EUROPEAN HEAT PUMP SUMMIT

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SYMPOSIUM + EXPO
NUREMBERG, 20–21.10.2015

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

hp-summit.de

NÜRNBERG MESSE

High
Efficiency
Solutions.

CAREL

A heat pump inside a ventilation system

Speaker: Arne Müller
Buisness Developer EU HVACmarket
Carel Deutschland GmbH

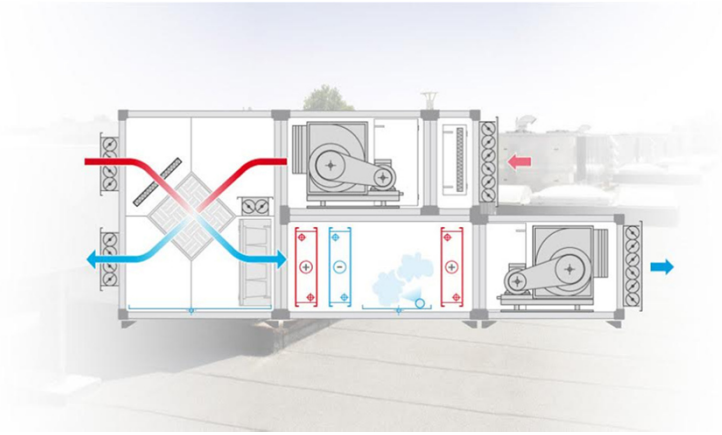
Agenda

1. Market development

2. Solution for residential AHU

3. Main improvements
   (Active Heat recovery, cooling, humidification)

4. Conclusion



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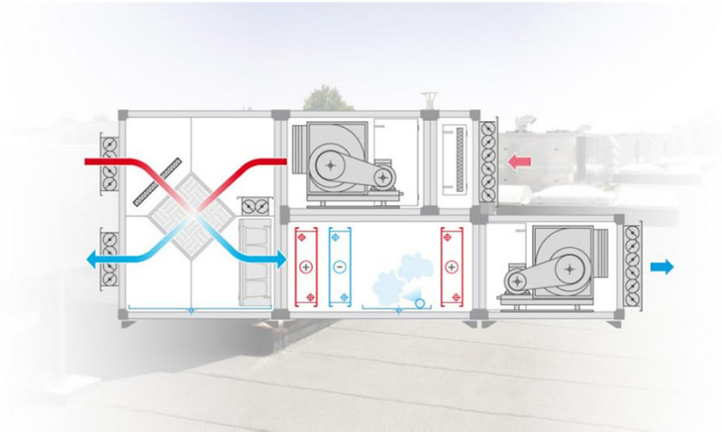
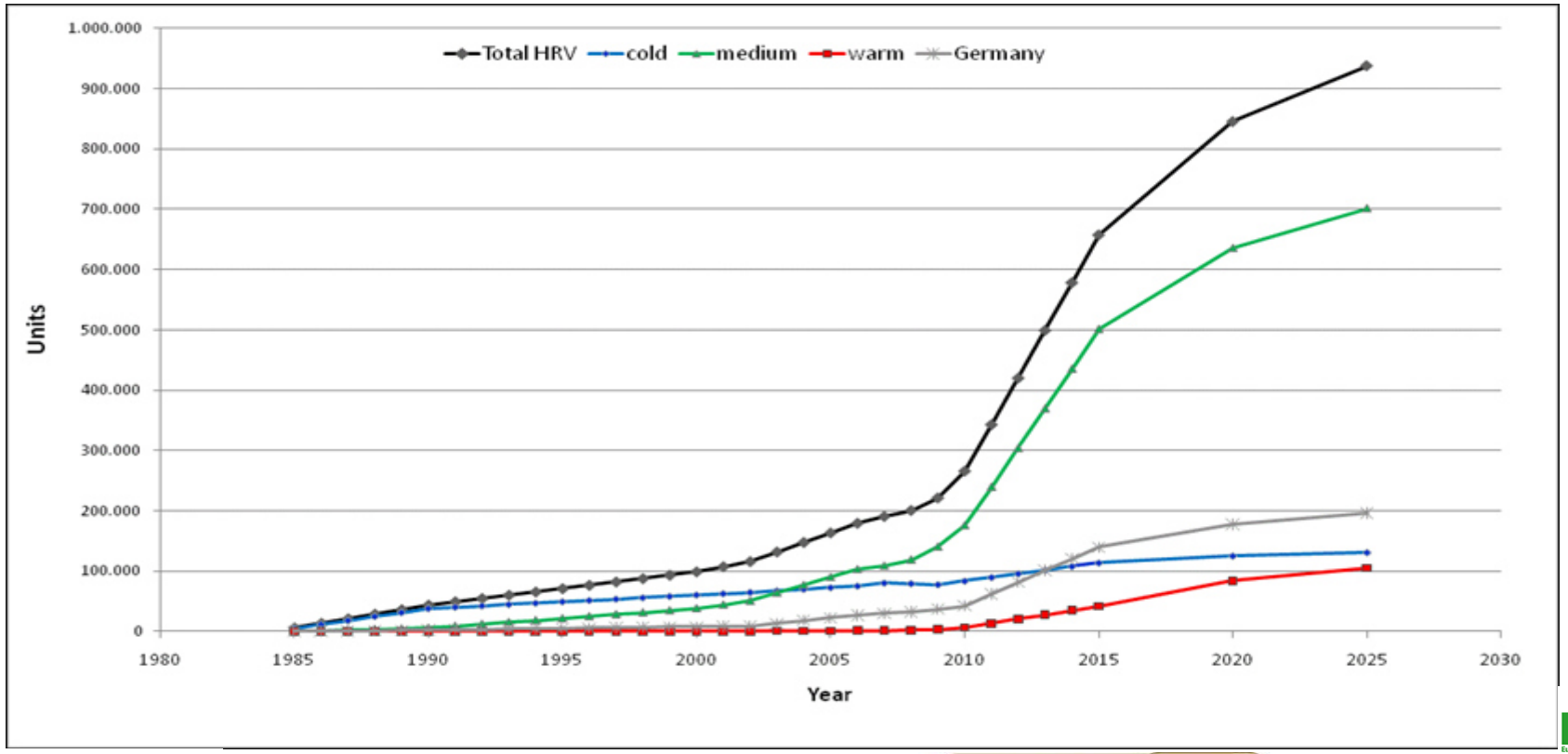
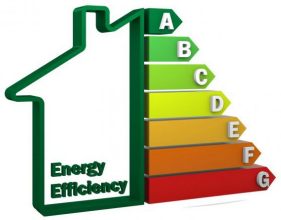


