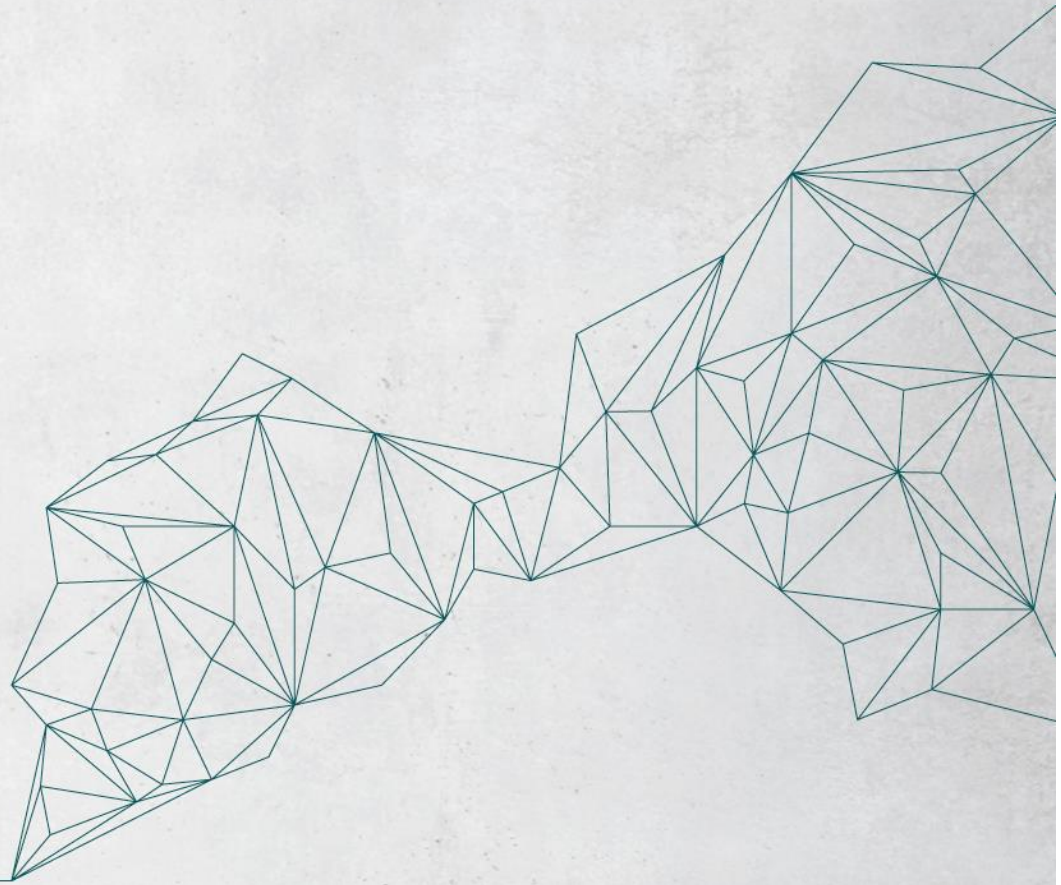
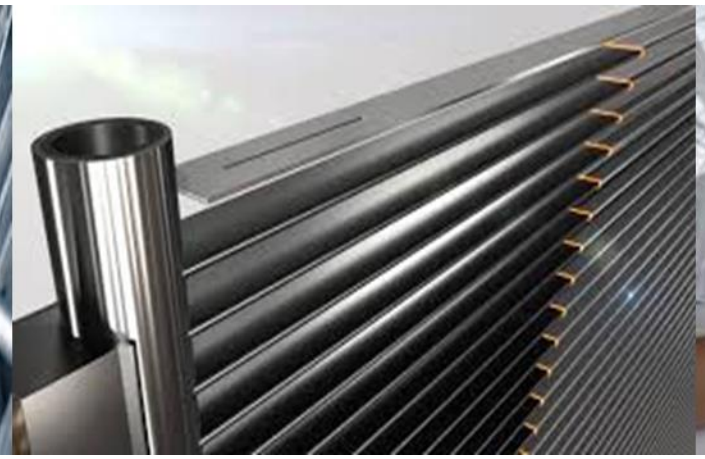
Hall 4A

Chillventa Specialist Forums 2022
Chillventa Fachforen 2022

CONNECTING
EXPERTS.



High Efficiency MCHE for Air Source Heat Pump Application and its Decarbonization Potential

***Presenter**: Dalle Pezze Paolo*
***Date**: 2022/10/12*

Content

SANHUA
Micro Channel Heat Exchanger

- Company Introduction
- High Efficiency MCHE for Air Source HP Application
- Decarbonization Potential of MCHE

