THE ITALIAN HVACR EXPERIENCE

A CONTRIBUTION TO ACHIEVING UN’S 17 SUSTAINABLE DEVELOPMENT GOALS

Wednesday, 6 November 2019 | 18:00 - 20:00 | Austria room
CO2 Transcritical Refrigeration Plants: Point of View of a Retailer, from Design to Maintenance

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Introduction

Who is who: Coop & INRES
Coop and environment
Coop and SDG
Who is COOP

Coop’s history dates back to 1854 when the first Cooperative store was opened in Turin to answer the growing and joint needs of workers and to “buy wholesale basic commodities such as rice, flour, pasta, soap, etc. and to resell them to members at price cost”.

1854
first cooperative store in Turin

2019
> 1,000 supermarkets
> 100 hypermarkets
The COOP System

Coop stores_multi format strategy

Coop ITALIA – National consortium for buying and marketing strategies, as well as for the development, production and control of Coop Private Label

CNNA – Non Food national consortium for non food logistics

INRES – Consulting, Engineering and Planning Services for the Design of Coop stores

SCUOLA COOP – Consortium for education and research

7
MAJOR COOPS
92% of total Coop sales

12
MEDIUM COOPS

84
SMALL COOPS

MAJOR COOPS

NOVACOOP

Coop LIGURIA

Coop LOMBARDIA

Coop ALLEANZA 3.0

Unicoop TIRRENO

Unicoop FIRENZE

Coop CENTRO ITALIA

MEDIUM COOPS

SMALL COOPS

The COOP System

Roma – MOP 31 – November 6th, 2019
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INRES Coop: CO2 Transcritical Refrigeration Plants: Point of View of a Retailer, from Design to Maintenance
INRES is the National Consortium that, within the Coop System, is responsible for architectural planning, systems and building of supermarkets, hypermarkets and shopping centers.

INRES is also responsible for store fitting-out, purchasing machinery and equipment necessary for store operations.
COOP AND THE ENVIRONMENT
COOP MISSION

To defend people’s interests, health and safety

To safeguard the environment

To promote an aware consumption

To contribute to the development of Cooperation
Coop’s environmental program

For stores, warehouses, transportation, administrative offices.

- Identifying new shopping centers respecting the territory and examining their environmental impact.
- Selecting low acoustic emission machinery and equipment.
- Privileging the use of easily recyclable material components or deriving from recycled materials.
- Taking measures regarding the cold chain to optimize performance and retrieve heat. Measures on climate control systems adapting thermal isolation through computerized management system and energy savings.
- Improving electrical systems using high performance lights and the optimum exploiting of natural lighting.
- Rationalizing warehouse management to program the flow of incoming and outgoing commodities. Increasing the use of distribution centers for reducing the use of transportation vehicles.
- Rationalizing road transportation of merchandise. Total exploiting of a truck’s loading potential for avoiding useless energy consumption and reducing air pollution.

Coop environmental policy: 2005
Each one of the Goals, account more than one action take from Coop in order to give a real contribution to their fulfilment
Just few examples...

Rain water recovery for gardening and flushing toilet
> 10 facilities
Just few examples...

> 200 PV plants
> 35 MWp
Just few examples...
Commercial refrigeration

Brief history of refrigeration in Coop
Coop experience and standards
An example of refurbishment
2015 Figures - (# 927 supermarkets)

**All Stores**
The annual refrigerant leakages are equivalent to up to 20% of energy consumption for refrigeration (effect on GWP)

**Refrigerants**
_FROM HFC TO?

- **HFC price**
- **European regulations**

**Actual need for alternative refrigerants**

Gas cost (price list)
- R448A – 91,50 €/kg
- R744 (CO2) – 9,6 €/kg

Relevant economic effect due to leakages
Refrigeration systems
Milestones toward sustainability

• In 1994 Coop realized its first refrigeration plant with secondary circuit (San Daniele of Friuli Nordest). Energy consumption is slightly higher but the environment is respected (ODP = 0) and the stability of the cabinets is greater.

• Since 1997, HCFCs have been abandoned in new systems.

• HCFCs were fully abandoned in 2009 (compared with the 2014 prohibition).

• The first system that uses CO2 as secondary refrigerant in the LT circuit dates back to 1999 (Iper Novate - Coop Lombardia); the first system that uses CO2 as primary refrigerant in the LT circuit dates back to 2003 (Iper Livorno - Unicoop Tirreno).

