

C02 Supermarket System

Case Study of a Green Chill Platinum Award-Winning Store



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A DOVER COMPANY

Case Study of a Green Chill Platinum Award-Winning Store

- Illustrate One of the Ways to Use CO₂ in a Supermarket to
 - *Reduce the Synthetic Refrigerant Charge*
 - *Lower the Systems Overall Equivalent CO₂ Emissions*

Sprouts Farmers Market



Refrigeration System for Sprouts Farmers Market

- *Store Location: Thousand Oaks, CA*
- *Required Load*
 - **MT: 438 kBtu/h**
 - **LT: 86 kBtu/h**

Design Challenge

- Reduce HFC Emission: *Meet GreenChill Platinum standards*
- Increase Energy Efficiency
- Control Refrigerant Costs
 - *Initial Charge*
 - *Potential Exposure to Catastrophic Leaks*

GreenChill Platinum Level

- The store must use only Significant New Alternative Policy (SNAP) listed, non-ozone-depleting refrigerants.
- The store must meet one of the following sets of conditions:
 - The store must achieve an average HFC refrigerant charge of no more than 0.5 pounds of refrigerant per 1,000 BTU per hour total evaporator cooling load and a store-wide annual refrigerant emissions rate of no more than 5%.
 - OR –
 - All refrigerants used in the store's commercial refrigeration system must have global warming potentials lower than 150

How Meeting These Challenges can be Accomplished Today

- **Second Nature- Transcritical CO2 Booster System**
 - *UL Listed*
 - *Energy Advantage in a Growing Number of Regions*
- **Second Nature- CO2 Combined MT Secondary and LT Cascade Refrigeration System**
 - *UL Listed*
 - *Energy Parity or Better in All Climates*

Meeting GreenChill Platinum Level at Sprouts, Thousand Oaks, CA

- Reduce the Refrigerant Charge to 0.5 lbs/kBtuH or Less and Obtain an Annual Refrigerant Emissions Rate of No More than 5%
 - Reduce the Initial HFC Charge
 - *Standard Stores had 3.8 lbs/kBtuH*
 - Reduce System HFC Leak Potential