SANHUA Holding Group

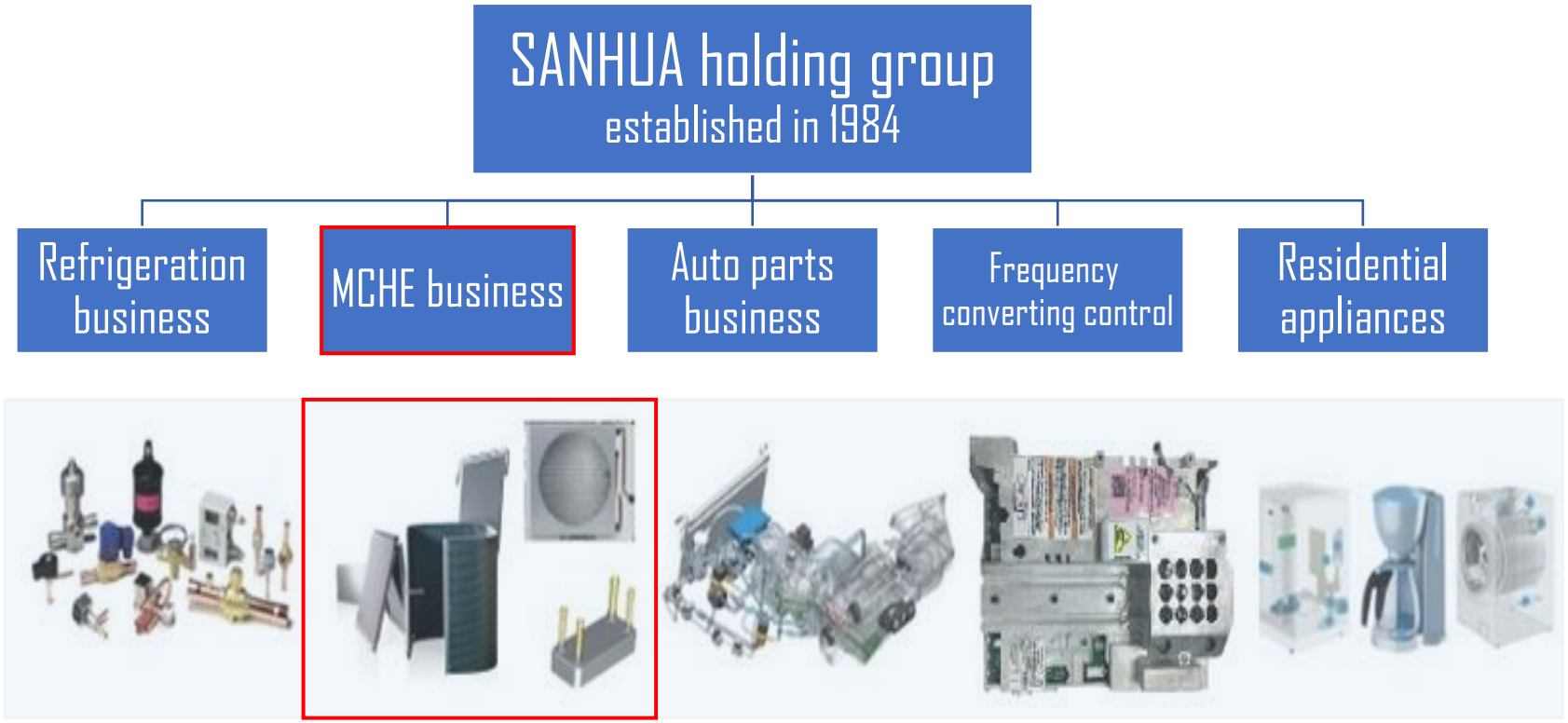
SANHUA
Micro Channel Heat Exchanger

Headerquarter location:
Hangzhou, Zhejiang, China

Established in:
1984

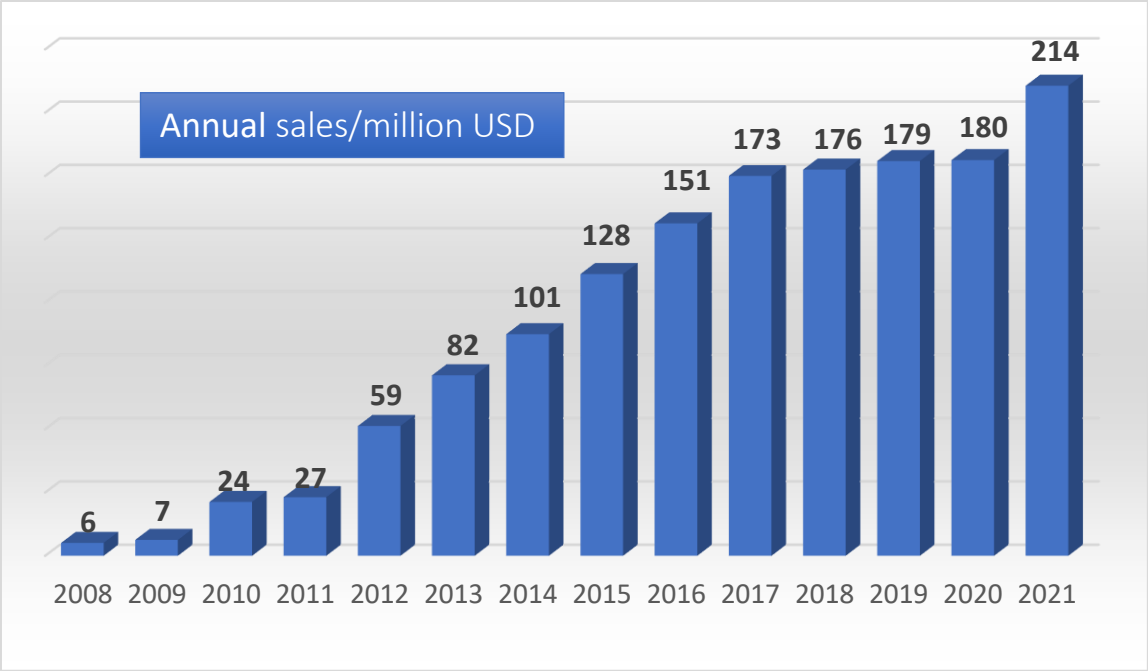
Employees Year 2021:
> 25,000

Annual income 2021:
> USD 6,400,000,000



SANHUA MCHE Division

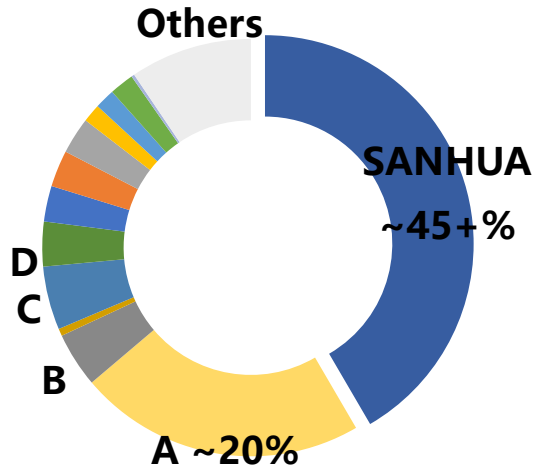
SANHUA
Micro Channel Heat Exchanger



SANHUA Global footprint

★ MCHE Manufacturing Sites

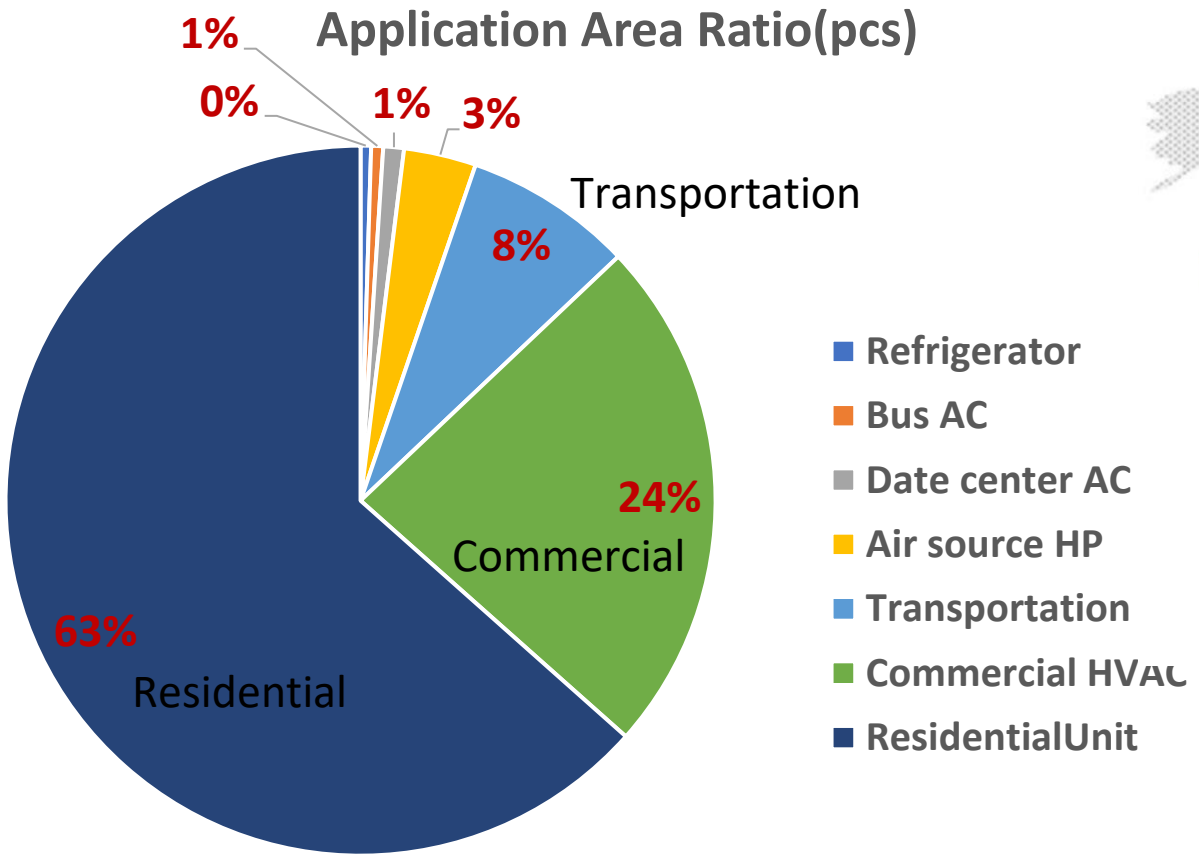
MCHE Global market shares in refrigeration and air conditioning industry



