



State of The Industry

Heatcraft Worldwide Refrigeration

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Global Leader – Center of Excellence for Alternative Systems





Heating & Cooling

Residential

Commercial



Refrigeration



\$2.95B in revenue

Products	Split Systems (AC, Heating) Indoor Air Quality Fireplaces	Package Rooftop Units Split Systems	Package Rooftop Units HVAC Chillers Split Systems	Food Preservation Industry Cooling
Geography	US / Canada	US / Canada	Europe EMEIA	Global
2012 Revenue (\$USD millions)	\$ 1376	\$ 785		\$ 788



#2

State of The Industry

Heatcraft Global Products and Brands

Americas

Europe

Asia Pacific / Australia

BOHN

CLIMATE CONTROL

CHANDLER
REFRIGERATION

LARKIN

KYSOR/WARREN

HYFRA
PEDIA

FRIGA-BOHN

HK REFRIGERATION

BOHN

BOHN

BOHN

KIRBY



- Europe
 - European F-Gas Regulations
 - 79% HFC phase down by 2030
 - Bans on new equipment with GWP > 150
- USA
 - Regulations that start in Europe Quickly Migrate to California
 - California Energy Commission (CEC)
 - California Air Resource Board (CARB)
 - Regulations that start in California Quickly Migrate to US Federal
 - US Department of Energy (DOE)
 - US Environmental Protection Agency (EPA)
- Australia
 - Carbon Tax Levy
 - Based on GWP equivalent CO2 of refrigerant
 - 3 to 5 times increased cost of refrigerants

List price example per kg (2.2 lbs.)

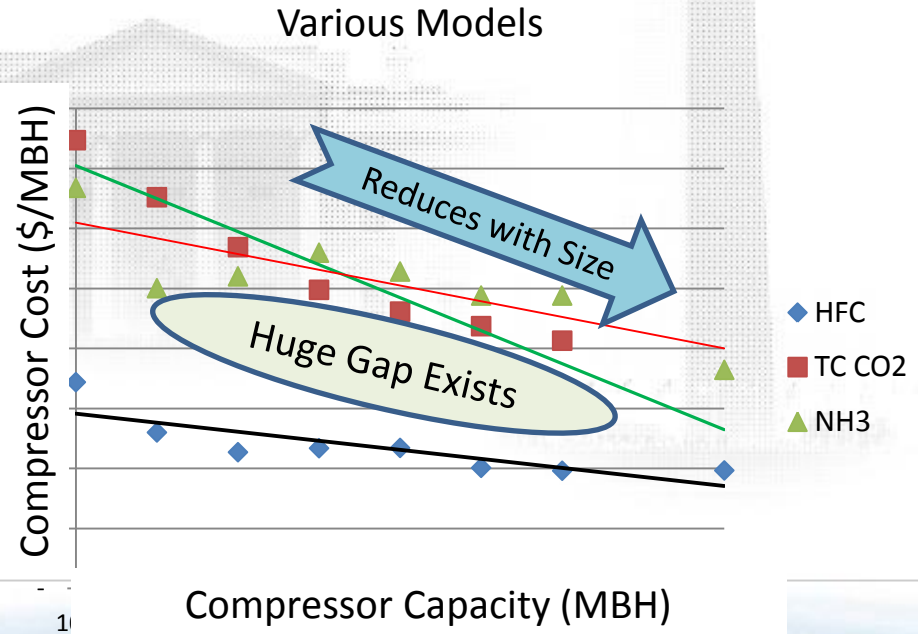
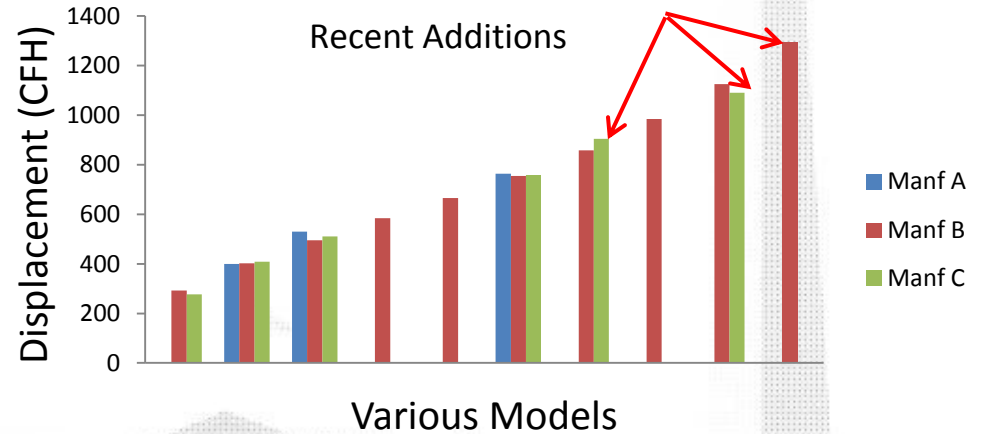
Refrigerant	June 2012	Nov2012
R-134A	\$ 16	\$ 54
R-404A	\$ 21	\$ 84