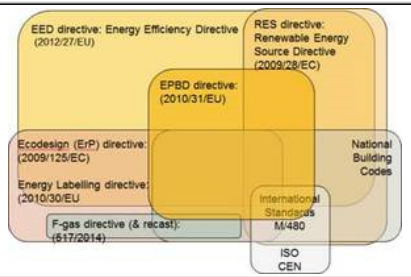
Forecast and Market Trends

Market data for R-AHU with heat recovery referring to the climatic zones in Europe





nZEB
NEARLY ZERO ENERGY BUILDING



Germany: Market data 2014

Luftleistung < 500 m³/h

Zentrale Geräte
ca. 40.000

Geräte mit Wärmepumpe
ca. 6.000

Dezentrale Geräte
ca. 32.000

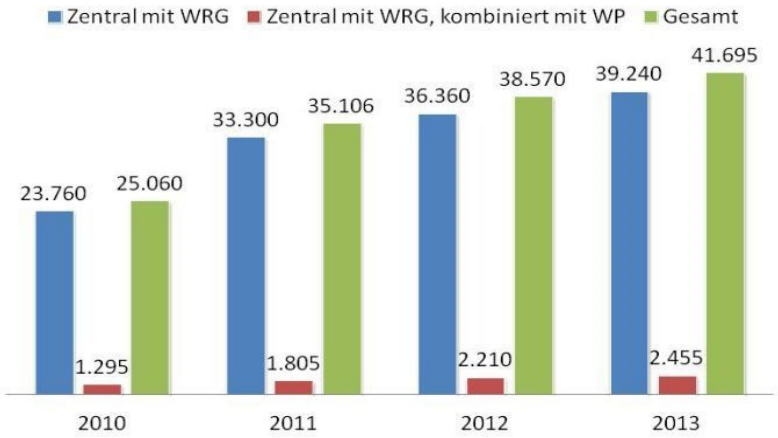
Luftleistung > 500 m³/h

Zentrale Geräte
ca. 20.000 davon 75% mit Wärmerückgewinnung

(1) Zentrale Lüftungsgeräte sind nach Systematik des TZWL Lüftungsgeräte mit Anschluss an ein Kanalsystem. Sie belüften mehrere Räume, eine Wohnung oder ein ganzes Haus

(2) Dezentrale Lüftungsgeräte belüften nach Systematik des TZWL nur einen einzelnen Raum. Nicht enthalten sind hier die sogenannten „Badlüfter" nach DIN 18017-3

Inlandsmarkt für Wohnungslüftung: 2010-2013



Fachverband Gebäude-Klima e.V.

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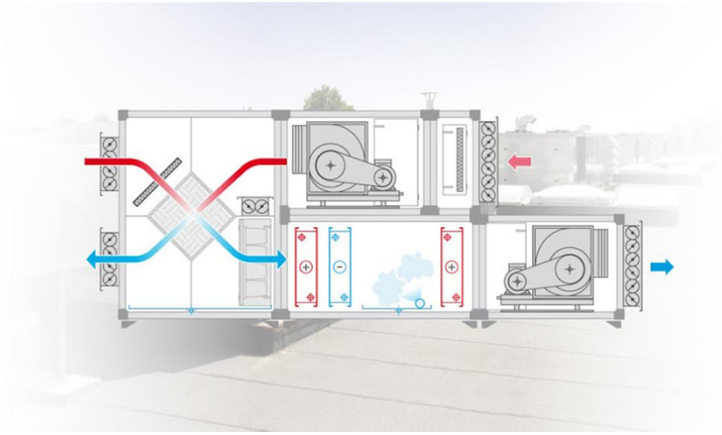
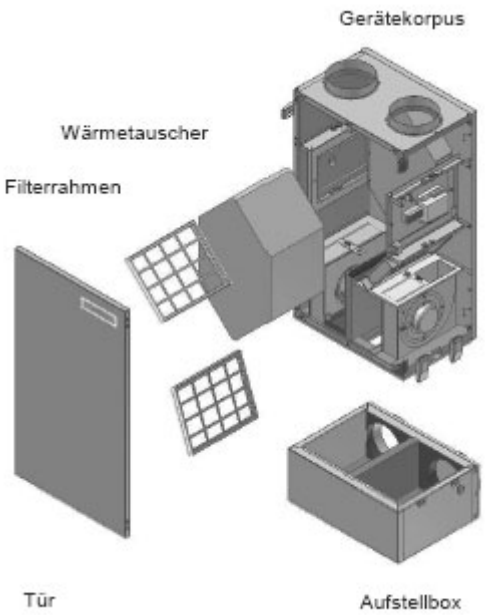


SCENARIO

The aim of Ventilation project: **put all these pieces together**,

SCENARIO

Typical solutions in the market:

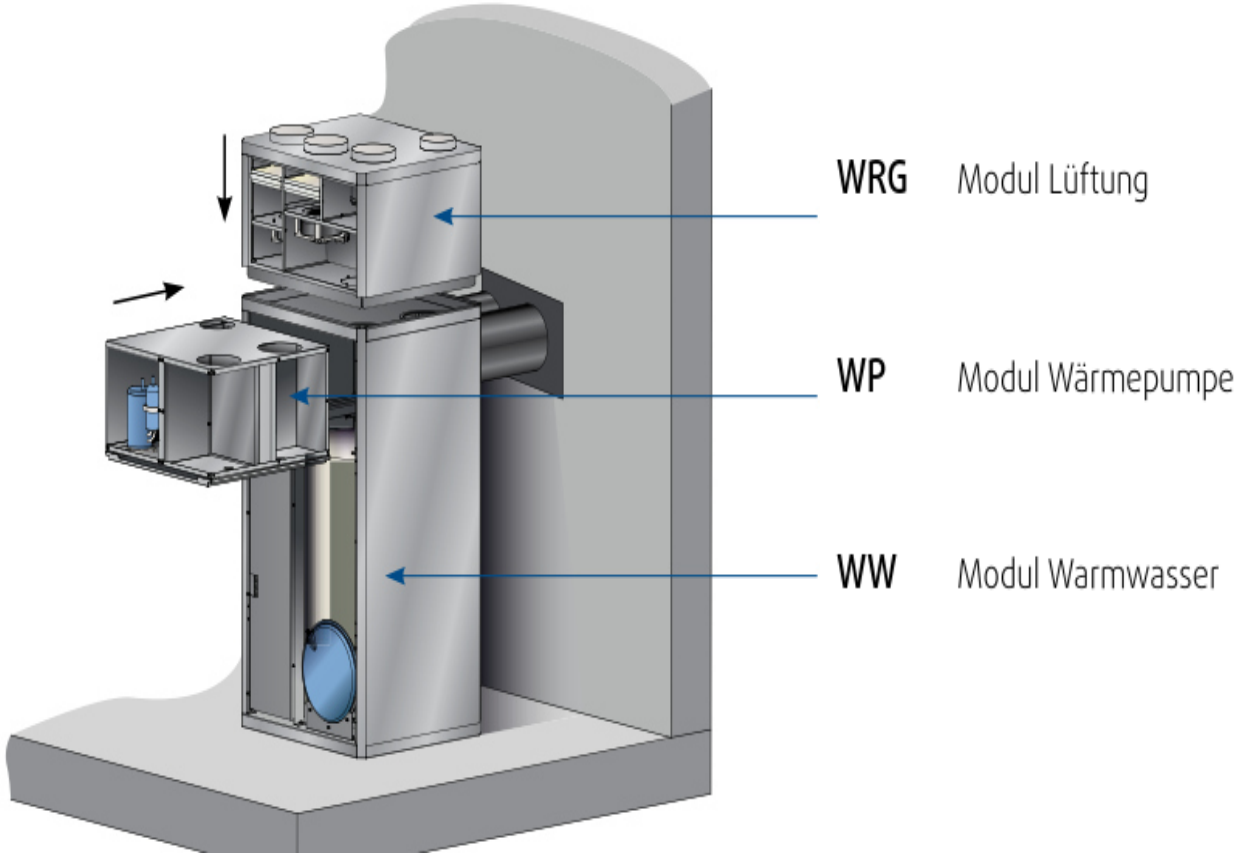


Quelle: http://http://www.ltm-ulm.de/

Quelle: http://www.dimplex.de

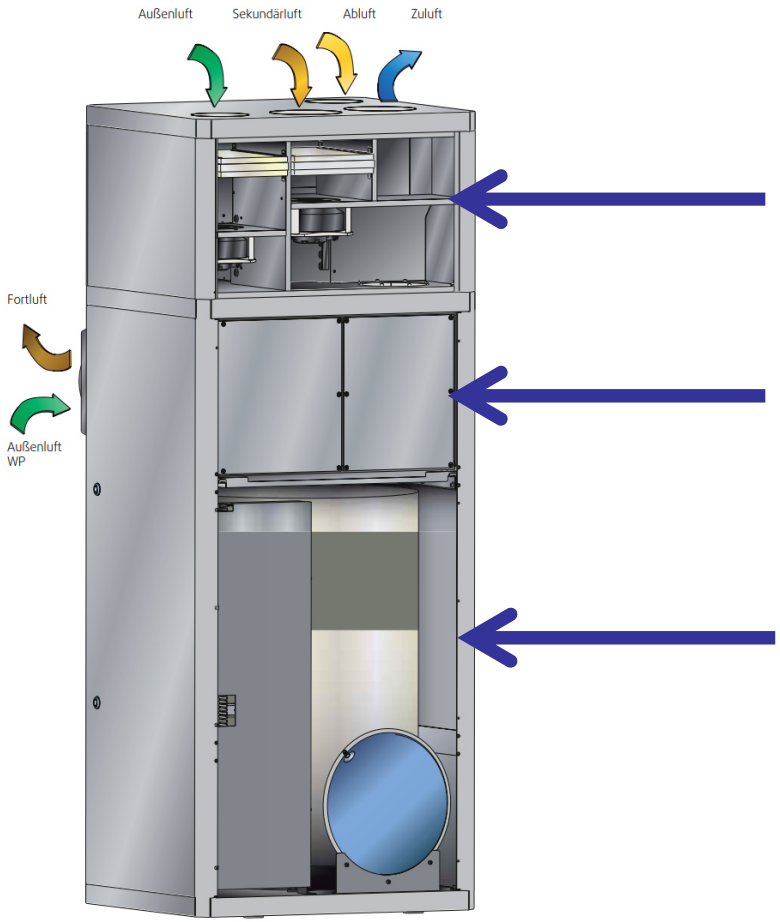
SCENARIO

All in one unit:



Quelle: http://www.systemair.com/Documents/Downloads/Leaflets%20and%20Catalogues/Deutsch/Genius_Planerbroschuere_2014-11_DE_E1456_web.pdf

PRODUCT CONCEPT



AHU module with integration of humidification

HP module with BLDC inverter

Integration of hot water tank

Quelle: http://www.systemair.com/Documents/Downloads/Leaflets%20and%20Catalogues/Deutsch/Genius_Planerbroschuere_2014-11_DE_E1456_web.pdf

