EUROPEAN HEAT PUMP SUMMIT

POWERED BY CHILLVENTA

SYMPOSIUM + EXPO
NUREMBERG, 20–21.10.2015

Industrial | Commercial | Residential
Heating & Cooling | Components & Equipment

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NÜRNBERG MESSE

WELCOME

EUROPEAN HEAT PUMP SUMMIT

Best fans for air source heat pumps possible ?!

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Agenda

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ZIEHL-ABEGG

The greenHP project: Optimization of an axial fan

green Heat Pump

New centrifugal impeller ZAvblue: Development and built-in situation

ZIEHL-ABEGG at a Glance

- Business divisions
  - Ventilation
  - Drives
  - Automotive
- Supplier relations with 109 countries
- 423 Mil. EUR annual sales in 2014
- 70% export sales
- 3.400 employees worldwide

Optimization of an axial fan for heat pumps

How to optimize a component on system level?

System Level

interaction with smart electric grids, other energy systems and components as well as control of different system components

Heat Pump Unit

developing, assembling and testing of a 30 kW lab-scale air/water pilot heat pump under stationary and transient conditions

green Heat Pump

Component Level

Refrigerant:
charge reduction and the use of refrigerants with low GWP

Evaporator:
brazed aluminum micro-channel heat exchanger with high performance fin designs offering good defrosting and optimized refrigerant flow distribution

Compressor:
modulating compressor with a large turndown ratio and low oil charge

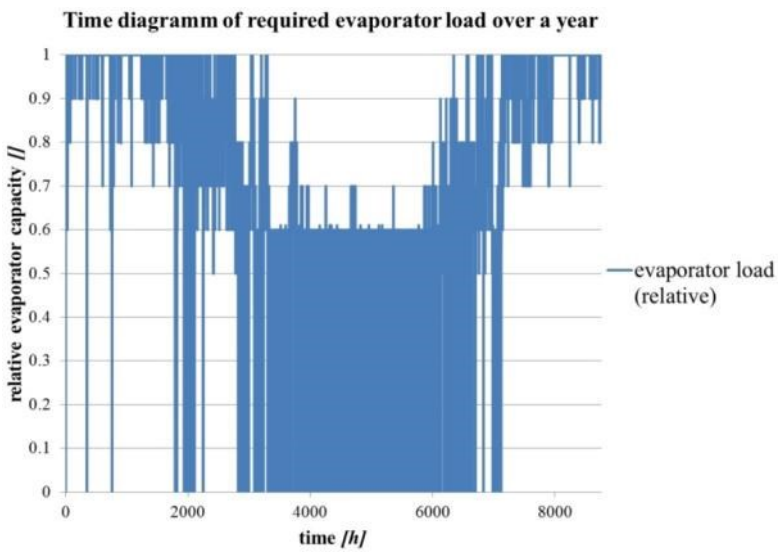
Fan and air duct:
high efficiency, low noise air duct for the evaporator including an advanced fan concept

Condenser:
brazed aluminum shell and tube heat exchangers based on MPE tubes

load profile

Table 3: Representative operation points and their required runtime

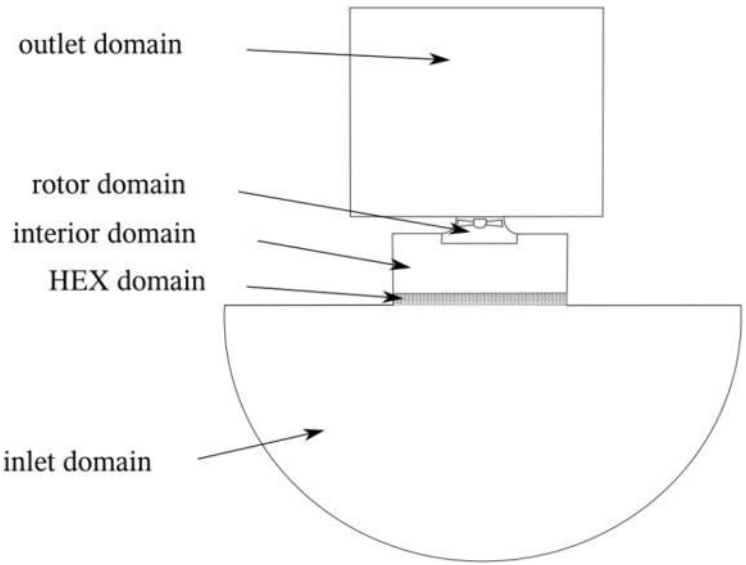
	Heat Power Q [kW]	Icing	Annual runtime [h]	Annual Heat Transfer [kWh]	Air Density [kg/m^3]
OP 1	18.4	Dry	1425	25650	1.3
OP 2	18.4	Medium	1062	19116	1.33
OP 3	18.4	Max	908	16344	1.33
OP 4	11.04	Dry	2334	25207	1.2



