# Sobeys' Natural Transition to $CO_2$

## FMI – Energy and Store Design

Atlanta, September 21st, 2011

Sobeys inc.

focus on food

# Table of contents

# Who is Sobeys?

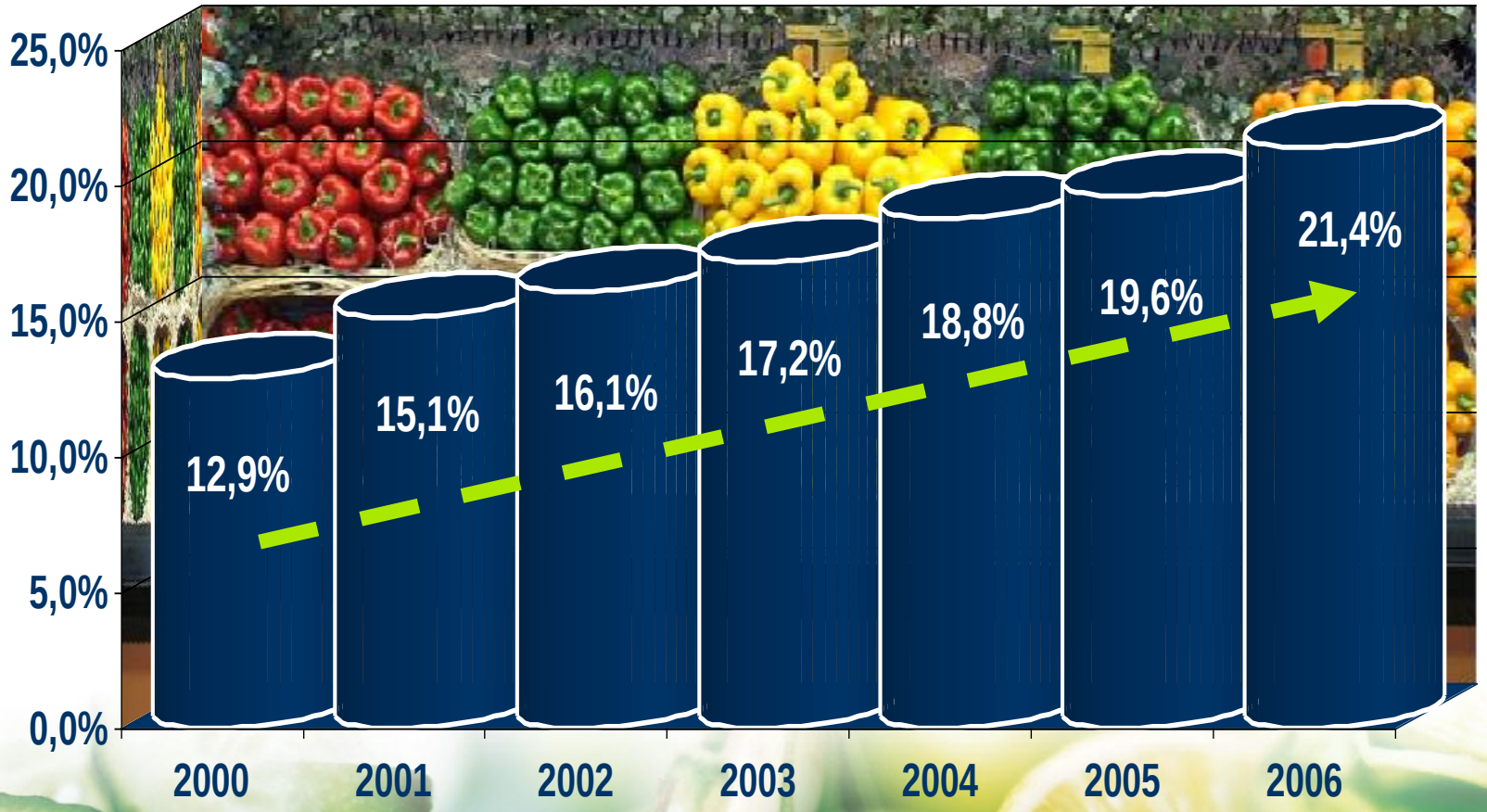
- Founded in 1907.
- Wholly-owned subsidiary of Empire Company Limited.
- Canadian company.
- Headquarters in Stellarton, Nova Scotia & Toronto.
- Annual sales over 15 B$.
- More than 1300 stores in 10 provinces.
- Atlantic, Québec, Ontario, West.
- 800 communities across Canada.
- 85,000 employees.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

# The various banners

# 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



# 30 bronze plates….

# IGA St-Pascal de Kamouraska


CANADA GREEN BUILDING COUNCIL • CONSEIL DU BÂTIMENT DURABLE DU CANADA •
SECTION


MIDLAND


JLG LIFT

# 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 $CO_2$ sub critical project |
| July 09 | First $CO_2$ 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.

