

# Sobeys' Natural Transition to CO<sub>2</sub>

FMI – Energy and Store Design

Atlanta, September 21st, 2011



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- 7-minute video.
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# Who is Sobeys?



- Founded in 1907.
- Wholly-owned subsidiary of Empire Company Limited.
- Canadian company.
- Headquarters in Stellarton, Nova Scotia & Toronto.
- Annual sales over 15 B\$.
- More than 1300 stores in 10 provinces.
- Atlantic, Québec, Ontario, West.
- 800 communities across Canada.
- 85,000 employees.
- Corporate and franchisees operations.
- Full services, fresh services, community services, convenience, discount, drug, others...

# The various banners



FRESH CO.



THRIFTY  
FOODS™

FOODLAND

Sobeys

IGA

MARCHE  
BONICHOIX

Lawtons  
DRUGS



Needs convenience



TRA  
ATLANTIC



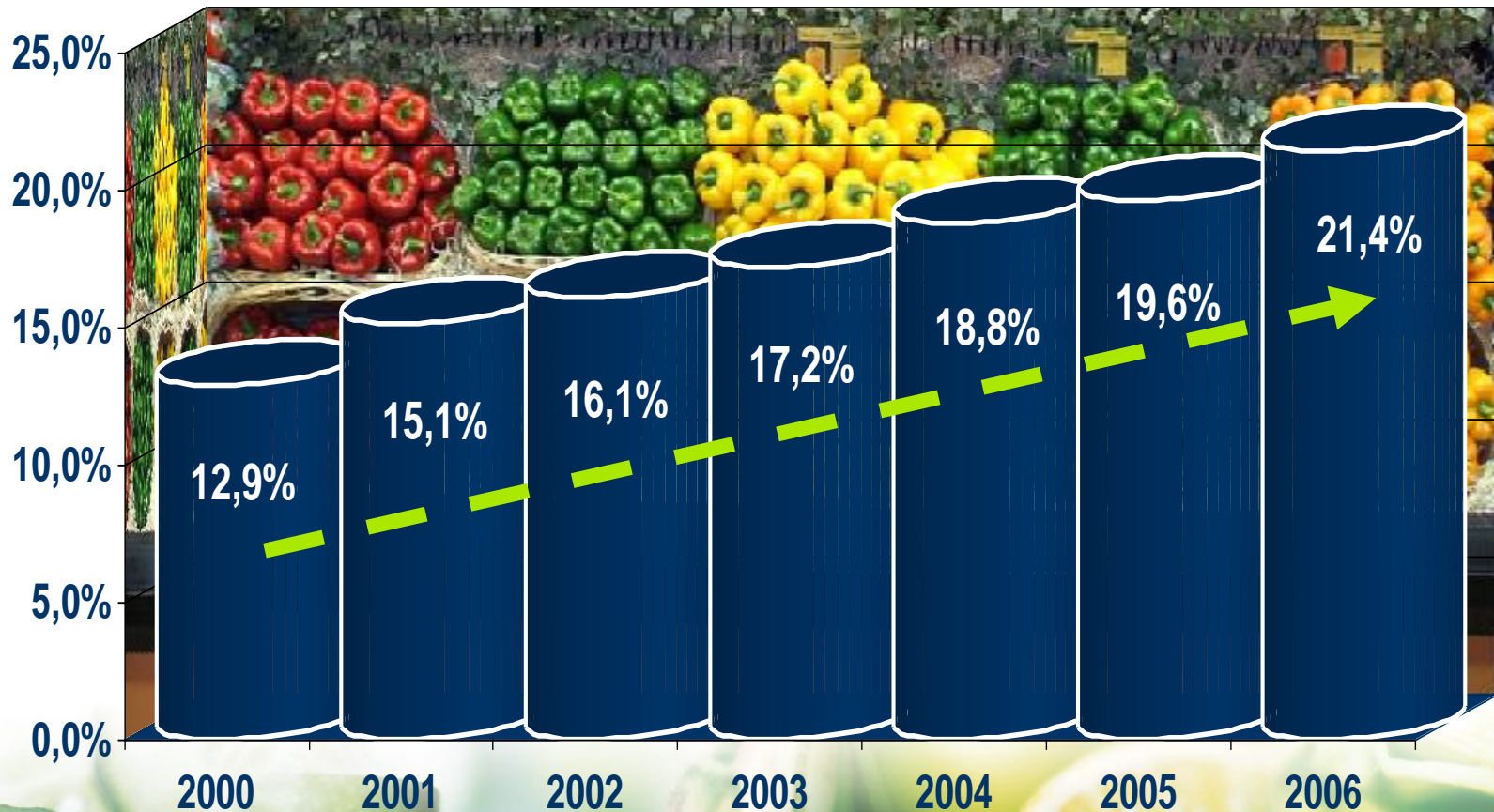
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# Sobeys Quebec in a nut shell...



- **IGA** & **IGA** extra No.1 banner in Québec.
- 260 stores, mostly franchisees .
- +250 major projects over the last decade.
- \$200 M, capital growth investment per year.
- A peak of 28 projects under construction at the same time.
- A record of 12 openings in a month.
- First LEED certified supermarket in Canada.
- First Gold certified refrigerated warehouse in Canada.
- « Most active company in Canada » as per the NRCAN.
- Many active R&D projects with various partners.

# Market shares IGA



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# 30 bronze plates....

**Programme  
d'encouragement  
pour les bâtiments  
commerciaux**



**Commercial  
Building  
Incentive  
Program**

**En reconnaissance  
d'une conception de bâtiment  
éconergétique visant à réduire  
les gaz à effet de serre**

**In recognition of an  
energy-efficient building  
design aimed at reducing  
greenhouse gas emissions**



**Ressources naturelles  
Canada**

**Natural Resources  
Canada**

**Canada **

# IGA St-Pascal de Kamouraska













# 7-MINUTE VIDEO

# Refrigerant leaks.

- In North America, 30% of the refrigerants are lost every year in the atmosphere.
- Actually, on the lifecycle of a refrigerant, we have to realize that it is 99%....
- 1000 pounds = 400 cars on the road for 1 year
- Tolerance 0 for the leaks...

