THE GREENCHILL PARTNERSHIP

Ammonia Cascade Systems

November 15, 2012

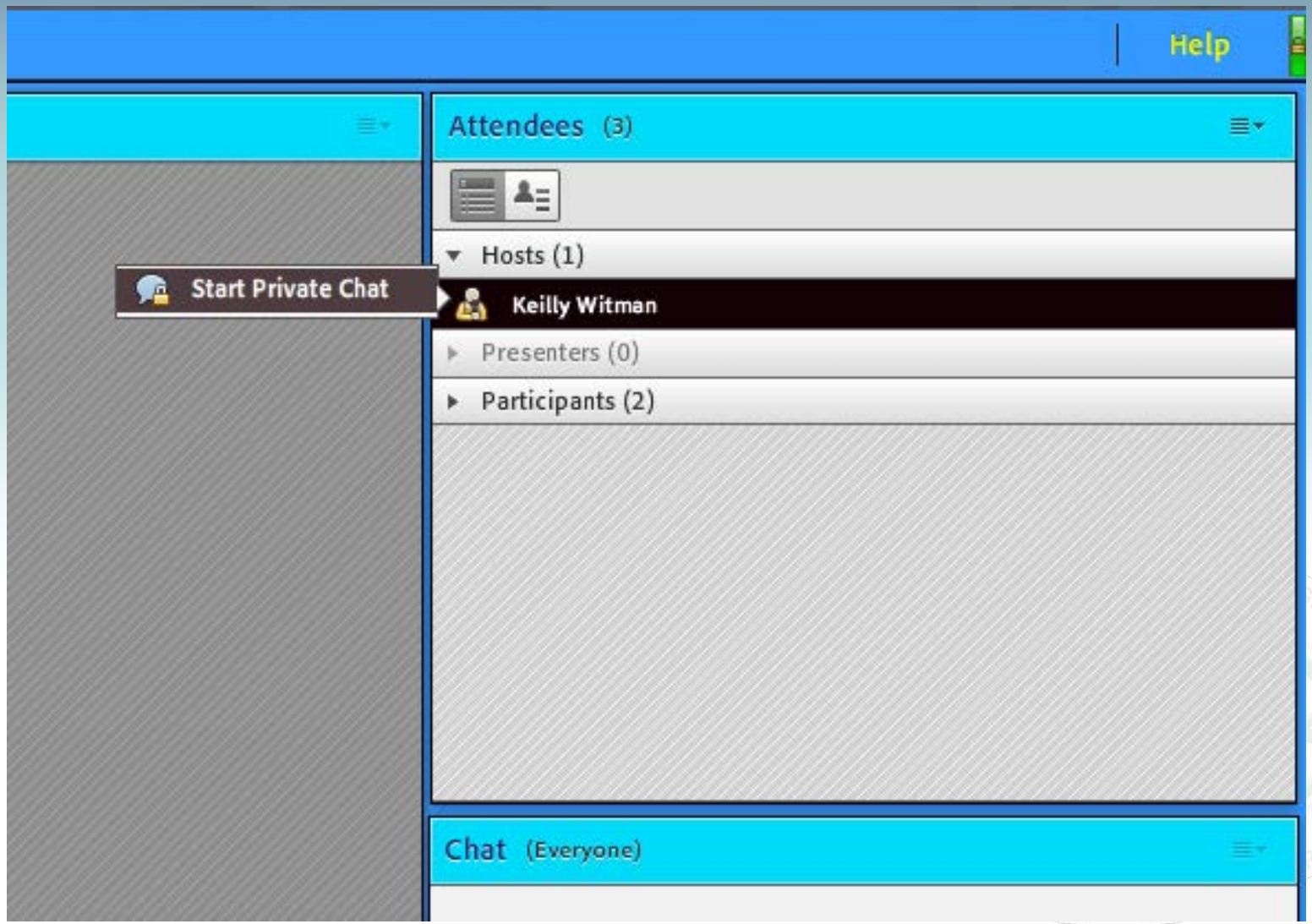
Welcome / Webinar Etiquette

- Webinar is being recorded
- Recording will be available on GreenChill LinkedIn site and GreenChill website, under "Events and Webinars": www.epa.gov/greenchill
- Phones are muted (#6 to unmute)

