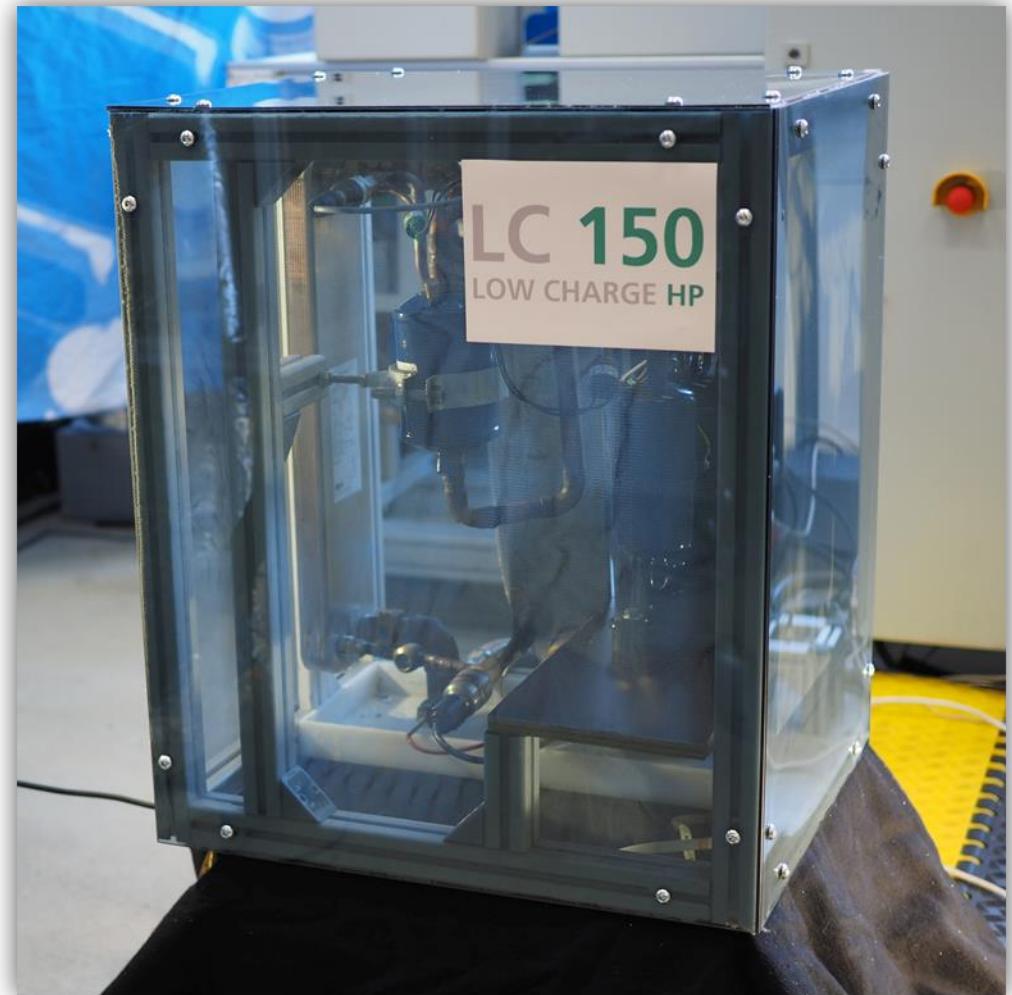


Low Charge Heat Pump Module using 150g of R-290

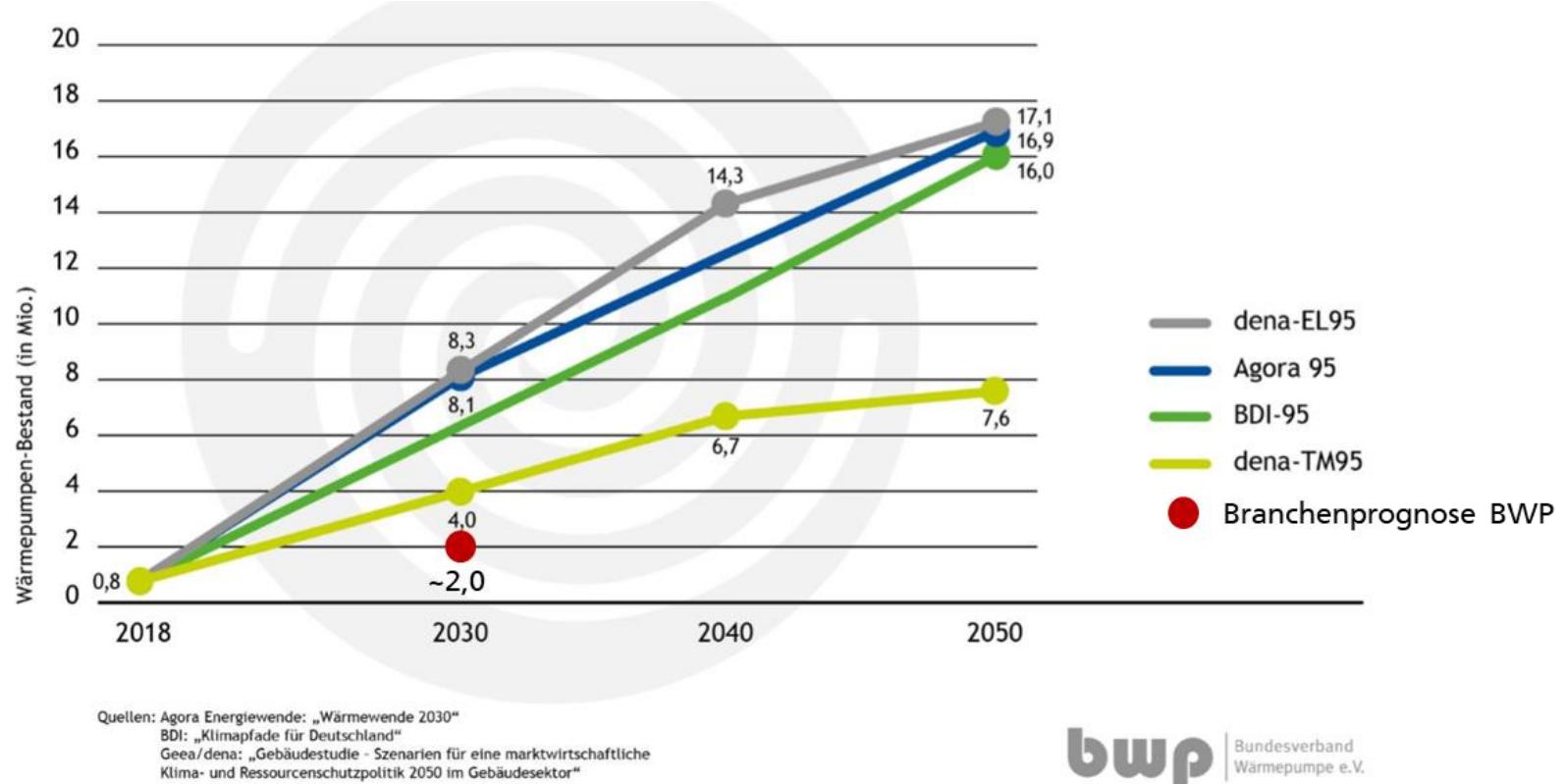
- Motivation and targets of the feasibility study
- Design of the heat pump module
- Measurements and results
- Targets of the LC150 project and consortium



