



ONLINE

23-24/06/2020



IMPROVEMENTS ON WATER & BRINE CHILLER FOR AIR CONDITIONING & PROCESS COOLING

Sergio Giroto- ENEX SRL 

The 'enex' logo features a blue circular icon with a white 'e' inside, followed by the text 'enex' in a bold, lowercase sans-serif font. Below the text is the tagline 'Leading in refrigeration' in a smaller, lowercase sans-serif font.

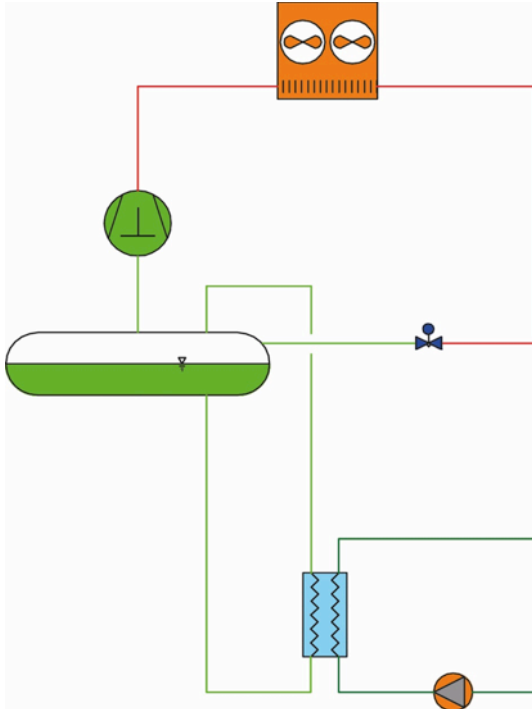
TESTING ON WATER CHILLER WITHIN THE MULTIPACK PROJECT

Giacomo Tosato- CNR-ITC 

The 'ITC' logo consists of the letters 'ITC' in a bold, white sans-serif font inside a blue square, followed by a white square containing a blue stylized 'C' shape.

#GoNatRefs

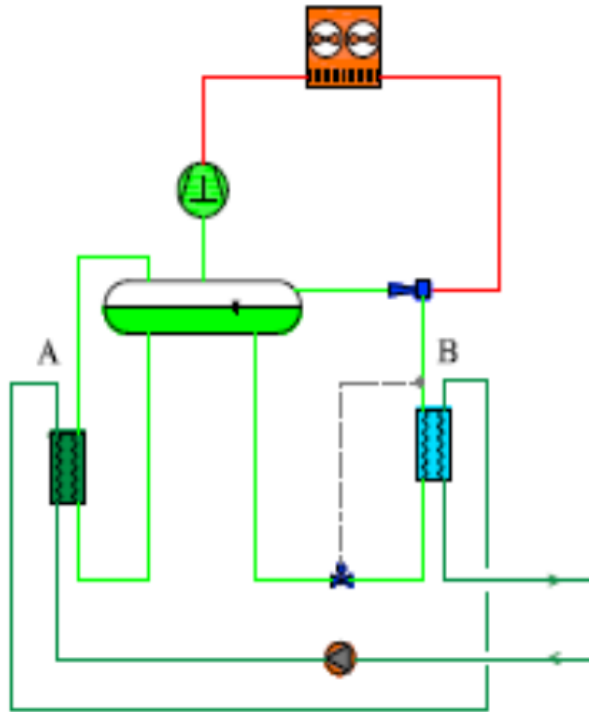
2015 : BASE SOLUTION INTRODUCED



- **Gravity** feeding: efficient use HT surface;
- Low ΔT at **part load**: higher efficiency;
- **Dynamic** set point.

