Demonstration project on replacement of high GWP refrigerants with trans-critical CO2 for warmer climate in a mid-sized supermarket

41st. OEWG, Bangkok
04 July 2019
Supermarket sector in Argentina

![Bar chart showing growth in supermarkets from 2010 to 2016](chart_image.png)

- Wholesalers
- Supermarkets (2-80 points)
- Argentine One point
- Hypermarkets (>80 points)
- Chinese One Point
Objective

- To evaluate the performance and energy efficiency of an upgraded trans-critical CO₂ technology in moderately warm climatic conditions and

- Identify incentives and barriers by phasing out HCFCs while leapfrogging the HFC conversion step.
The project was approved by the Executive Committee of the MLF in May 2016

- Budget of U$S 527,169
- UNIDO as implementing agency
- Implementation period of 30 months.
Methodology

- Electricity consumption was continuously measured during one year prior to the start up in order to determine the pre-conversion baseline level.

- The measurements and data collection continued during one-year after the installation of the new system.

- Thus, it was possible to compare the pre- and post-conversion energy consumption using real data.

- Temperature, as well as general climate condition information were registered from the nearest meteorological station.
In order to identify barriers and address the long term sustainability, following aspects were assessed:

- Technical viability
- Costs implications
- Environmental benefits
- Impact on energy consumption
- Availability of components
- Installer and service sector skill requirements
- Other possible advantages and disadvantages

These factors were considered to be important to assess the opportunities for replication at country, regional and/or global level.
Average Maximum Temperature during summer period
December 2017 to March 2018
<table>
<thead>
<tr>
<th>The Old System</th>
<th>The New System</th>
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</thead>
<tbody>
<tr>
<td>• two R22 central refrigeration systems, one for low and another for medium</td>
<td>• Central CO₂ transcritical booster system with parallel compressor and R290</td>
</tr>
<tr>
<td>temperature, and</td>
<td>subcooler, and</td>
</tr>
<tr>
<td>• a number of self-contained freezer units (islands and upright reach-in</td>
<td>• Stand alone units were replaced and integrated to the central system</td>
</tr>
<tr>
<td>cabinets) working with R-404A.</td>
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Results

- During the trial period the electricity consumption of the CO2 transcritical system was **28.8%** lower compared to the baseline.

- Weekly electricity consumption of the new CO$_2$ transcritical system compared to the baseline registered during the test period:
Results

- The total reduction of climate impact per year was of approximately 760 metric tons CO₂ equivalent. This is equivalent to the annual CO₂ release of approx. 340 passenger cars running 15,000 km in a year!
Economical and technical incentives and barriers

- Initial cost of a TC CO₂ system used to be higher than an HFC system but the price is decreasing due to the standardization. Difference in price is around 20% in Latin American Region.

- Cost of installation of CO₂ system is still very high in Argentina due to that TIG brazing is made by specialized companies so the price is much higher than standard brazing.

- If leaks would occur in the future, the recharge would be done at a low price due to the much lower price of CO₂ compared to the current prices of synthetic refrigerants.
Economical and technical incentives and barriers

- CO₂ with 20 ppm humidity is available in Argentina, as well as R-290.

- Frequency of preventive maintenance is similar to HCFC/HFC systems and the only need is the adequate training of the service staff.

- CO₂ central system as well as evaporators and subcooler were manufactured in Italy. The size of the market is still not sufficient for manufacturing it locally.
Economical and technical incentives and barriers

- CO$_2$ with 20 ppm humidity is available in Argentina, as well as R-290.

- Frequency of preventive maintenance is similar to HCFC/HFC systems and the only need is the adequate training of the service staff.

- CO$_2$ central system as well as evaporators and subcooler were manufactured in Italy. The size of the market is still not sufficient for manufacturing it locally.
Economical and technical incentives and barriers

- Compressors were manufactured by Bitzer.

- Exhibitors are manufactured locally by EPTA

- Carel control systems for CO₂ transcritical installations are manufactured in Italy.

- Most electrical components are available locally but some cables as well as special connectors are imported.
Replicability

- The recipient company is adopting since then TC CO2 as the default technology for its new or refurbished branches.

- 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 climatic zones (e.g. Córdoba, Santa Fe, Salta and Tucuman provinces)

- The number of supermarkets using TC CO2 systems in Argentina increased from 1 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
Refrigerants were recovered and sent to Reclaiming center