# CFC phase-out (R22)

- Montreal protocol in 1989.
- Gradual phase-out of the CFC.
- Expectation is that by 2014 demand > availability.
- Cost of R22 will increase...
- Drop-in or replacement gas?

# What has been done?

- 2004, R22 + Heat reclaim with gaz...
- 2005, R22 + Glycol heat reclaim.
- 2006, R134 + Turbocor + Glycol heat Reclaim
- 2006-07, Phase-out of freon in all our distribution centers.
- 2007, R507 + Glycol heat reclaim.
- 2007, Australia trip (Norway, South Africa, Russia)
- 2008, Trois-Rivières project.
- 2008, Canmet (NRCan) meeting.
- 2008, The vision... And we will achieve it.....
- 2008, 9 suppliers, 5 invited, 2 official proposals.



# What has been done?

- 2008-09 Negotiation with the AEE for subsidies.
- 2008-09 2 R&D Laboratories.
- May 09 Nicolet.
- June 09 First CO<sub>2</sub> sub critical project
- July 09 First CO<sub>2</sub> trans critical project
- Oct 09 Visit to UK, France, China (we're ahead...)
- Nov 09 Third supplier is on board
- Jan 10 Technology Award, 1st place in North America.
- Feb 10 First project delivered that meets the vision!!!!
- Oct 10 CGF in Chicago.
- Nov 10 Cancun Summit.
- Sept 11 CGF in Atlanta.

# The vision.

- Smaller system.
- Simpler system.
- Lower energy consumption system.
- Lower initial cost.
- Lower maintenance cost.
- No HFC.
- Retrofit kit for convenience stores.
- System that will be installed coast to coast.



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# Contents of the Presentation



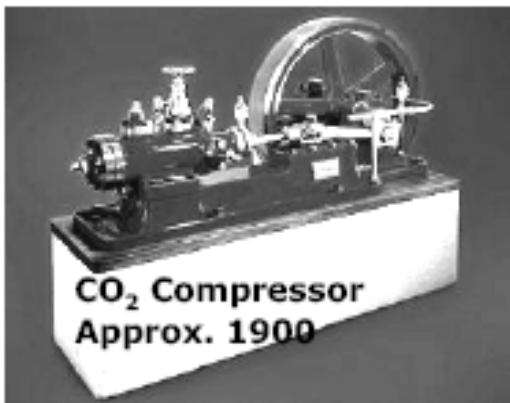
The Greenest way to preserve and save

- History
- CO<sub>2</sub> refrigeration systems
  - Cascade
  - Transcritical
- Challenges
- Applications in North America



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## CO<sub>2</sub> utilized as refrigerant in sub- and supercritical refrigeration systems



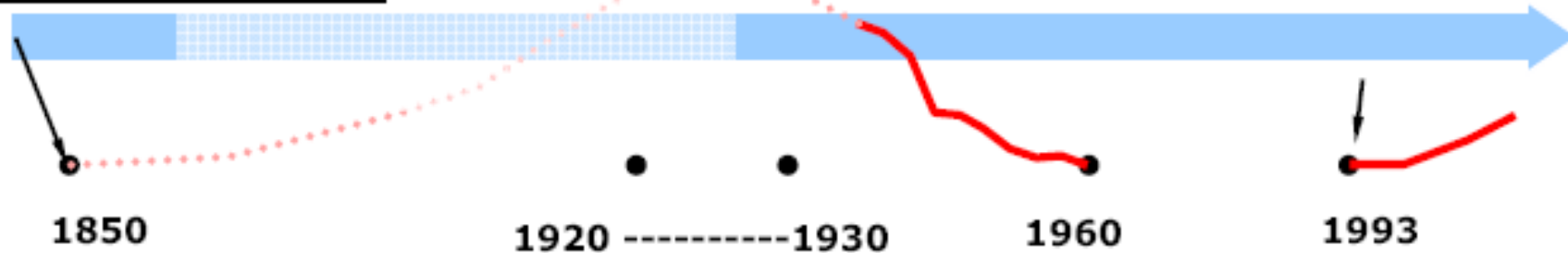
CO<sub>2</sub> Compressor  
Approx. 1900



Reinvention of CO<sub>2</sub>-refrigeration technology (G. Lorentzen)

Proposal to use CO<sub>2</sub> as a refrigerant (Alexander Twining, British patent)