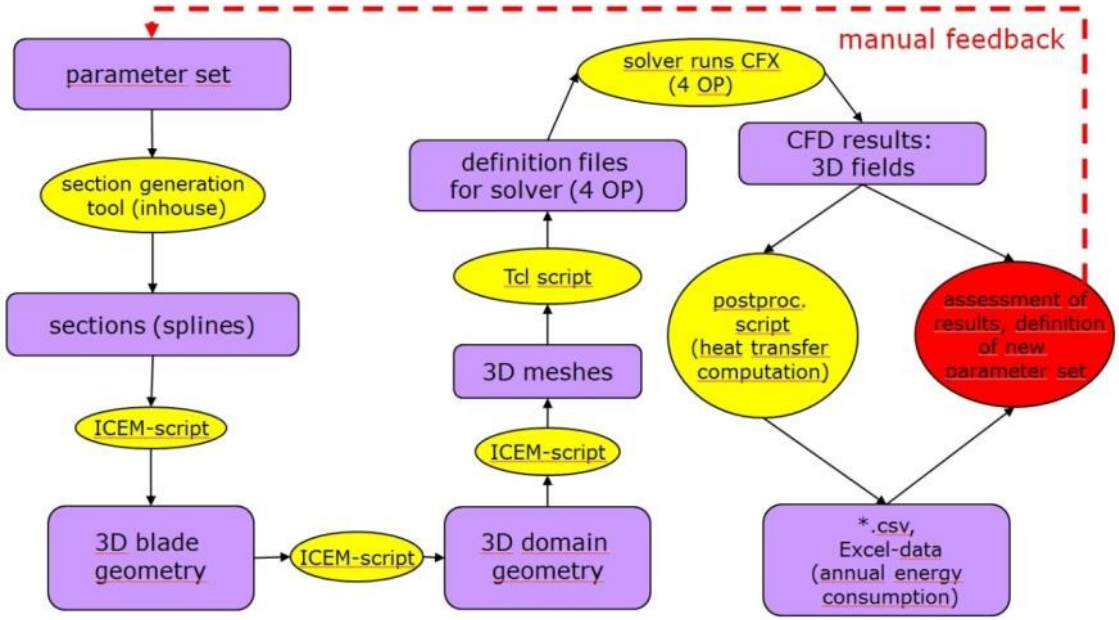
- 4 representative operation points
- Icing conditions are taken into account