• First system in 2011 that use R134a in MT and CO2 in cascade LT (Conselice - Coop Adriatica).

• Coop has built in 2013 the first system that uses only transcritical CO2 as refrigerant (Monghidoro - Coop Reno).

• Coop has built in 2015 the first transcritical CO2 plant with parallel compression (Carasco - Coop Liguria).

• Coop has built in 2017 its first refrigeration plant with FTE technology. (Castenaso – Coop Alleanza 3.0)

• Coop has built in 2018 its first refrigeration plant with ejector technology. (Gravellona Toce - Novacoop)
COOP EXPERIENCES

In transcritical R744 system
Started in 2013 with the first plant.

44 Full transcritical plant installed – UPDATE October 2019 - 8 new ones coming in next months

Technology utilized:
- Parallel compression
- Sub cooler
- Heat recovery
- FTE
- Ejector
COOP standard - Transcritical CO2

Exceptions (very small plants and retrofit) - R448A
We do

- Technical specifications
- Design
- Commissioning
Most influencing variables on energy consumption:

1. Weather conditions ➔ Condensing Temperature
2. Internal Store Temperature ➔ Cabinet thermal load
3. System Set Point
4. Ratio of installed MT cooling power and LT cooling power
5. Opening hours of the store
6. Cabinet load and cold room load

These are the MAIN influencing variables but we could consider more variables.
Transcritical = NEW Technology

Technicians use working and optimal set points. Otherwise how to set? It’s new!

Proper operation of transcritical plants

Usually, CO2 Transcritical plants have better performance in comparison to older system due to a poor maintenance

Cascade = OLD Technology

Field technicians anarchy. Their Know-how leads to working but NOT optimal set points

Improper operation of cascade plant

Importance of correct operation and qualifications like UNI EN 13313 or

Fundamental for energy saving

Refrigerants

_FROM HCF TO CO2?
Refrigerants

_INFLUENCE OF SET POINTS NT

Energy consumption reduction - 6 %

Daily Energy consumption of a NT system

Variation of the evaporating set point

BLUE
Evaporating set point
-14°C

RED
Evaporating set point
-10°C
INFLUENCE OF SET POINTS LT

Daily energy consumption of LT system

Evaporating set point from -35 °C to -33°C

Energy consumption reduction

-9.2%
• Since 2005, the most stringent quality standards have been adopted to guarantee temperatures in MT refrigerated cabinets efficiently

• In 2006, the first closing frozen cabinet (Lastra a Signa Unicop Firenze, Pesaro and Bologna San Ruffillo) was made, which later became a standard.

• The first supermarket with MT refrigerated cabinets dates back to 2011 (Oderzo of Coop Nordest)

• New outlets adopt this solution in a standard way
HVAC and Food Refrigeration are designed to work in cooperative way

The power flows depend on season

Energy efficiency

INTEGRATED SOLUTIONS

Standard

HVAC

Refrigeration

Independent systems
No energy exchanges

Integrated

HVAC

Refrigeration

Integrated systems
Energy exchanges to maximise energy efficiency

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Below the solutions adopted in the Modena Canaletto retrofitting:

1. **Artificial Lighting for the mall (common areas and corridors):** new LED light fixtures with color temperature and intensity control;
2. **Natural Lighting for the supermarket:** solar tubes for the central laboratory;
3. **Coupling HVAC and Refrigeration system:** CO2 based refrigeration system for commercial refrigeration in warm climate. Plus: Mechanical free cooling strategy (using the already existing Air Handling Unit);
4. **The best vents (for air supply) and diffusers selected and applied to reduce cabinet windows mist;**
5. **Passive solutions for the supermarket:** thermo insulation of external walls and new windows with glazing: $U_g = 1.01 \text{ W/m}^2\text{K}$;
6. **Multifunctional colored paint on the roof (smart coating);**
7. **iBEMS** (hardware, software, programming, installation) for the systems of the gallery and the supermarket.

The LEAN construction management approach has not experimented during the construction phase.
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36% reduction in energy consumption

+ light & building insulation

Integrated solutions

A SIGNIFICANT EXAMPLE

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COMPARISON BETWEEN CONSUMPTION BEFORE AND AFTER THE REFURBISHMENT

Results after one year

Saving > 36%

Before and after consumption comparison for each month.
The Italian HVACR Experience: A Contribution to Achieving UN’s 17 Sustainable Development Goals (SDGs)

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