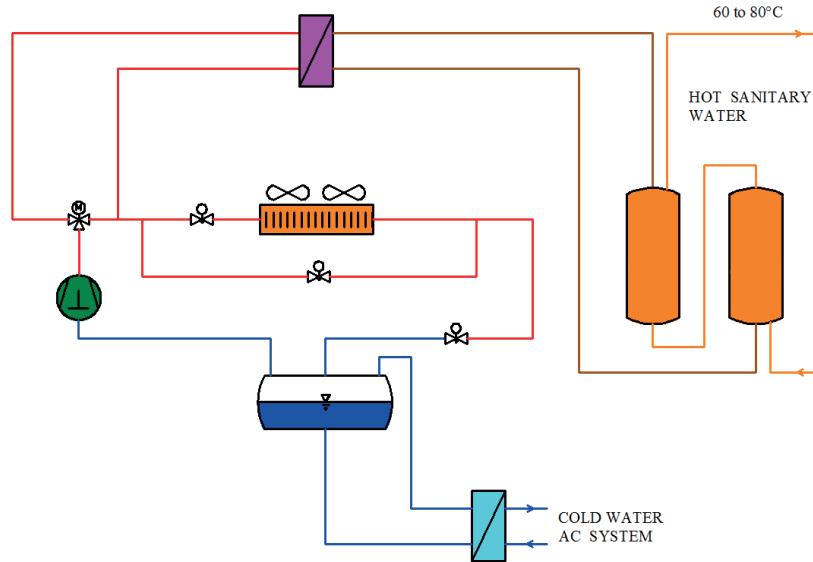
Extreme reliability
confirmed by several
installations in 2015-2017.

2017: CHILLER WITH EJECTOR



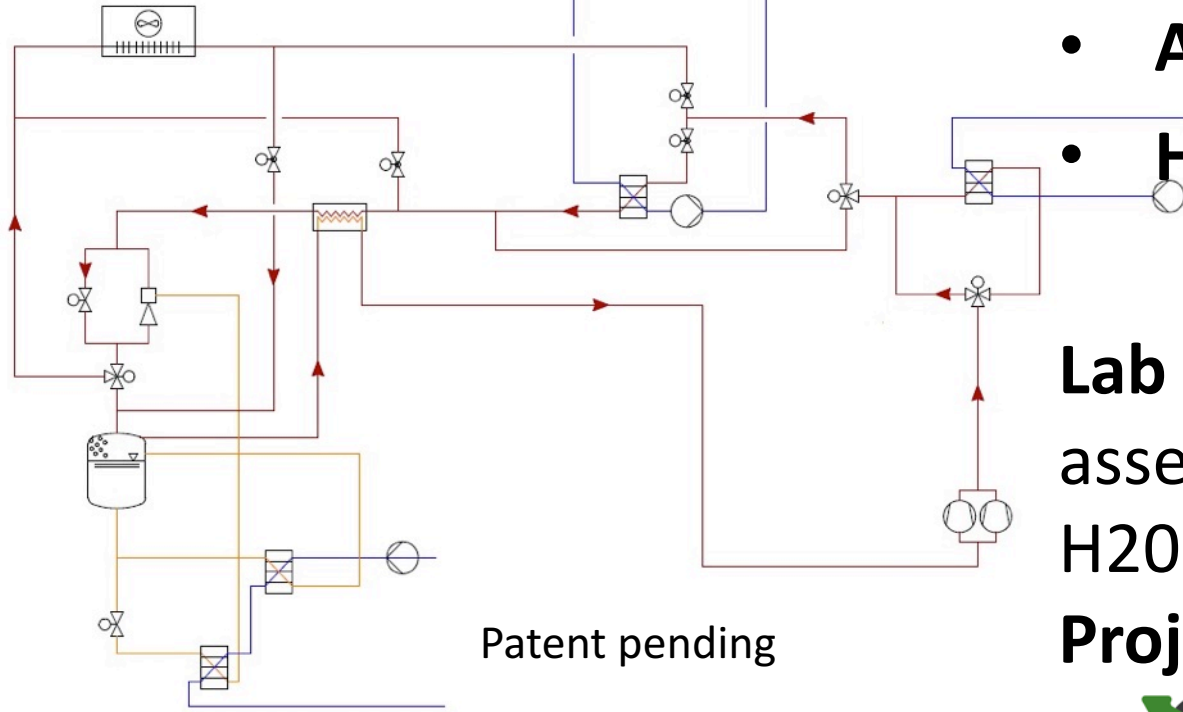
- **Gravity + ejector** driven evaporators;
 - **Simple** lay-out, **stable** operations (no switching over);
 - Works at **all ambient conditions**.
- Efficiency gain** (towards only gravity) **5-15%** depending on outdoor/water temperature.

