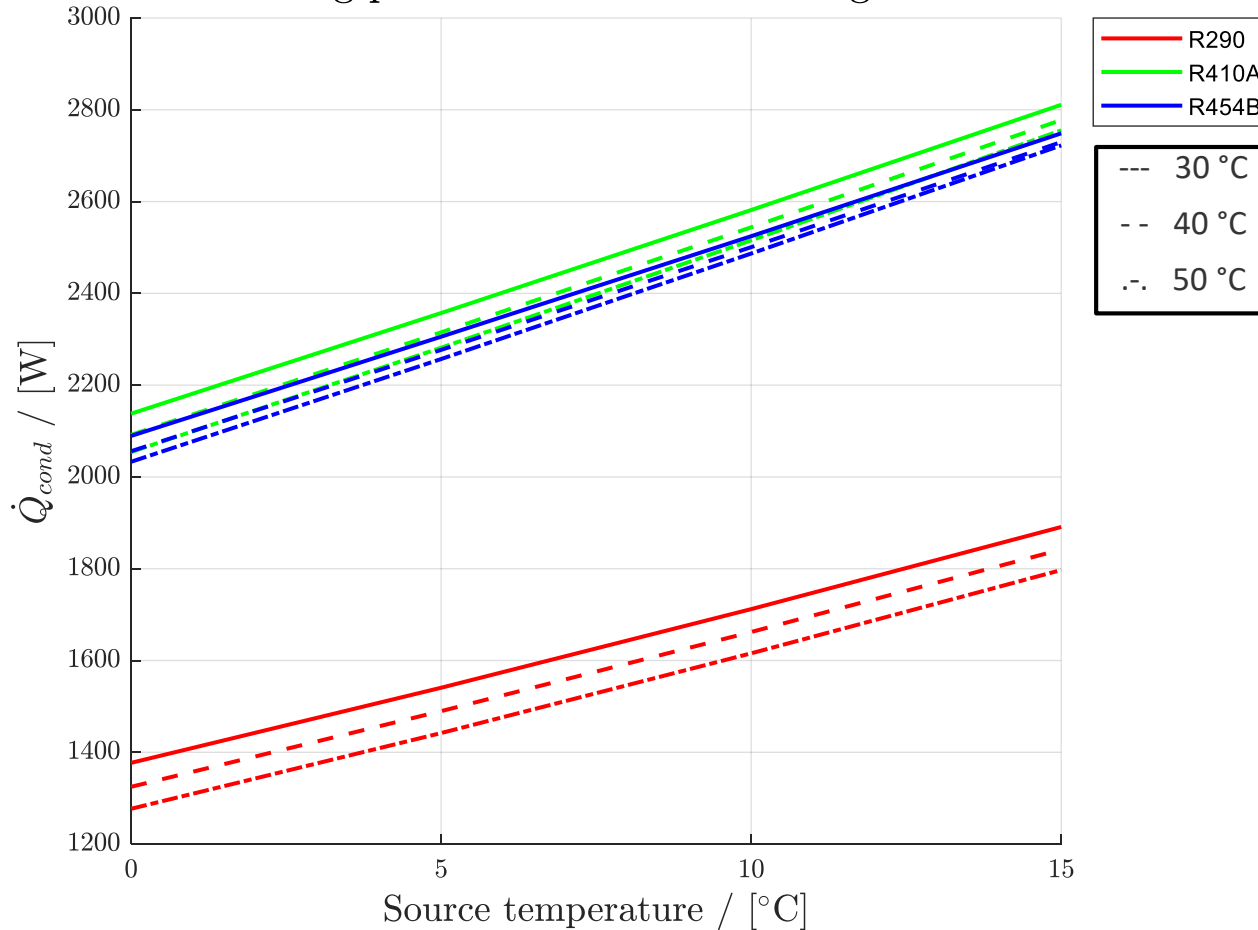
# Application: Evaluation of alternative refrigerant mixtures



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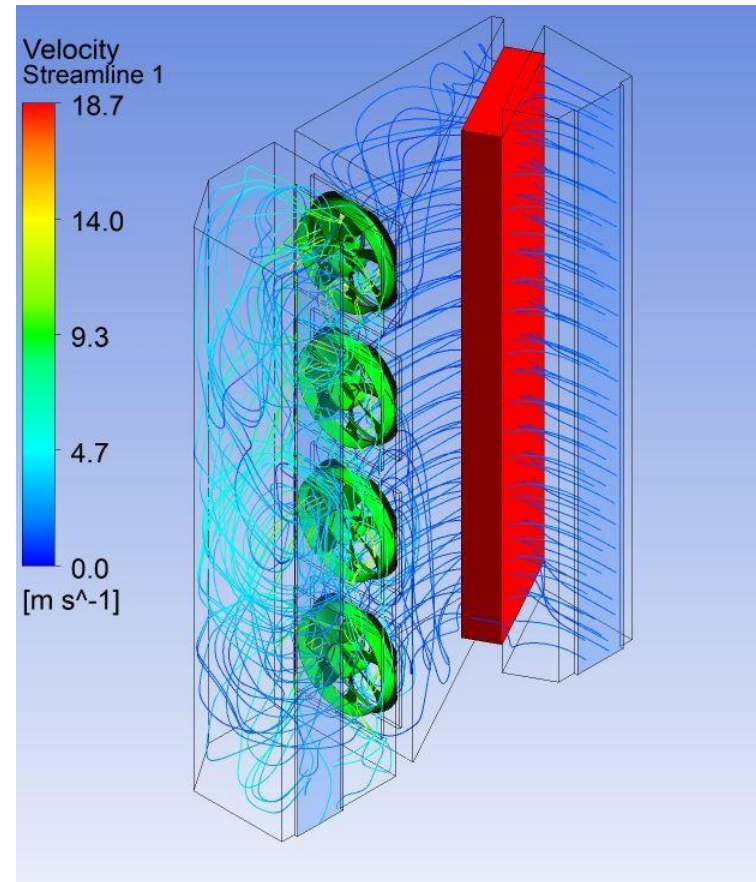
Heating power for alternative refrigerants



- Analysis of possible refrigerant alternatives for replacement of phased out/to be phased out refrigerant mixtures.
- Example: evaluation of alternative refrigerants for a small scale air-to-water heat pump.

# Conclusions and further planned optimizations

- » Tool able to forecast with an acceptable degree of accuracy the performance data of a tested heat pump
- » Developed concept for a facade-integrated split-type air-to-water heat pump
- » Coupled evaluation of non-homogeneous airflow patterns for air-to-water heat pumps
- » More detailed heat transfer model for the condenser and the evaporator through correlations



# THANK YOU VERY MUCH FOR YOUR ATTENTION