Compressor Capacities

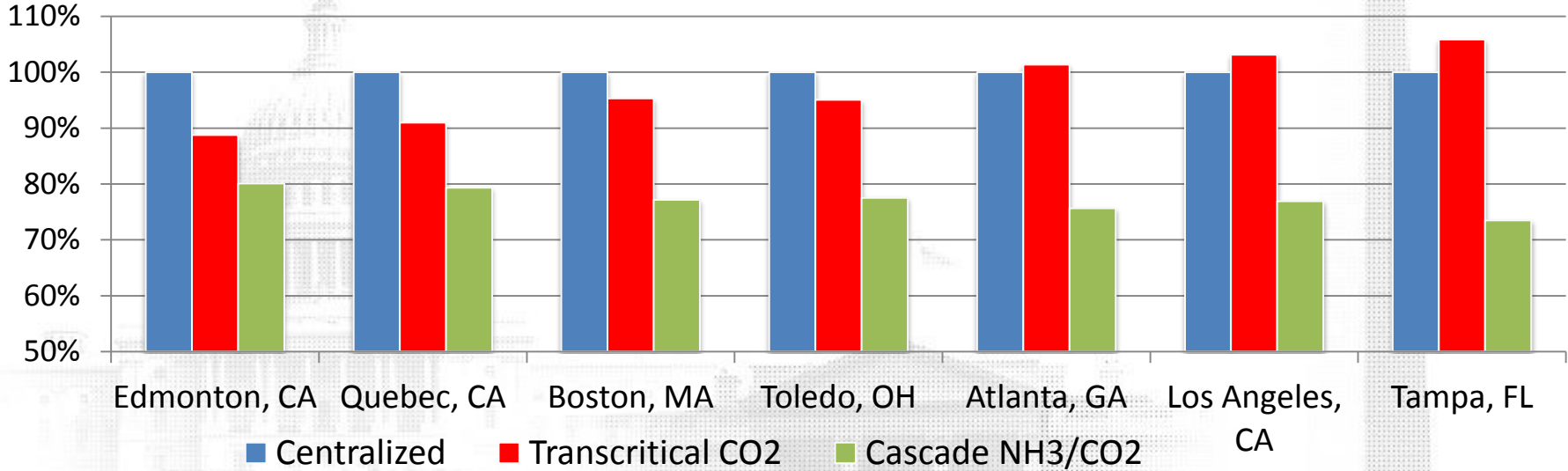
Component Availability

- Supplier base is increasing
- Lack of economies of scope and scale
- Gap exists in product range
- Costs are driving down
- Regulatory / Standards
 - UL WG has approved provisions for CO2 trans-critical.
 - In last 6 months, 3 major compressor manufactures obtained UL approval of trans-critical compressors.
 - ASHRAE 15 update for CO2 trans-critical is yet to be done