2018: HEAT RECOVERY (both with/without Ejector)



- **Chiller+ Heat Recovery;**
- **Suitable for DHW and/or space heating;**
- **Gravity evaporator (+ ejector evaporator);**
- **Optimized high pressure.**

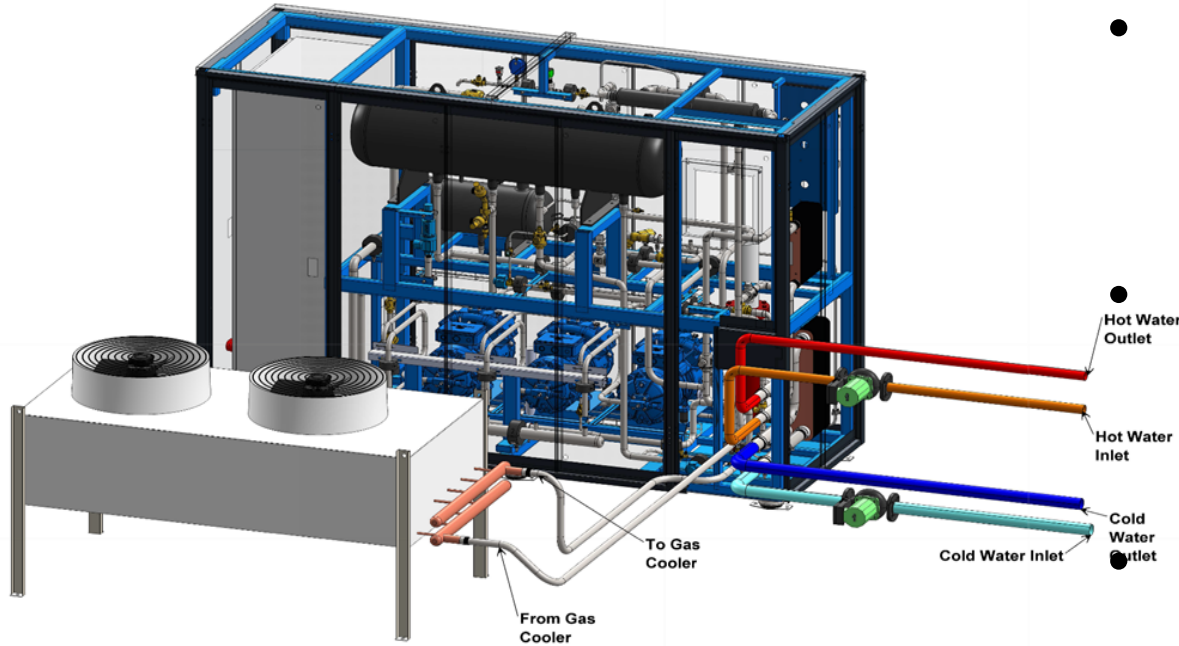
2018: Reversible chiller and heat pump



- All-in-one solution;
- Hot gas defrost.

Lab tests and field assessment within the H2020 MutiPACK Project

Additional benefits of the unit design....



- All HX dedicated and optimized for their specific duty;
 - Single HX air / CO₂ (evaporator/gas cooler);
- Simple and cheap installation.**

CHILLER YUKON – References



Process chiller for the wine industry

Location	Italy
City	Bolzano
Dimensions	75 hectares of vineyards
Enex model	Yukon Gravity standard
Capacity	120kW – (glycole 6°C / 1°C T _{air} 33°C.)
Heat recovery	Hot water up to 90°C

CHILLER YUKON – References



Process chiller for the wine industry	
Location	Italy
City	Bolzano
Dimensions	471 hectares of vineyards
Enex model	Yukon Gravity standard
Capacity	700kW – (glycole -1°C / -6°C T.air 33°C.)
Heat recovery	Hot water up to 80°C

CHILLER YUKON – References



Air conditioning Chillers for industry	
Location	Italy
City	Trento
Dimensions	11.000 m2
Enex model	Yukon Reversible – water cooled
Capacity	Cooling 500kW – (water 10°C / 15°C) Heating 500kW – (water 30°C / 35°C)
Heat recovery	Heating 500kW – (water 30°C / 35°C)

CHILLER YUKON – References



Air conditioning Chillers for Industry

Location	Italy
City	Fossano
Dimensions	3.000 m2
Enex model	Yukon Reversible
Capacity	Cooling 150 kW, Air temp. +35°C, Water 7°C – 12°C Heating 160 kW, Air temp. -5°C, Water 35°C – 50°C
Heat recovery	No