Q & A

- Q&A session after presentation
- Submit your questions using CHAT at anytime; we'll go through them during Q&A
  - If you'd like to remain anonymous, send your question by CHAT to Keilly Witman instead of to all participants
- Raise your hand during Q&A (hand button is on the upper right part of the screen)

Sending Questions via Chat



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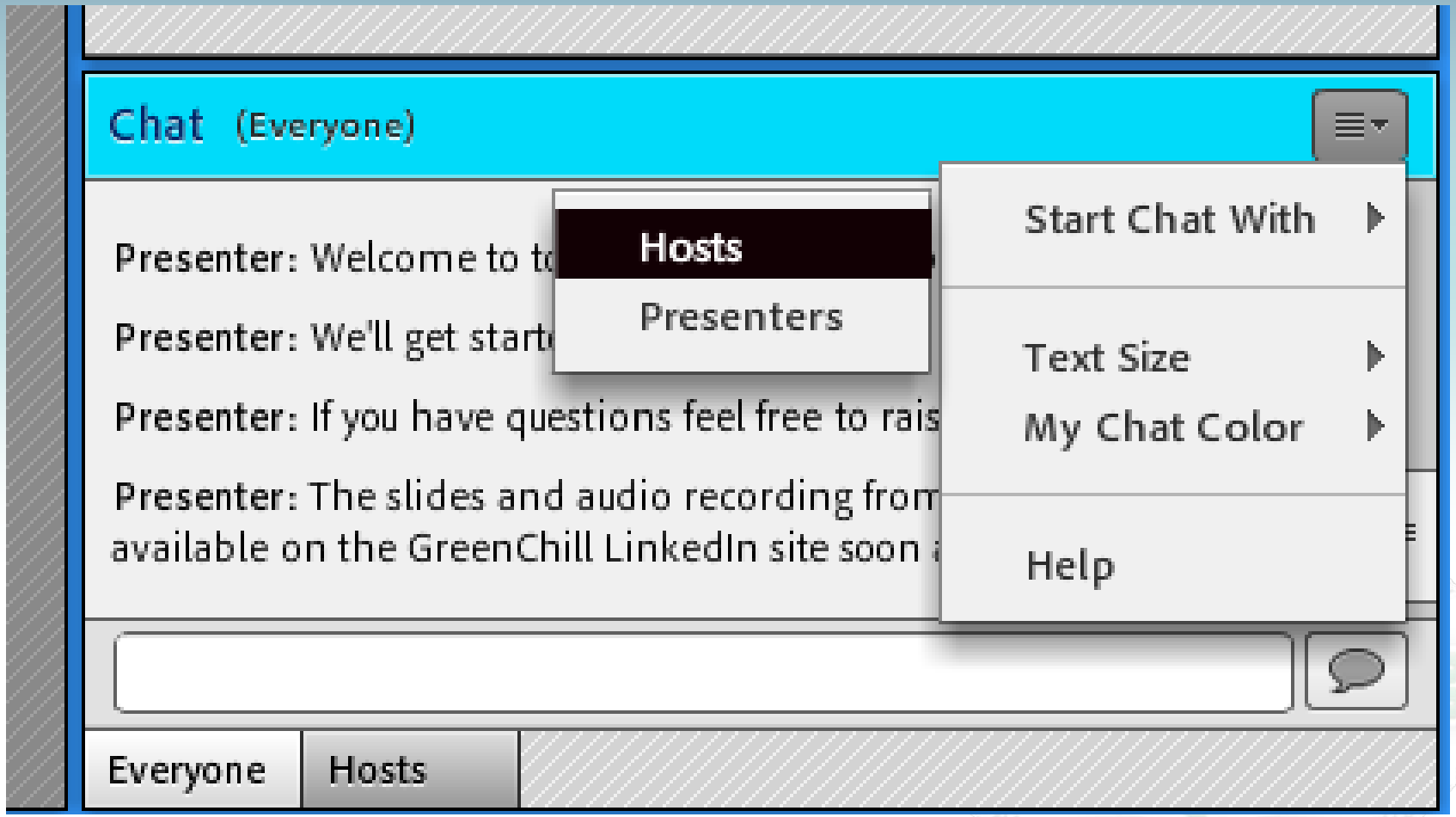


Raising Your Hand

Please Note!