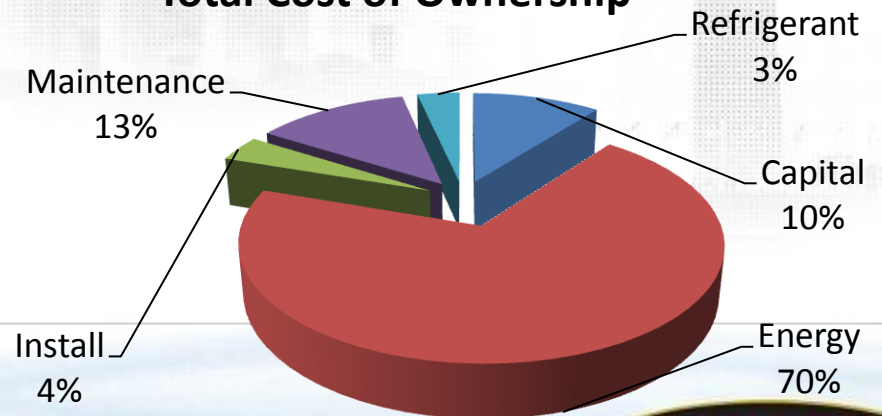
#5 Energy Efficiency & Costs

Energy Comparison



- Natural refrigerants have an energy efficiency advantage.
- Transcritical CO2 trails behind in warmer climates

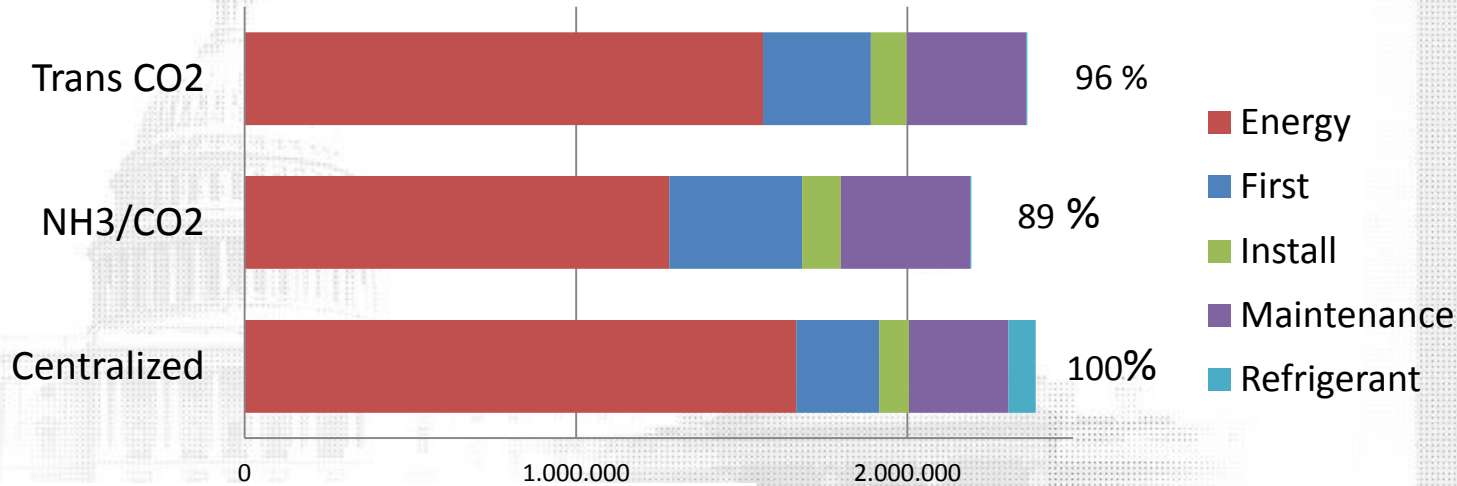
Total Cost of Ownership



System Concept	Centralized (Baseline)	Cascade	Trans-critical Booster
Refrigerant	R404A	R717/R744	R744
LT Load (MBH)	373	373	373
MT Load (MBH)	1095	1095	1095
Rack SST LT/MT	-23 / 18	-18/ 24	-18 / 24
Heat Rejection Method	Air Cooled	Water Cooled	Gas Cooler
Condenser TD	15 MT / 10 LT	12 F	3 F

- Location : Toledo, Ohio
- Pack Calculation II Software for BIN analysis, .

TCO - Business Case for Natural Refrigerants



U.S. Residential Electricity Price



Natural refrigerants hedges against uncertainty due to refrigerant cost increase / taxes on HFC / increase in energy cost

In the last decade energy prices increased by 50% : Future predictions ?



- Installation costs : Conflicting information. Practical costs are perceived higher.
 - Lack of familiarity / awareness by the contractors – not allowing real cost savings and adding uncertainty
- Training of Service Technicians
 - Training centers by OEM's / Equipment Manufacturers
 - Ammonia Certification by GCAP etc
- Cost of Training
 - Range between \$ 1500 to \$ 4000





ATMO
sphere
the Business Case

natural refrigerants

Thank you!