Energy Efficiency in Supermarkets

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Overview

- Supermarkets are Unique
  - high energy use, unique systems, etc
- Using Simulations to Predict Savings
  - examples using SST
  - what’s coming in the future (E+)
- Examples of Promising Improvements
  - floating head pressure, mechanical subcooling
  - Heat recovery, suction pressure reset
CDH Supermarket Experience

- Research Projects Evaluating Energy Efficiency
  - Combined heat and power (subcooling, heat recovery)
  - Dehumidification (desiccants, mechanical, etc)
  - Advanced refrigeration system concepts (defrost, controls)

- Developed Computer Simulation Tool (SST) to Predict Annual Energy Impacts
  - Developed for EPRI
  - Models Refrig/HVAC/Building interactions
  - Verified model with data from several supermarkets
  - Used SST to accurately predict energy and cost savings
Commercial Buildings are Not All the Same

End-Use or On-Site Energy Use

Commercial Buildings - 1995 CBECs

Energy Intensity (MBtu/ft²)

- Office
- Mercantile and Service
- Education
- Health Care
- Food Service
- Warehouse and Storage
- Food Sales
- Public Order and Safety

- Other
- Lighting
- Water Heating
- Space Cooling
- Space Heating
Energy Cost By Building Type

Commercial Buildings - 2003

$1.80/sq ft for all Commercial
Supermarket Benchmarking

• Have Worked with Supermarket Chains to Analyze and “Rank” Fleet of Stores
  – Identify problems and opportunities
  – Provides high level view of where efforts should be focused
  – Provides a basis for normal operation
CHP in Supermarkets

- Supermarkets have consistent electric loads
- Significant heat loads due to case credits
- CHP can also meet other thermal loads:
  - Preheating air for gas-fired desiccant (Waldbaums, NY)
  - Absorption chiller for liquid subcooling (TX)
  - Fuel Cells with Abs. Chillers
Supermarket Simulation Tool - SST

• A Windows-based hourly building simulation model that simulates modern supermarkets:
  – building envelope and internal loads
  – refrigeration systems
  – HVAC systems
  – water loop
• “Icon-based” software application
SST Analysis Example: “Floating” Head Pressure

Minimum Condensing Temperature

Annual Refrigeration Energy (MWh)

Minneapolis
Atlanta
Oklahoma City

16C Med / 4C Low
16C Med / 10C Low
16C
21C
27C
32C
Subcooling with Chilled Water

Chilled water provided by Absorption Chiller
Benefit of Liquid Subcooling

Displaces 10-30% of refrigeration load from low-temp compressors
Mechanical Subcooling

Evaporator

Subcooler

Expansion Valve

Receiver

Condenser

Head Pressure Control

Medium Temp. Compressor

Low Temp. Compressor

Evaporator

Subcooler

Expansion Valve

Receiver

Condenser

Head Pressure Control