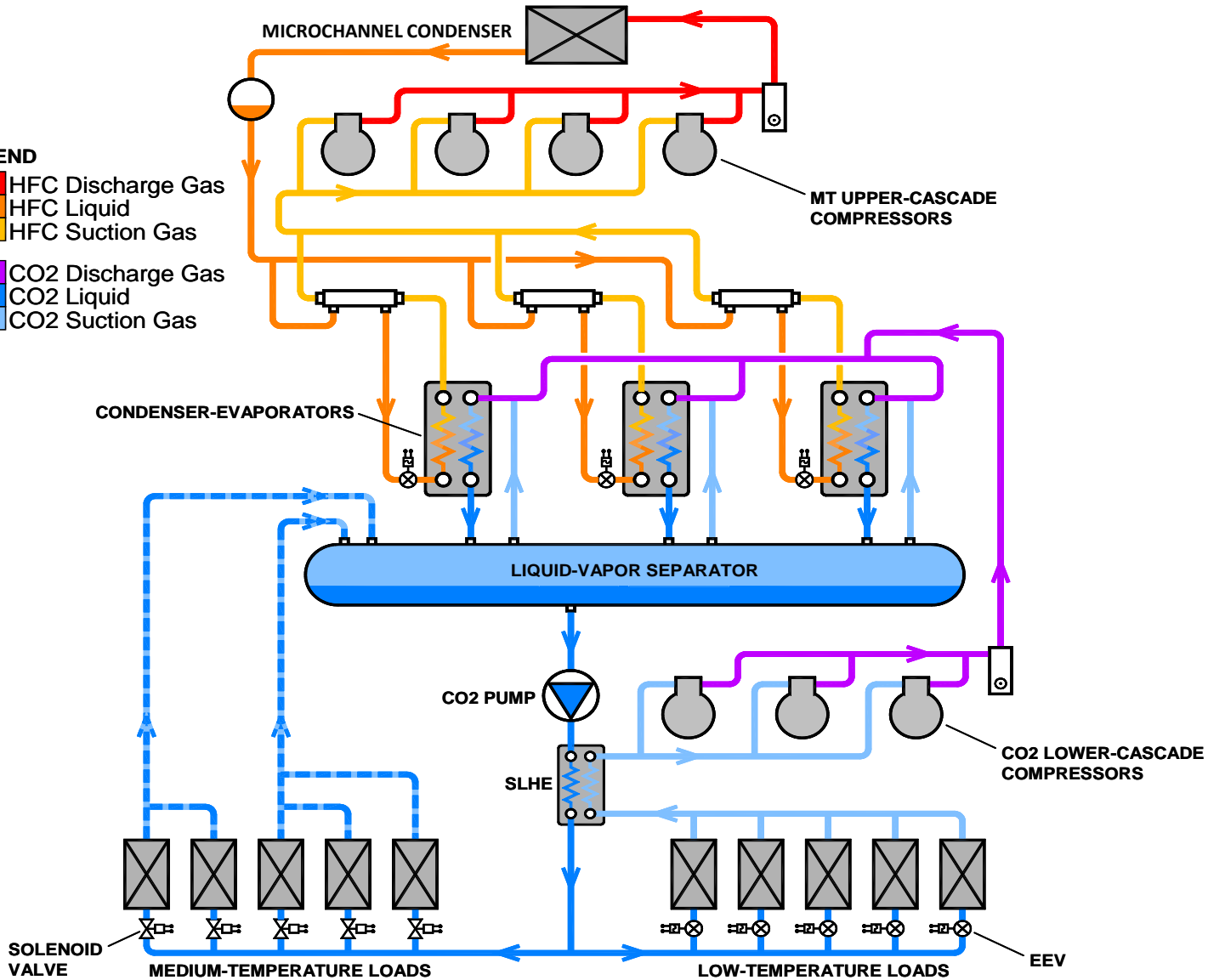
How Reducing HFC Charge and Emissions was Accomplished

- **Second Nature CO2 Combined MT Secondary and LT Cascade Refrigeration System (SNMT2LX)**
- **Air-Cooled Micro-Channel Condenser**

CO2 Combined Secondary / Cascade Refrigeration System (SNMT2LX)