CFD simulation

Boundary conditions



Optimization process



- automated optimization process

Result of different fans

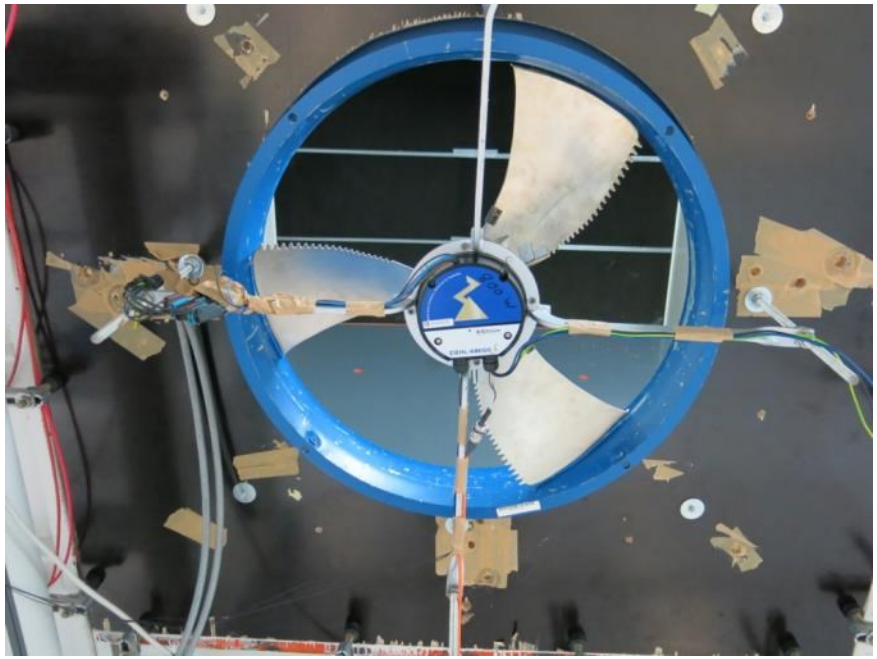
Table 4: comparison of best performance fans at isolated duty points

Annual cons. [kWh]	**SUM**	**OP 1**	**OP 2**	**OP 3**	**OP 4**
Best Fan	2061	570	524	670	297
Best OP 1	2256	544	522	890 (?)	290
Best OP 2	2234	564	518	850 (?)	302
Best OP 3	2087	599	525	655	308
Best OP 4	2269	551	537	850 (?)	288
Best efficiency	2282	555	520	915 (?)	292

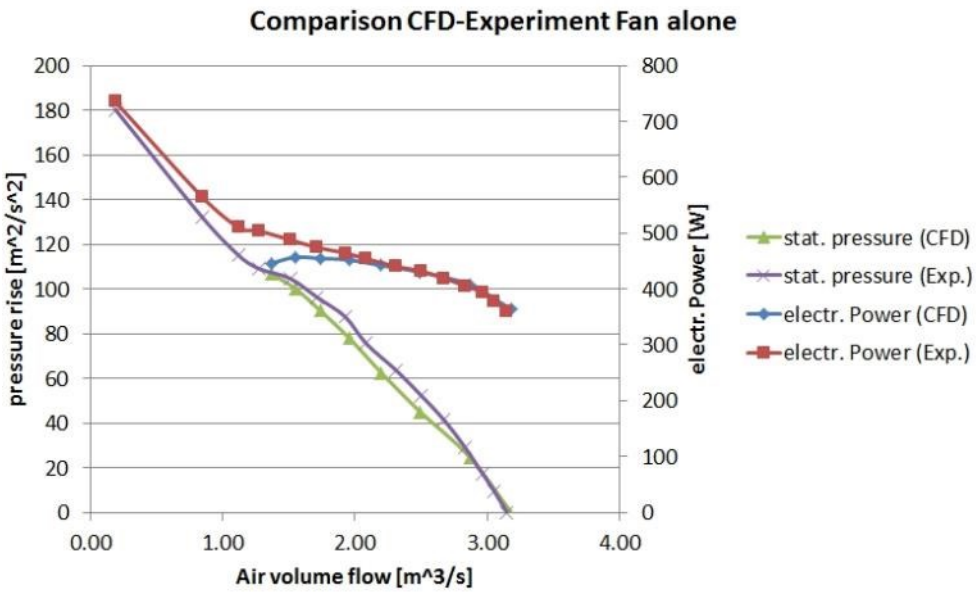
- Optimal design for small EC motor
  - Important is real load profile
    - ***Peak efficiency doesn't count!***

