Transcritical CO$_2$ in Supermarkets in Chile

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Bangkok, Thailand, July 13$^{th}$ 2017
• General background.
• Main achievements: removing barriers.
• A Closer look to the project: Lift-off for transcritical CO$_2$ in Chile.
GENERAL BACKGROUND
• **Project’s objective:** Strengthening technical capacity for the adoption of transcritical CO₂ refrigeration system as alternatives to HFCs in the supermarket sector in Chile.

• **Deliverables**
  - Road-map on requirements to adopt the transcritical CO₂ refrigeration technology in Chile.
  - Refrigeration system based on transcritical CO₂ technology installed and in operation.
  - Energy efficiency assessment of the transcritical CO₂ system installed.
  - Training and awareness campaign report.
• Project started on October 2014.

• Budget: US$ 482,790.

• Main counterparts:
  • Ministry of Environment of Chile.
  • Supermarkets companies.
  • Chilean Association of Supermarkets.
  • Chilean Chamber of Refrigeration.
  • Refrigeration system designers/installers.
National context:

• Limited experience on the use of CO$_2$.

• No experience on transcritical CO$_2$.

• Heavy dependence on HFC-based refrigerants in the supermarket sector.

• Sector is dominated by four large chains: Wal-Mart (through the brand *Líder*), Cencosud, Tottus, SMU. Representing **90% of the sector**.
Project’s components:

1. Assessment
2. Training
3. Installation
4. Validation
5. Dissemination
Removing barriers

MAIN ACHIEVEMENTS
Main achievements

- Assessment of national needs to adopt transcritical CO₂ refrigeration systems conducted.

<table>
<thead>
<tr>
<th>Identified need</th>
<th>Project’s answer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Financial Support.</td>
<td>Seed capital to cover incremental cost given to one Company for its first facility with TC CO₂.</td>
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<td>Knowlegde of succesful experience</td>
<td>International experts invited, 2 workshops conducted.</td>
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<td>Training on the use of the technology</td>
<td>Detail training course to trainers, technical personal from supermarkets and local experts.</td>
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<tr>
<td>Lack of equipment availability</td>
<td>Facilitation of meetings between providers and supermarkets.</td>
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</table>
Main achievements

• Training on transcritical CO$_2$ refrigeration systems.
  
  – International experts from Canada and UK shared their experiences on the use of TC CO$_2$ in the supermarket sector through workshops in 2015 and 2016, respectively.
  
  – Detail study tour to Italy for 11 persons (4 senior engineers from supermarkets, 4 trainers from universities and training institutions and 3 local refrigeration experts).
  
  – Participation on technical congress in Brazil (Febrava/Conbrava 2015) of 2 local refrigeration experts. Discussion with technology providers.
- Transcritical CO\textsubscript{2} refrigeration systems designed and installed.
  - Project supported \textbf{Cencosud} in the construction of 1 supermarket using TC CO\textsubscript{2}.
  - Built in Valdivia (848 km South of Santiago).
• Cencosud adopted transcritical CO$_2$ as the default technology for its future supermakets.

• It will also use this technology for update/refurbish current supermarkets, when feasible.

• The project was **fundamental** for the adoption of transcritical CO$_2$ in Chile, it helped to create confidence in the technology, remove barriers and accelerated its adoption.
Lift-off for transcritical CO\textsubscript{2} in Chile

A CLOSER LOOK TO THE PROJECT
Temperature: Max, Min, Average.
A fast track Project:

<table>
<thead>
<tr>
<th>Milestone</th>
<th>Day</th>
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<tbody>
<tr>
<td>CCAC/UNDP/NOU co-funding award</td>
<td>1</td>
</tr>
<tr>
<td>Begining of installation in the supermarket site</td>
<td>60</td>
</tr>
<tr>
<td>Refrigeration equipment on job site.</td>
<td>105</td>
</tr>
<tr>
<td>Equipment installation ending on</td>
<td>165</td>
</tr>
<tr>
<td>Start up and commissioning on</td>
<td>170</td>
</tr>
<tr>
<td>Store opening to the public</td>
<td>181</td>
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</table>
Some project’s milestones

Day 1: CCAC/UNDP/NOU co-funding award.