The peak of utilizing CO<sub>2</sub> as refrigerant





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# History



The Greenest way to preserve and save

Wisconsin, 1934



Eco<sub>2</sub>-System<sup>®</sup>  
Evolution, Innovation, Progress

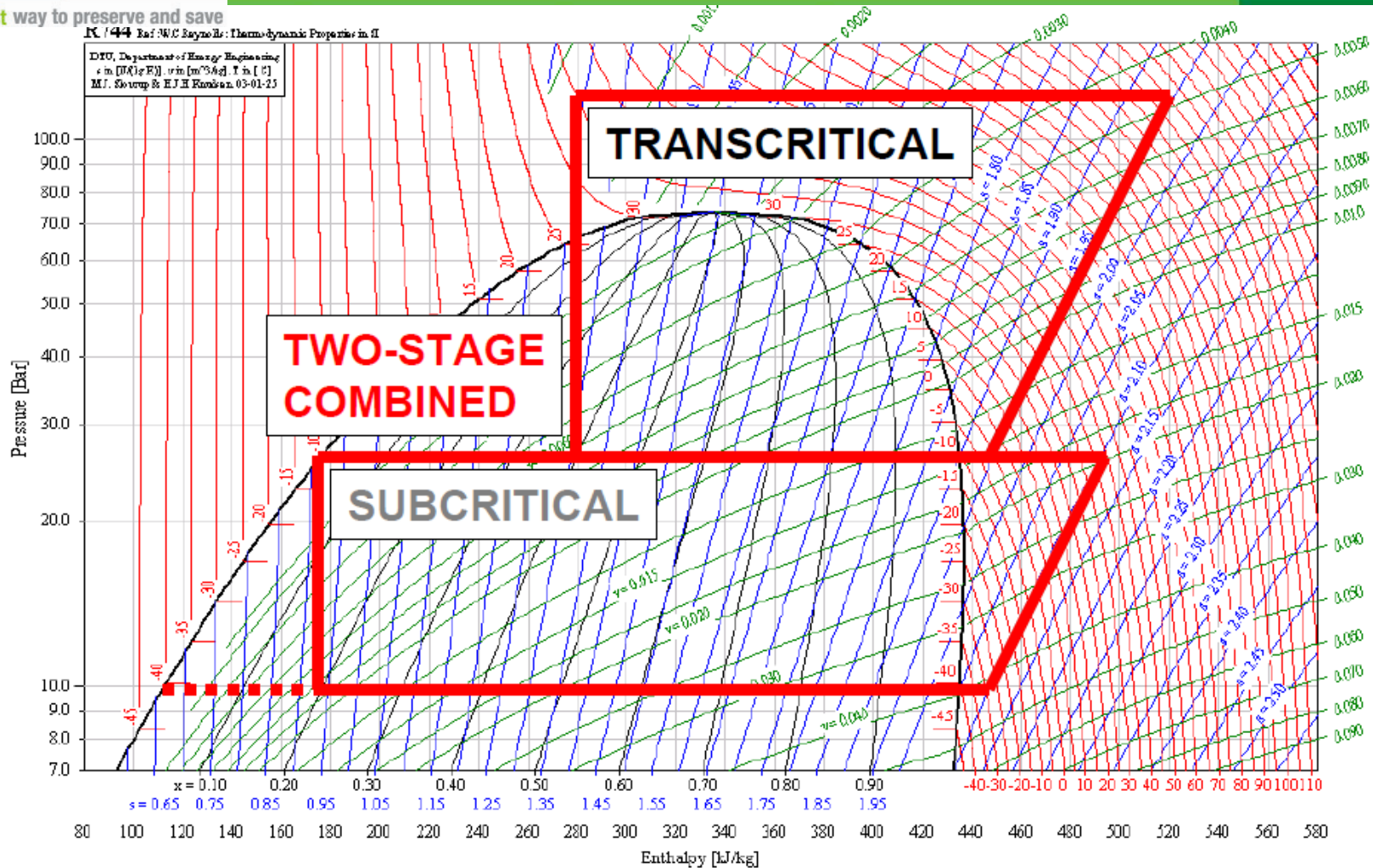


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- CO<sub>2</sub> difference with other refrigerants:
  - Critical point at lower temperature
  - Below critical point : liquid and vapor regions are separated by the saturation curve
  - Over critical point: there is no difference between liquid and vapor
  - Concept of transcritical vs sub-critical

| Refrigerant            | R404a   | NH3      | CO <sub>2</sub> |
|------------------------|---------|----------|-----------------|
| Critical point (psi/F) | 542/162 | 1640/270 | 1067/88         |