Low Charge Heat Pump Module using 150g of R-290

motivation and targets

- Heat pumps are the central heating technology for a climate-friendly future
- New refrigerant solutions are needed due to F-Gas-Regulation

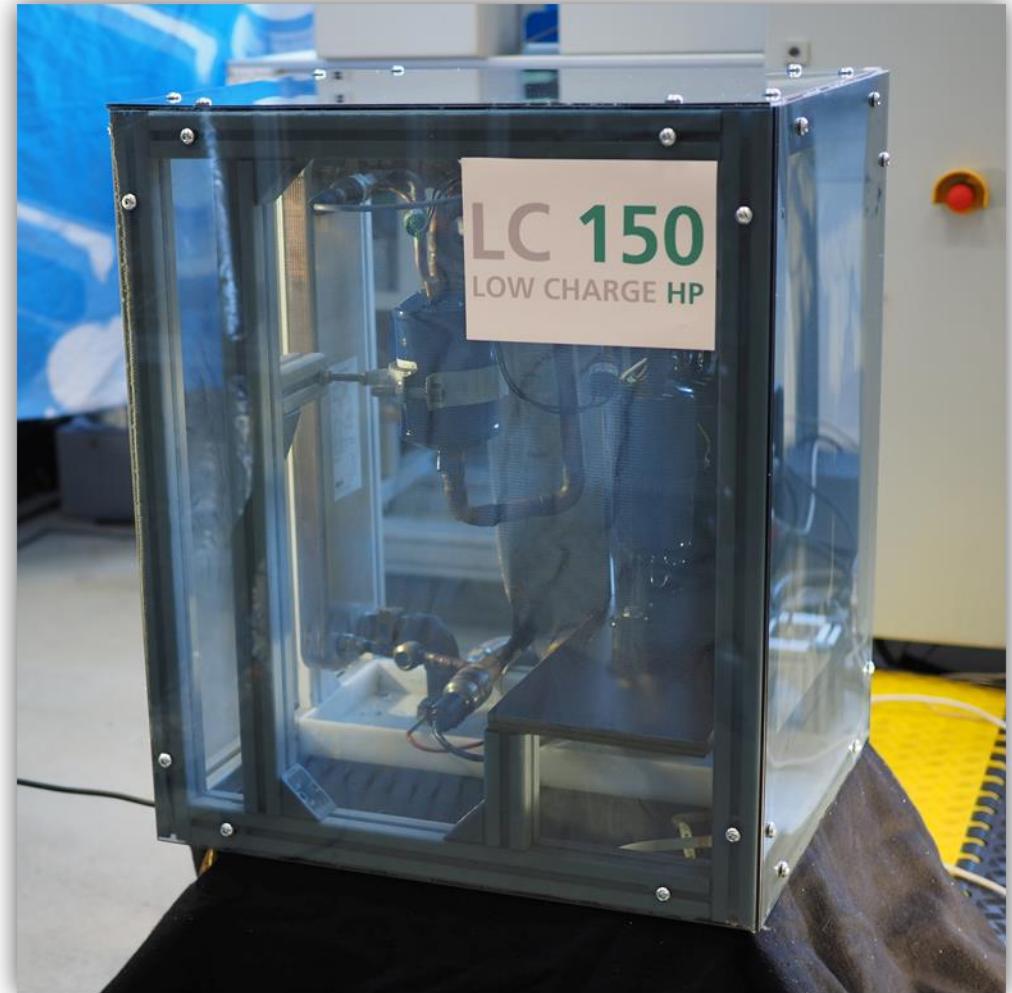


Low Charge Heat Pump Module using 150g of R-290

motivation and targets

Targets of the feasibility study

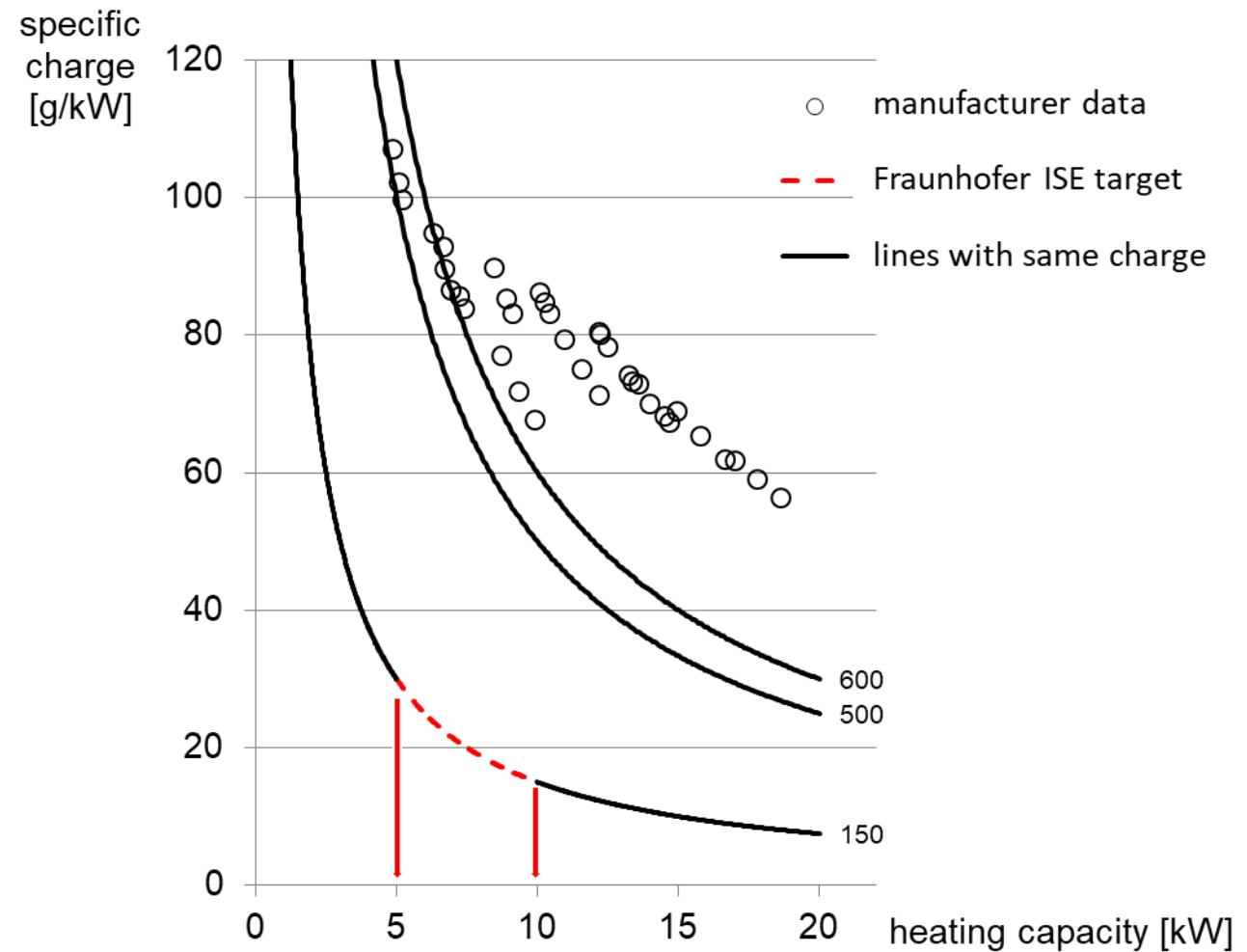
- Usage propane (R290) as refrigerant
- Does not exceed more than 150g of charge
- Providing a heating capacity between 5-10kW
- Use of market available components



Low Charge Heat Pump Module using 150g of R-290

Motivation and targets

- Market available brine-to-water heat pumps systems use 60-100 g/kW of refrigerant charge
- 150 g of refrigerant for 5-10 kW heating capacity corresponds to ~20 g/kW