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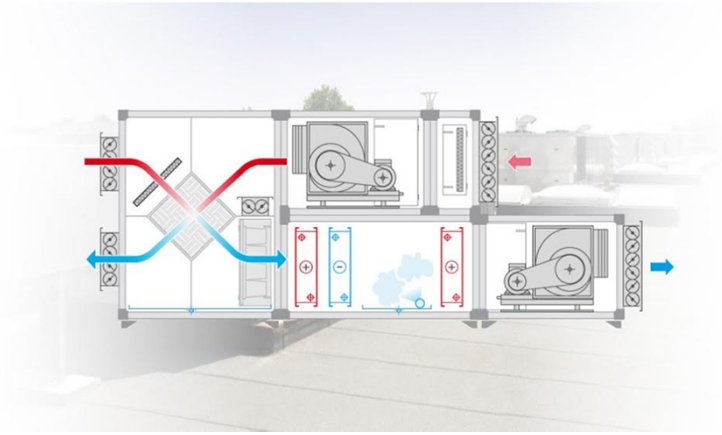
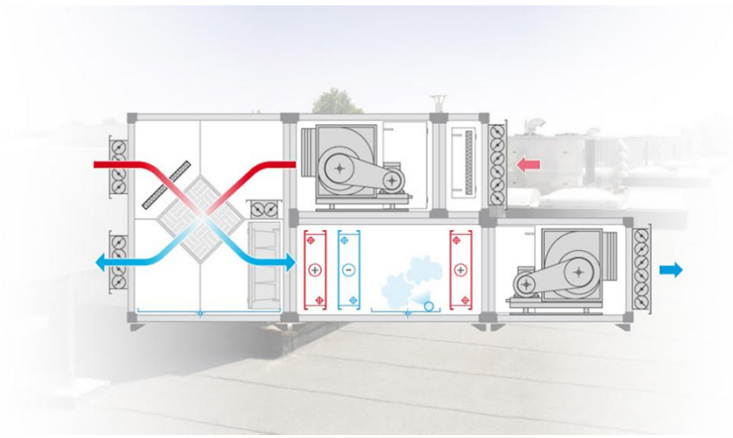
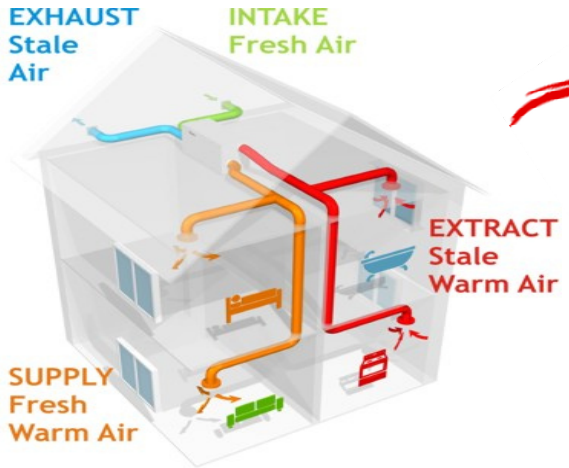


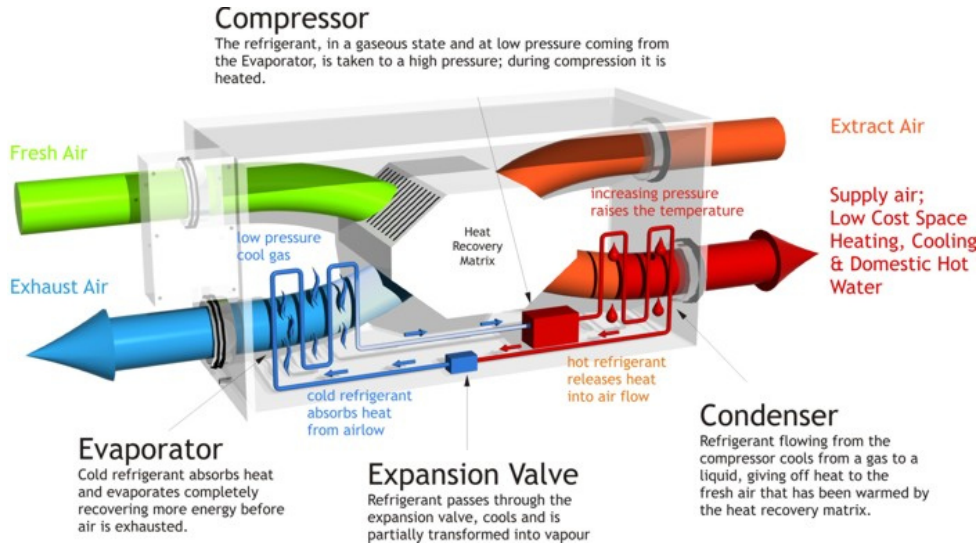
Main improvements

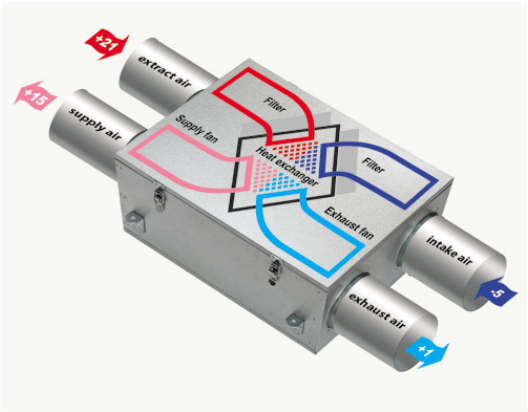
Active Heat Recovery



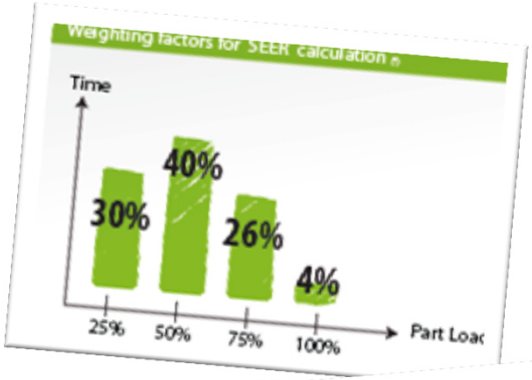
Active Heat Recovery

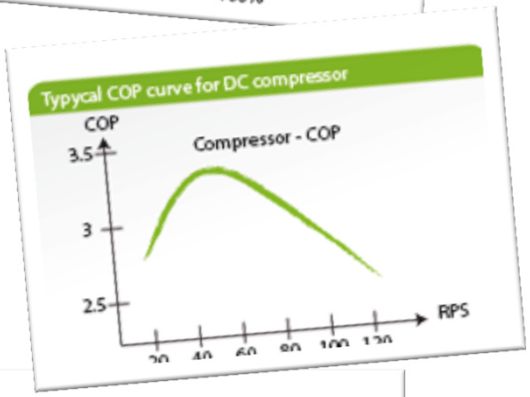


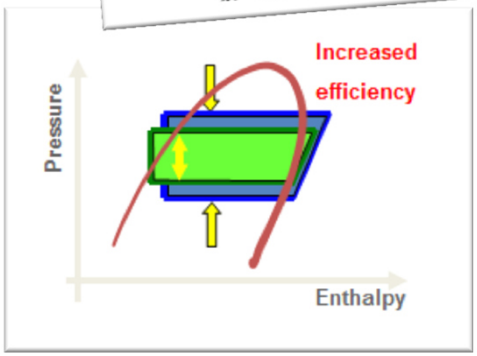




Refrigerating cycle performances





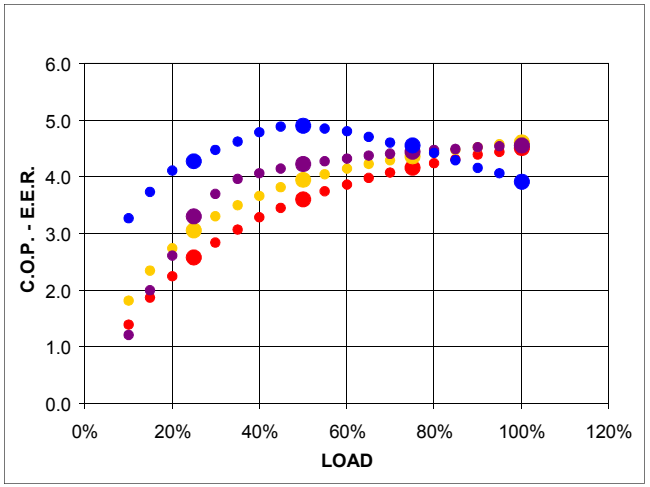


Variable speed compressors, can match the partial load giving an extremely high unit efficiency due to…