LEGEND

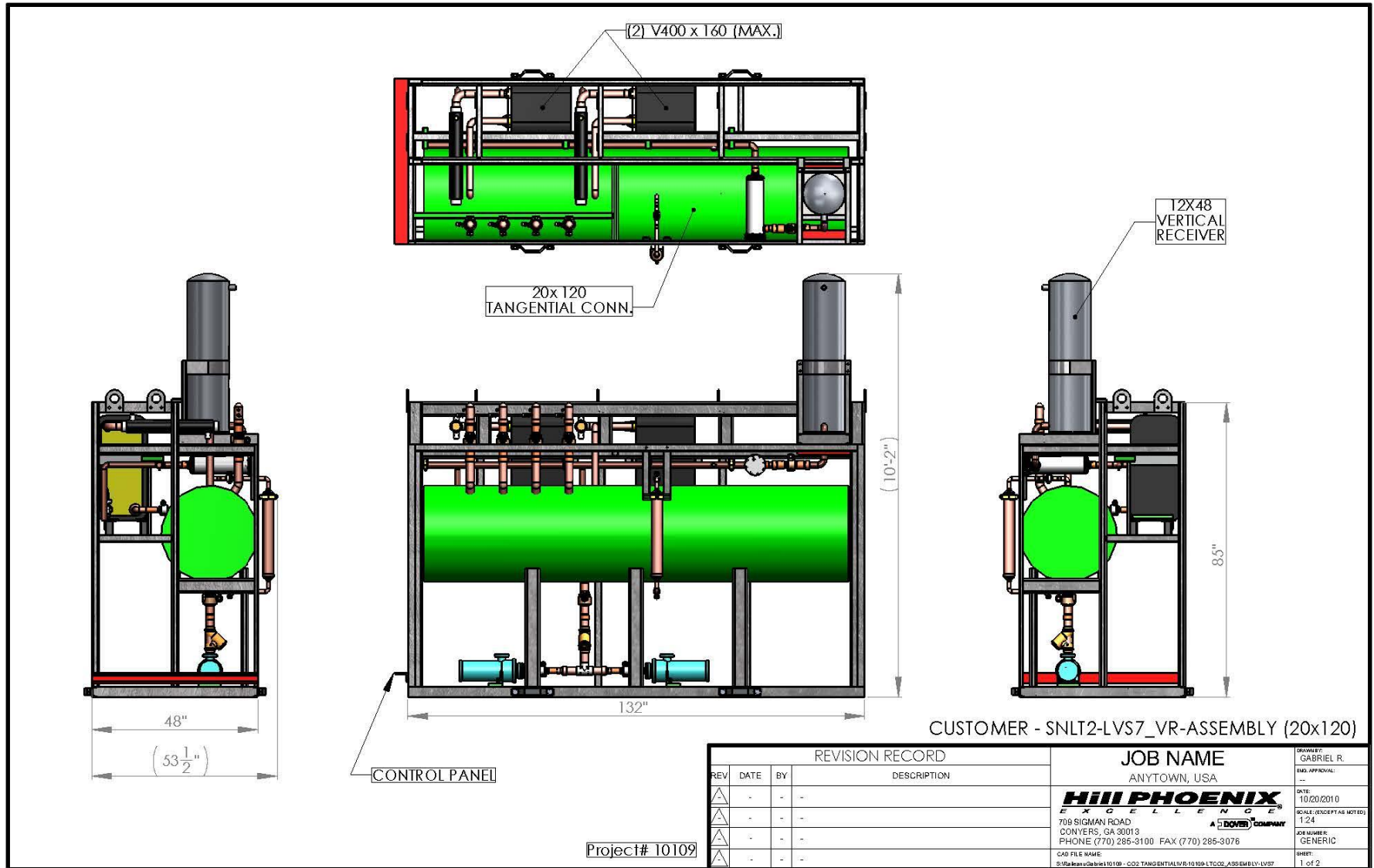
- █ HFC Discharge Gas
- █ HFC Liquid
- █ HFC Suction Gas
- █ CO2 Discharge Gas
- █ CO2 Liquid
- █ CO2 Suction Gas



CO2 Refrigeration System-SNMT2LX



CO2 Refrigeration System-SNMT2LX



CO2 Refrigeration System-SNMT2LX



Air-Cooled Microchannel Condenser



Benefits-SNMT2LX

- **CO2 is a Natural Refrigerant with Very Low Global Warming Potential (GWP=1)**
- **CO2 is Inexpensive Compared with HFC**
- **CO2 is Widely Available**
- **CO2 Requires Smaller Copper Piping - Lowers Cost and Carbon Footprint**
- **HFC Refrigerant Charge is Confined to the Machine Room and Condenser for Simple Leak Detection and Servicing**
- **System Energy Consumption Equivalent or Better than Conventional HFC System**

CO2 Refrigeration System-SNMT2LX



Energy Efficiency-SNMT2LX

Medium-Temperature CO₂ Secondary System:

- Fully Flooded Coils for Efficient Heat Transfer: Evaporating Temperature can be 2-3 ° F Higher than HFC System

Low-Temperature Cascade System:

- SmartValve System for Efficient and Cost-Effective EEV Control
- Low Heat Gain: 30 to 50% Lower Heat Gain than HFC Systems
- Saturated Suction Temperature : 1-2 ° F Higher than HFC System

CO2 Equivalent Emission Comparison

(Pack Calculation II by IPU)