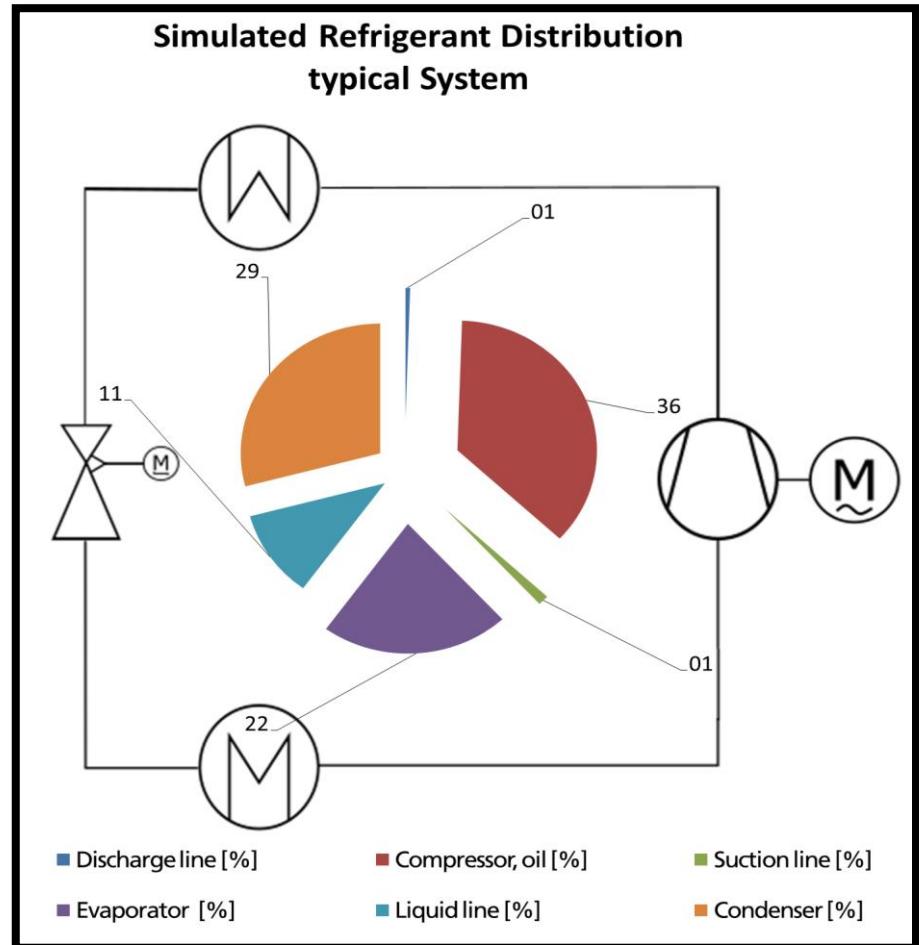


Low Charge Heat Pump Module using 150g of R-290

Design of the heat pump module

Addressing the parts with high refrigerant content

- reduced volume due to asymmetric plate heat exchangers
- Reduced diameter and length of piping
- Reduced quantity of oil in cooperation with compressor manufacturer



Low Charge Heat Pump Module using 150g of R-290

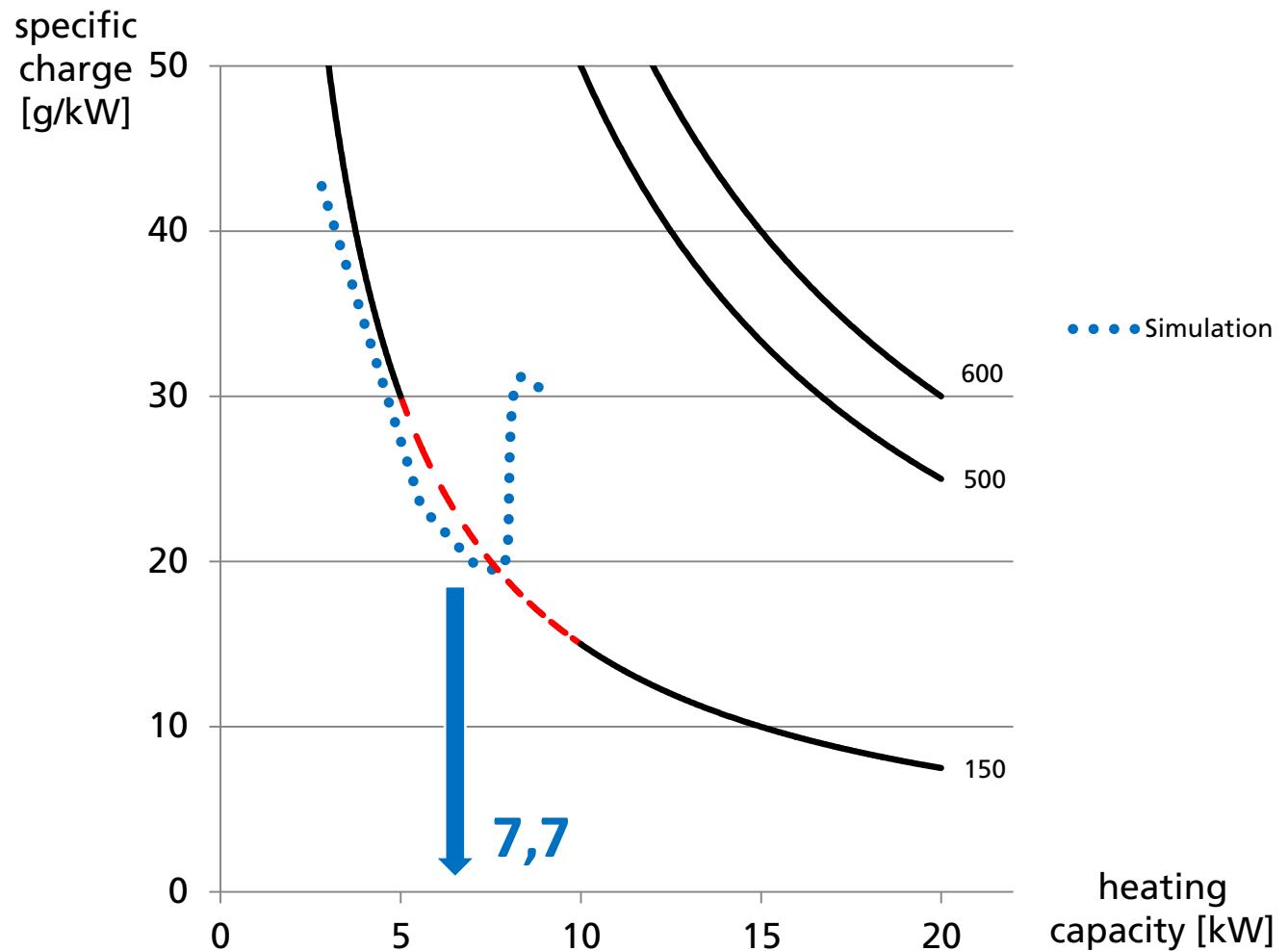
Design of the heat pump module

Addressing the parts with high refrigerant content

- reduced volume due to asymmetric plate heat exchangers
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➤ Simulation results for B0/W35 @120Hz, SH10K:

- design meets the addressed capacity range, predicted COP 3.3 (120Hz), 3.59 (60Hz)

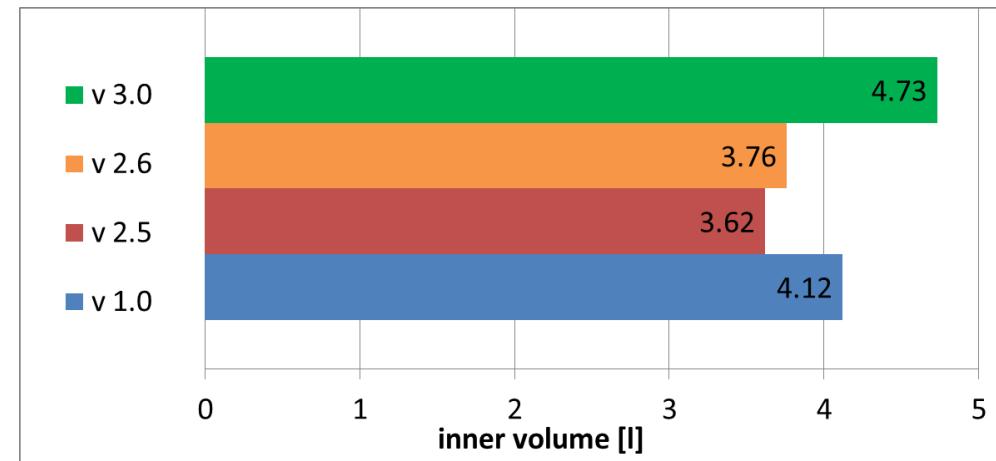


Low Charge Heat Pump Module using 150g of R-290

Measurements and results

Evaluation of four different configurations

- Two different compressor types
- different heat exchanger types

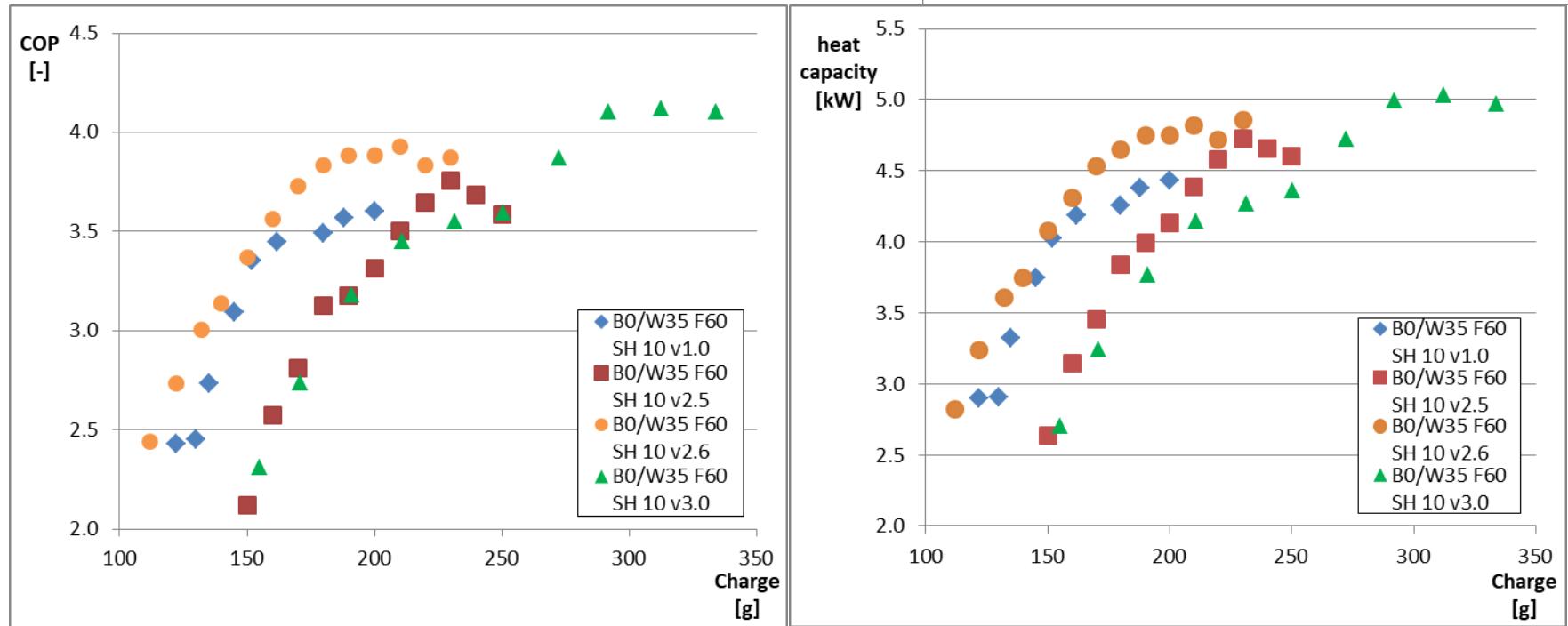
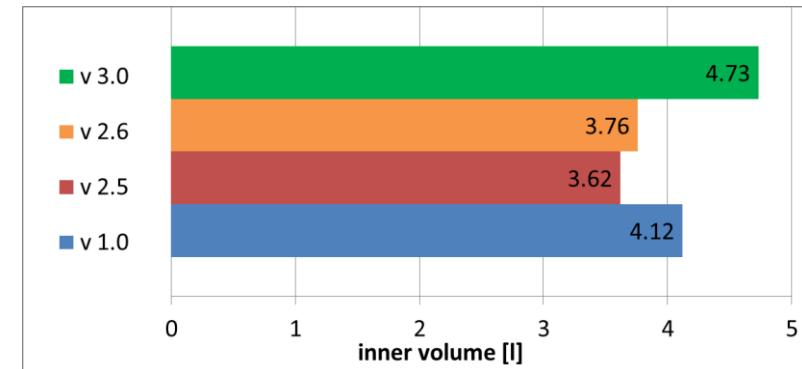


