

## Demonstration project on replacement of high GWP refrigerants with trans-critical CO<sub>2</sub> for warmer climate in a mid-sized supermarket in Argentina

### Key parameters

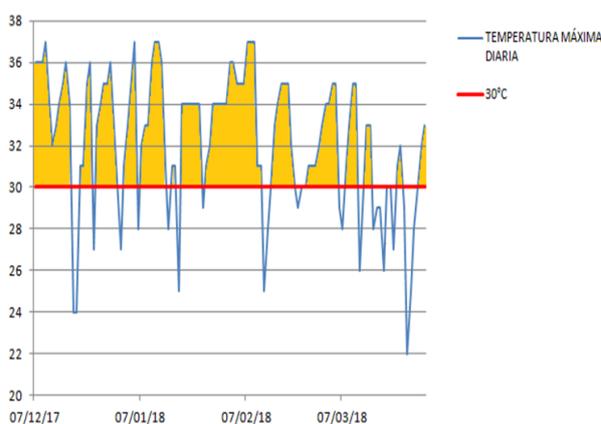
The objective of the project was to evaluate the performance and energy efficiency as well as to identify incentives and barriers related to an upgraded trans-critical CO<sub>2</sub> technology in a carefully selected representative supermarket located in moderately warm climatic conditions, by phasing out HCFCs and leapfrogging the HFC conversion step.

The project was approved by the Executive Committee of the MLF in May 2016 with a budget of U\$527,169 with UNIDO as implementing agency and an implementing period of 30 months.

To quantify the impact of the technology, the electricity consumption was continuously measured during the year prior to the start-up of the new system, and data collected was used to determine the pre-conversion baseline electrical consumption level. The measurements and data collection continued throughout one-year of post conversion period. Thus, a comparison of pre- and post-conversion energy consumption based on real data was performed.

Temperature, as well as, general climate condition information were registered for all the measuring period from the nearest meteorological station, Venado Tuerto in Santa Fe province, 174 km away from Lincoln.

It is important to note that in the summer period monitored from December 2017 to March 2018 the average maximum temperature was 32 °C, and most of the time over 30°C, as shown in the following figure.



During the implementation of the conversion process the smooth operation of the supermarket had to be maintained, thus the operation of the baseline machinery was in operation. The old machinery was dismantled and

destroyed only after successful start-up and trial runs of the new system.

### Supermarket

La Anonima, Lincoln branch, Province of Buenos Aires, Argentina, located in a moderately warm climatic zone (GPS coordinates: Latitude: -34.8637778 (34° 51' 49.6" S), Longitude: -61.528350 (61° 31' 42.062" W).

Total sales area: 1,258 m<sup>2</sup>

### The Old System

In the baseline, the supermarket had two R22 central refrigeration systems, one for low and another for medium temperature and a number of self-contained freezer units (islands and upright reach-in cabinets) working with R-404A.

### The New System

Central CO<sub>2</sub> transcritical booster system with parallel compressor and R290 subcooler.



*The CO<sub>2</sub> Transcritical Refrigeration Rack*



*R290 subcooler*



The layout of the supermarket remained similar to the baseline system.

R404A units replaced and integrated to the central system.

**Cooling Capacity:** MT 69Kw  
LT 10Kw

**Compressors:** Bitzer

- 2 x 2KSL-1K (LT)
- 1 x 4FTC-20K (MT1)+1 x 4HTC-15K (MT2)
- 1 x 4JTC-15K (PARALLEL)

• **Gas cooler:** LU-VE XAV9X 9912 H 2VENT (1X2) - CO2  
- EC fans

• **Controller:** Carel pRack PR300T

**Energy saving devices:**

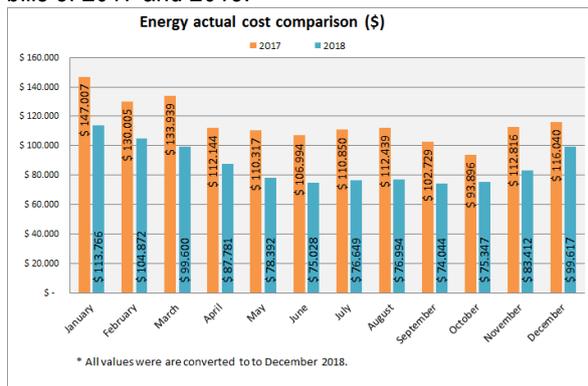
- Parallel compressors
- Inverter on: - 1° MT compressor  
- 1° LT compressor  
- 1° parallel compressor
- Subcooler Heat Plate Exchanger that work with a R290 chiller EKO.E 91S

**Design conditions:**

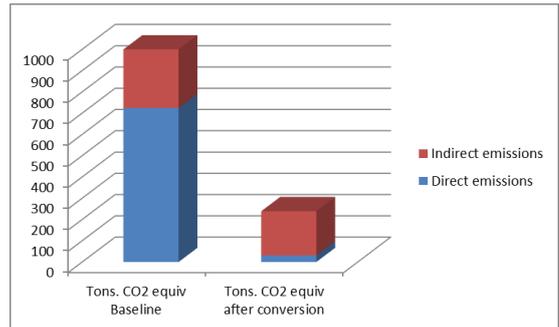
- Evaporating temperature LT: -32 °C
- Evaporating temperature MT: -9°C
- Maximum pressures:
  - HP 120 bar
  - MP 53 bar
  - LP 30 bar

**Current results**

- During the trial period the electricity consumption of the CO2 transcritical system was 28,8% lower compared to the baseline.
- The electricity bills showed a 27% reduction in total branch electricity consumption and a year saving of pesos \$343.673 (U\$S 9,200). The following graph shows energy cost comparison based on electricity bills of 2017 and 2018:



- The average annual consumption of refrigerants at Lincoln La Anonima supermarket amounted to some 300 kg with a refrigerant cost of U\$S 5,700.
- The total reduction of climate impact per year after the conversion is of approximately 760 metric tons CO<sub>2</sub> equivalent. For illustration, this number is equivalent to the annual CO<sub>2</sub> release of approx. 340 passenger cars running 15,000 km in a year! (A currently used mid-size car releases 150 - 180 g CO<sub>2</sub> per km.)



**Replicability**

At the time the project was formulated, there was only one supermarket in Argentina using a transcritical CO<sub>2</sub> centralized refrigeration system in Caleta Olivia, Province of Santa Cruz at the south of Argentina (Patagonia region), a location with a very cold climate condition.

Based on the good results obtained in the project, the recipient company La Anónima, has adopted transcritical CO<sub>2</sub> as the default technology for its new branches as well as for updating or refurbishing of current ones, whenever it is feasible.

The project helped to create confidence in the technology. It demonstrated its feasibility, removed many barriers and accelerated the adoption of this technology even for warmer climate zones of our country (e.g. Córdoba, Santa Fe, Salta and Tucuman). The number of supermarkets using CO<sub>2</sub> transcritical systems in Argentina increased to a total of 13 belonging to seven different supermarket chains.

At regional level, the same vendor has installed 3 more systems in Chile and 9 in Ecuador from 2017 up to now.