CO2 Emissions

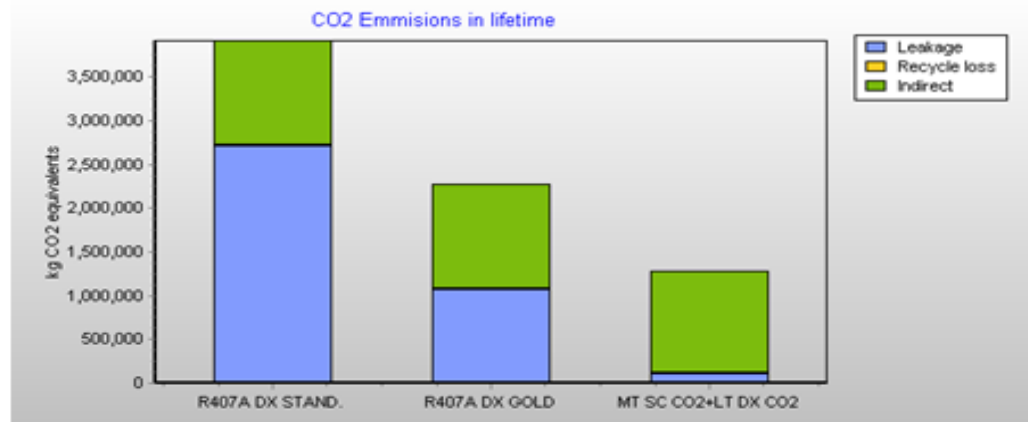
PLATINUM

	R407A DX STAND. (R407A)	R407A DX GOLD (R407A)	MT SC CO2+LT DX CO2_LT (R744)	MT SC CO2+LT DX CO2_MT (R407A)
Refrigerant charge [kg]	907.00	358.00	408.00	107.00
Recycle rate [%]	100.0	100.0	100.0	100.0
Leakage rate [%/year]	15.0	15	15.0	5.0

Summary of CO2 Emissions.

	Leakage [kg CO2]	Recycle loss [kg CO2]	Indirect [kg CO2]	Total [kg CO2]
R407A DX STAND.	2,721,000 (69.5%)	0 (0.0%)	1,194,047 (30.5%)	3,915,047
R407A DX GOLD	1,074,000 (47.4%)	0 (0.0%)	1,194,047 (52.6%)	2,268,047
MT SC CO2+LT DX CO2	107,612 (8.4%)	0 (0.0%)	1,174,901 (91.6%)	1,282,513

CO2 Emission results.