# Contents of the Presentation



- History
- $CO_2$ refrigeration systems
  - Cascade
  - Transcritical
- Challenges
- Applications in North America

# History



## CO2 utilized as refrigerant in sub- and supercritical refrigeration systems


Proposal to use $CO_2$ as a refrigerant (Alexander Twining ,British patent)

The peak of utilizing $CO_2$ as refrigerant

Reinvention of CO2-refrigeration technology (G. Lorentzen)

1850 1920 ----------1930 1960 1993

# History

Wisconsin,1934

# CO2 refrigeration systems



- $CO_2$ 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 | CO2 |
|---|---|---|---|
| Critical point (psi/F) | 542/162 | 1640/270 | 1067/88 |

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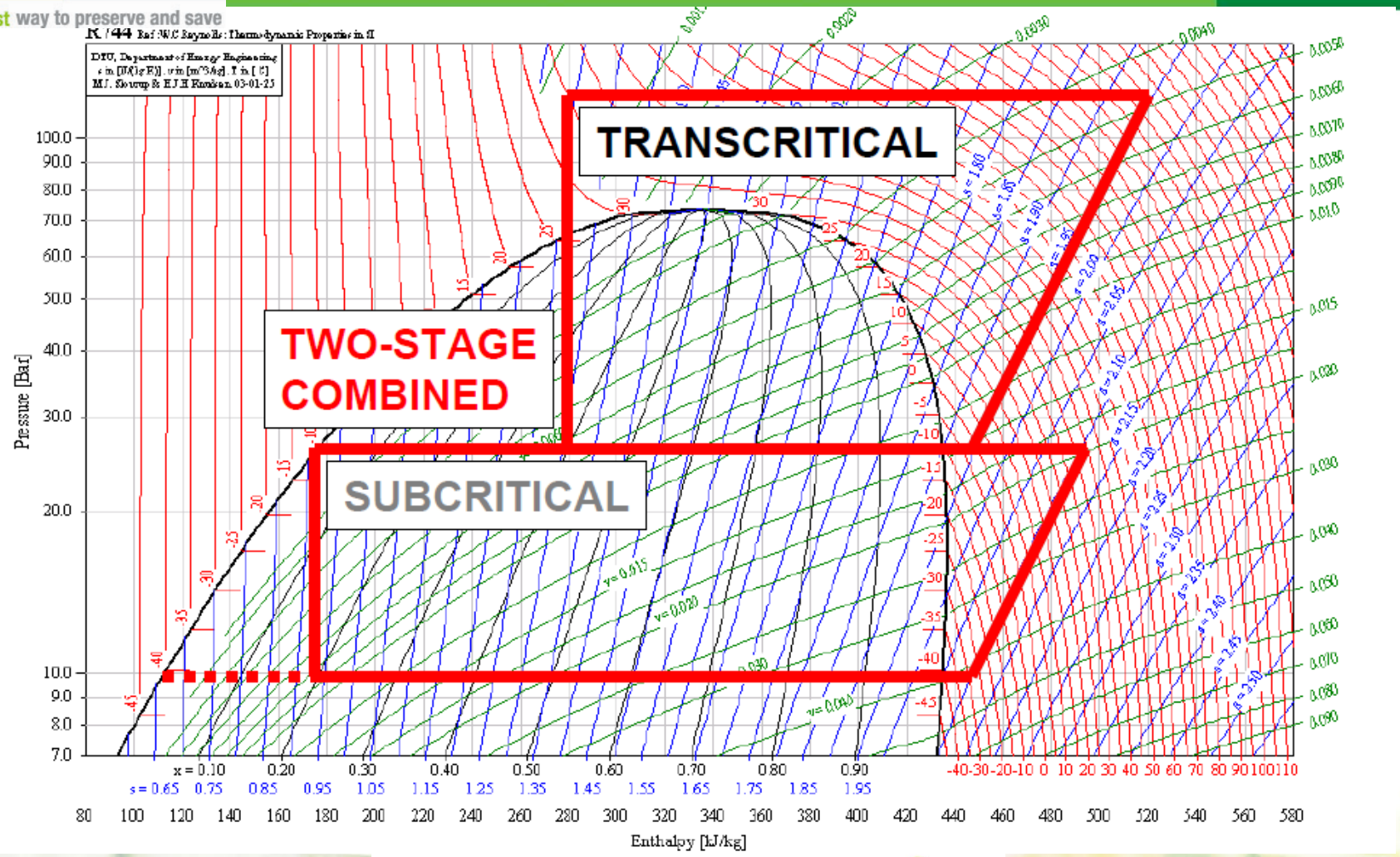
# CO2 refrigeration systems

Sobeys Inc.