CHILLER YUKON – References



Air conditioning Chillers for Hotel	
Location	Italy
City	Bolzano
Dimensions	5* hotel
Enex model	Yukon Gravity standard
Capacity	Cooling 150 kW (water 12°C / 7°C)
Heat recovery	Hot water up to 65°C



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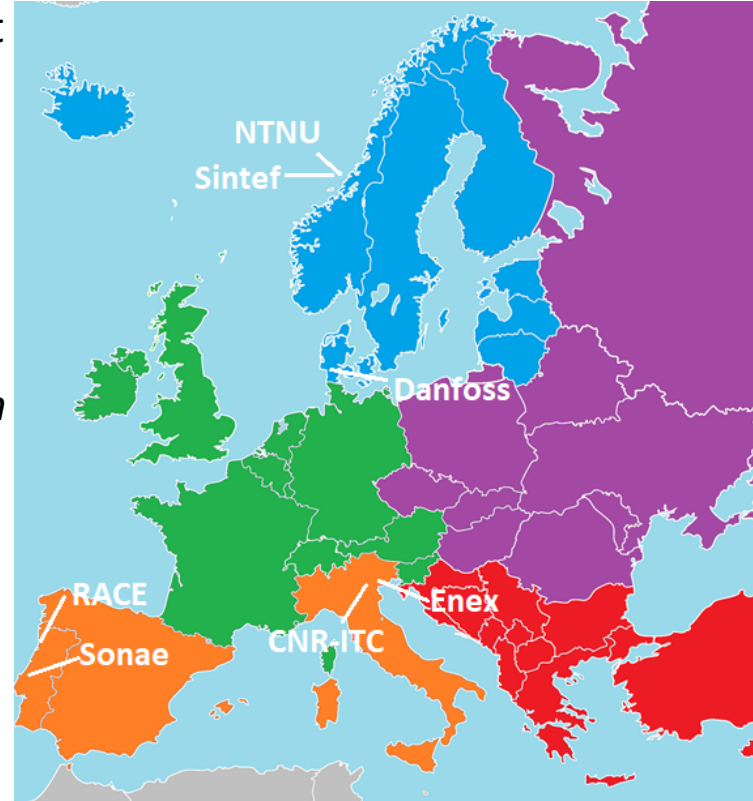


#GoNatRefs

The MultiPACK Project

- EU funded Horizon 2020 Project (Grant number 723137)
- Duration: 48 months
- Partners: NTNU (coordinator), Sintef, Danfoss, **Enex**, **CNR-ITC**, Sonae, RACE
partners are present in all the links of the value chain from initial innovation to the actual end user
- Main focus areas:
 - Supermarkets
 - **High energy demanding buildings** (hotel, gyms, etc.)

23-24/06/2020 - Online



What is a MultiPACK reversible chiller/heat pump?