Day 60: Beginning of installation in the supermarket site
Day 75: Basement piping layout and installation.

Day 105: Gas Cooler positioning.
Day 140: Piping connection to Refrigeration Rack.

Day 162: Final assembly and commissioning of cases.
Day 170: TC CO₂ start-up and commissioning.
Day 181: Grand opening!
• Which were the main technical, financial and political challenges and risks faced by the Project? How were they solved?

<table>
<thead>
<tr>
<th>Challenges</th>
<th>Solutions</th>
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</thead>
<tbody>
<tr>
<td>Develop local installation and service skills</td>
<td>• 2,000 hours of engineering and technicians training on SC and TC CO2. 10,000 hours of accumulated of SC Installation.</td>
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<tr>
<td>Challenges</td>
<td>Solutions</td>
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<tr>
<td>------------------------------------------------</td>
<td>--------------------------------------------------------------------------------------------</td>
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<tr>
<td>Successful commissioning and start-up and reliable operation in time</td>
<td>• 2 full time supervisor coming from Europe with large experience on TC CO₂ Systems.</td>
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<td></td>
<td>• European supervisors guiding, auditing, installation, programming of systems during start-up and commissioning.</td>
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<td></td>
<td>• 3 months after opening, visit to the store with local technicians to perform fine tuning and check up all refrigeration systems.</td>
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<td>• 7/24 remote surveillance and remote monitoring.</td>
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<td></td>
<td>• 3 years maintenance contract with installation Company.</td>
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</table>
Supply highly reliable, engineering, equipment and components.

- Only world class equipment suppliers, with more than 10 years of experience and over 1,000 TC CO₂ equipment supplied.
- Proven component suppliers, with support from their head office in Europe, to make them locally available in Chile.
- Engineering standards collected from different leading retailers in Europe.
- Definition of Booster TC CO₂ system that is ideal for climate conditions where the store is located, and is also the most installed and used option in Europe.
- “Over Engineered” Refrigeration racks and safety system to minimize human mistakes.
Challenges

Cost of the first TC CO₂ was 30% higher than a standard HFC system.

Solutions

• CCAC funding reduced the cost gap from 30% to less than 20%.

Cost of equipment becoming comparable to systems using HFCs

Prices are falling as technology reaches mass production (in commercial refrigeration same as HFC technology or 5-10%)

Cencosud project economic and technical conditions.
<table>
<thead>
<tr>
<th>Risk</th>
<th>Solutions</th>
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</thead>
<tbody>
<tr>
<td>Mid-management afraid to lose job and credibility with in the Company.</td>
<td>• High management was involved on the decision, the sponsorship of UNDP/NOU supporting the technology and co-financing helped to convince them.</td>
</tr>
<tr>
<td>Risk of delaying significantly the opening of the store, with a cost of image, market share lost, financial cost (US$ 40,000/day).</td>
<td>• Installation technicians, were increased in number and supervision, the store opened on the established date.</td>
</tr>
<tr>
<td>Lack of recognition outside and inside the company.</td>
<td>• UNDP/NOU publicly awarded the Company; the high management was well evaluated by the board of directors.</td>
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Present and Future opportunities for TC CO2 v/s HFC

The results of the project...

– 10-15% more energy efficient than HFC equivalent.
– 4,000 times fewer CO₂ emissions compared to HFC.

... opened the door for future ventures:

– 3 new TC CO₂ Projects approved, they should be operative by the end of the year 2017 and beginning of 2018.
– Average over cost compared to HFC solution, reduced from 30% to 15-18%. Further reduction in cost gap can be achieved with volume increase.
– 4 New additional TC CO₂ Projects with engineering process under development.
– By the end of 2018, 9 TC CO₂ projects should be operative, increasing by 400% the number of TC CO₂ systems in operation in 2 years.
Recommendations from the technical point of view

- To keep this trend is advisable to develop incentives to adopt this technology and to have in the local rules and standards a clear face out program with economic disincentives for companies that will continue using HFC Refrigerants.

- It is important to maintain and increase the formation of technical capacities on this technologies. As it will be fundamental to support the high growth of new TC CO\textsubscript{2} systems being installed in the next 24 months.
THANK YOU!