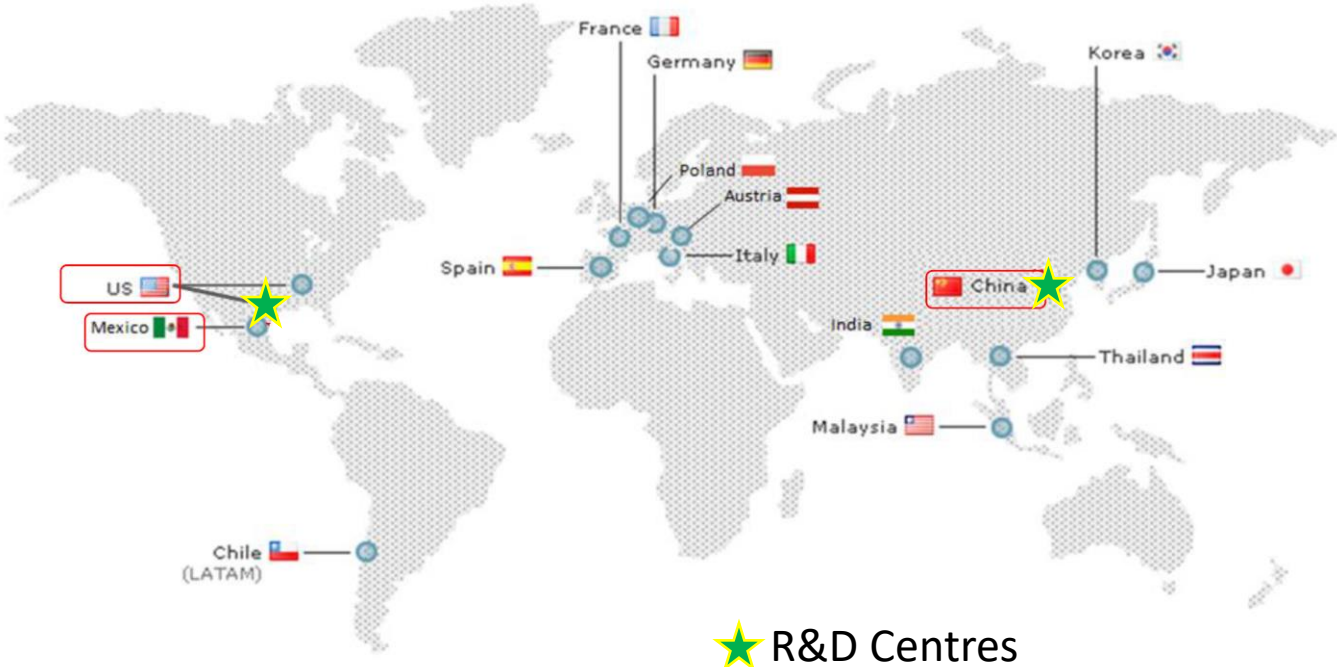
- Hangzhou (China) – Y2007, 5 production lines, 40.000m2
- Zhengzhou (China) – Y2021, 2 production lines, 10.000m2
- Puckett (Mississippi, USA) – Y2007, 5 production lines, 15.000m2
- Saltillo (Mexico) – Y2015, 6 production lines, 46.000m2

Application and R&D

SANHUA
Micro Channel Heat Exchanger



SANHUA Global footprint



★ R&D Centres

- Hangzhou (China) – Y2007, 10.000m2
- Houston (Texas, USA) – Y2018, 5.000m2

Focus on R&D and new APPLICATIONS → 3% annual T/O investment

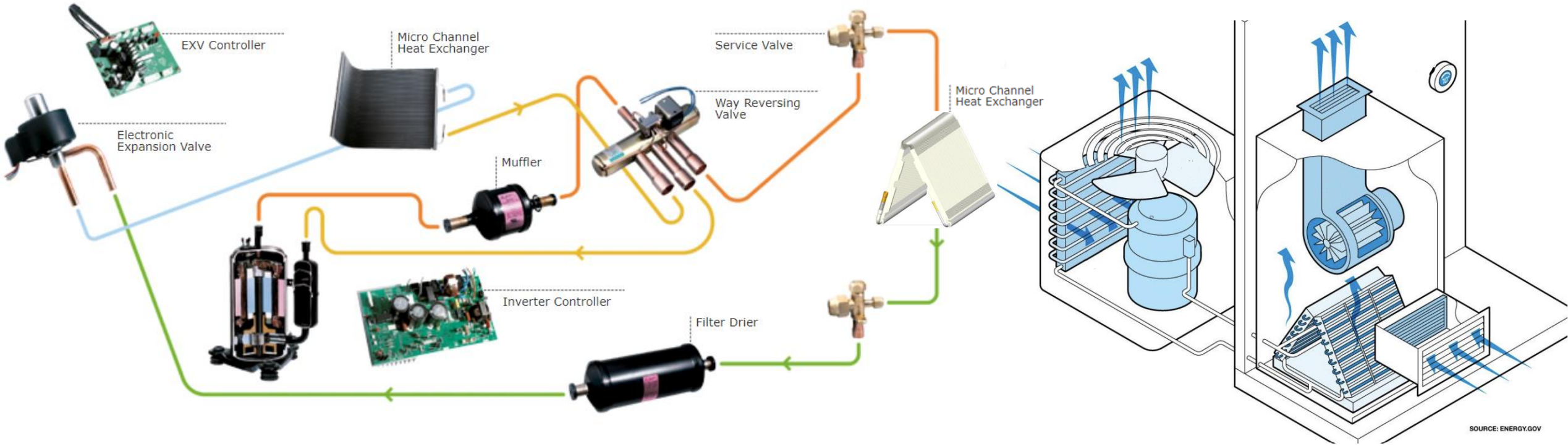
Content

SANHUA
Micro Channel Heat Exchanger

- Company Introduction
- High Efficiency MCHE for Air Source HP Application
- Decarbonization Potential of MCHE