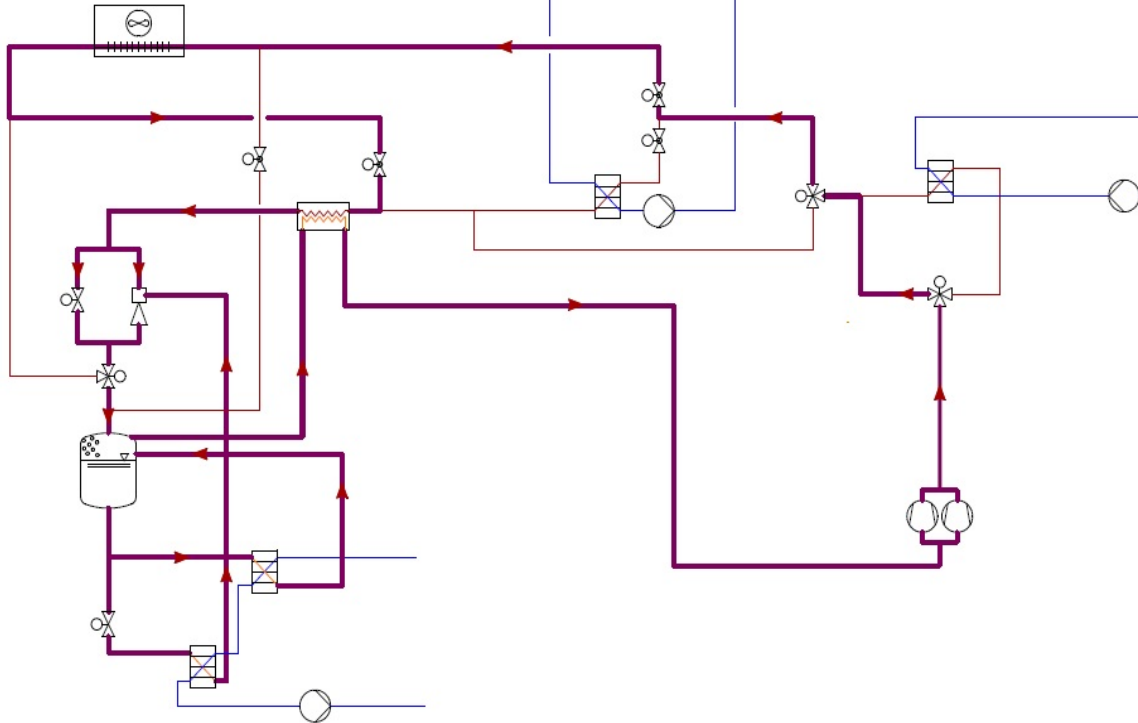
- An **integrated unit** providing **Heating, Air Conditioning** and **DHW**, based on **Carbon Dioxide** as the refrigerant, with air or water as heat source/sink
- Combining **ejectors** and **gravity evaporators** for performance improvement
- Scalable and adaptable to different load ratios and HVAC design
- **Fully instrumented** for performances monitoring

What are the MultiPACK objectives?

- **Prove** technical feasibility, reliability and serviceability
- Build up **confidence**
- **Demonstrate** energy performances in the field

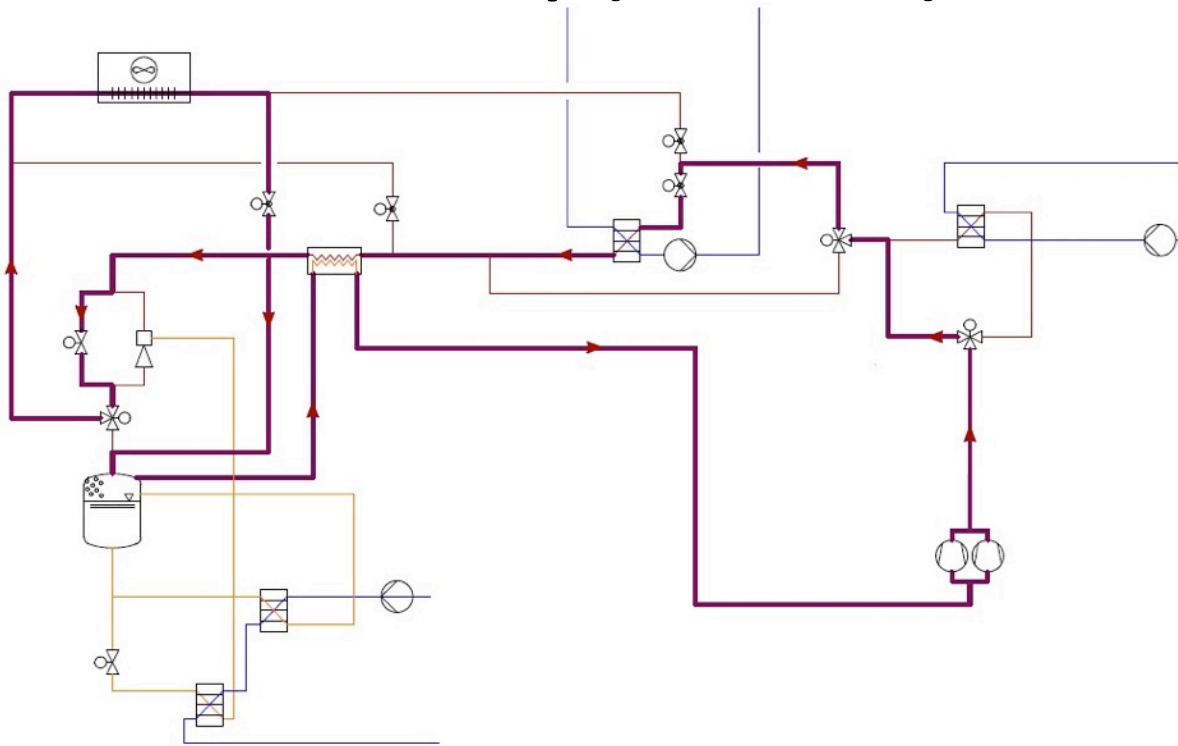


Chiller (water/air)