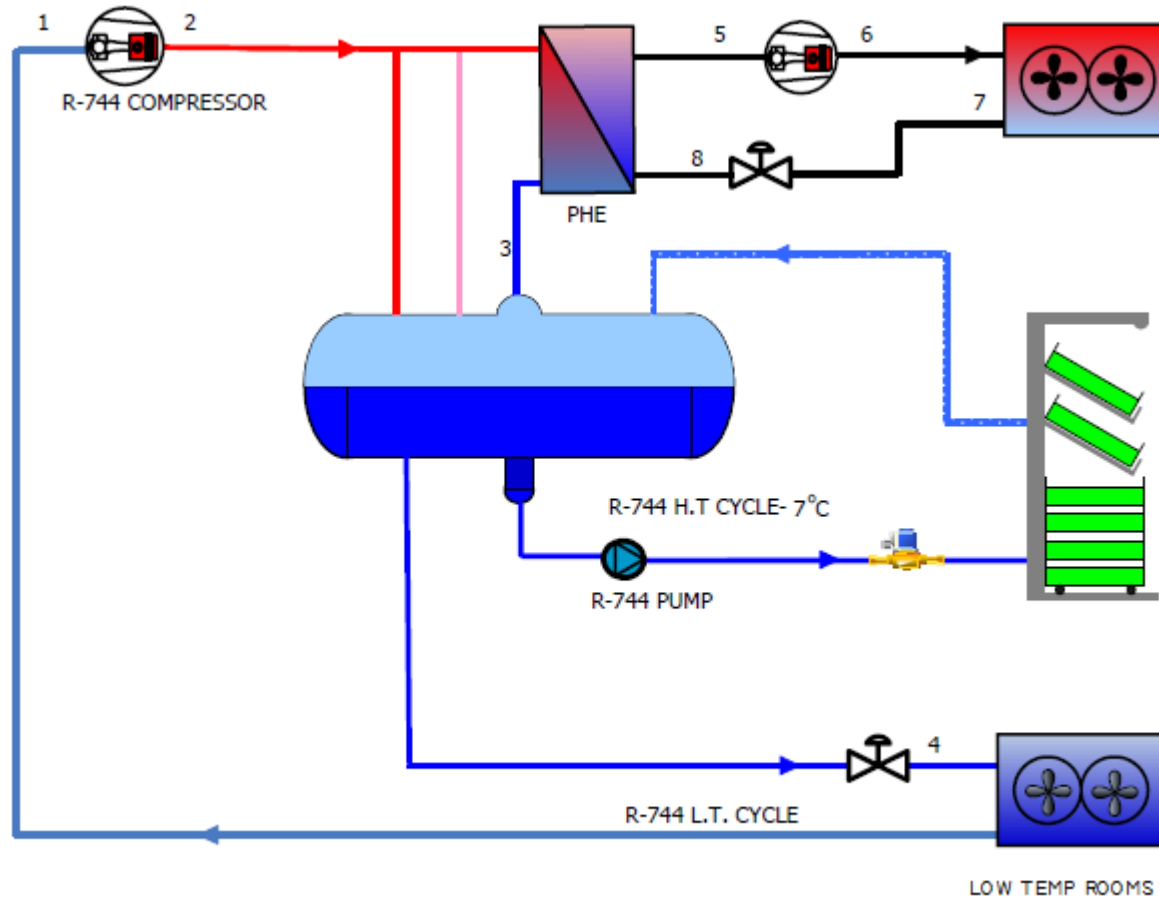
The Greenest way to preserve and save



- Sub-Critical applications : Cascade
  - CO<sub>2</sub> is used as a secondary refrigerant
  - Many versions:
    - LT DX CO<sub>2</sub>, MT pumped glycol
    - LT DX CO<sub>2</sub>, MT pumped CO<sub>2</sub>
    - LT pumped CO<sub>2</sub>
  - Common fact: all sub-critical applications need another refrigeration system to maintain CO<sub>2</sub> at low pressure / temperature:
    - R404a
    - R134a
    - NH<sub>3</sub>
    - Etc...



Sub-critical:

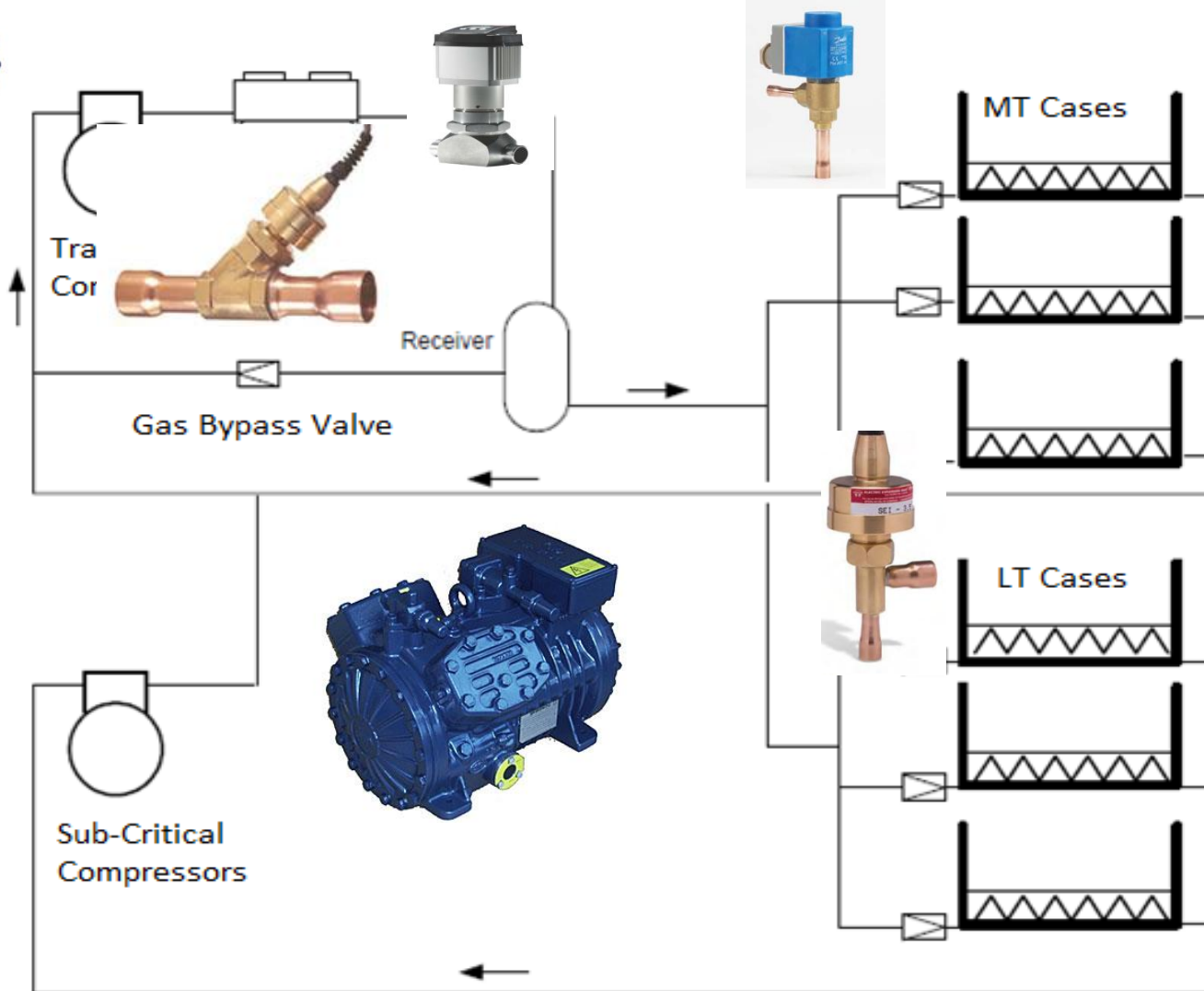


The **Greenest** way to preserve and save

Sub-critical:

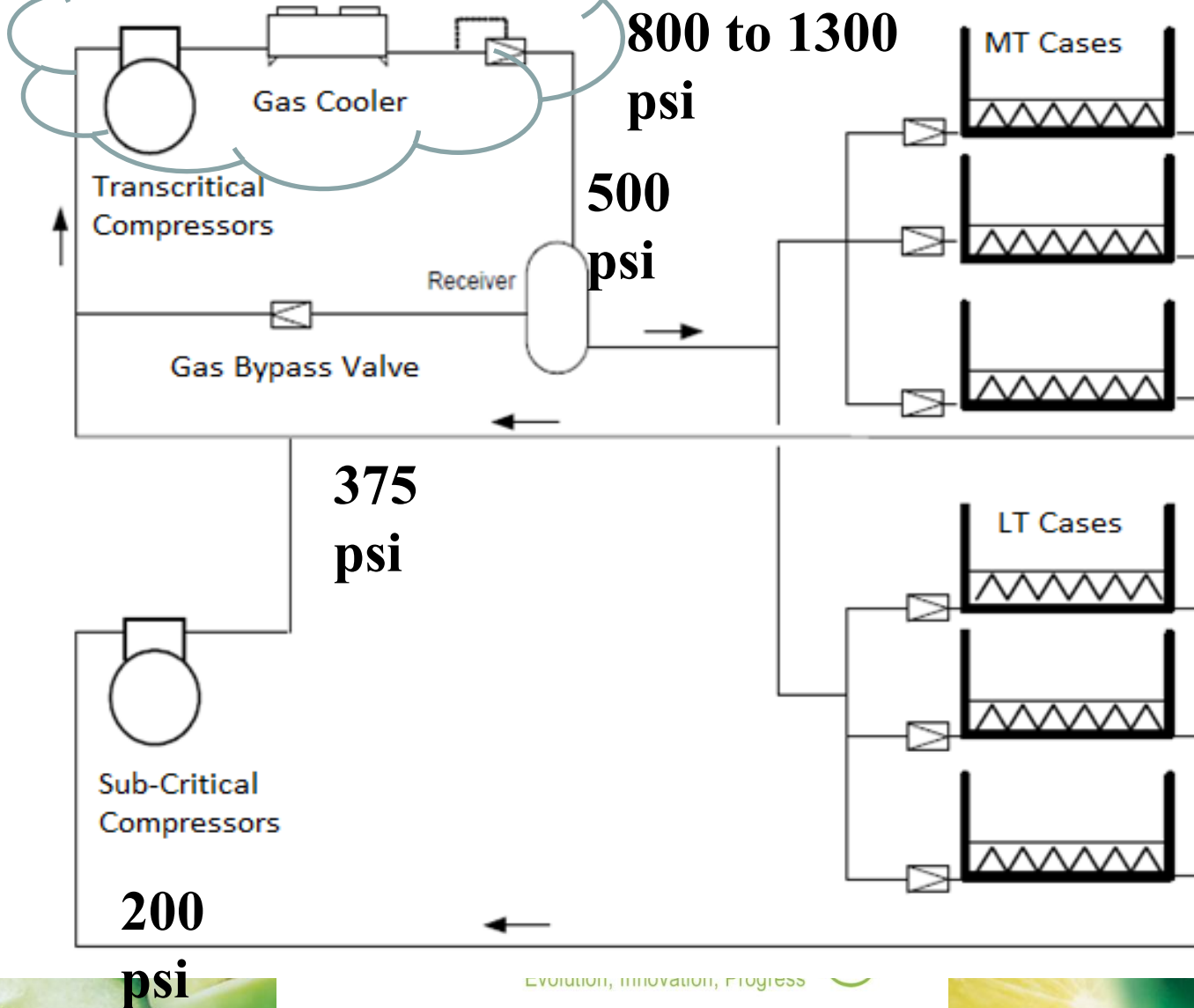


## Transcritical Booster with Gas Bypass:



The Greenest way to preserve and save

## Transcritical Booster with Gas





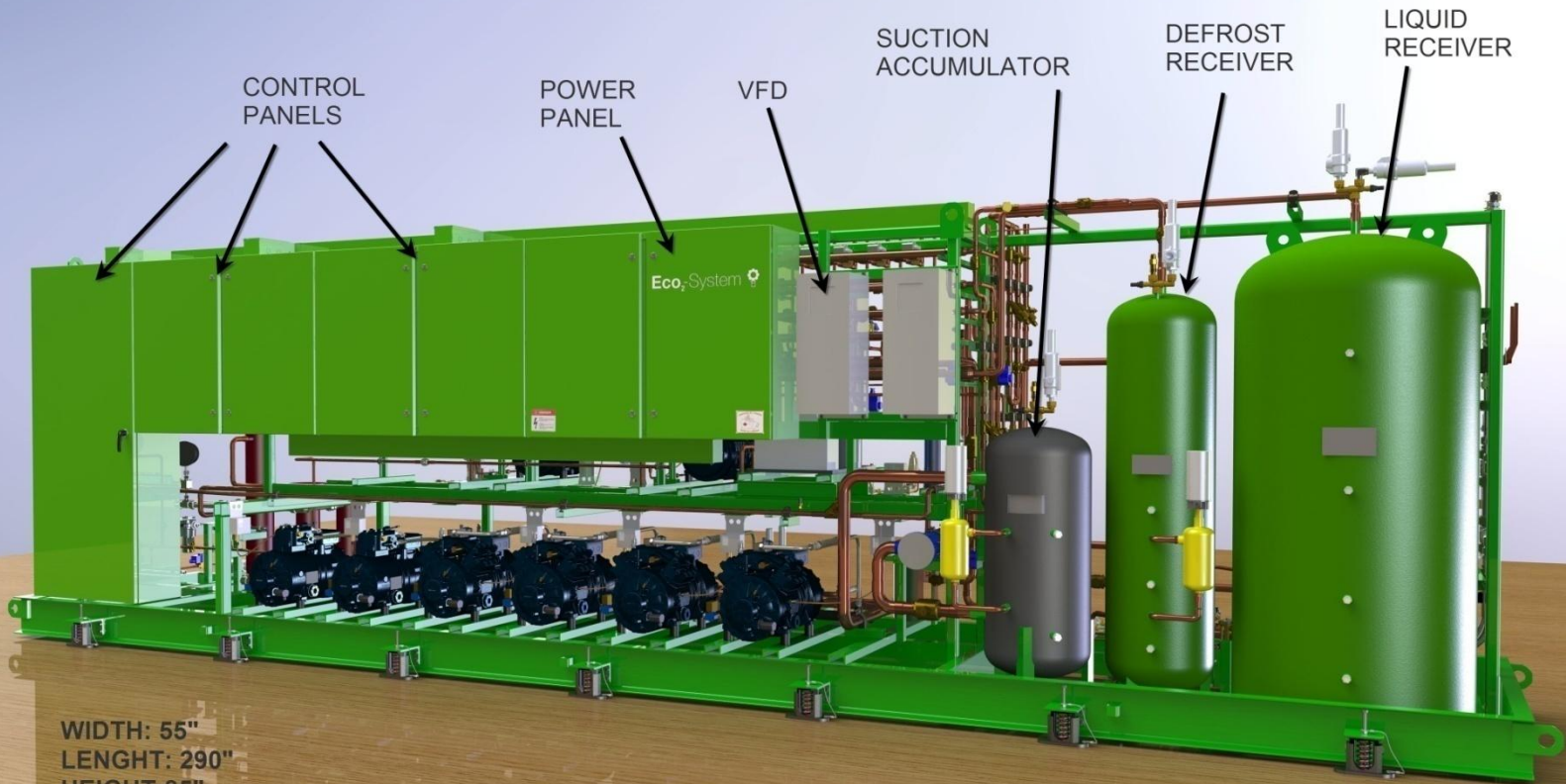
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# CO2 refrigeration systems