- GreenChill and EPA do not endorse products or companies.
- The information in the webinar is from the presenters. It is not verified by GreenChill or EPA.
- The opinions of the presenters are their own, and they do not represent GreenChill or EPA.
- We are not webinar-ing experts.

Today's speakers…

George Ronn
SUPERVALU

George Ronn
SUPERVALU
Office: 651-779-4098
Email: george.h.ronn@supervalu.com

George Ronn is the Senior Manager of Refrigerant Compliance and Control Systems at SUPERVALU. He manages refrigerant compliance activities for SUPERVALU, which includes training in-house service technicians and outside contractors on the company's expectations regarding leak repair and refrigerant use in 1,500 stores across the country. In his role, he is also responsible for leak reduction measures, including the R-22 Initiative referenced in this presentation.

Richard Heath
SUPERVALU

Richard Heath
Director Energy Innovations & Projects
SUPERVALU
Office: 208-380-4361
Email: richard.heath@supervalu.com

Richard Heath and his team in Boise work with OEMs, design engineering firms, and government agencies to develop and validate technologies needed to meet enterprise and industry sustainability goals and requirements. His team also manages all energy efficiency projects and is responsible for meeting corporate energy reduction goals.

Caleb Nelson
CTA

Caleb Nelson
Mechanical Engineer
CTA
Office: 406-258-7325
Email: calebn@ctagroup.com

Caleb Nelson is a Mechanical Engineer and one of CTA's group managers specializing in refrigeration systems for commercial applications. One of the main goals of his group at CTA is to lead the industry in providing unique solutions for end-users to meet their own efficiency and stewardship goals. The use of natural refrigerants has played an essential role in meeting those goals and has been a primary focus for Caleb for the past several years. Caleb is an active member of the IIAR and continues to seek out ways to fine tune the use of NH3 and other natural refrigerants for commercial use.

Journey to Net-Zero

NREL
NATIONAL RENEWABLE ENERGY LABORATORY

BETTER BUILDINGS CHALLENGE

SUPERVALU and GreenChill

- Superior Goal Achievement – 2008, 2009, 2010
- Distinguished Supermarket Partner – 2009, 2011
- Best of the Best Award
  - Shaw's/Star Market Chestnut Hill, MA – 2010
  - Albertsons Carpinteria, CA – 2012

SUPERVALU and GreenChill

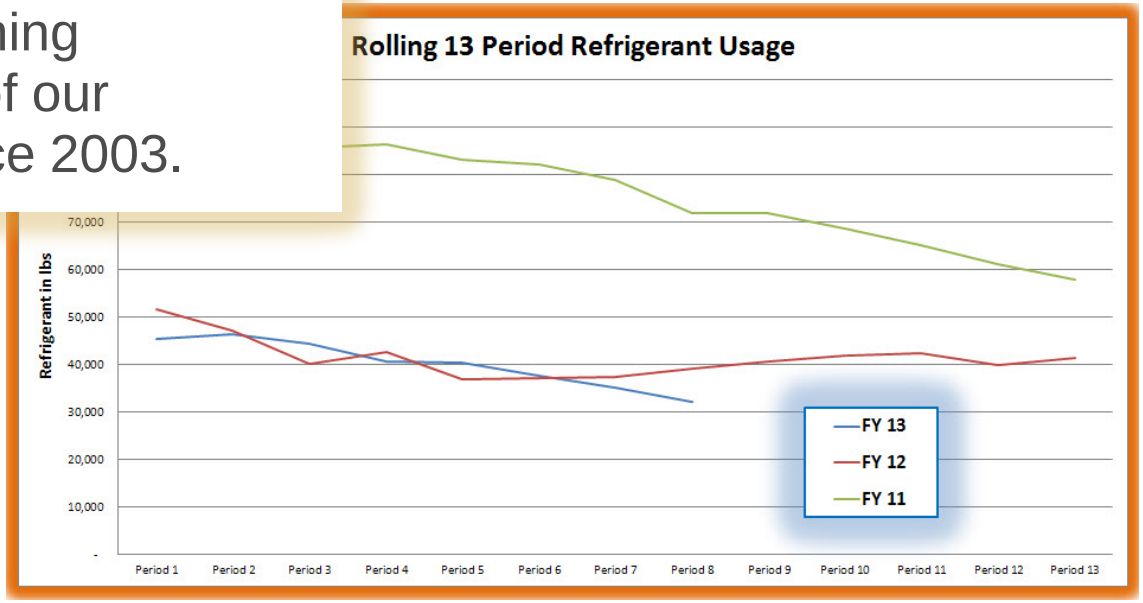
- First GreenChill Certified Store - Gold
  - Cub Foods Phalen – December 2008

