



Climate change: melting glaciers, diminishing water resources, trapped sunrays increase global warming



MULTIPACK: INTEGRATED COOLING AND HEATING PACKAGES FOR COMMERCIAL AND PUBLIC BUILDINGS WITH CO₂ AS REFRIGERANT

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MULTIPACK: DEMONSTRATION OF THE NEXT GENERATION STANDARDISED INTEGRATED COOLING AND HEATING PACKAGES FOR COMMERCIAL AND PUBLIC BUILDINGS BASED ON ENVIRONMENT-FRIENDLY CARBON DIOXIDE VAPOUR COMPRESSION CYCLES

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Abstract

MultitPACK is an EU project demonstrating and building up confidence for standardised integrated cooling & heating packages installed in high energy demanding buildings. The roll-out of new energy efficient plug-and-play units should reduce the specific energy consumption by more than 25 %, simultaneously reducing the total cost of ownership. A scientific-supported introduction of innovative packages, all parts made in Europe, applying the natural working fluid CO₂ and the latest efficiency enhancing technologies will validate the suitability of the CO₂ heat pumping and refrigeration technology for warm climate applications.

The EU F-gas regulation forces the end-users to request new heat pump solutions in the near future. The upcoming process of replacing non-renewable or F-gas based heating/cooling units, especially in Southern Europe, represents the business case for the industry. Especially South-European contractors have to be further trained to become confident and motivated to offer innovative heat pumping solutions, as for example developed by MultitPACK.

SME pack manufacturers do not have the possibility to shake down new developments in a laboratory environment representing real life conditions. Therefore, MultiPACK reduces the risk and fear for the end-user accepting the installation of demonstration/validation units in their properties, solving the challenge of “innovation without risk for the end user”.

To this aim, six remotely controlled and monitored demonstration/validation sites (3/3) at several South-European locations at energy demanding end-users are utilised. The real performance of new integrated packs providing refrigeration/space cooling & heating with high levels of indoor comfort and sanitary hot water demand are measured and reported.

Training material supporting end users and contractors towards a successful implementation of integrated packs will become public via the MultitPACK communication centre.

1. Introduction

The overall aim of MultiPACK is devoted to demonstrate performance evidencing of the integrated CO₂ vapour compression packs at a commercial level through full-scale applications at the end-users in Southern Europe. Namely, the concept of multifunctional HVAC¹ & DHW² units are demonstrated for a group of various commercial and public high-energy-consumption buildings throughout Southern Europe, while refrigeration prioritized packs for supermarkets will be proven in three medium- and large-scale shops in Portugal.

2. Hvac And Dhw For High Performance Buildings

Reversible HVAC units with a DHW function containing the multi-ejector block for expansion work recovery enables four different operation modes:

- heat pump mode,
- cooling mode,
- cooling mode with hot water production, and
- prioritized hot water production.

All the modes are supported by the multi-ejector block for expansion work recovery, enabling operation in conditions of flooded evaporator, increasing not only suction pressure but also evaporation pressure, when compared to a standard CO₂ cycle. A duplicate-coil, air-supplied exterior heat exchanger, working as evaporator in the heat pump mode and as gas cooler in the cooling mode, together with a set of three-way valves enable swift reversible operation.

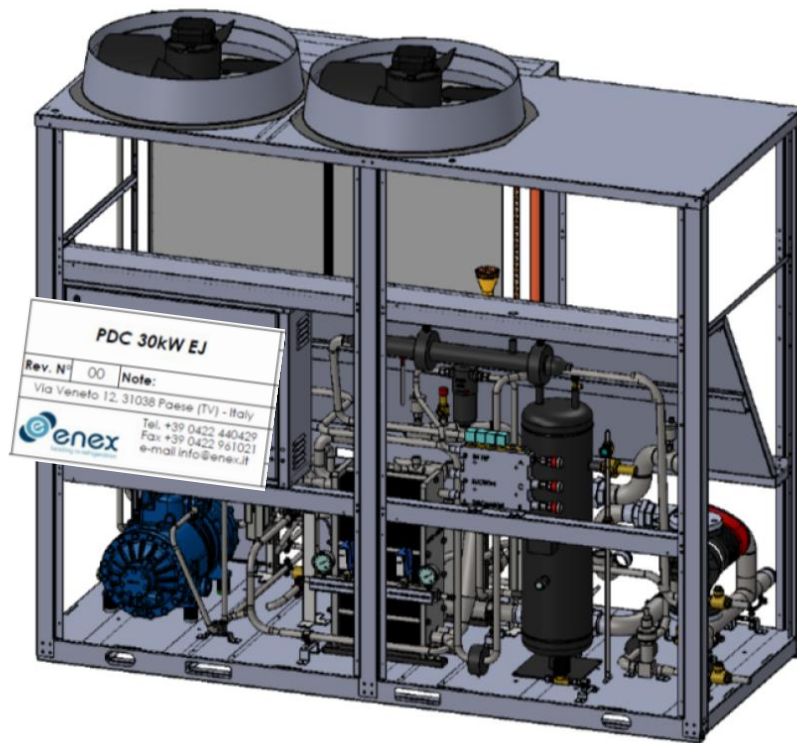


Figure 1. A prototype reversible HVAC & DHW CO₂ unit by ENEX

¹ HVAC Heating Ventilation Air Conditioning

² DHW Domestic Hot Water

3. Integrated CO₂ Packs For Supermarkets

In fully integrated CO₂ packs for supermarkets the multi-ejector expansion work recovery system substitutes for a single high-pressure valve (HPV) used in conventional booster systems to reduce high pressures below a certain level prior liquid distribution, as shown in Figure 2. From the separator tank refrigerant is metered to the individual cabinets/cold room evaporators (low temperature evaporators (LTEV) between -28 °C and -22 °C and medium temperature evaporators (MTEV) between -8 °C and -2 °C). Inside the ejector, a series of vapour ejectors are assembled in parallel. The internal geometry of each ejector can be optimized for different operating conditions governed by variable ambient temperatures.