…the improved efficiency of the compressor at partial load as basic COP…

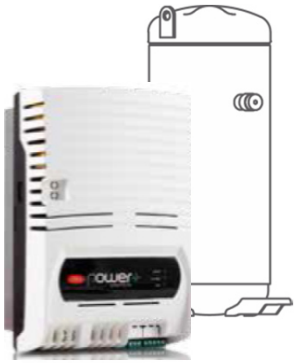
… together with improved heat exchangers efficiency

Which technology is winning?



- ON-OFF
- ON-OFF + EEV
- DIG. SCROLL + EEV
- DC INVERTER + EEV

BLDC compressor

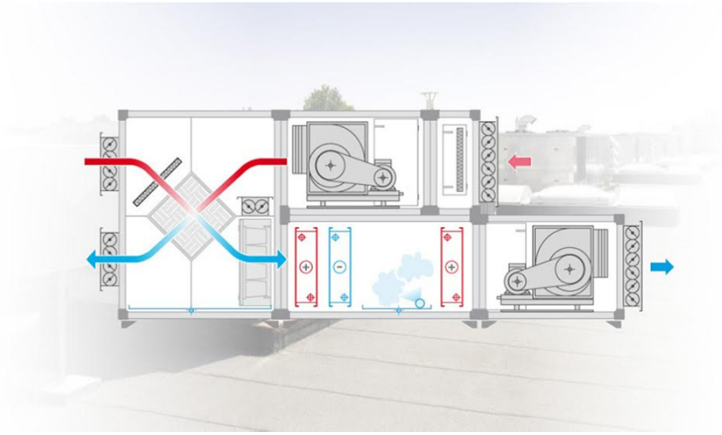


INCREASED UNIT **ENERGY EFFICIENCY**:

10-35% higher part load COP compared with on-off compressor

Main improvements

Ultrasonic Humidification



WHY Humidification?

TO:

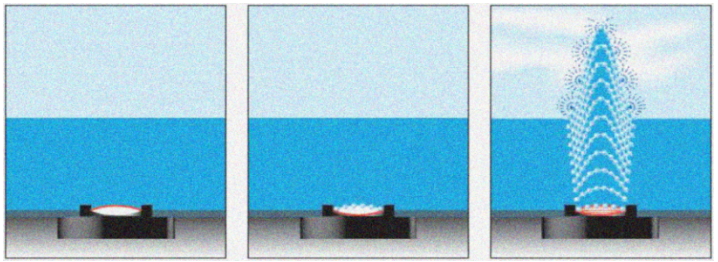
- Maintains optimal comfort during heating seasons by minimizing problems associated with dry air

- Creates a healthier home and reduce
  - dry skin
  - sinus congestion
  - dry throat
  - nose irritation
  - bloody noses
  - dry cough
  - cracked lips

- Protects home and furnishings by reducing the risk of wood warping and cracking

Ultrasonic Humidification

humiSonic is an adiabatic humidifier that utilizes the ultrasonic technology.



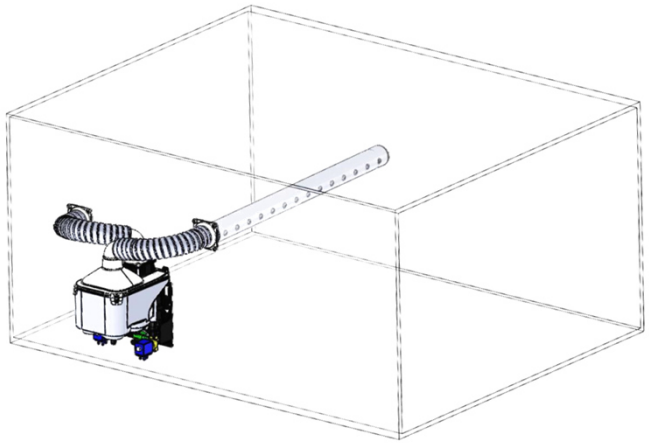
Very fine drops (**Ø = 5 µm**).

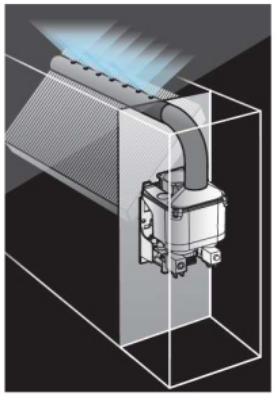
Low energy consumption (**100 W**).

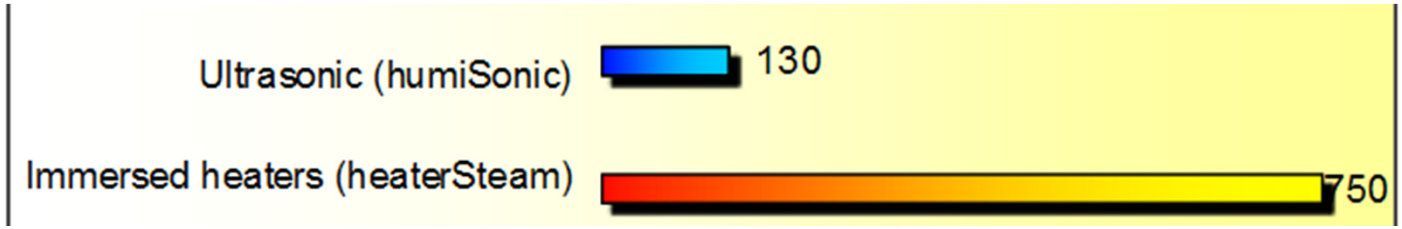
Water flow: **1,0 l/h (230 V)**.
Water flow: **0,8 l/h (115 V)**.