- First GreenChill Platinum Certified Store
  - Shaw's/Star Market – Chestnut Hill, MA - September 2009

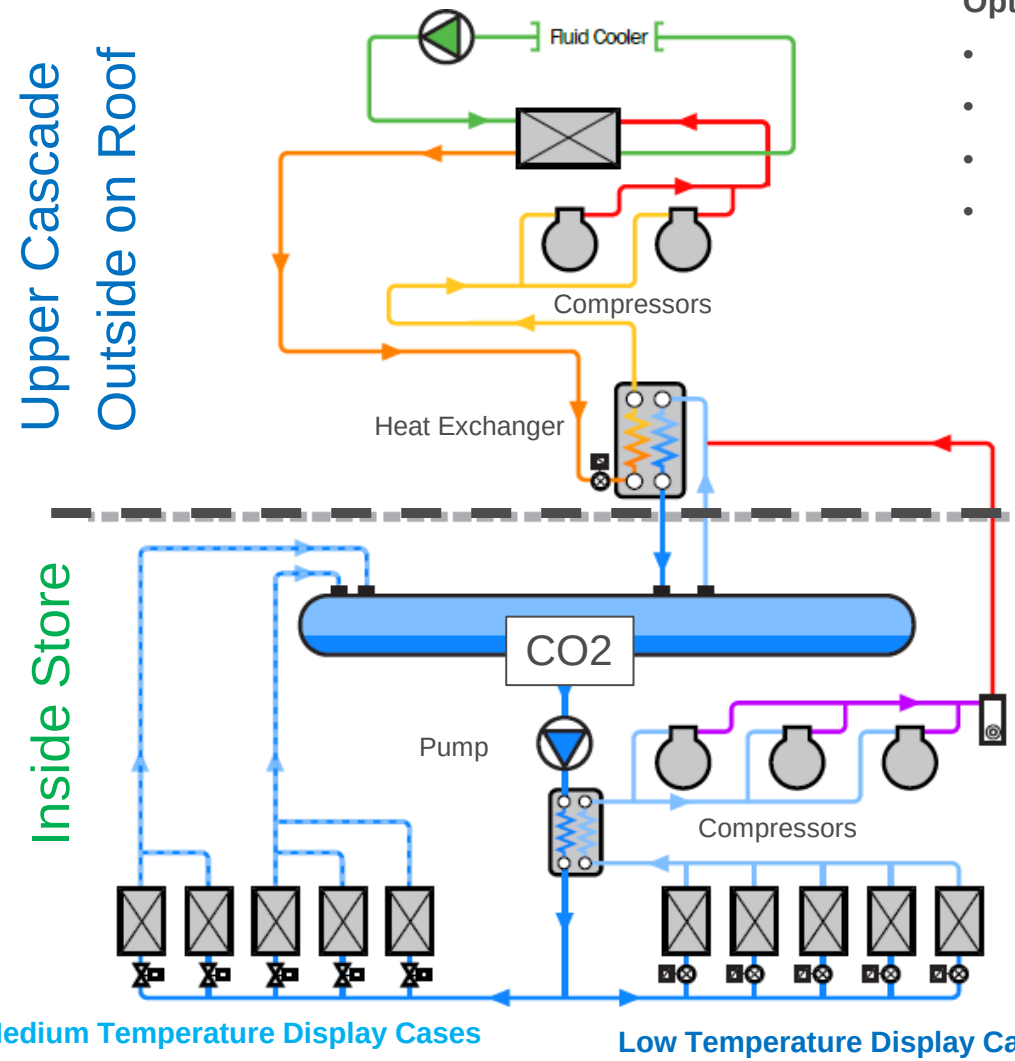
- First Natural Refrigerant Store
  - Albertson's – Carpinteria, CA - July 2012

SUPERVALU and GreenChill

- Reducing refrigerant use year-over-year is one of our facility team's 3 key metrics; and our individual and collective annual performance is measured against it within SUPERVALU!
- Re-enforced after joining GreenChill, but part of our corporate culture since 2003.