Comparison CFD vs. prototype

Prototype measurement

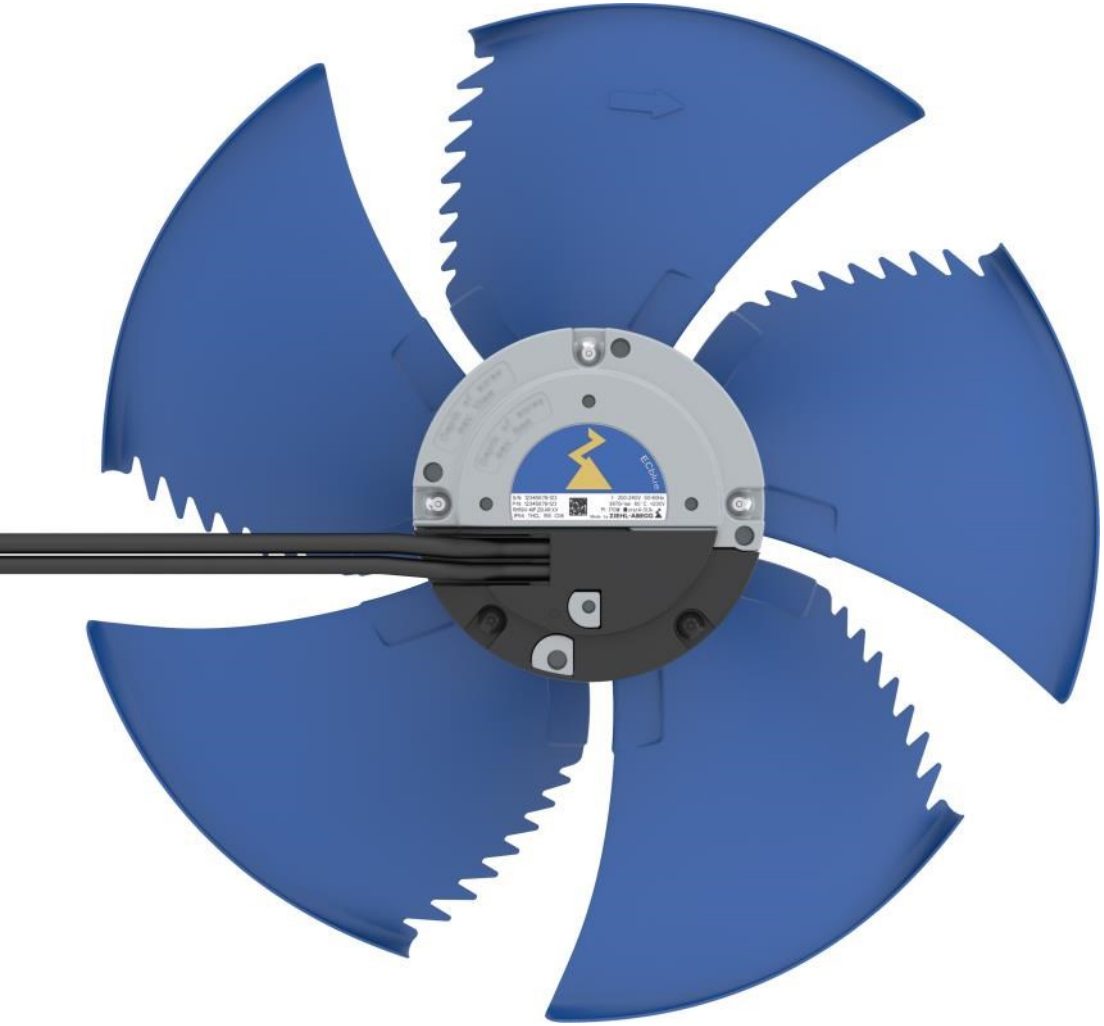


Comparison



- Measurement accord with CFD

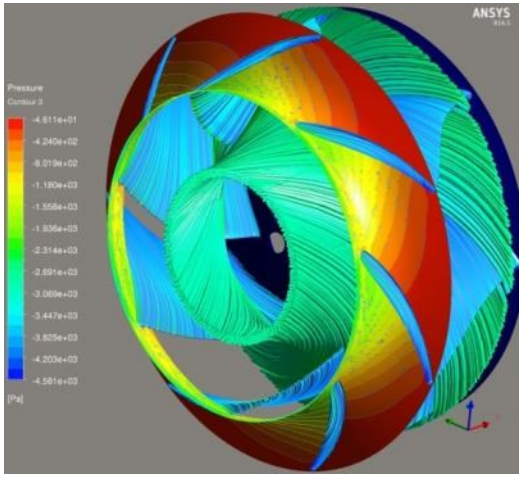
New FE2owlet

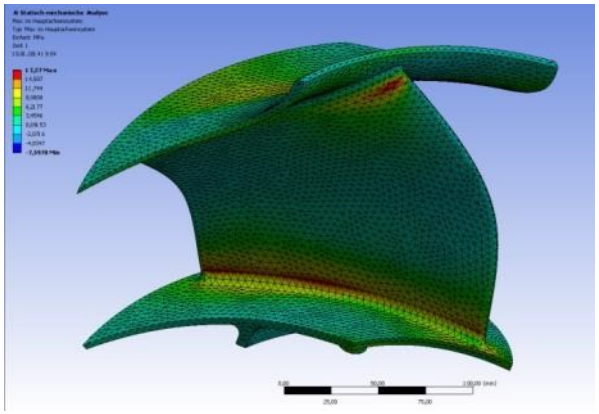


- New motor EC055
- New optimized impeller
- New solutions for heat pumps

New centrifugal impeller ZAvblue

ZAvblue development process





CFD Simulation: optimization
by analyzing about 120 geometries with fluid flow simulation software.