	V 1.0	V 2.5	V 2.6	V 3.0
Compressor	Scroll Manufacturer 1	Rotary v1 Manufacturer 2	Rotary v1 Manufacturer 2	Rotary v1 Manufacturer 2
Condenser	Long Asymmetric 16 Plates	Long Asymmetric 16 Plates	Short Asymmetric 38 Plates	Short Asymmetric 46 Plates
Evaporator	Long Asymmetric 16 Plates	Long Asymmetric 16 Plates	Long Symmetric 16 Plates	Long Symmetric 28 Plates
Piping	Pipes v1	Pipes v1	Pipes v1	Pipes v2

Low Charge Heat Pump Module using 150g of R-290

Measurements and results

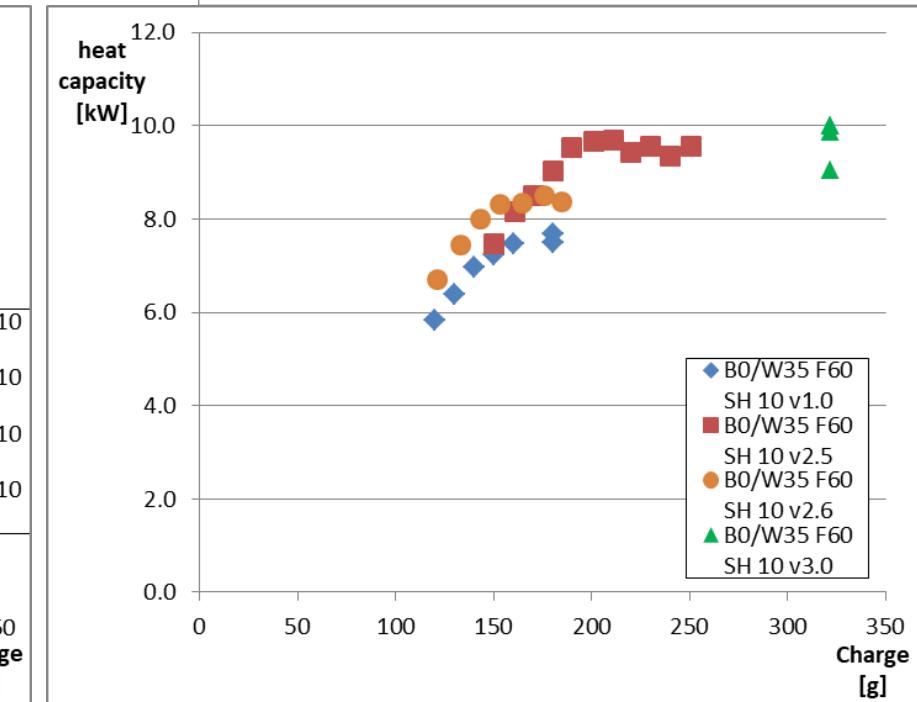
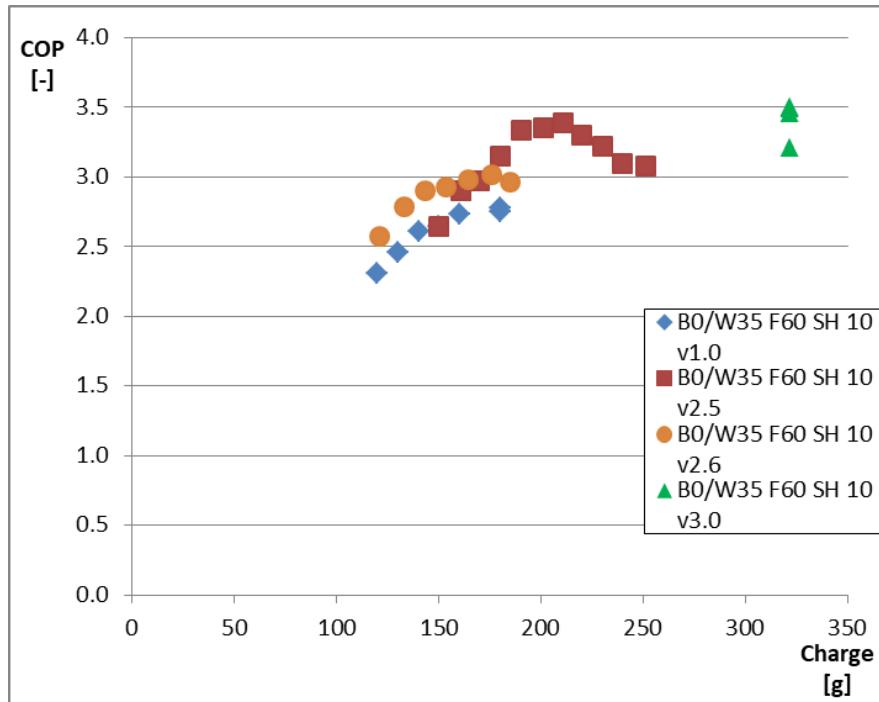
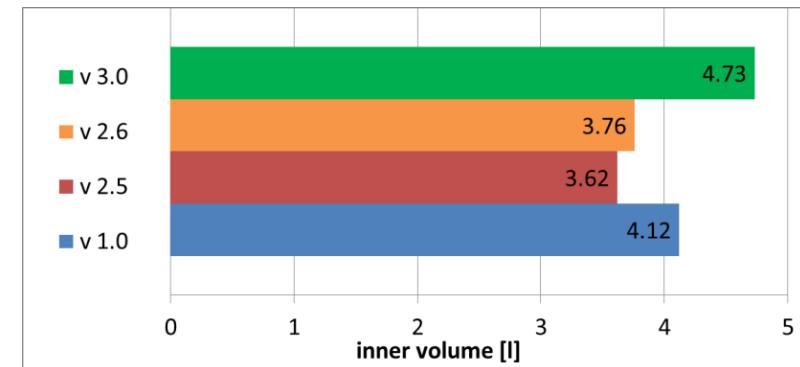
Results for B0/W35 @60Hz, SH10K