Modulation according to request.

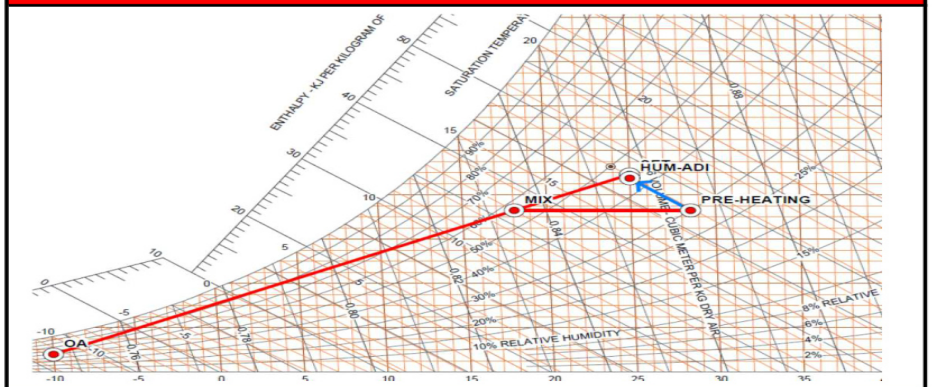
Ultrasonic vs. Immersed Heater







ADIABATIC HUMIDIFICATION



HUMISONIC

DUCT SIZE		
Internal width	300	mm
Internal height	400	mm
Air flow	540	kg/h [20% OF OUTSIDE AIR]
Air speed	1,3	m/s

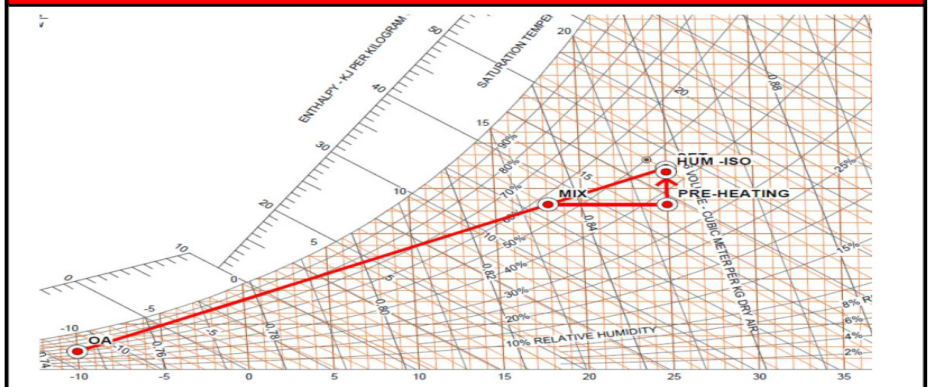
PREHEATING	in		out	
Relative humidity	56%	rH	30%	rH
Temperature	18,08	°C	28,53	°C
Specific humidity	7,29	g/kg	7,29	g/kg
Enthalpy				
Relative humidity				
Temperature				
Specific humidity	7,29	g/kg	8,74	g/kg
Enthalpy	47,29	kJ/kg	47,29	kJ/kg

Power consumption Humidification	36	€/y
Total Cost Power Consumption	**84**	**€/y**
Cost of hourly consumption	0,04	€

delta X	1,45	g/kg
water to be absorbed	0,9	kg/h
absorbtion ratio	100%	
Humidification load	**1**	**kg/h**

POWER CONSUMPTION		
Working hours	2160	hours/y
E.E.R. heating coil	4	
delta H	10,634	kJ/kg
mass	121	kg/h
Preheating	0,36	kW
Total Preheating	193	kWh
Power consumption humidifier	70	W/kg/h
Humidification	142	kWh
FIXED COSTS		
List Price	1100	€
discount	50%	
Net price	550	
Installation	100	€
Maintenance	150	€/y
VARIABLE COSTS		
unit cost E.E.	0,25	€/kWh
Power consumption Preheating	48	€/y
Power consumption Humidification	36	€/y
Total Cost Power Consumption	**84**	**€/y**
Cost of hourly consumption	0,04	€

ISOTHERMAL HUMIDIFICATION



UR/UE

DUCT SIZE		
Internal width	300	mm
Internal height	400	mm
Air floW	540	kg/h [20% OF OUTSIDE AIR]
Air speed	1,3	m/s

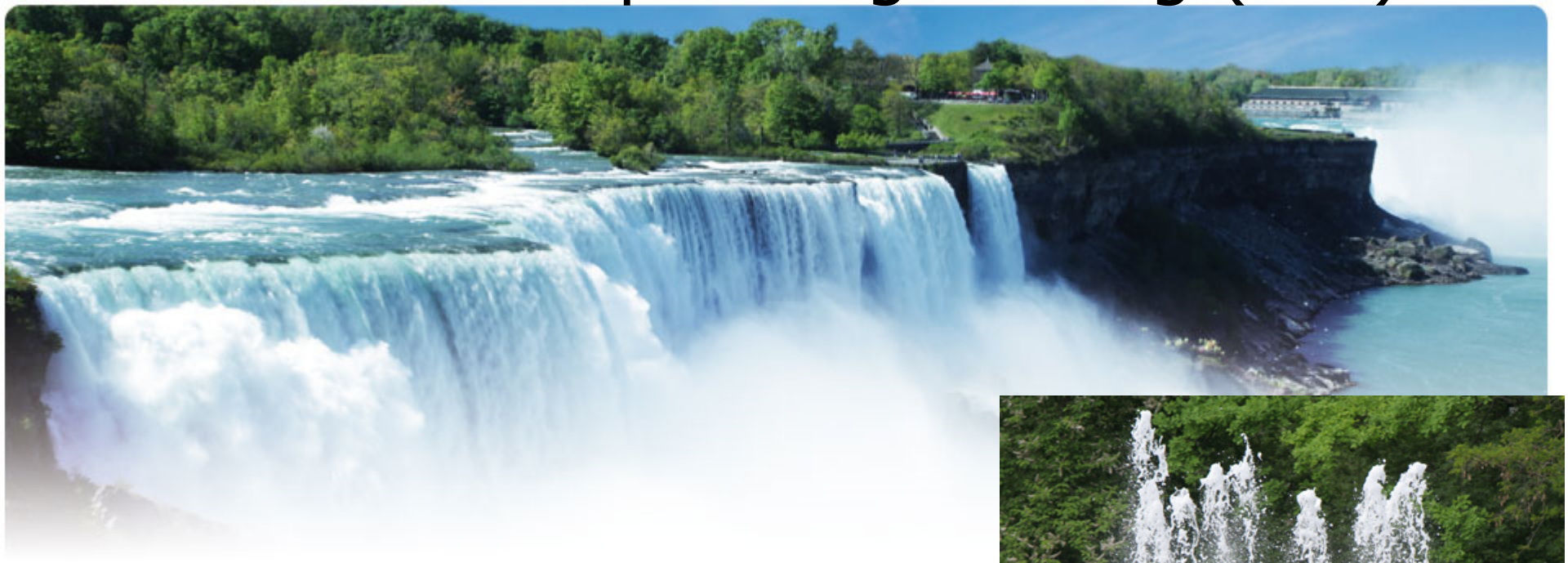
PREHEATING	in		out	
Relative humidity	56%	rH	37%	rH
Temperature	18,08	°C	25,00	°C
Specific humidity	7,29	g/kg	7,29	g/kg
Specific humidity	7,29	g/kg aria	8,74	g/kg
Enthalpy	43,70	kJ/kg	47,29	kJ/kg