The Greenest way to preserve and save

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# CO2 refrigeration systems



- Sub-Critical applications : Cascade
  - CO2 is used as a secondary refrigerant
  - Many versions:
    - LT DX CO2, MT pumped glycol
    - LT DX CO2, MT pumped CO2
    - LT pumped CO2
  - Common fact: all sub-critical applications need another refrigeration system to maintain CO2 at low pressure / temperature:
    - R404a
    - R134a
    - NH3
    - Etc…

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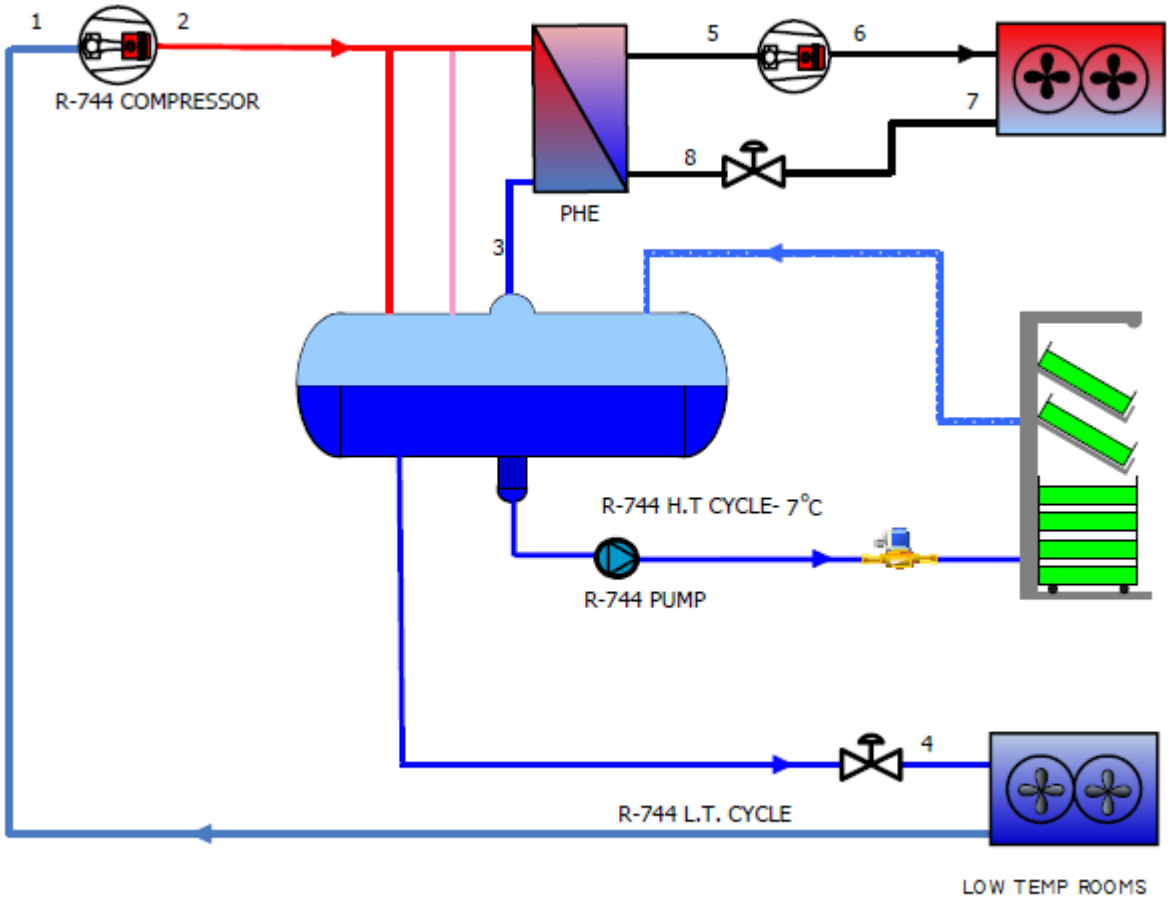
# CO2 refrigeration systems

Sobeys Inc.