Journey to Zero Direct Emissions



Options for the Upper Cascade System:

- Low-charge **Synthetic** Refrigerant **(Existing Assets)**
- **Natural** Ammonia (NH3) Chiller. **(NEW Assets)**
- **Natural** Hydrocarbon **(NEW Assets)**
- Future ???

10%
Total Charge

90%
Total Charge

Using CO2 as the in-store refrigerant eliminates 90% of the non-natural refrigerants:

- This is a feasible and proven technology available for all supermarket projects now.

Better Refrigerant, Better Environment, and We Know it Works

Don't reinvent the wheel

Supermarket Distribution Center
Anywhere, USA

Albertsons Supermarket
Carpinteria, California

Ammonia has been used as a refrigerant far longer than **any** of the Synthetic Refrigerants.

We do not need to prove that it works; we need to prove that we can apply the technology to Supermarkets, validate the benefits, and determine the feasibility point.

NH3 System Design Development

- Why Reciprocating Compressors?
  - Proven, work-horse of Industrial systems for decades.
    - Simple, Cheap & Familiar
  - Full and part load efficiency
- Why Open-Drive?
  - Efficiency
  - Recip. application range (high discharge temps with NH3)
  - Small leakage through shaft seal is insignificant and not an issue.
- Why Flooded Evaporator?
  - Efficiency
    - No “Hot Spots”
    - Practically no superheat at compressor suction
  - Allowed use of standard Non-miscible, Mineral Oil.
    - Able to use and Automatic Oil Return System.

NH3 System Design Development

- Challenges with Dry Expansion and Miscible Oil
  - Evaporator loses efficiency
  - Miscible Oils such as PAG are very Hygroscopic! …So is NH3.
  - Need superheat to separate miscible oil and NH3.
    - Compressor Efficiency
    - Reciprocating Application Range
  - Specific Volume of NH3—approximately 6 times R-22 or R404a

***A Dry Expansion System boasts many attractive benefits, but not without concerns that must be addressed.**

Real vs. Perceived Obstacles

• Regulations	• Keep Charge below 500 pounds
• Safety	• Standard OSHA Requirements
• Energy Use	• > 25% Increase in Efficiency
• Design Complexity	• Use Dedicated System Engineering vs. Equipment OEM
• Operational Complexity	• Very similar to standard DX Racks
• Controls Complexity	• Need to work with Control OEMs to develop canned packages similar to existing refrigeration controls.
• Service Contract Cost • First Cost Premium	• Here's our Hurdles: Costs are prohibitive at this point for large scale roll-out.

Environmental and Financial Viability of 100% Natural Refrigeration

The Carpinteria refrigeration system is a Cascade design with CO2 as the in-store refrigerant:

The CO2 is cooled by the Upper Cascade located on the roof .

- For the Upper Cascade on this project we have (2) independent technologies; Ammonia (NH3) and R-407A.
- NH3 cascaded with CO2 provides us with a 100% natural solution. This is the first application for NH3 in supermarket commercial refrigeration in the U.S.
- The overall feasibility and lifecycle environmental benefits of NH3 will be evaluated with this project.
- The R-407A system is installed for the sole purpose of direct comparison and real-time validation of the expected benefits of the NH3 system.

Working with the DOE and EPA through GreenChill and NREL, we will conduct a complete comparative analysis of the two options. The result will be a validated Total Equivalent Warming Impact (TEWI) for both options and the results will be shared with the industry.