Heat Pump system - General

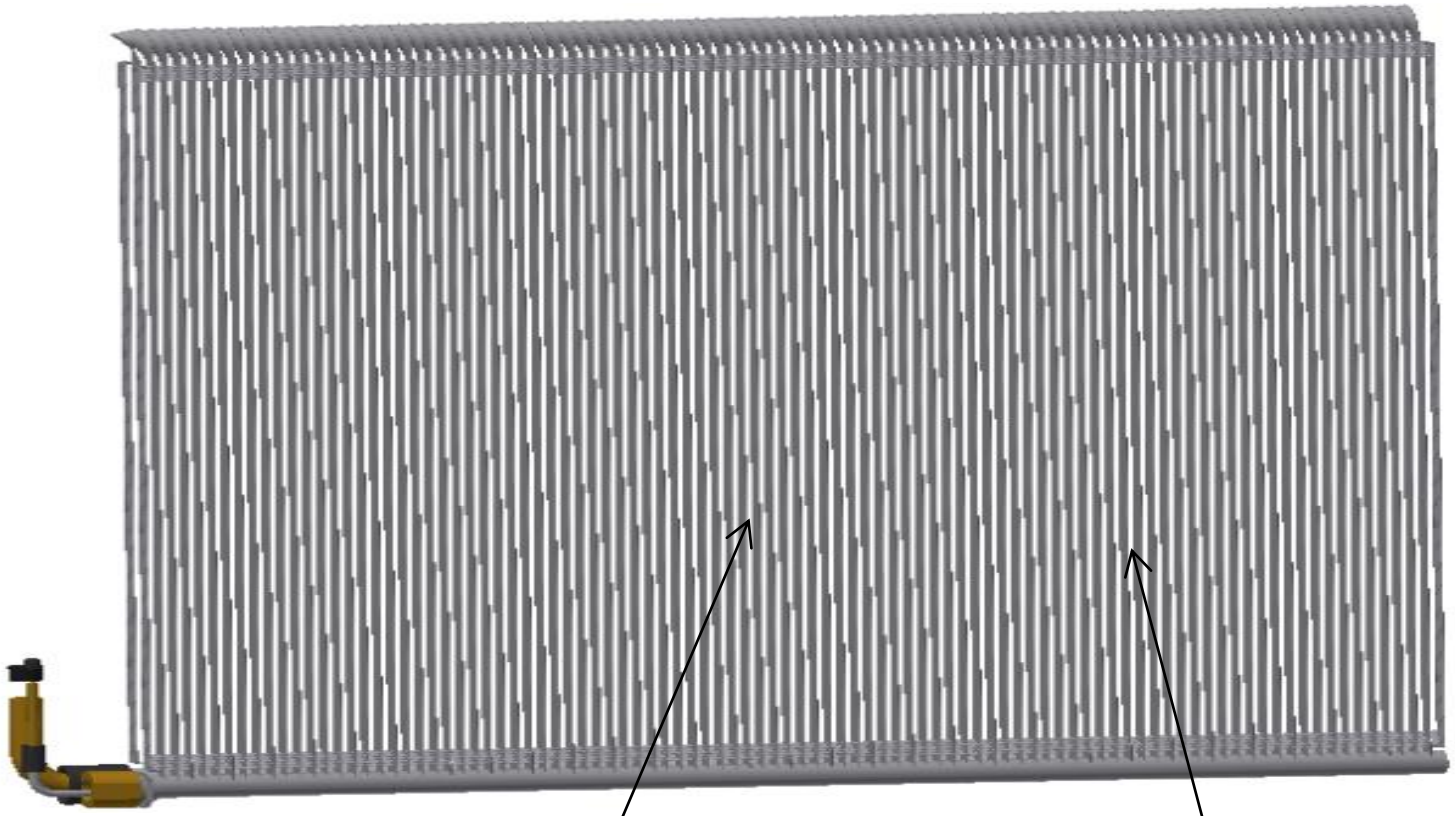
SANHUA
Micro Channel Heat Exchanger



Increasing the required capacity → from 1R MCHE to 2R MCHE

MCHE HP with 2 rows
(mass production in China)

SANHUA
Micro Channel Heat Exchanger



Special tube design for high performance and refrigerant saving

Special fin design for frosting and water drainage

Proprietary bending to reduce internal volume for refrigerant saving

2 row design for high performance

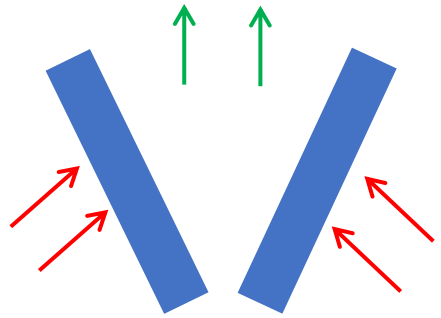
Integrated distributor for good refrigerant distribution

Testing Platform
(100kW Chiller HP Unit)

SANHUA
Micro Channel Heat Exchanger

100kW Unit

Heat Exchanger Information

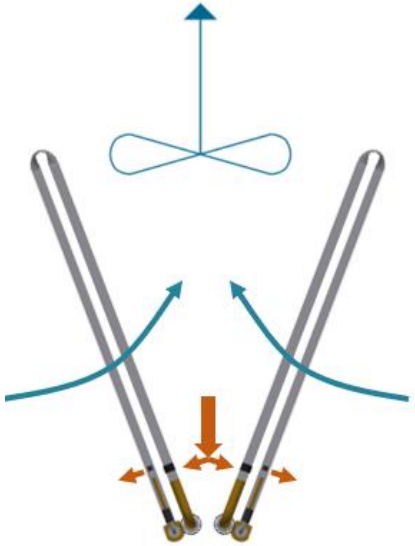


Single V, one system

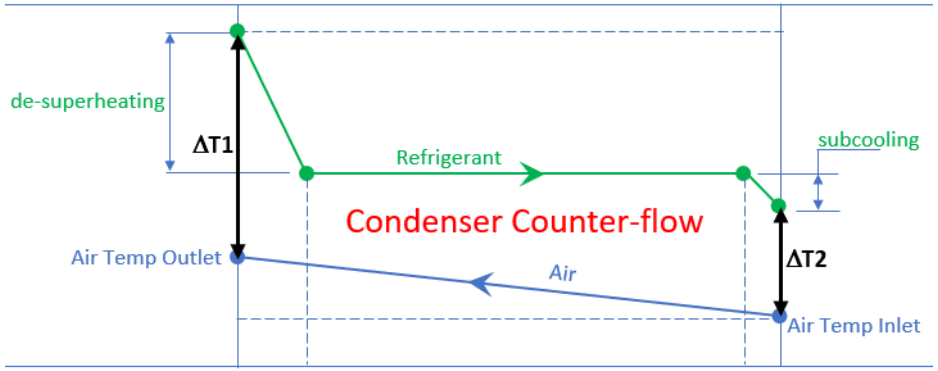
	Baseline	MCHE-1	MCHE-2
Refrigerant	R410A		
Single piece coil dimension /mm	2100*1200		
Cooling capacity /kW	90		
Heating capacity /kW	100		
Tube diameter /mm	ϕ7	20x1,3	20x1,0
Rows	4	2	2
Number tubes	55x4	222	230
FPI	12	8,5	8,5
Fin type	Wavy	Special Louvered	Special Louvered

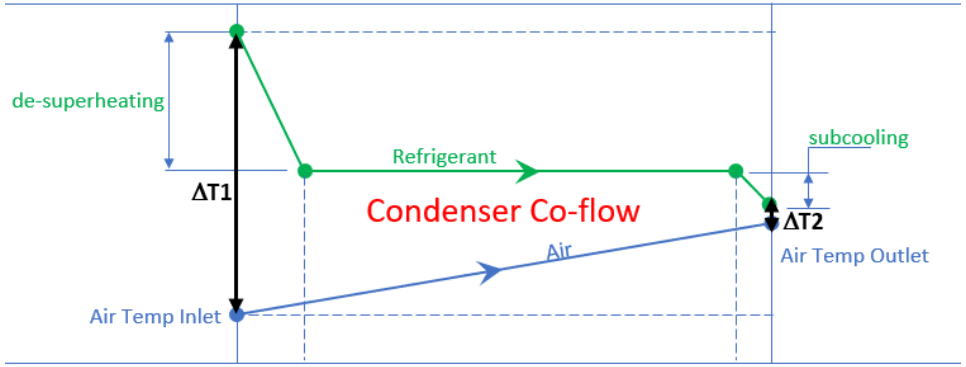
Heat Pump system (Co-flow vs Counter-flow)