Sub-critical:

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# CO2 refrigeration systems

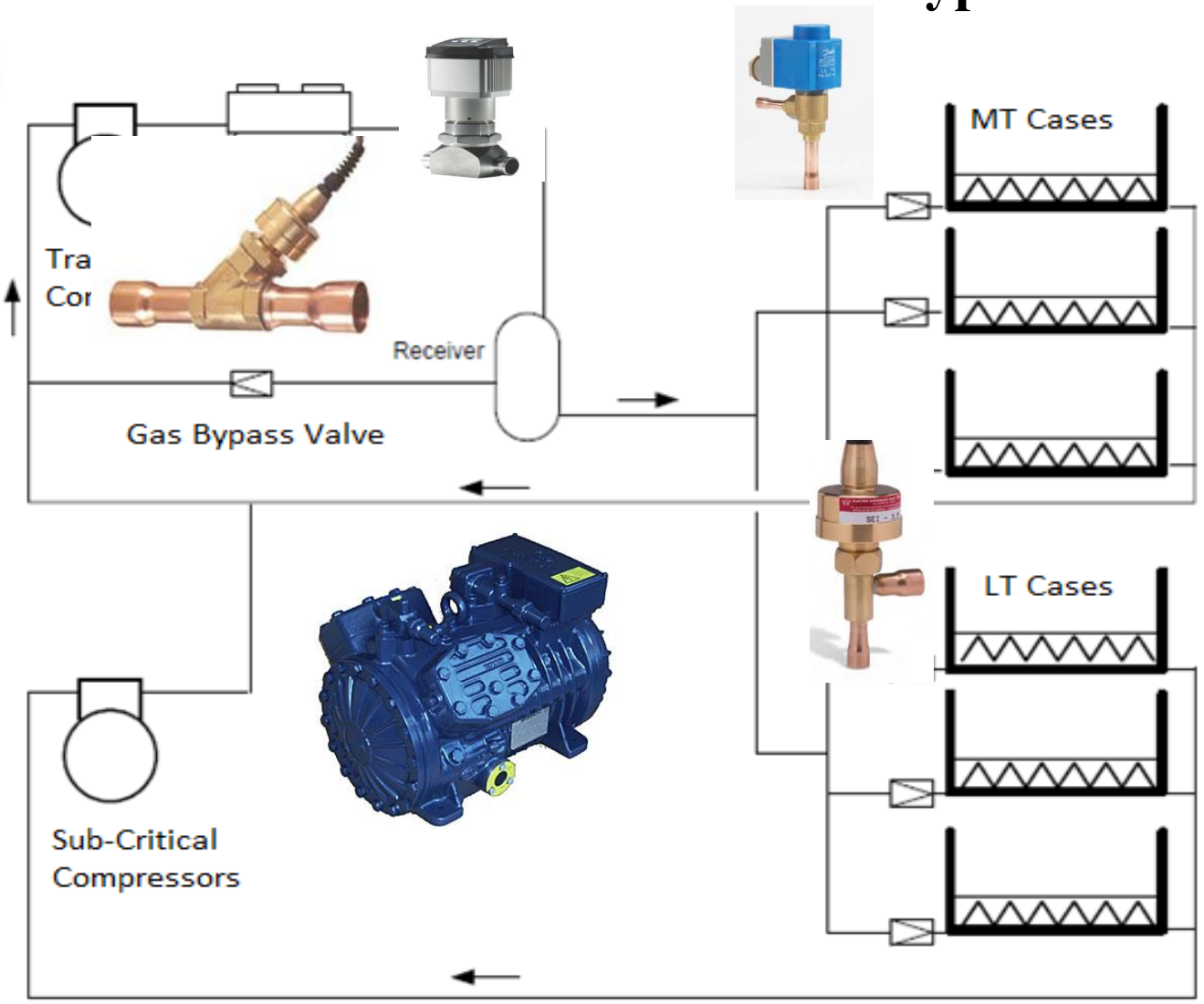


Sub-critical:

# CO2 refrigeration systems

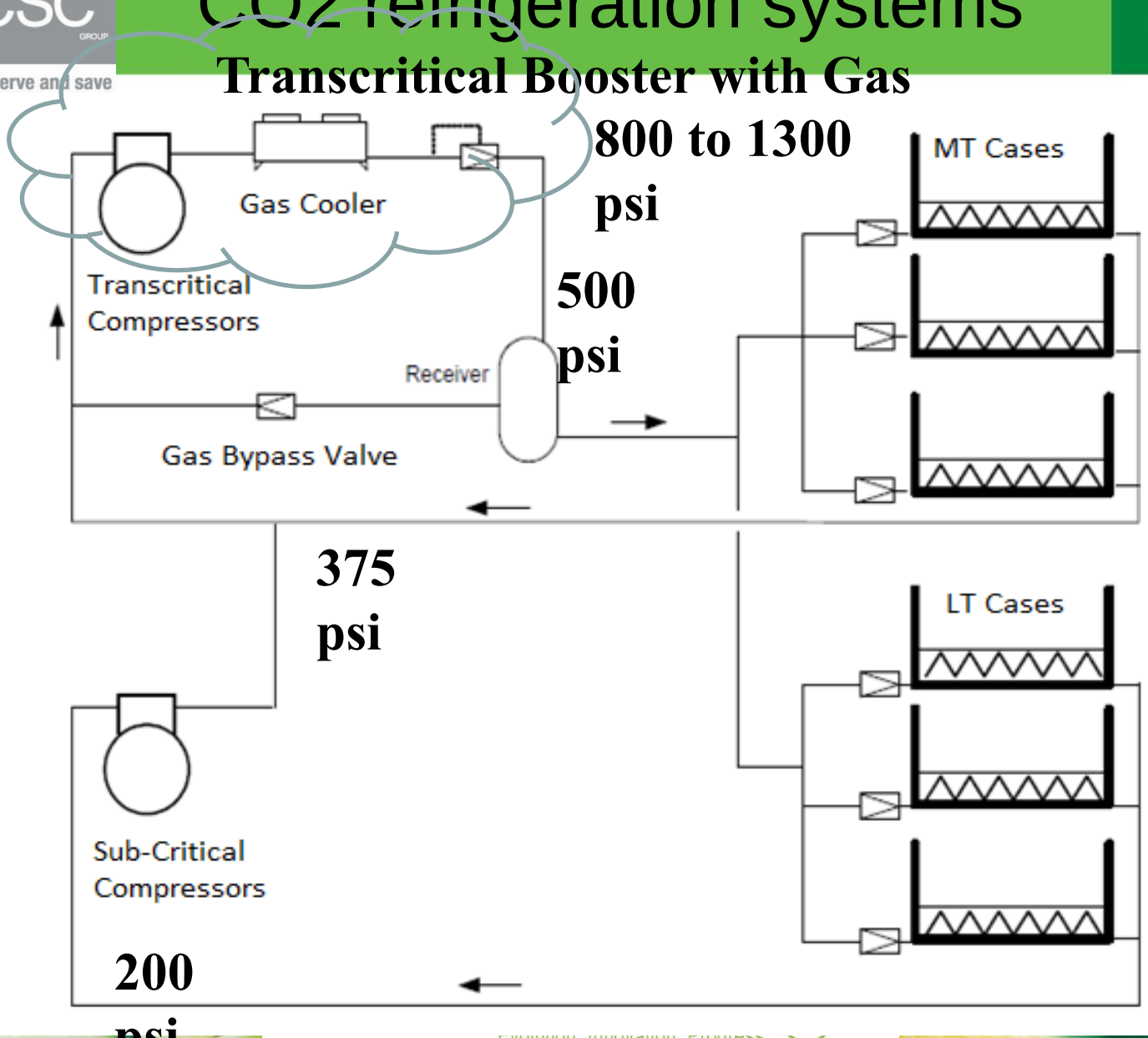


## Transcritical Booster with Gas Bypass:



# CO2 refrigeration systems

## Transcritical Booster with Gas



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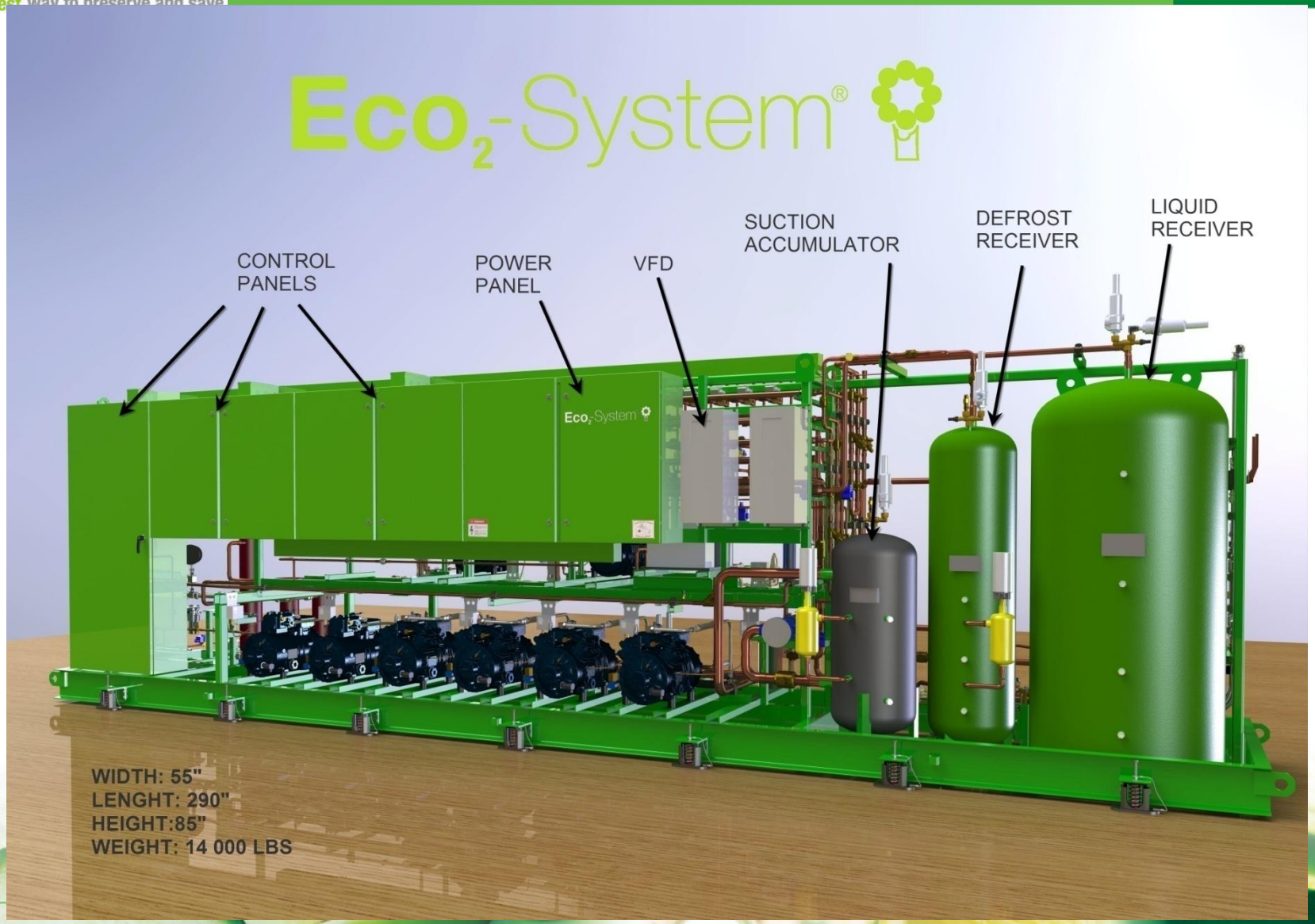
# CO2 refrigeration systems

Sobeys inc.

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# CO2 refrigeration systems

Sobeys inc.


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# Challenges