Power consumption Humidification	381	€/y
Total Cost Power Consumption	**413**	**€/y**
Cost of hourly consumption	0,19	€

delta X	1,45	g/kg
water to be absorbed	0,9	kg/h
absorbtion ratio	100%	
Humidification load	**1**	**kg/h**

POWER CONSUMPTION		
Working hours	2160	hours/y
E.E.R. heating coil	4	
delta H	7,045	kJ/kg
mass	121	kg/h
Preheating	0,24	kW
Total Preheating	128	kWh
Power consumption humidifier	750	W/kg/h
Humidification	1522	kWh
FIXED COSTS		
List Price	1032	€
discount	50%	
Net price	516	
Installation	100	€
Maintenance	150	€/y
VARIABLE COSTS		
unit cost E.E.	0,25	€/kWh
Power consumption Preheating	32	€/y
Power consumption Humidification	381	€/y
Total Cost Power Consumption	**413**	**€/y**
Cost of hourly consumption	0,19	€

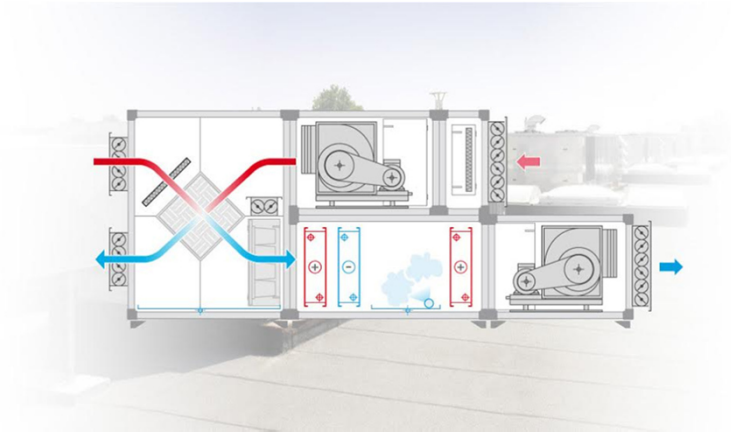
Indirect Evaporating Cooling (IEC)



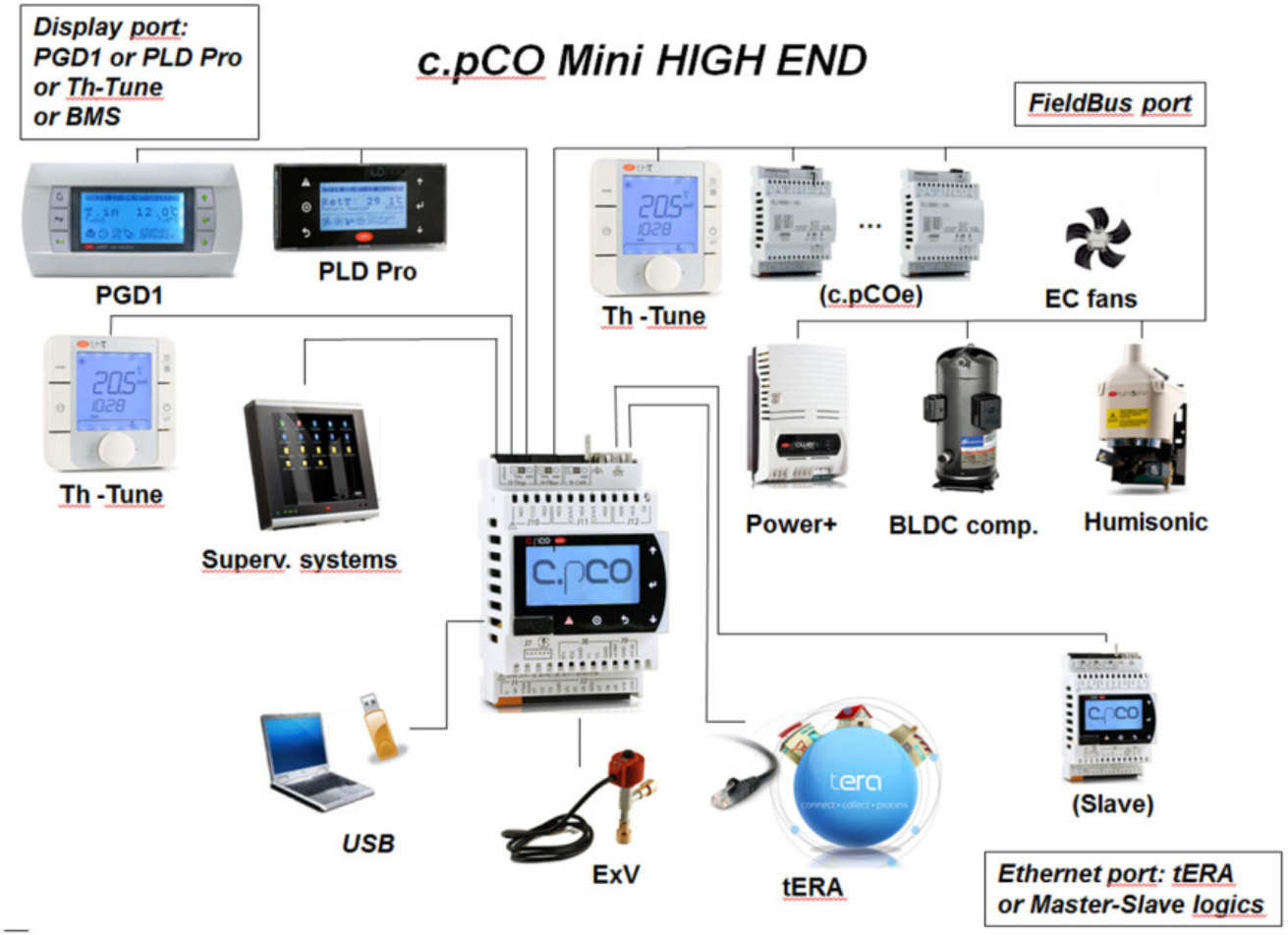
Very low energy consumption means evaporative cooling systems are environmentally-friendly, energy saving solutions: 100 kg/h of evaporated water absorbs around 69 kW of heat from the air, for a power consumption of less than 1 kW!