Structural analysis and weight optimization with FEM. Investigation of feasibility molding tool. About 30 geometries analyzed.

Prototype construction and experimental analysis of aerodynamics and aeroacoustics. 4 prototypes built and measured.

Iterative process (numerical, 120 designs)

Iterative process (experimental, 4 designs)

ZAvblue performace

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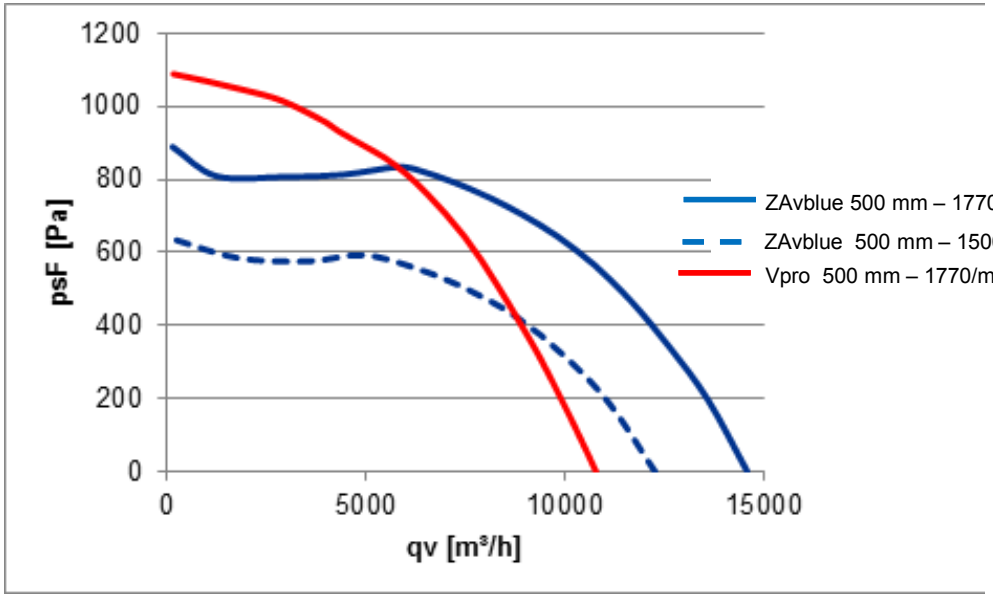
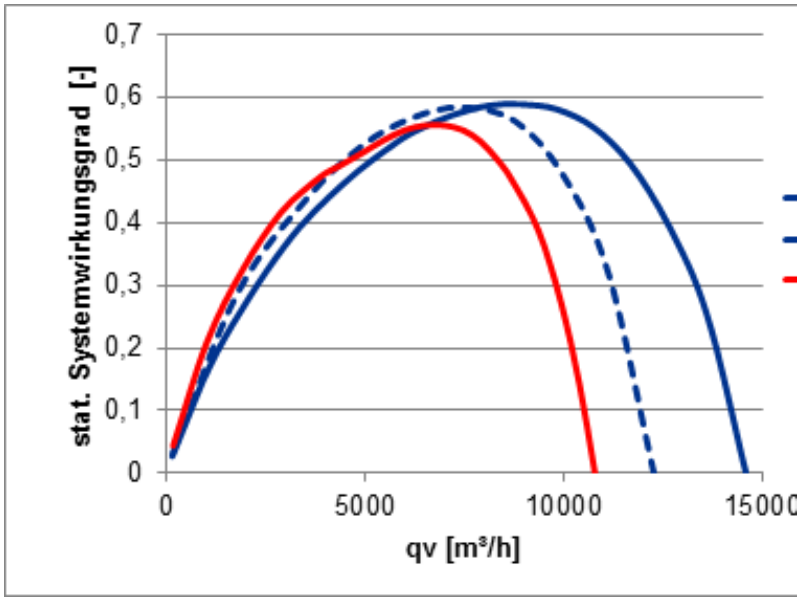
Characteristic curve