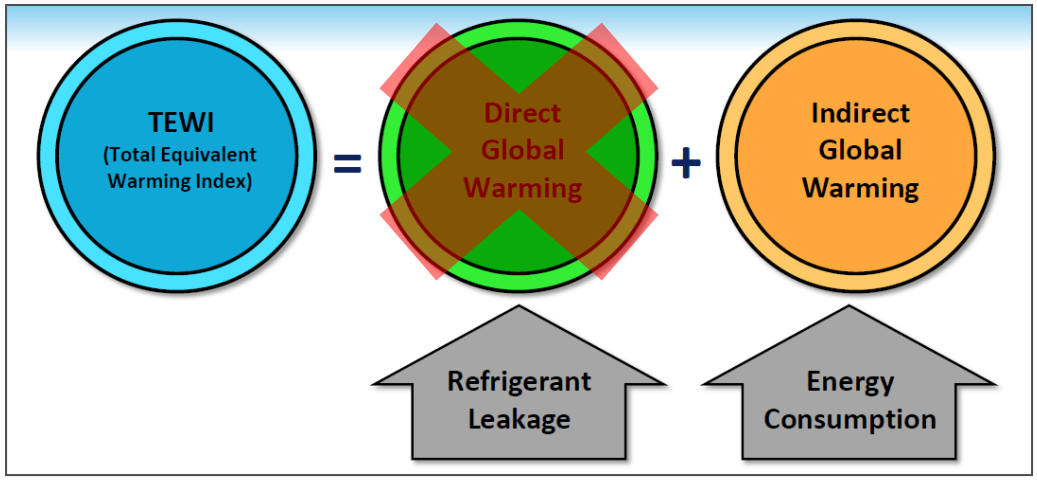
U.S. ENVIRONMENTAL PROTECTION AGENCY GREENCHILL ADVANCED REFRIGERATION PARTNERSHIP

NREL NATIONAL RENEWABLE ENERGY LABORATORY

Additional System Information

- Charges:
  - R717: 300#.
  - R407a: 350#
  - R744: 1600#
- Capacities:
  - C02 Combined System: Approx. 70 TR (Low and Med Temp)
  - R407A & NH3 Systems: Approx. 85 TR (+13 evap)

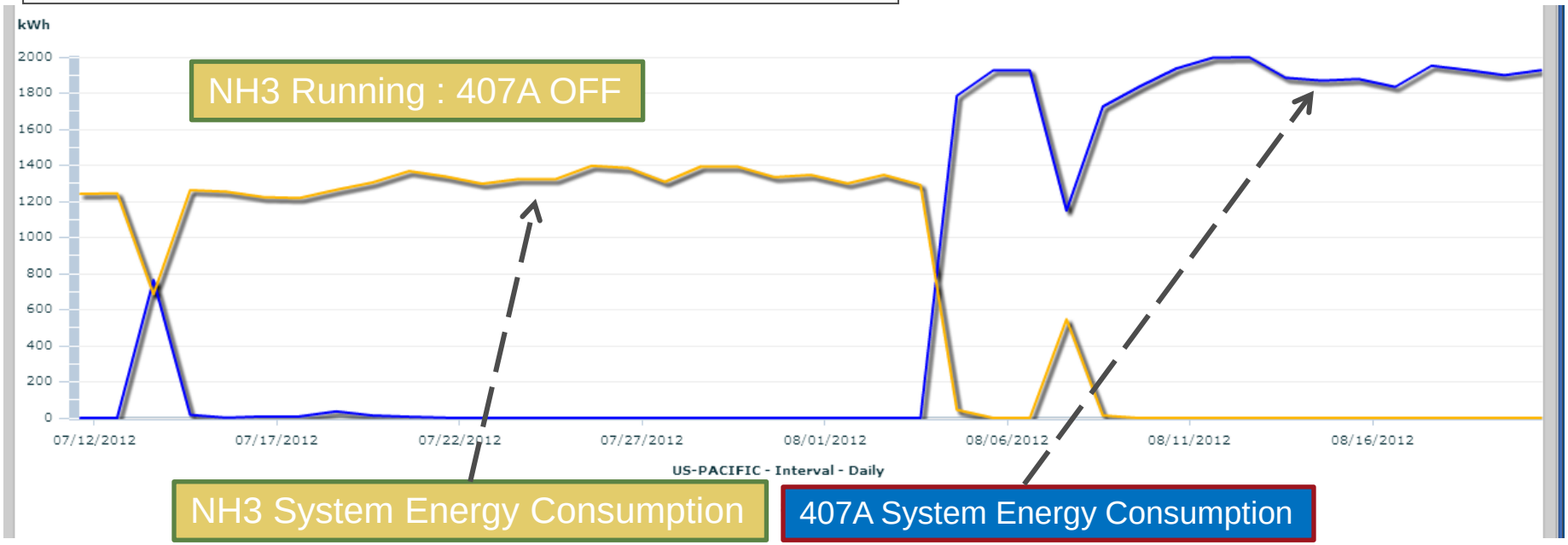
Use of All-natural Refrigerants Reduces TEWI both Directly and Indirectly!



The all-natural refrigeration solution deployed at the Carpinteria store reduces the primary refrigeration energy by >25%.