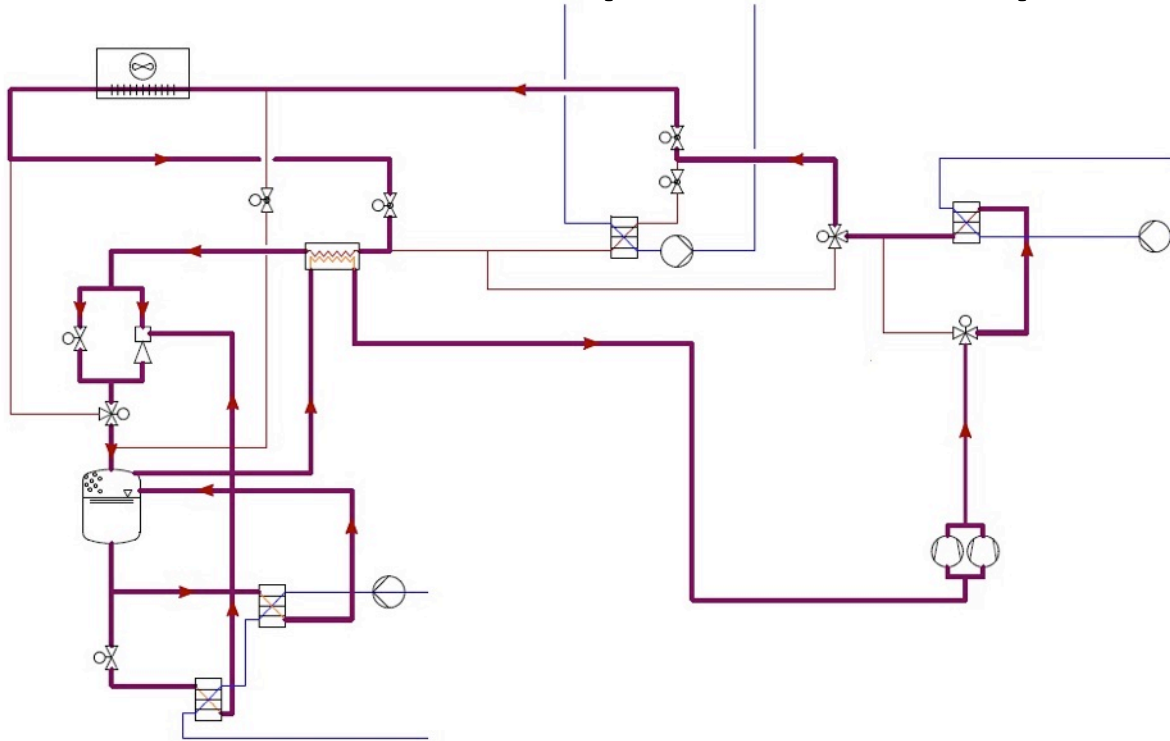


Heat Pump (air/water)





Chiller – DHW (water/water)



Unit test before commissioning



- **Fully instrumented:**
 - Temps, Pressures, Thermal Powers,
 - Electrical Power, Flow meters
- **Controlled boundaries:**
 - Water temperature and flow rate
- **Uncontrolled boundaries:**
 - Air temperature (outdoor air as heat source/sink)

Chiller – DHW

Working conditions

TEST 1

- 2 comp ON – inverter 50Hz
- High pressure: 99 bar
- Temp out GC: 38.5°C
- COP: 4.9
- Power El: 49 kW

TEST 2

- 1 comp ON
- High pressure: 94 bar
- Temp out GC: 36.5°C
- COP: 5.3
- Power el: 23 kW

Chiller Side

Tin Water	Tmid water	Tout water
14.1 °C	11.1 °C	6.8 °C
Q ev Tot	Q ev gravity	Q ev ejector
104 kW	43 kW	61 kW