Low Charge Heat Pump Module using 150g of R-290

Measurements and results

Results for B0/W35 @120Hz, SH10K



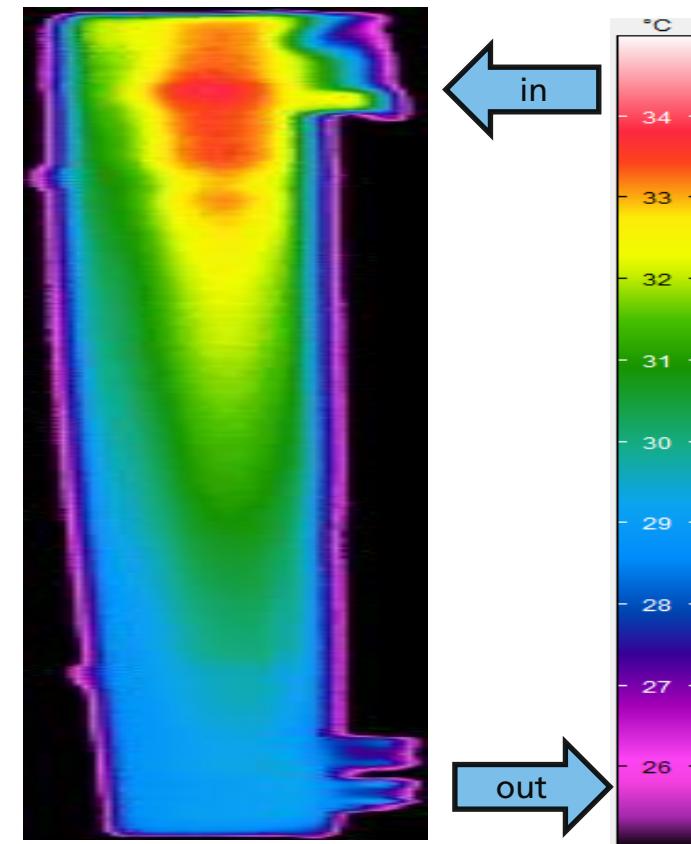
Low Charge Heat Pump Module using 150g of R-290

Measurements and results

- Pictures of ice profiles of the evaporator
→ maldistribution → higher dTs → lower COPs