And eliminates all Direct Emissions.

407A System Running : NH3 OFF



NH3 vs 407A Daily Energy Use Comparison

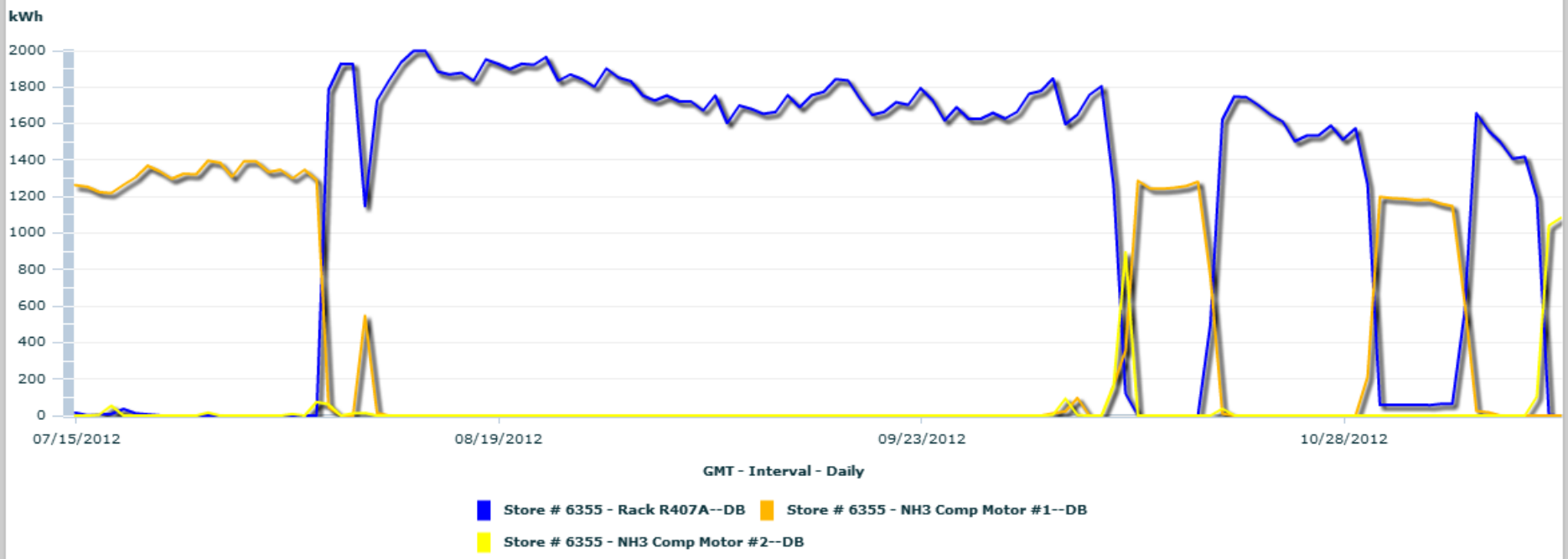
(Actual Data to-date as of 11/14/2012)

Start Date: 07/14/2012 End Date: 11/14/2012 D W M Q Y

Interval: Daily Time Zone: GMT

Serial No.	Channel	Name
001EC6001910012	5	Store # 6355 - Rack R407A--DB
001EC6001910019	5	Store # 6355 - NH3 Comp Motor #1--DB
001EC6001910020	5	Store # 6355 - NH3 Comp Motor #2--DB

Clear Channel List | Remove Channel(s)



SUPERVALU's Commitment

BETTER BUILDINGS CHALLENGE

Better Buildings CHALLENGE
U.S. DEPARTMENT OF ENERGY

U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

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Carpinteria remodel produce area

ALBERTSONS CARPINTERIA REMODEL & EXPANSION

Showcase Project: SUPERVALU

LOCATION
Carpinteria, CA

PROJECT SIZE
Original: 18,850 SF; Final: 40,200 SF

Annual Energy Use (Source EUI)

Baseline (2010)	798 kBtu/sq. ft.
Expected (2012-13)	558 kBtu/sq. ft.
Actual	COMING SOON

Expected Energy Savings: 30%

Annual Energy Cost

Baseline (2010)	$340,000
Expected (2012-13)	$240,000
Actual	COMING SOON

Expected Savings: $100,000