- 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

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# Applications in North America

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- Where transcritical CO2 systems can be applied:
  - Cold climate with annual mean ambiant 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

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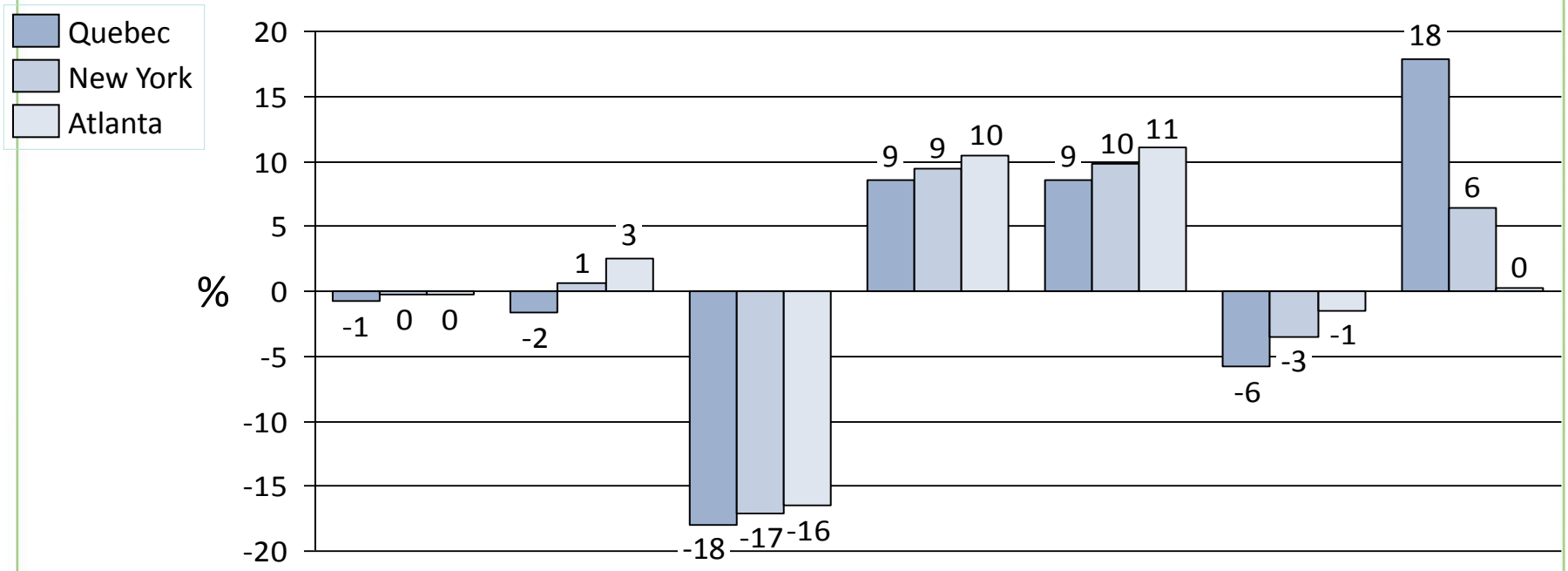