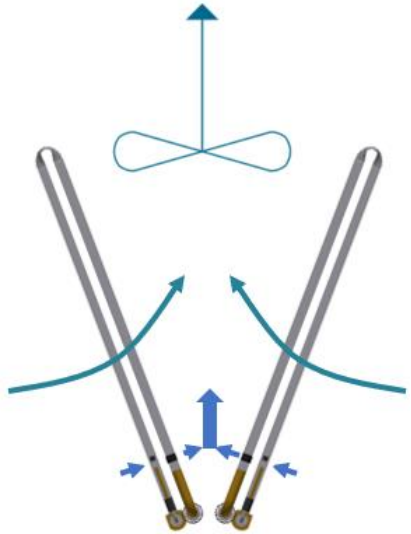
SANHUA
Micro Channel Heat Exchanger



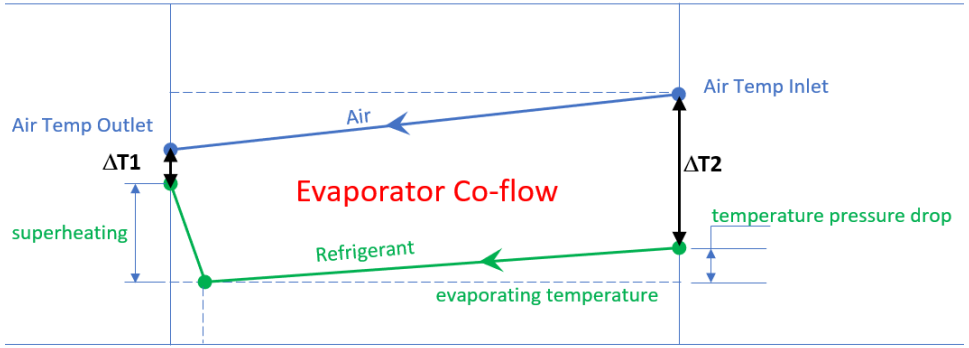
Condensing Mode

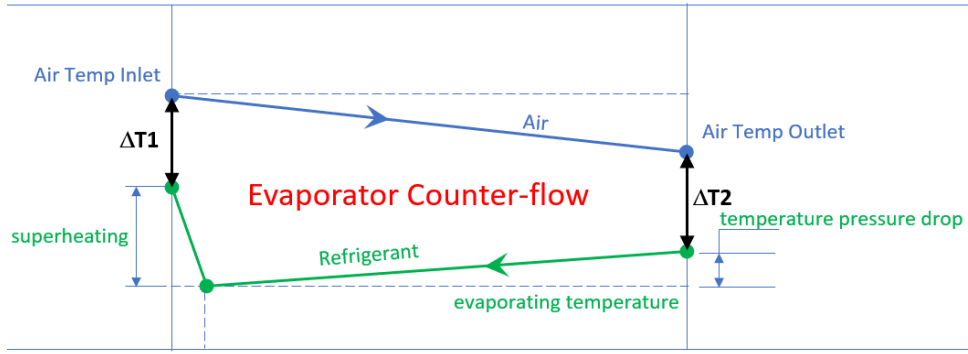






Evaporating Mode

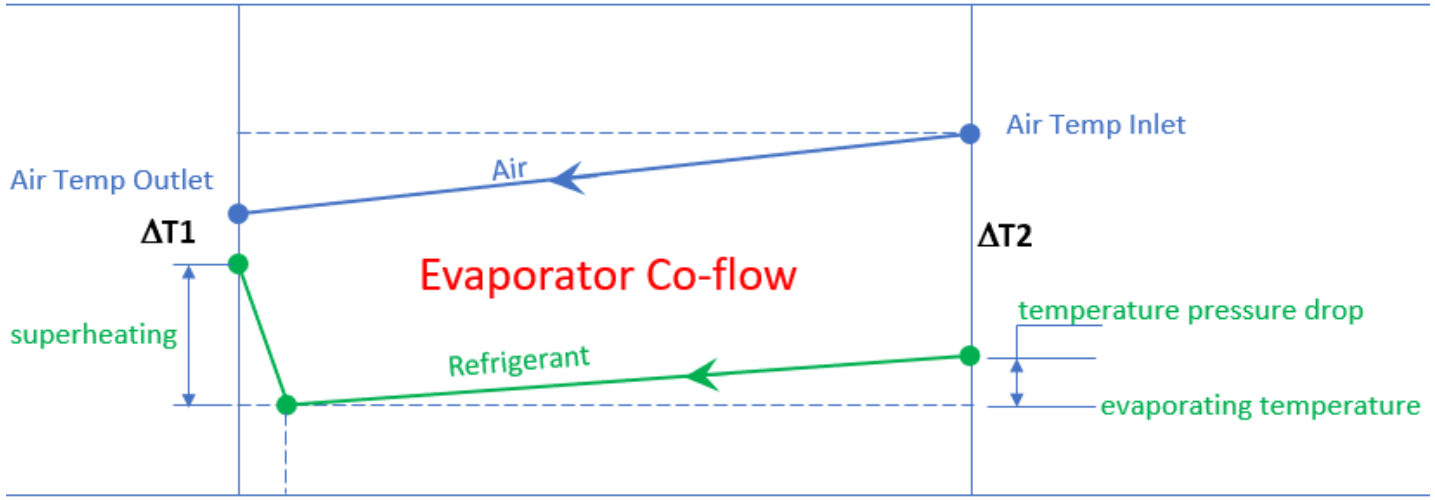




Heat Pump system

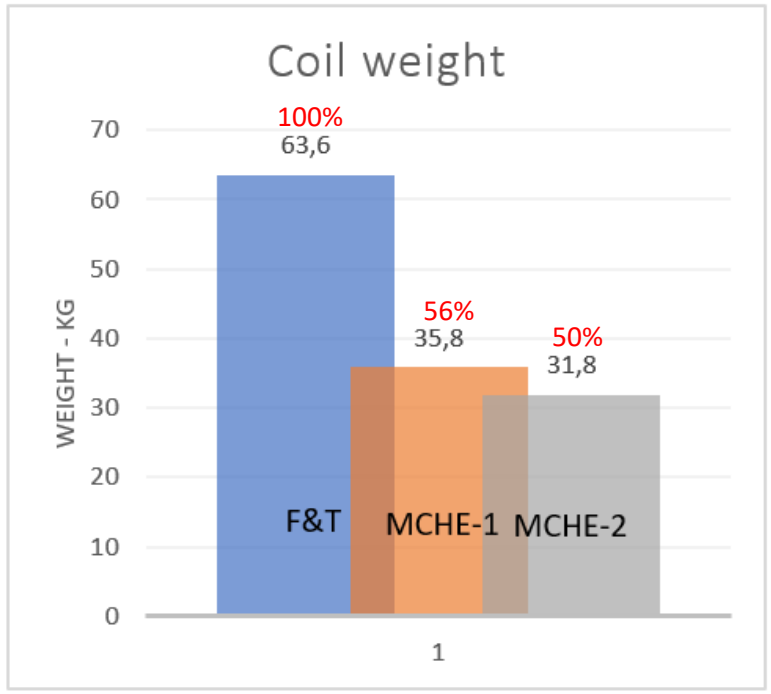
SANHUA
Micro Channel Heat Exchanger

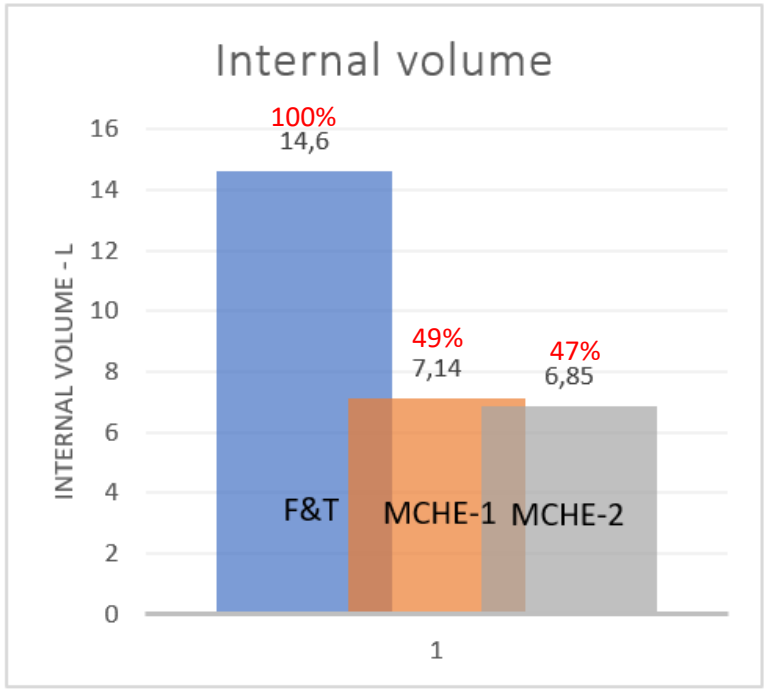
- Counter-current flow is always preferred in a condenser for optimal utilization of the high de-superheating temperature
- When the HEX works as condenser → Counter-current flow
- As consequence, when the HEX works as evaporator → Co-current flow