Main improvements

Full Integration



Full Integration



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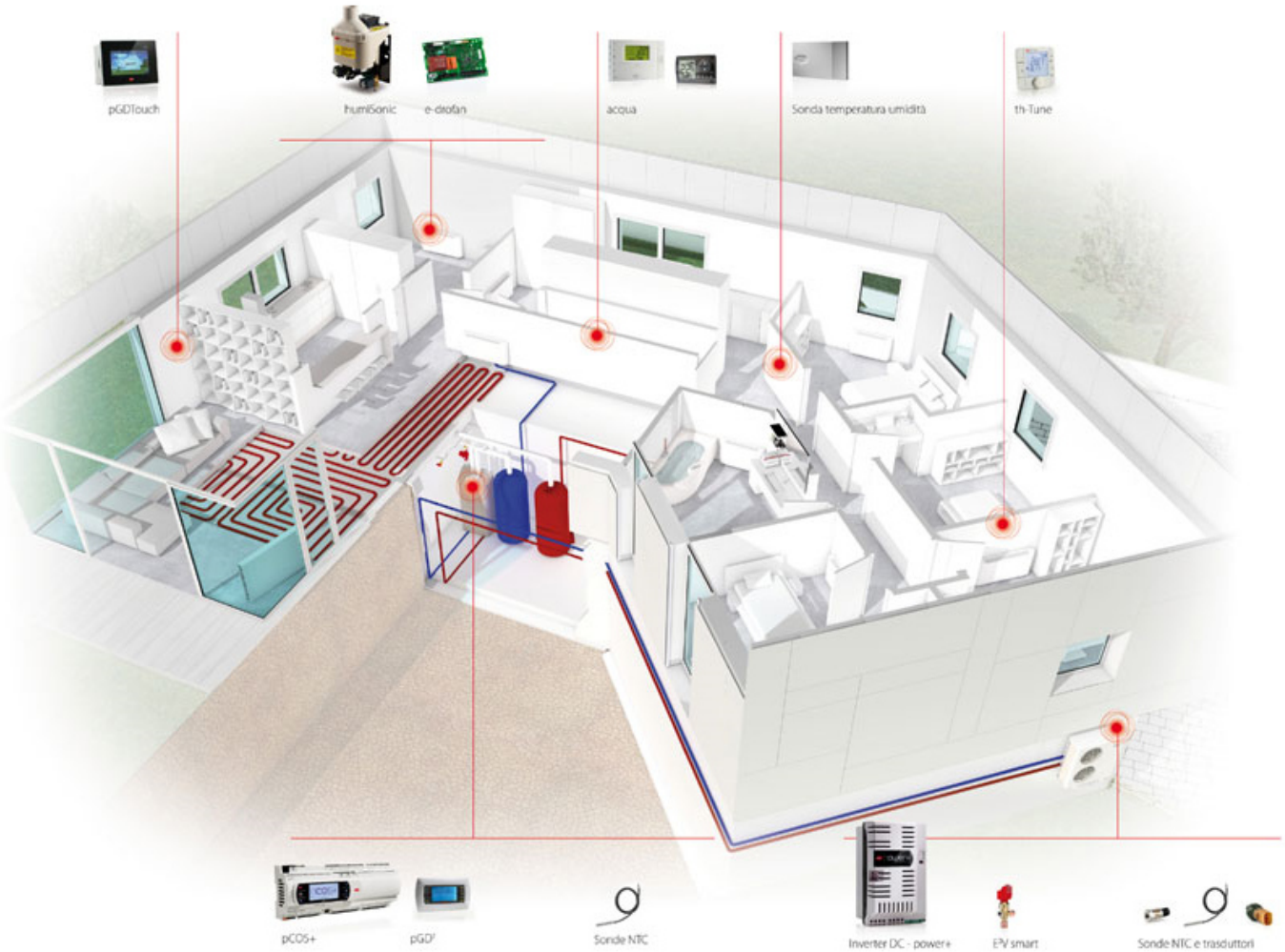

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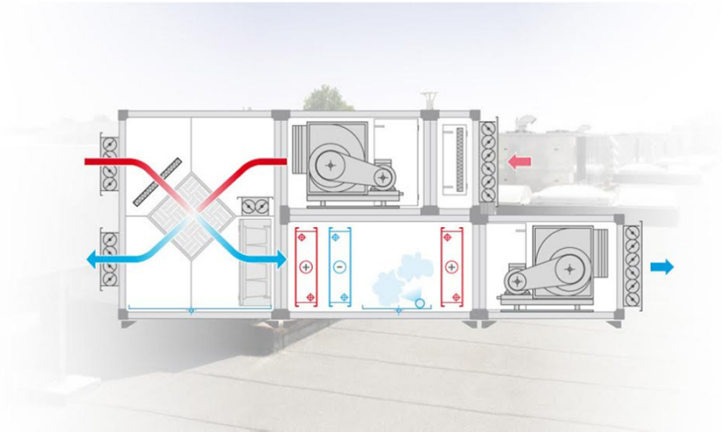

Conclusion

1. The residentail AHU market is good growing market and due to new Building standards very intersting to combine (better integrate) with a heat pump.

2. With new types of combined Heat Pump + AHU + Hot Water the integration can help with new technologies to increase the efficiency.

3. HumiSonic humidification helps to save energy and specially to increase the comfort and the heathiness of the people in winter time and also in summer time for cooling.

4. The controller has to integrate all the techology to make the control very smart and efficient.

thank you for your attention,
any questions?

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