The Greenest way to preserve and save

## Eco<sub>2</sub>-System<sup>®</sup>



WIDTH: 55"  
 LENGHT: 290"  
 HEIGHT: 85"  
 WEIGHT: 14 000 LBS

The Greenest way to preserve and save

## Eco<sub>2</sub>-System®



- Main challenges for a rack manufacturer:
  - Oil management
  - Efficient and quick low pressure hot gas defrost
  - Pipe/components sizing
  - Power failure management
  - Electronic
  - Heat reclaim strategies
  - Training

- Where transcritical CO<sub>2</sub> systems can be applied:
  - Cold climate with annual mean ambient temp of 50F or less.
  - Warm climate with low Wet bulb temp values using adiabatic cooling





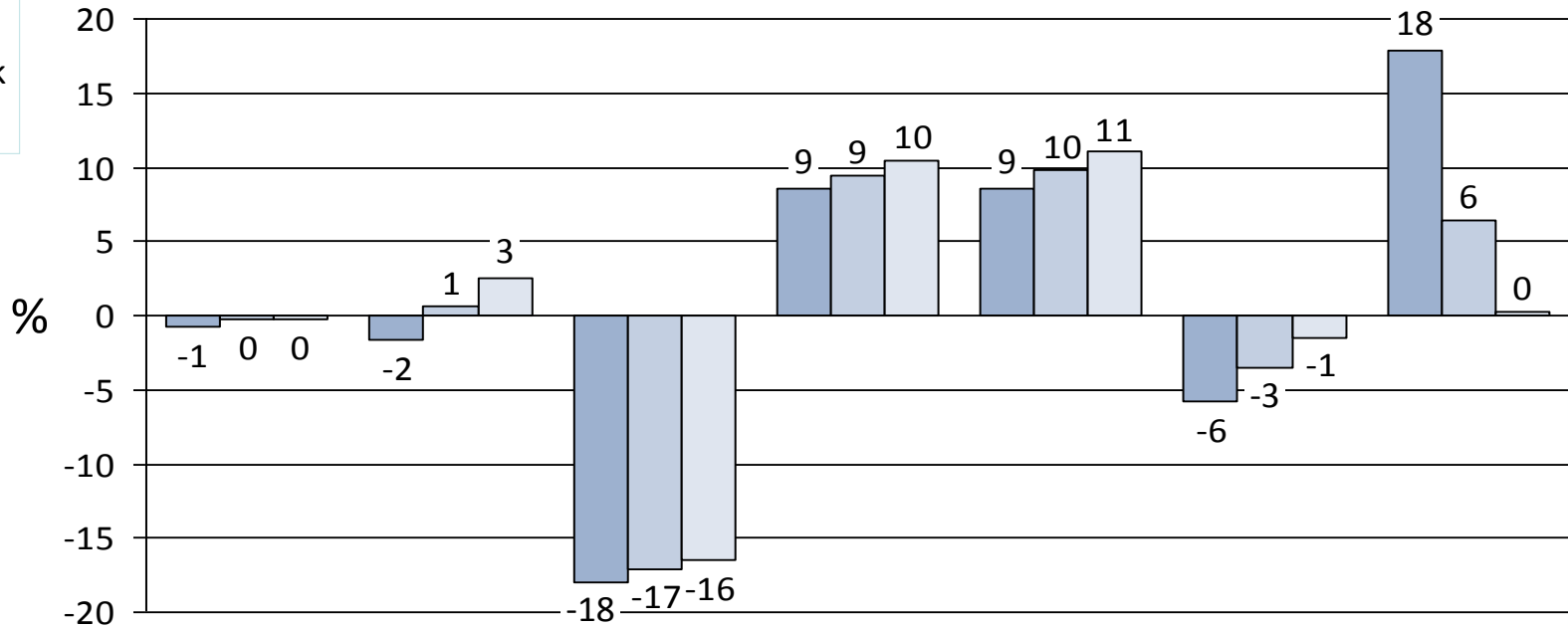
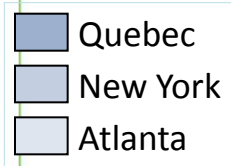


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# Deviation of alternative system annual energy consumption compared to R404A reference system



The Greenest way to preserve and save



| Alternative System | (1) R404A/CO2 Cascade | (1) R134A/CO2 Cascade | (2) R404A Chiller | (3) Propane Chiller | (3) Ammonia Chiller | (3) R134A Chiller | (4) Transcritical CO2 Booster |
|--------------------|-----------------------|-----------------------|-------------------|---------------------|---------------------|-------------------|-------------------------------|
| MT                 | R404A DX              | R134A DX              | Prop. Glycol      | Pumped CO2          | Pumped CO2          | Pumped CO2        | CO2 DX                        |
| LT                 | CO2 DX                | CO2 DX                | CO2 DX            | CO2 DX              | CO2 DX              | CO2 DX            | CO2 DX                        |





## *Who is Carnot Refrigeration?*

## *What is our experience?*

- 2007: Sobeys Trois-Rivières
  - ASHRAE'S BEST 2010 Technology Awards
  - Refrigeration and heat recovery Design and built.