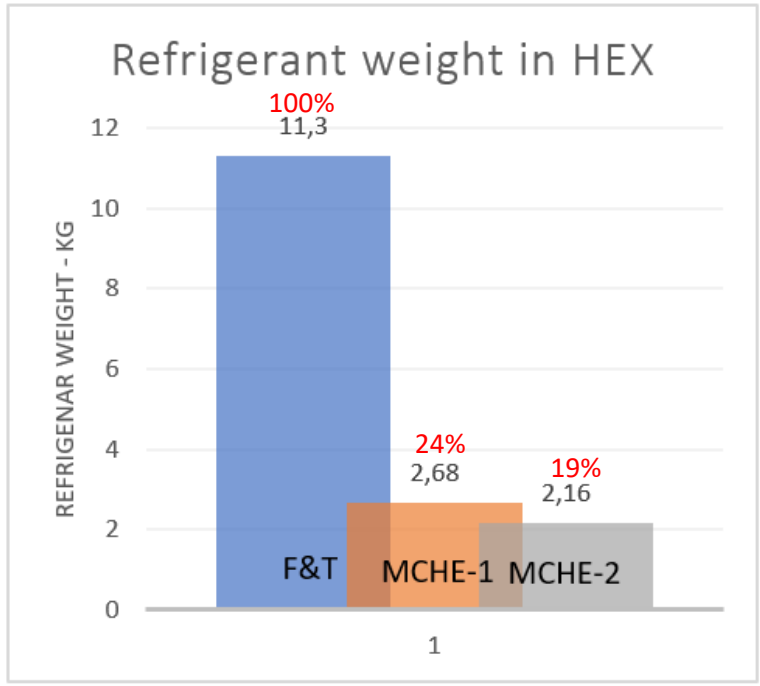


Weight and Internal Volume Comparison

SANHUA
Micro Channel Heat Exchanger



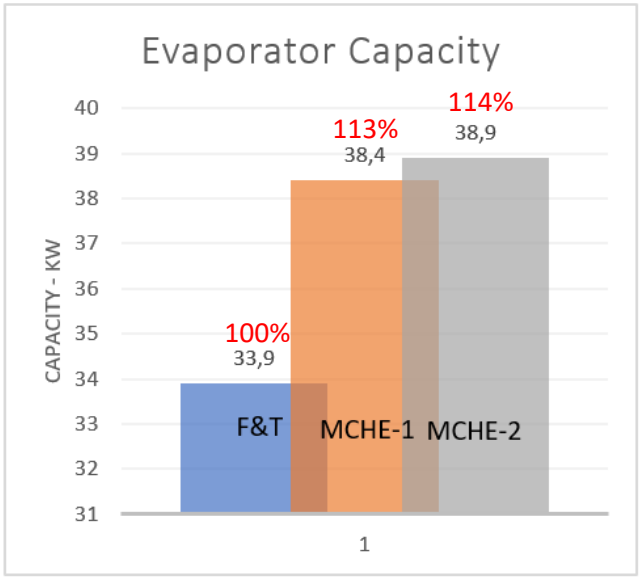


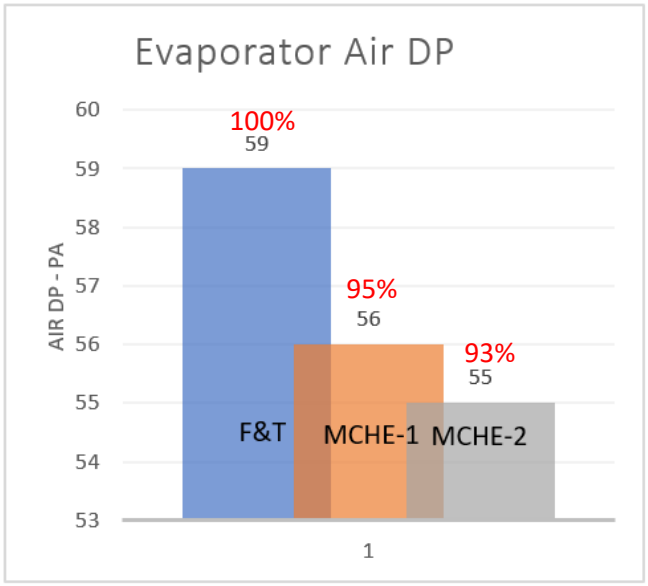


MCHE is much less on coil weight as well as internal volume compared to RTPF

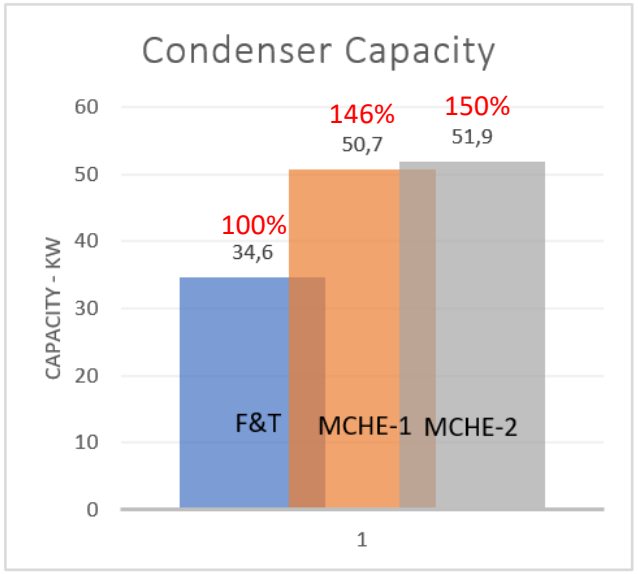
HX Only Testing Results

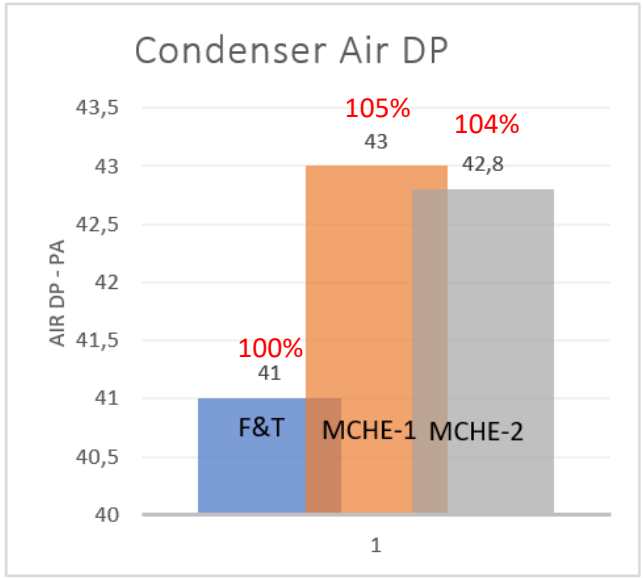
SANHUA
Micro Channel Heat Exchanger





MCHE is 13% higher than RTPF on capacity, Air DP is lower than RTPF





MCHE is much better than RTPF on condenser capacity, Air DP is similar

Critical Evaporating Temperature
(Testing for Frosting)

SANHUA
Micro Channel Heat Exchanger

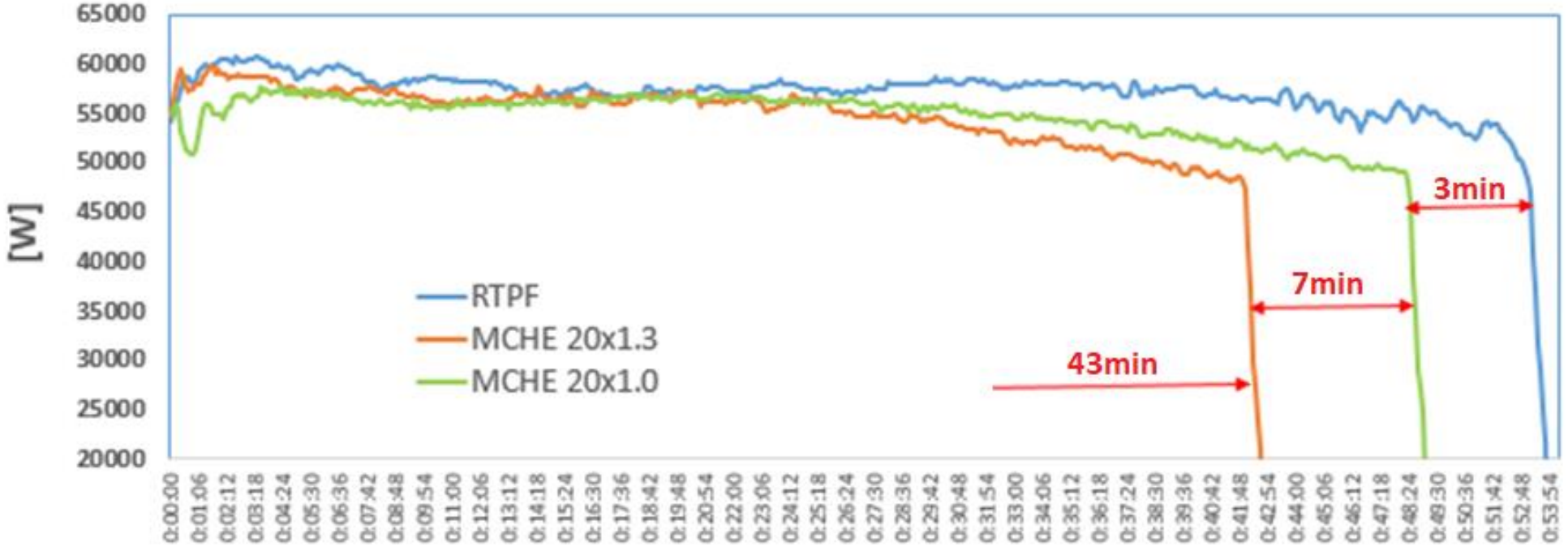
Critical Evaporating Temperature: Decreasing gradually the Evaporation Temperature until frosting using air at DB=2°C/WB=1°C