Every ejector is individually controlled only by a single shut-off valve at the inlet to the motive nozzle and a check valve at the inlet to the suction nozzle. Thus, by controlling the number of ejectors in operation and maintaining the high side pressure level according to ambient temperature or load requirements, system operation at the maximized overall COP is possible. Additionally, an auxiliary liquid ejector (LEJ) pumps the remaining liquid not vaporized in the evaporators back to the separator tank upstream the individual evaporators. This enables the advantages of having wet evaporator outlets all year, i.e. optimum use of the effective heat transfer area, higher values of the heat transfer coefficient and simpler and more cost-effective metering valves can be applied.

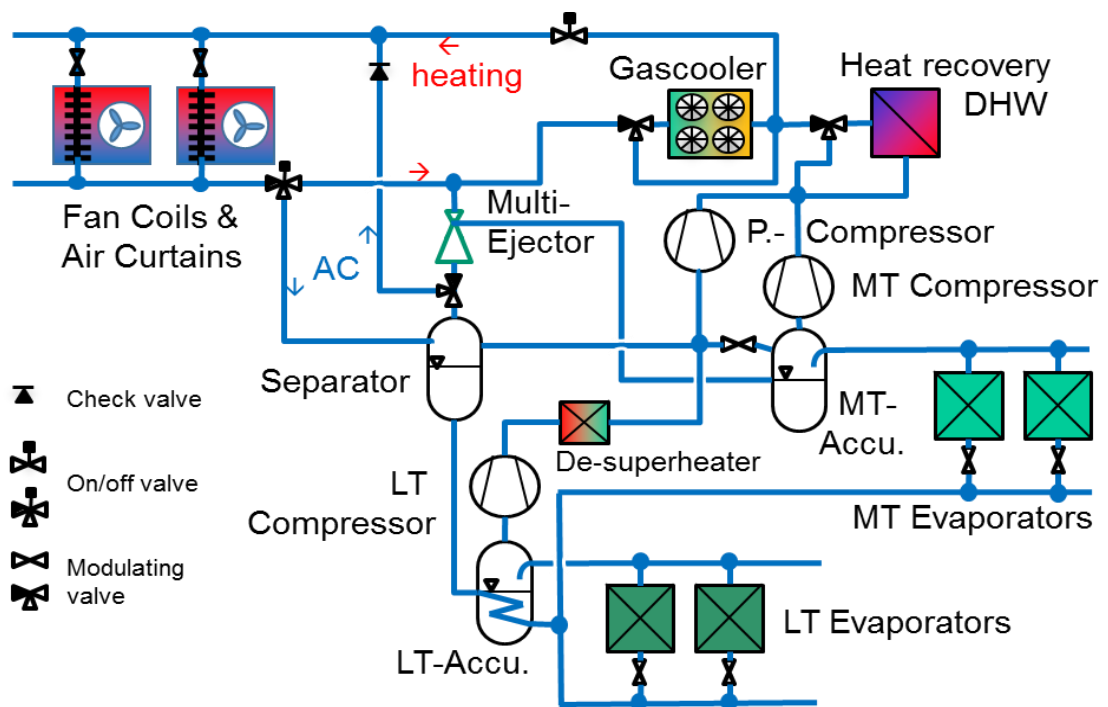


Figure 2: Example of an integration of direct heating and cooling fan coils and air curtains in CO₂ commercial refrigeration units (MultiPACK). Ejector utilised also during AC.

4. Expected Impact Of MultitPACK

- Overall improvement of environmental attitude within the refrigeration and heat pump suppliers.
- Empowerment of the European HVAC-related industry (including SMEs)
- Increasing the level of technological education and confidence of vendors

HVAC-DHW:

- availability of new unique integrated units for heating, cooling and hot water production,
- availability of modular, scalar and easily assembled (plug-and-play) units
- integrating options for energy storage

Supermarket

- demonstrating the next generation commercial refrigeration in Southern Europe
- representing and indicating the top energy level
- total compliance with F-gas and safety regulation
- establishing novel remote control for performance optimisation
- revising of technical specification (content of call for tender)

Summary

MultiPACK partners are present in all the links of the value chain from initial innovation, testing and development (primarily SINTEF, CNR and NTNU), to the producers and installers (Danfoss, ENEX) delivering to the actual users (SONAE) via contactors (RACE).

Thus needs, development, technical competence, installation and service expertise will be incorporated into the work, making the demonstrated/validated technology particularly well suited for end-users all across Europe.

MultiPACK Communication Centre: visit <http://www.ntnu.edu/multipack>



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