Refrigerants and Refrigeration Plant Design The Path Forward

Coles



Coles Overview

- Full Line Supermarket Retailer
- Operating Since 1914
- Australia Wide Footprint
- 780 Supermarkets
- 110,000 plus Team members
- Wesfarmers Owned (November 2007)
- FY15 38.2b Revenue
- One of Australia's Largest Refrigeration
 - Plant Operators



Current Standard R134a/Co2 Hybrid

COMBINED COOLING PLANT (LARA)



R134a/Co2 Hybrid CCP Plant Integration of Mechanical /Refrigeration plant simplifies installation and maintenance

- Store Count 120 plus
- Plant Designed to Retrofit HFC to low GWP Refrigerant once tested & approved
- Plant Refrigerants
 - Low Temperature Sub-Critical Co2
 - Medium/High Temperature & A/C R134a
- Number of Racks Three
 - 2 off Med/High Temperature
 - 1 off Low Temperature
- Store Load Diversification per Rack
 - High-Medium Temperature Plants
 - 50% Low Temperature Condensing
 - 50% Med/High Temperature Loads

A little better every day

50% Air-Conditioning

Trial Transcritical Parallel Compression System

COMBINED COOLING PLANT COBURG NORTH



Brief: Replicate current standard with a Natural Solution

Transcritical Plant Specifics

- Store Count One
- Plant Refrigerant Co2
- Number of Racks Two
- Store Load diversification, 50% per Plant
 - 50% Medium/High Temperature Refrigeration
 - 50% Low Temperature Refrigeration
 - 50% Air-Conditioning
- 620kWr Total Store Refrigeration Duty
 - 250kWr Chilled Water A/C Duty
 - 40kWr Low Temperature Refrigeration Duty
 - 330kWr Medium Temperature Refrigeration Duty



Coles Refrigeration

TRANSCRITICAL TRIAL RESULTS

Coburg North V's Lara "First 6 Months"

Parameter	Coburg North 7919S	Lara 7776S	% Diff
Climate Zone	6	6	
Age (months)	7	15	
SLA (m2)	2995	2151	28%
Total kWh	421700	485496	-15%
Avg Temperature	18.3	17.7	3%
Avg kWh Open	118.80	135.11	-14%
Avg kWh Close	89.92	109.49	-22%
Avg kW Demand	112.78	129.77	-15%
Refrig Design Load (kW)	621	629	-1%
Theoretical COP	5.51	4.85	12%

<u>Co2</u>

- Coburg North Transcritical plant delivered a <u>15% energy reduction</u> over Lara
- Combined Cooling Plant an average consumes 67% of total store power

Hydrocarbon Water loop

- Proof of concept in Liquor Format
- Results being validated
- Next step Cost Modelling for larger application



The Journey to Date

REFRIGERANTS



Refrigeration Plant Options

NEW & EXISTING PROS / CONS



Walk Both Paths & Mitigate Risk to Business



Coles Refrigeration Estate

OVERVIEW

- Coles Estate Plant Configuration
- Number of Supermarkets
 - 780
- Plant Refrigerants Present
 - HFC, HCFC, HFC/Natural Cascade (Hybrid)
- HCFC's phased out of refrigeration plant FY16
- Current Standard R134a/ Co2 Cascade (Hybrid)
- 120 R134a/Co2 Hybrid Plants
- 660 Previous HFC Plant Configuration
- Lose European Example using 15 Year Phase Down on HFC's (R404a)
- Constant Store Count
- 35 Store Refrigeration Plant Replacement Per Year
- Challenges....
- Large Capital Program
- Potential Exposure of 135 Refrigeration Plants after 15 Years
- Plant less than 10 years old (WDV)

HFC / Natural Hybrid HFC HCFC



Store Count of 135 Sites post 15yr Phase Out

HFC Plant

Coles Next Steps

THE PATH FORWARD

In conjunction we are running three streams of innovation in refrigeration and two for air conditioning;

Refrigeration

- 1. Develop Transcritical Co2 Plant Design
 - 1. Refine plant design
 - 2. Plan for another two stores
 - 3. Drive for Cost Parity
 - 4. Continue to drive the upskilling of Maintenance Assets
- 2. Develop Water loop
 - 1. Quantify Coburg Liquor results
 - 2. Model solution in supermarket
- 3. Continue Deploy Current Standard (HFC/Co2 Hybrid)
 - 1. Continue to trial HFO's
 - 2. Lowest GWP / Highest Efficiency
 - 3. Retro fit existing estate inline with internal and external forces

Air-Conditioning

- 1. New Plant, (Existing Fleet), Hydrocarbon / Ammonia
 - 1. Low Charge
 - 2. Highest Efficiency
 - 3. Highest Capacity
- 2. Existing Plant, HFO
 - 1. Low GWP
 - 2. Highest Capacity / Highest Efficiency
 - 3. Retro fit existing estate inline with internal and external forces