| Alternative System | (1) R404A/CO2 Cascade | (1) R134A/CO2 Cascade | (2) R404A Chiller | (3) Propane Chiller | (3) Ammonia Chiller | (3) R134A Chiller | (4) Transcritical CO2 Booster |
|---|---|---|---|---|---|---|---|
| MT | R404A DX | R134A DX | Prop. Glycol | Pumped CO2 | Pumped CO2 | PumpedCO2 | CO2 DX |
| LT | CO2 DX | CO2 DX | CO2 DX | CO2 DX | CO2 DX | CO2 DX | CO2 DX |

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# CARNOT REFRIGERATION INC

***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**

FISRT PLACE: INDUSTRIAL FACILITES OR PROCESS, NEW

# CARNOT REFRIGERATION INC

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

# CARNOT REFRIGERATION INC

- 2009: 1st generation
  - MT: Glycol 295kW (1 010 000 btu/hr)
  - 100% heat recovery

  *New features:*
  - **LT: Direct $CO_2$ 80kW (273 000 btu/hr)**
  - **Hot gas defrost at low pressure**

# CARNOT REFRIGERATION INC

- 2010: 2nd generation
  - LT: $CO_2$ 85kW (290 000 btu/hr)
  - Hot gas defrost at low pressure
  - 100% heat recovery

  *New features:*
  - **MT: $CO_2$ 350kW (1 200 000 btu/hr)**

# CARNOT REFRIGERATION INC

- 2010: 3rd generation "***SUPER*** **$CO_2$OL**" system design for ***SUPER***markets
  - Hot gas defrost in low pressure

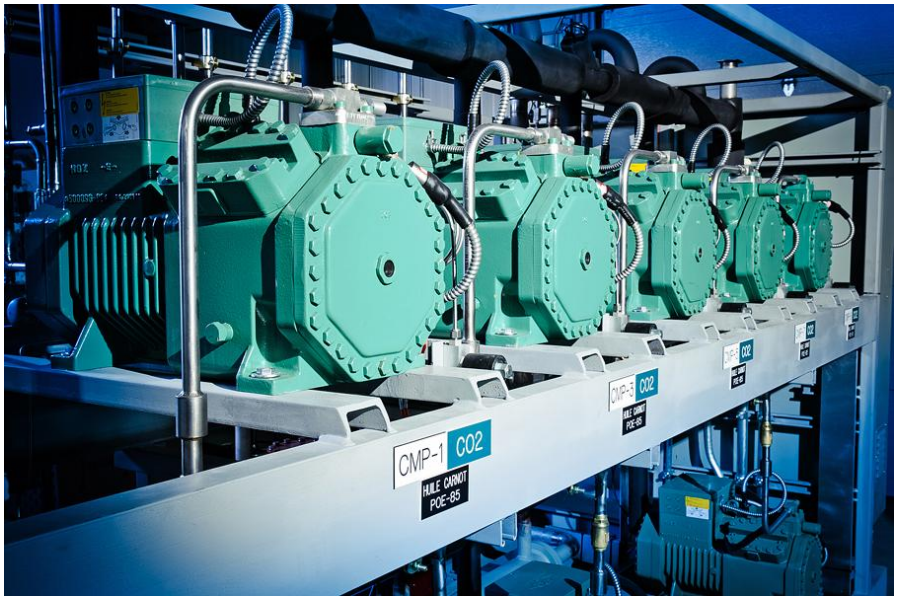
  *New features:*
  - **$CO_2$ Transcritical**
  - **$CO_2$ Direct heat recovery**
  - **APD in MT**