Efficiency

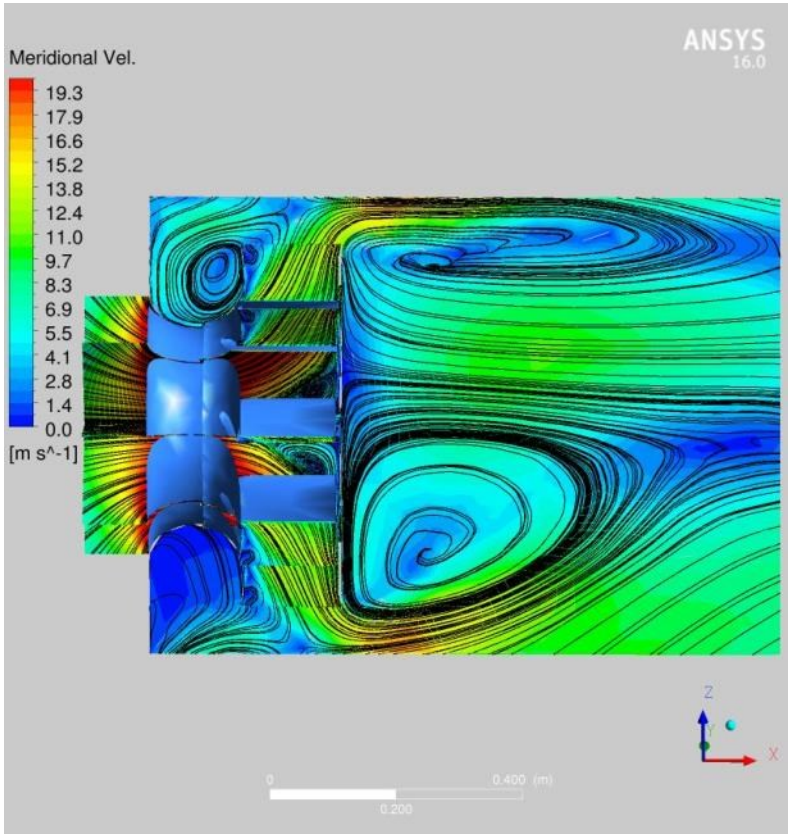


- Peak efficiency on lower pressure
- higher power density

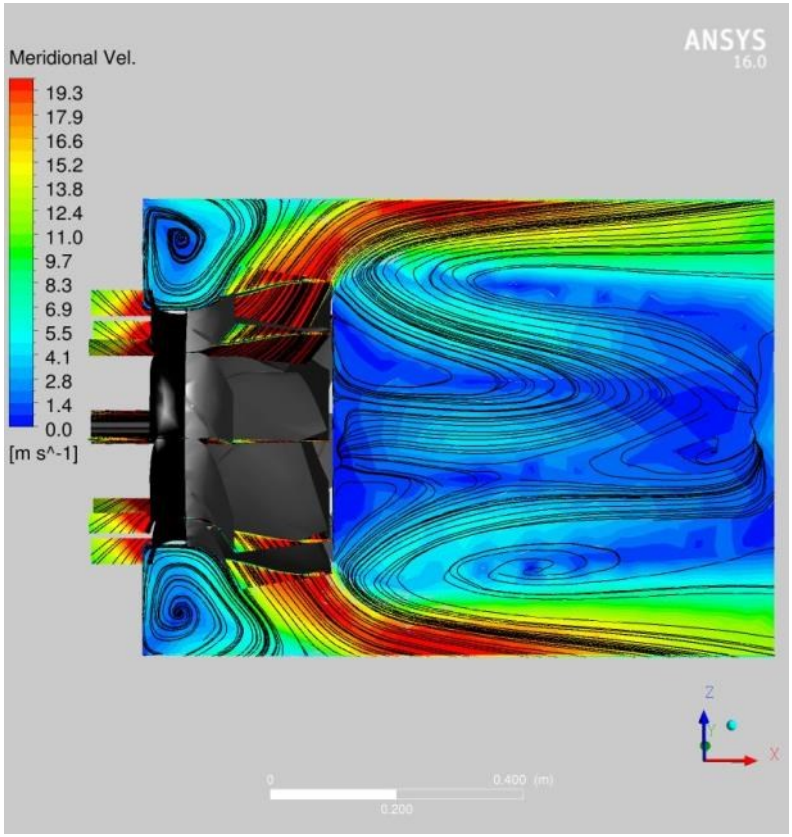
CFD-Simulation : Velocity

Built in situation with square section 1.4 D x 1.4 D

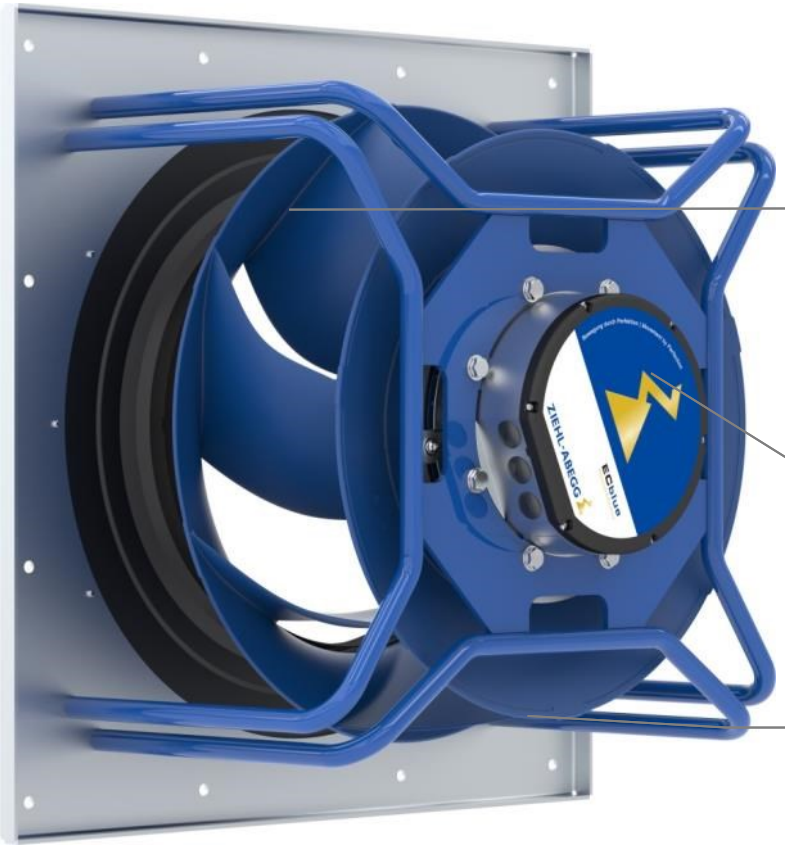
Vpro impeller



New ZAvblue impeller



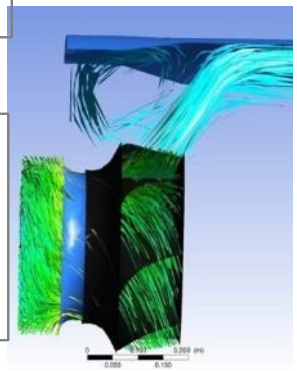
ZAvblue Conclusion



bionic lightweight construction

ECblue-technology

impeller for future-proof heat pumps



- Silent
- Efficient

Thank you for your attention

See you in the lobby