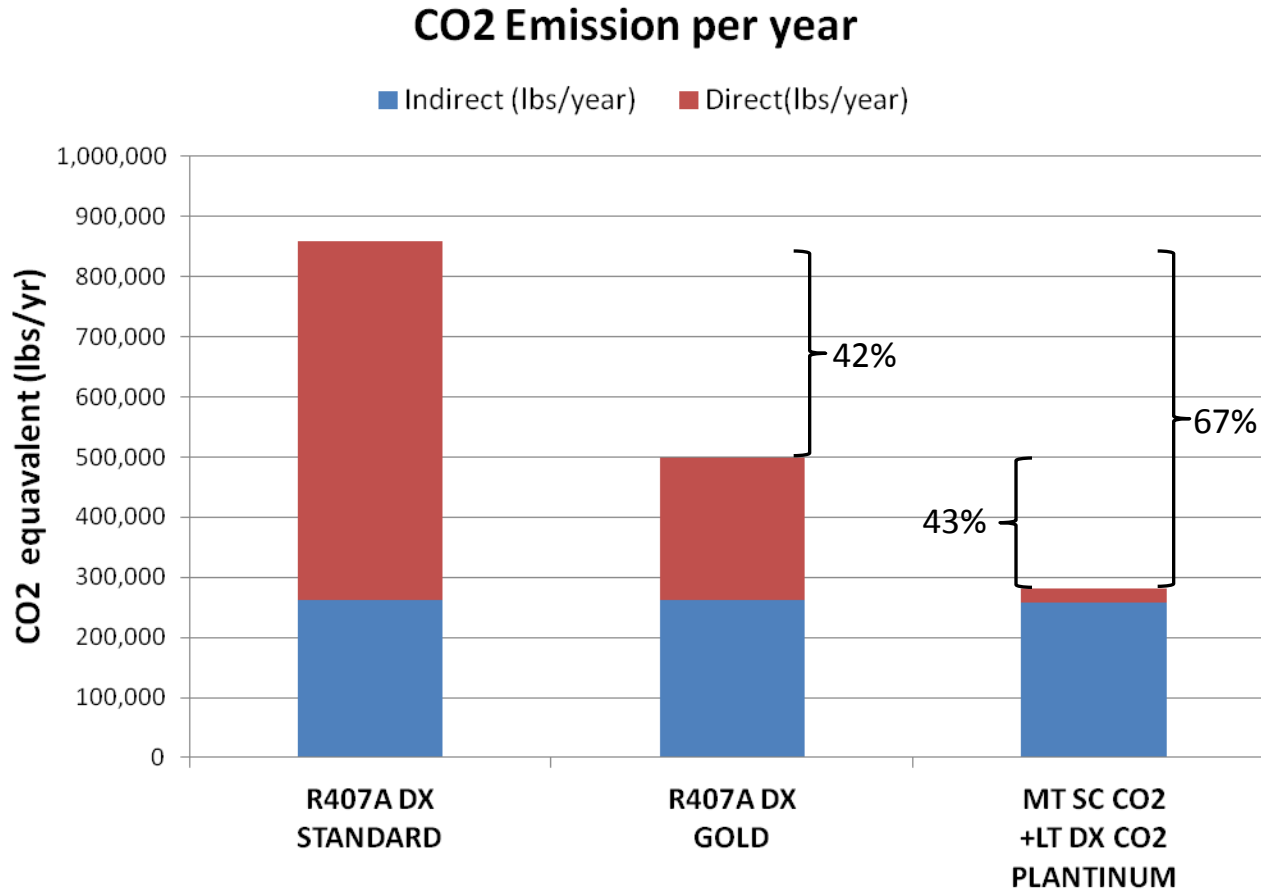


CO2 Emissions.

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CO2 Equivalent Emission Comparison

(From Pack Calculation II by IPU)



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Gallons of Milk Comparison



Financial Impact Calculator - The Cost of Refrigerant Leaks*

1) Cost to Replace Leaked Refrigerant		2) Sales/Profit	
1. Refrigerant type:	R-407A <small>click inside the yellow box and select the refrigerant from the drop-down menu</small>	1. Item to be sold (milk, frozen peas, hotdogs, etc.)	milk <small>type the name of the product in the yellow space</small>
2. Amount of refrigerant leaked (in pounds):	300 <small>type number of pounds in yellow box</small>	2. Units (gallons, pounds, packs, ounces, etc.)	gallons <small>type the unit of the product in the yellow space</small>
3. Price per pound that you pay for refrigerant:	\$6.00 <small>for \$7.00, type in 7.00</small>	3. Sales price per unit	\$3.50 <small>for \$3.50, type in 3.50</small>
		4. Profit margin per unit sold (in percent):	1.00 <small>for 1%, type in 1; for 2.03%, type in 2.03</small>
Cost to replace leaked refrigerant: \$1,800		You have to sell 51,429 gallons of milk to pay the replacement cost of 300 pounds of refrigerant	

*This calculator deals solely with refrigerant replacement costs. There are of course, other costs incurred due to refrigerant leaks, such as service technician costs for parts and labor, costs due to decreases in energy efficiency when the refrigeration system is not properly charged, and food spoilage costs.

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Gallons of Milk Comparison

.vs. GreenChill Platinum - Gallons of Milk Per Year Sold to Recover the Cost of the Additional Refrigerant Lost by:

Traditional DX System
43,629

GreenChill Gold DX System
12,514

R407A@\$6.00/lb R744@\$1.50



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natural refrigerants

Thank you!