Heat Exchangers	Critical Evaporating Temperature	Frosting Location
RTPF	**690kPa（-4.4℃）**	Ref. inlet side
MCHE-1 (20x1.3)	**730kPa（-2.7℃）**	Ref. inlet side
MCHE-2 (20x1.0)	**700kPa（-4℃）**	Ref. inlet side

MCHE-2 is similar to RTPF on critical evaporating temperature!

Frosting Performance

SANHUA
Micro Channel Heat Exchanger

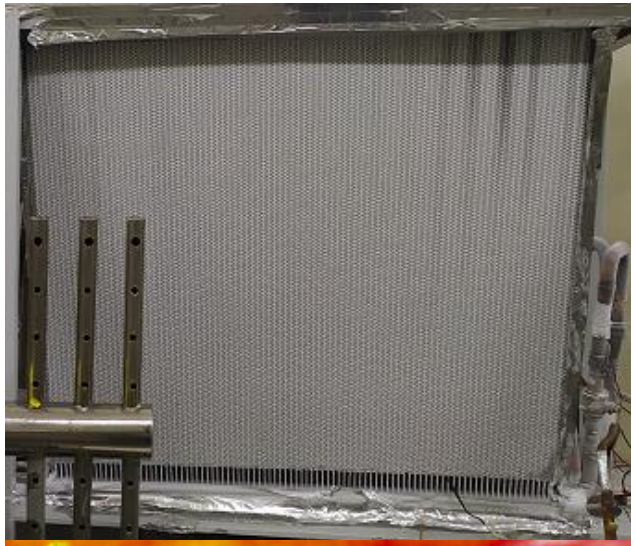


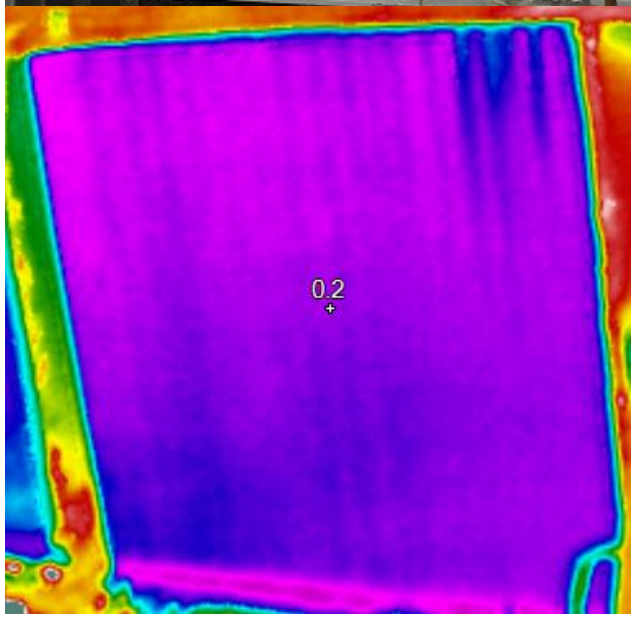
Items	RTPF	MCHE-1 (20x1.3)	MCHE-2 (20x1.0)
Average capacity / W	53690（100%）	51562（96%）	52195（97%）
Frosting period / min	54	43	51
Defrost time / min	4	4	4
Average COP	2.503（100%）	2.463（98.4%）	2.469（98.6%）

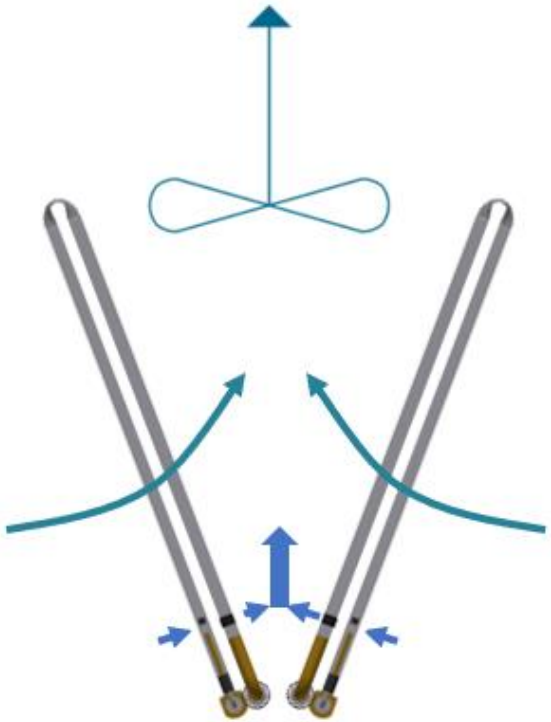
MCHE is comparable on frost performance compared to RTPF

Frosting Performance

SANHUA
Micro Channel Heat Exchanger

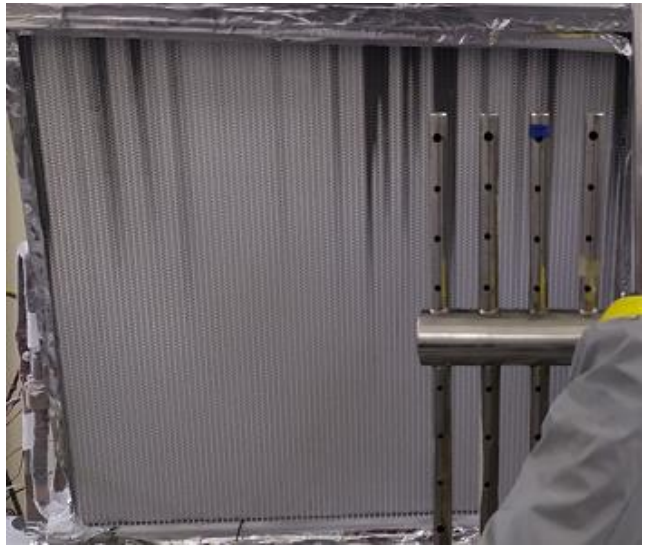


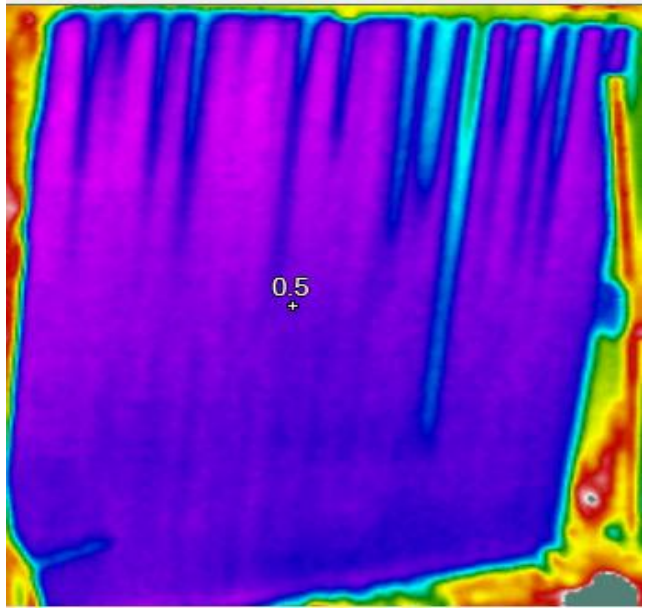




Evaporating Mode

The frosting is corresponding to refrigerant distribution





Conclusions

SANHUA
Micro Channel Heat Exchanger

- This new MPE tube used in MCHE Heat Pump can achieve similar frosting performance of equivalent F&T at same rated heating conditions
- This is possible thanks to a higher refrigerant pressure drop that generate a lower critical evaporating temperature