Tin Water	Tmid water	Tout water
11.0 °C	9.0 °C	7.0 °C
Q ev Tot	Q ev gravity	Q ev ejector
60 kW	30 kW	30 kW

DHW side

Tin Water	Tout water
30.0 °C	60.0 °C

Q Tot
132 kW

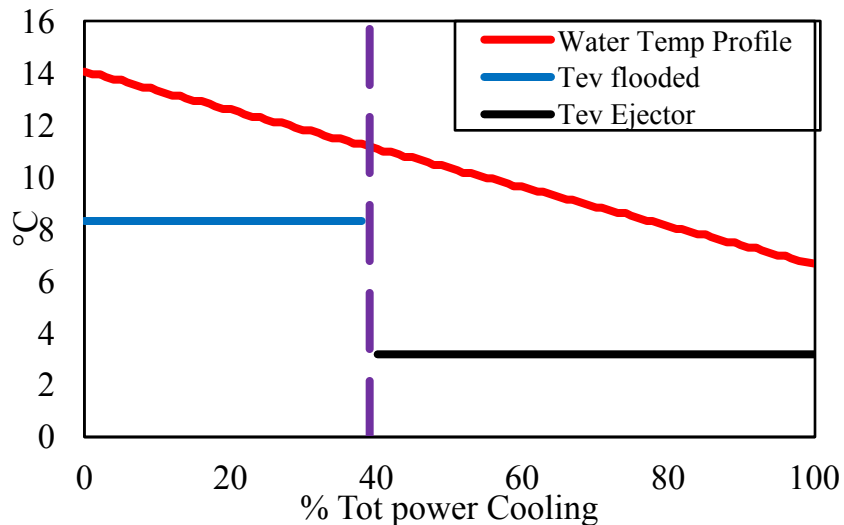
Tin Water	Tout water
30.0 °C	60.0 °C

Q Tot
67 kW



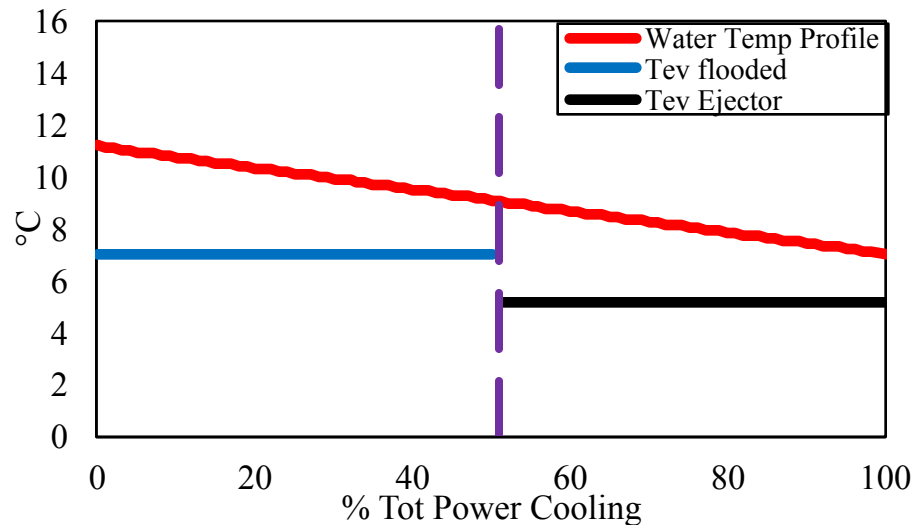
Evaporators temperature profiles

TEST 1



Estimated energy savings *: 10 %

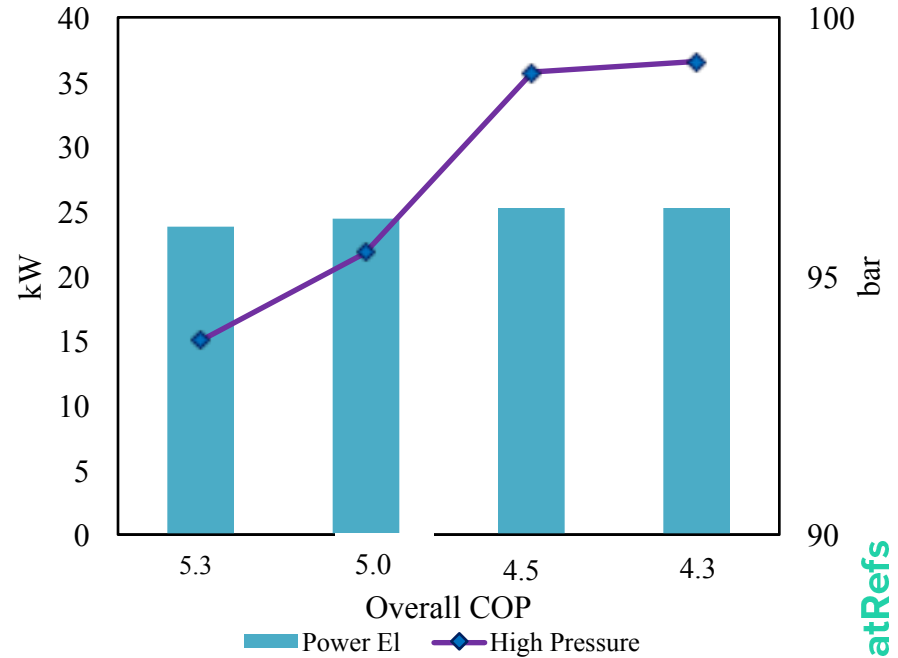
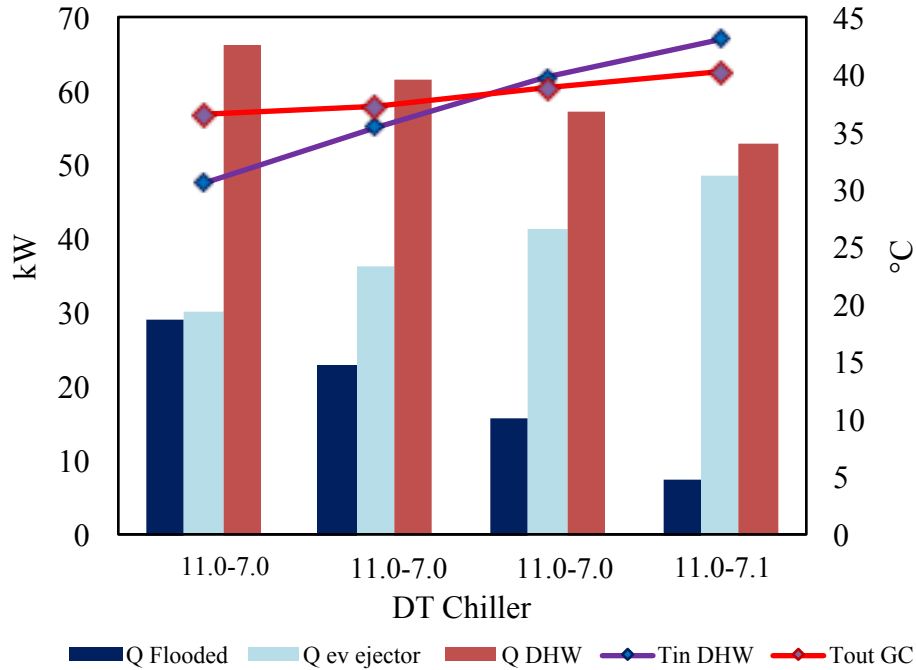
TEST 2



Estimated energy savings*: 7%

Greater benefit achievable in the case of larger water ΔT (es. process chiller)

Impact of DHW inlet temperature



MultiPACK installations

GARDA LAKE REGION

- Eco Hotel installation
- Water / water – ground water benefit
- Reversible water side
- DHW 30 kW
- Chiller 30 kW
- Heating 45 kW
- Chiller + DHW
- Heating + DHW

BOLZANO REGION

- Luxury Hotel
- Water / air
- Chiller 150 kW
- Chiller + DHW
- DHW 200 kW



Conclusions and future developments

- The design of the MultiPACK water/unit is **completely defined**;
- The **control logic** has been optimised with an extensive test campaign;
- **Tests** for performance measurements and feedbacks to the control unit are **continuing**;
- **Field data** for chiller and chiller+DHW operations will be soon available;
- **A transient numerical model** is under development and validation against experimental data;
- The model will be used for **control logic testing** and **performances prediction** under variable boundary conditions.



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Thank you
for listening!



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