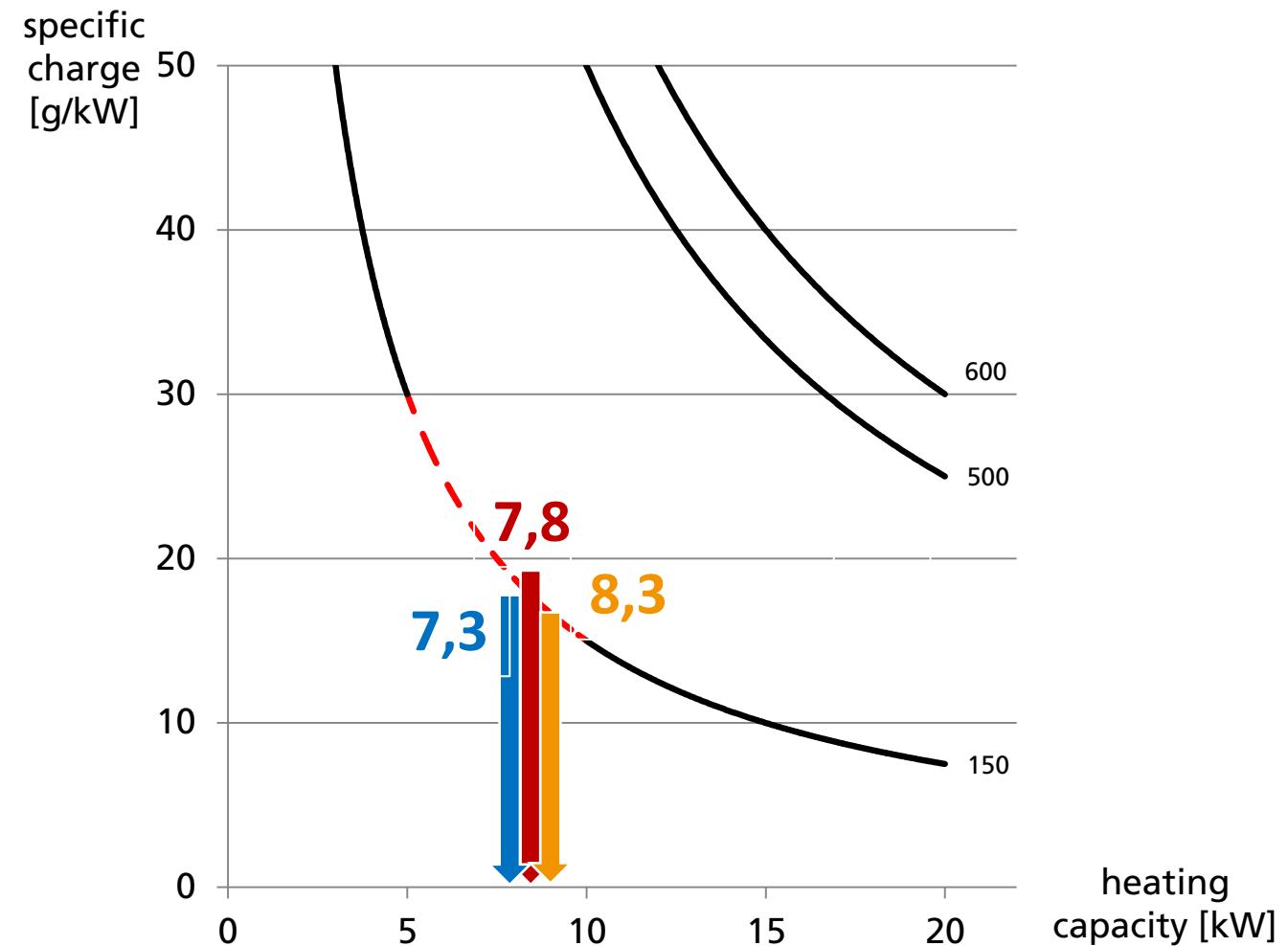
- Thermography pictures of the condenser
→ maldistribution → higher dTs → lower COPs



Low Charge Heat Pump Module using 150g of R-290

summary

- With the Low Charge Heat Pump using 150g propane a heating capacity of ~8kW was achieved with different configurations.
- COP needs to be improved by
 - more equalized flow distribution in heat exchangers,
 - insulation of components,
 - well designed configuration.



Low Charge Heat Pump Module using 150g of R-290

Project consortium LC150



Steering Committee, definition of requirements, receipt of results and access to IPs



1,2 Mio. € (approx. 1-4 % of total project volume, pro rata market share)



Supported by:



3,6 Mio. €
(75 % funding rate,
Funding reference number **03EN4001A**)



on the basis of a decision
by the German Bundestag



LC150 PLATFORM DEVELOPMENT OF A CHARGE-REDUCED HEAT PUMP MODULE WITH PROPANE

4,8 Mio. € project budget, 2.5 years, 1.10.2020 – 31.03.2023

- Component testing (heat exchangers, compressors, valves etc.) in single component tests and in broad cross evaluation
- Charge reduction and localization of refrigerant
- Operating strategies
- Standardization
- Network and platform for manufacturers

Low Charge Heat Pump Module using 150g of R-290

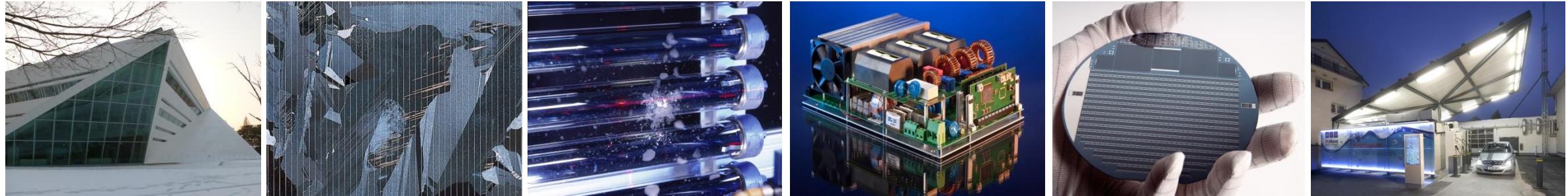
Project consortium LC150

Next steps

- finalizing consortium (further european heat pump manufacturer are welcome) and identifying innovation component suppliers
- discussing requests with component suppliers for modules with 4, 8 and 12 kW heating capacity
- identifying suitable options, defining components and cycles to be measured
- setting up infrastructure for cross evaluation
- using available experimental data for identification of interacting effects and first steps to evaluate the IMST-Art simulations

- Cross evaluating measurement campaign will start in 05/2021.

Vielen Dank für Ihre Aufmerksamkeit!



Fraunhofer-Institut für Solare Energiesysteme ISE

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