Content

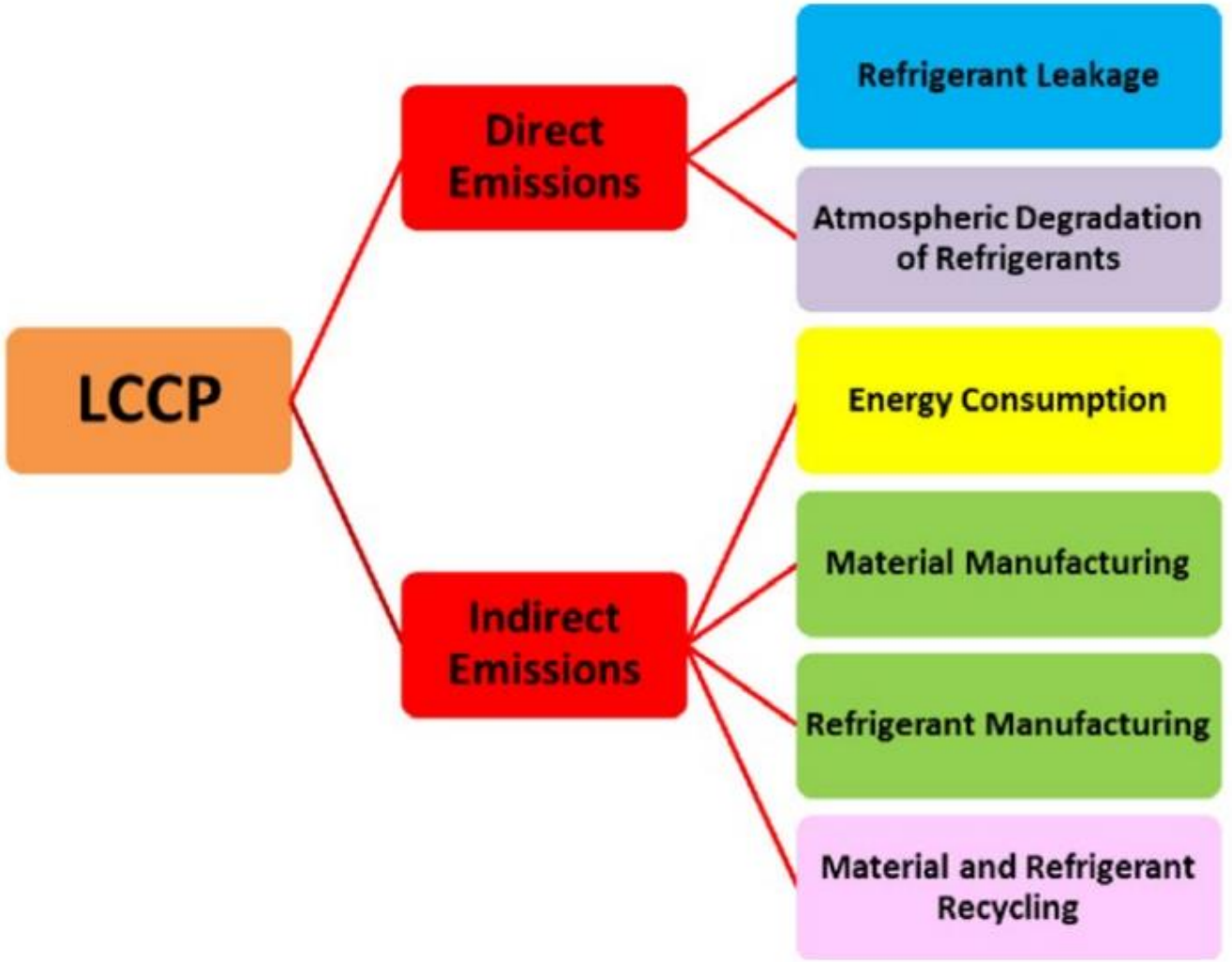
SANHUA
Micro Channel Heat Exchanger

- Company Introduction
- High Efficiency MCHE for Air Source HP Application
- Decarbonization Potential of MCHE

LCCP Analysis Method

SANHUA
Micro Channel Heat Exchanger

- Life Cycle Climate Performance (LCCP) is an index by which HVAC&R systems can be evaluated for their global warming impact over the course of their lifetime
- LCCP index will become more and more important increasing the environmental sensibility of the market



LCCP Analysis Case

SANHUA
Micro Channel Heat Exchanger

Input	100kW Chiller HP Unit	
	RTPF	MCHE
Refrigerant	R410A	R410A
Charge（kg）	20	18
Weight（kg）	500	450
Refrigerant GWP（kgCO2/kg）	2088	2088
Refrigerant manufacture CO2 emission（kgCO2/kg）	10.7	10.7
Refrigerant leak rate（%）	4	4
Product life（year）	15	15
Refrigerant residual before scrap（%）	15	15
Power generation CO2 emission（kgCO2/kWh）	0.65	0.65
Heating Capacity (kW)	100	100
SCOP	2.95	3.1
Operating hours every year	4910	4910
Output	**100kW Chiller HP Unit**	
	RTPF	**MCHE**
Direct emission		
Emission of refrigerant leaked（kgCO2）	25056	22550
Emission of refrigerant leaked when the product is scrapped（kgCO2）	6264	5638
Total direct emission（kgCO2）	31320	28188
Indirect emission		
Emissions corresponding to the energy consumption of refrigerant manufacture（kgCO2）	342	308
Emissions corresponding to the energy consumption of unit manufacture（kgCO2）	1777	1902
Emissions corresponding to the energy consumption of unit recycle（kgCO2）	28	25
Annual power consumption（kWh）	166441	158387
Emissions corresponding to the energy consumption of unit operation（kgCO2）	1622797	1544274
Total indirect emission（kgCO2）	1624944	1546509
Total LCCP emission（kgCO2）	1656264	1574697

Analysis Case : 100kW Chiller HP Unit

Assumption :

- SCOP +5% with MCHE replacement
- Charge -20% with MCHE replacement
- Weight -50kg with MCHE replacement

	RTPF	MCHE
Total direct emission (kgCO2)	31320	28188
Total indirect emission (kgCO2)	1624944	1546509
Total LCCP emission (kgCO2)	1656264	1574697
Total LCCP emission (%)	**100%**	**94%**

Decarbonization Potential for EU

SANHUA
Micro Channel Heat Exchanger

EU air-water HP about 1,000,000 units in 2021

Refrigerant charge about 20 million kg

CO2 direct emission about 31320 million kg + CO2 indirect emission about 1624944 million kg

70% with MCHE replacement

20% charge saving

Charge reduction about 2.8 million kg

Direct emission reduction about 2192 million kg + Indirect emission reduction about 54905 million kg

SCOP+5%

Forest Planting equivalent (*)

6005 hectare/year + **150425 hectare/year**

(*) one hectare forest absorbs 365ton CO2 per year

➔ For EU, 70% of air-cooled commercial HP with MCHE is equivalent to plant **156430-hectare forest!**


SANHUA
A2L
R32
R290
R744
Visit us at Chillventa – Hall 7A-310
CHILLVENTA

Thank you!

Hall 4A

CHILLVENTA

Chillventa Specialist Forums 2022
Chillventa Fachforen 2022

CONNECTING EXPERTS.