ATMOsphere AMERICA
business case
natural refrigerants
25 & 26 June - Atlanta, Georgia

Rob Arthur, PE/PEng
CTA Architects Engineers
Principal

Natural Refrigerant Technologies

A Design Consultants Perspective

#1 Company Profile

CTA Architects Engineers

400+ person Architectural Engineering Firm

17 Offices

Work National and International

Refrigeration Engineering Division
20+ Engineers/Designers/Commissioiners

Project Role - Engineer of Record

#2 Projects

Albertsons

- Carpinteria, CA (NH3/CO2 Cascade)
  - Greenchill Platinum
  - First 100% Natural Refrigerant Grocery store in the United States

DeCA

- San Antonio, TX (NH3/CO2 Cascade)
- Kanto Plains, Japan (NH3/CO2 Secondary)

Walgreens

- Chicago, IL (Transcritical CO2)

Wholefoods

- Northern CA (Transcritical CO2 in Design)
- Multiple Secondary Glycol Systems

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#2 Projects

Target

Columbia, MS (R134a MT/CO2 Cascade LT)
Los Angeles, CA (R134a MT Secondary Glycol/LT CO2 Cascade)

Walmart

Multiple R-407a MT Secondary Glycol/LT CO2 Secondary

SuperValu

Boston, MA (First Greenchill Platnium Store)
(R404a MT Secondary Glycol/LT Secondary CO2)
Multiple MT Secondary Glycol

#3 Reasons for Change

Why Movement to Natural Refrigerant Systems

Concerns with high GWP Refrigerants

- Leak rate concerns
  - Global Warming
  - Cost of Refrigerant
  - EPA Penalties
- Conversion
  - Avoid future refrigerant conversions
- Energy Reduction
- All Advanced Refrigeration systems
  - Reduce amount of high GWP refrigerant charge
  - Utilize a lower GWP refrigerant
  - Eliminate high GWP refrigerant

#3 Reasons for Change

Progression to address High GWP refrigerant charge

- HFC Distributive Systems
- HFC MT Secondary Glycol Systems
- HFC LT Secondary CO2 Systems
- HFC/LT CO2 Cascade/MT Secondary CO2
- NH3/LT CO2 Cascade/MT Secondary CO2
- Transcritical CO2 Booster System
- Enhanced Transcritical CO2 Booster System
- Hydrocarbon Micro Distributive

#4 Refrigeration Design

Advanced Refrigeration System Design

- Build time into schedule for full development
- Bring all stake holders together
- Designate one controls manufacture and integrated them early in the design process
- Utilize Refrigeration Consultant/Vendor as hub that receives, distributes and coordinates with all stake holders.
  - Owner
  - Architect/Engineers
  - Equipment Manufacturer
  - Controls Manufacturer
  - Contractor

#5 Benefits

Benefits of a Natural Refrigerant System

- Lowest Life Cycle Costs for some system types.
- No more major Refrigerant Conversions every 10 to 15 years.
- Energy Efficiency (in the right application)
- Environmental Benefits
- Future Proofing
  - Phase Outs, De-Listing, Taxes, Fines, Charge Limits
  - When there is a cost/penalty for CO2 emissions this will change all the financial equations and business cases for natural refrigerant systems.

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#5 Benefits

	R-407a Central System	R-407a Distributed System	R-407a Med Secondary Glycol Low Secondary CO2	R-407a Med Secondary CO2 Low Secondary CO2
Life Cycle Cost	**100%**	**98%**	**113%**	**104%**
TEWI Direct (metric Ton CO2-e)	14,715	9,479	2,141	2,142
TEWI Indirect (metric Ton CO2-e)	18,053	18,053	20,761	18,053
TEWI Total (metric Ton CO2-e)	32,768	27,531	22,901	20,194
TEWI % of Baseline	**100%**	**84%**	**70%**	**62%**

		R-407a High Side Med Seconday CO2 Low Cascade CO2	NH3 High Side Med Seconday CO2 Low Cascade CO2	Med/Low Transcritcal CO2 Booster
Life Cycle Cost		**98%**	**114%**	**96%**
TEWI Direct (metric Ton CO2-e)		2,142	1	3
TEWI Indirect (metric Ton CO2-e)		16,247	15,345	15,345
TEWI Total (metric Ton CO2-e)		18,389	15,346	15,347
TEWI % of Baseline		**56%**	**47%**	**47%**

#6 Future

What Future Holds

- Don't believe Advanced systems of the future will look like current advanced refrigeration systems of today.
  - Standardized
  - Assembly Line
  - Modules
  - Off the shelf package units
  - Less customization

#6 Future

System Types

- LT Cascade/MT Secondary CO2
  - Ammonia or Hydrocarbon over CO2
  - Low GWP Synthetic over CO2
- CO2 Transcritical/CO2 Enhanced Transcritical
- Micro Distributive

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