ASHRAE'S BEST TECHNOLOGY AWARD CASE STUDIES

FIRST PLACE: INDUSTRIAL FACILITIES OR PROCESS, NEW



- 2008: First CO2 refrigeration experimentations in our R&D Laboratory



- 2009: 1<sup>st</sup> generation

- MT: Glycol 295kW  
(1 010 000 btu/hr)
- 100% heat recovery

*New features:*

- **LT: Direct CO<sub>2</sub> 80kW  
(273 000 btu/hr)**
- **Hot gas defrost at low pressure**





- 2010: 2<sup>nd</sup> generation
  - LT: CO<sub>2</sub> 85kW (290 000 btu/hr)
  - Hot gas defrost at low pressure
  - 100% heat recovery

*New features:*

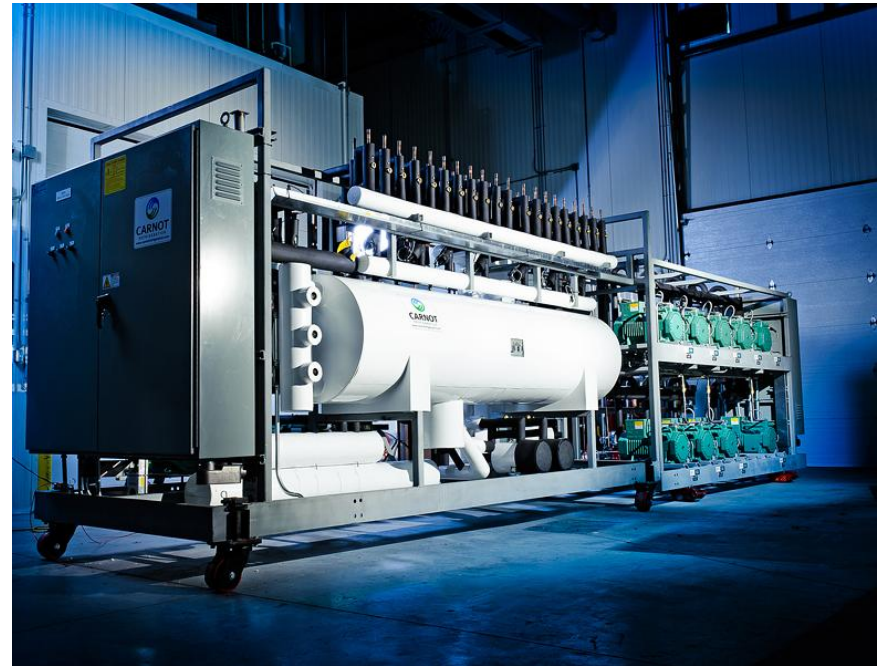
- **MT: CO<sub>2</sub> 350kW  
(1 200 000 btu/hr)**



- 2010: 3<sup>rd</sup> generation  
“**SUPER CO<sub>2</sub>OL**” system design  
for **SUPER** markets
  - Hot gas defrost in low pressure

*New features:*

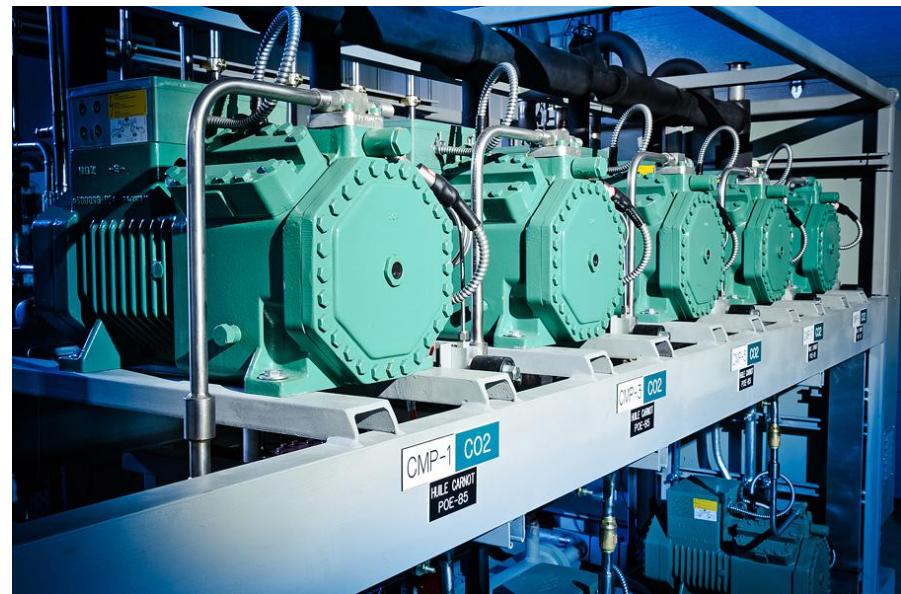
  - **CO<sub>2</sub> Transcritical**
  - **CO<sub>2</sub> Direct heat recovery**
  - **APD in MT**



- 2010: Distribution centre  
“**MEGA CO<sub>2</sub>OL**” system
  - NH<sub>3</sub>/CO<sub>2</sub> LT and MT  
Range 1 to 5 MW  
(1 to 1400 TR)
  - TFC
  - 100% Heat recovery