# CARNOT REFRIGERATION INC

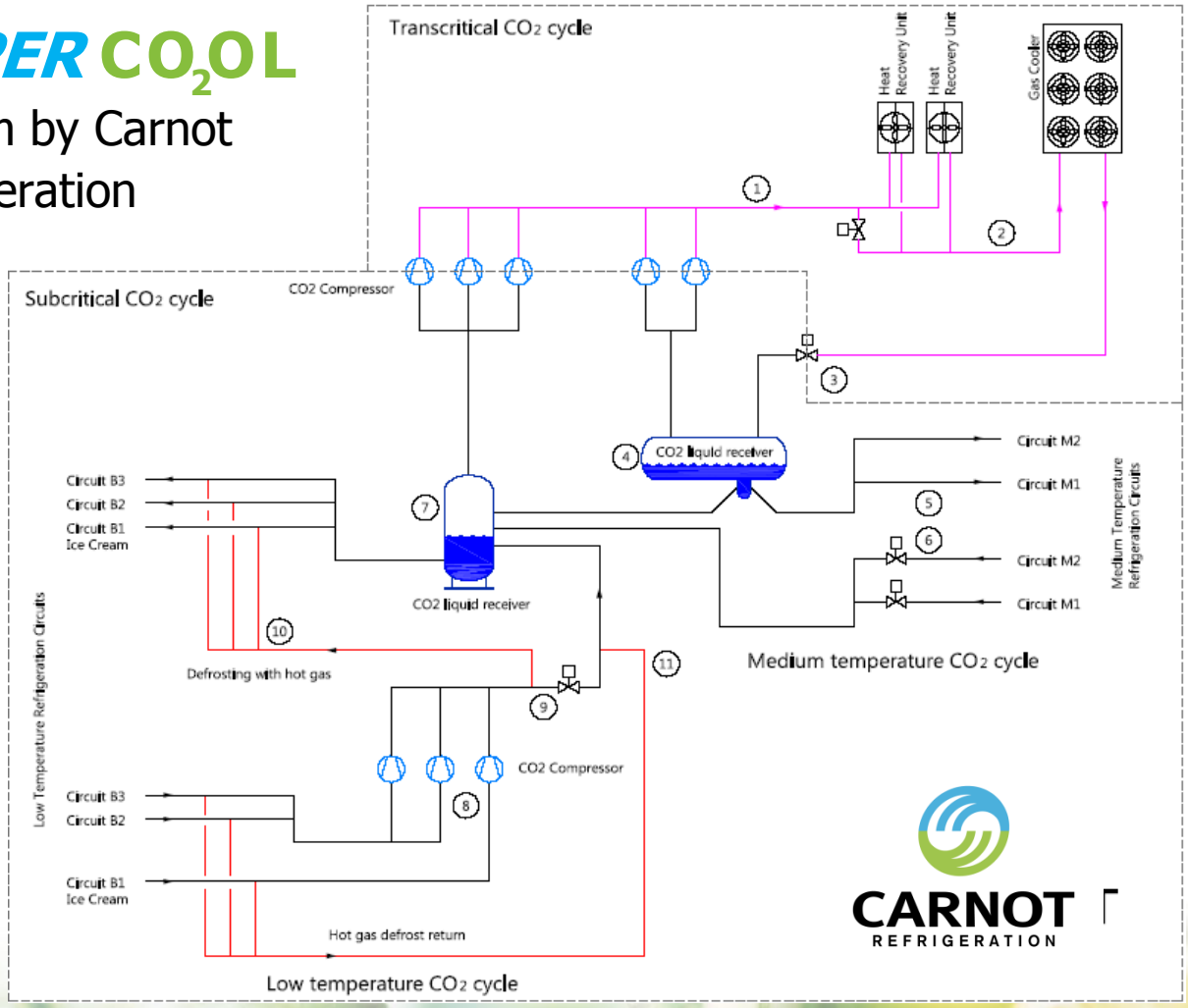
- 2010: Distribution centre "*MEGA* $CO_2OL$" system
  - $NH_3/CO_2$ LT and MT
    Range 1 to 5 MW
    (1 to 1400 TR)
  - TFC
  - 100% Heat recovery

# CARNOT REFRIGERATION INC

- 2011: In progress
  - Several "***SUPER*** $CO_2OL$" systems for supermarkets
  - Several "***MEGA*** $CO_2OL$" systems for distribution centres



**SUPER $CO_2OL$** system by Carnot Refrigeration



## ***Advantages***

- ✓ High energy efficiency
  - Direct $CO_2$ 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

# $CO_2$ 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 = CO2 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 CO2 refrigeration system would have the same GWP impact as a solitary fisherman using his motor boat on the lake…


AMAHA

# Conclusion

- Retailers are more then welcome to come visit us.

- $CO_2$ technology is **NOT** the technology of the future…

- It's today's technology !!!

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