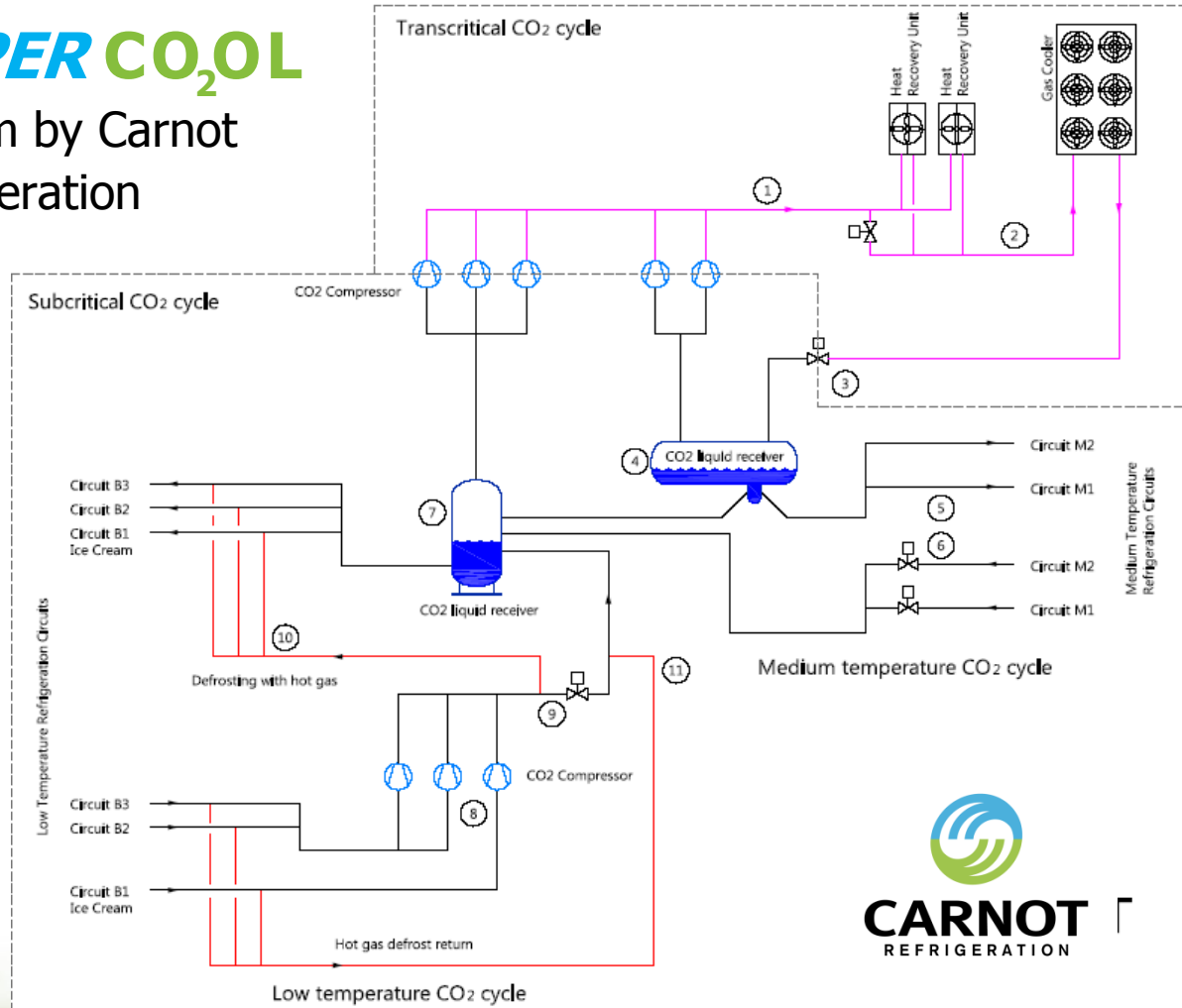


- 2011: In progress
  - Several “**SUPER CO<sub>2</sub>OL**” systems for supermarkets
  - Several “**MEGA CO<sub>2</sub>OL**” systems for distribution centres





## **SUPER CO<sub>2</sub>OL** system by Carnot Refrigeration



## Advantages

- ✓ High energy efficiency
  - Direct CO<sub>2</sub> heat recovery (no pumps, no heat exchanger)
  - APD in MT and low temperature hot gas defrost. No electrical elements, consumption and wiring (reduction of pull down energy required after defrost)
- ✓ Accessible replacement parts by local wholesalers
- ✓ HFC free; phase-out free, low maintenance cost
- ✓ Lowest installation cost of any system
- ✓ Light weight and small footprint required for skids and condenser/gas cooler
- ✓ Industrial quality skids



## *Challenges*

- Technicians learning curve
- Follow-up of provisioning system
- Oil management
- New design criteria

# CO<sub>2</sub> vs Sobeys September 2011

- 32 stores in operation, sub & transcritical.
- 6 generations of system, continuous improvements.
- Initial cost = conventional systems.
- 4 manufacturers so far.
- Cases & controls manufacturers = not an issue.
- Sobeys National standard = CO<sub>2</sub> transcritical.
- 2 hottest summers ever = less concerns than conventional.
- First transaction on the voluntary carbon market, 15000 tons.
- Energy saving, initial survey = up to -18%.
- Active member of the CGF, refrigeration summits.
- Challenge is still for the R22 conversion.

A major leak in a conventional synthetic refrigerant system would have the same GWP as driving 1 200 cars on the road for a year...



A major leak in a CO<sub>2</sub> refrigeration system would have the same GWP impact as a solitary fisherman using his motor boat on the lake...



# Conclusion

- Retailers are more than welcome to come visit us.
- CO<sub>2</sub> technology is **NOT** the technology of the future...
- It's today's technology !!!



# Contacts

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