



*Opportunity Through Adversity:
Natural Refrigerants in North America*

#1

Everywhere you look...



“...ammonia is environmentally benign...and offers superior thermodynamic properties, cost and self-alarms odor (unlike natural gas, ammonia is its own warning agent). These facts suggest that the expanded use of ammonia as a refrigerant in light of the HCFC situation is not just highly worthy of consideration, but necessary and practical.”

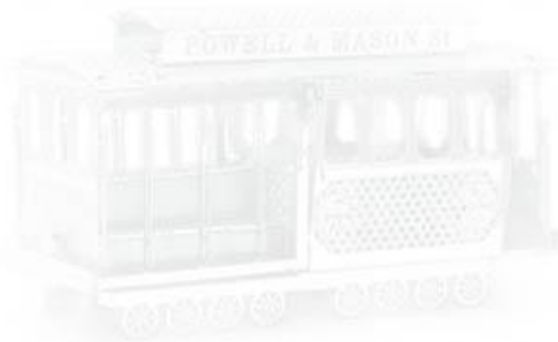
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-Forum: Ammonia as an alternative refrigerant
ASHRAE Journal December 1990 p27 ff

- NH₃/CO₂
- Water
- CO₂ Heat Pump
- NH₃ Heat Pump



- Trending Observations
 - Industrial
 - Dominated by conventional ammonia refrigeration
 - Strong drive to find charge reduction solutions
 - Commercial
 - Strong interest in natural refrigerants, but hesitant to adopt a complete solution
 - Great opportunities for “whole store solution” (hot and cold)



- Technical viability of natural solutions proven
- 2nd Generation solutions moving to market
- Greatest adoption risk remains economics

- Ability of equipment and service providers to establish a viable economic model of implementation critical to advance past demonstration projects

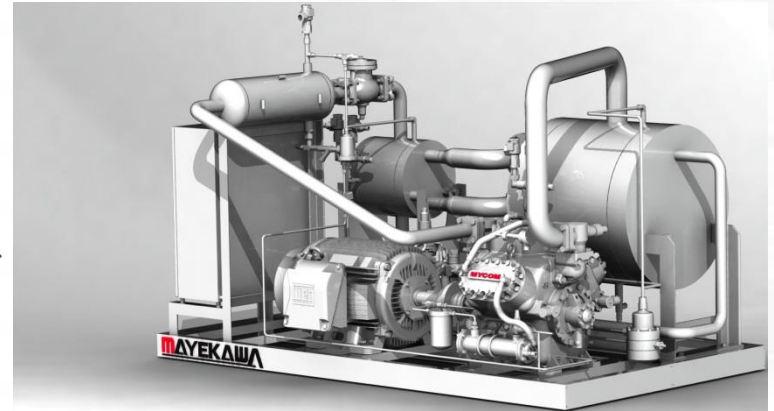
- Continued engagement on the part of all stakeholders to continue to advocate natural solutions

- Join us in the Food & Retail Session for a more detailed discussion

#6

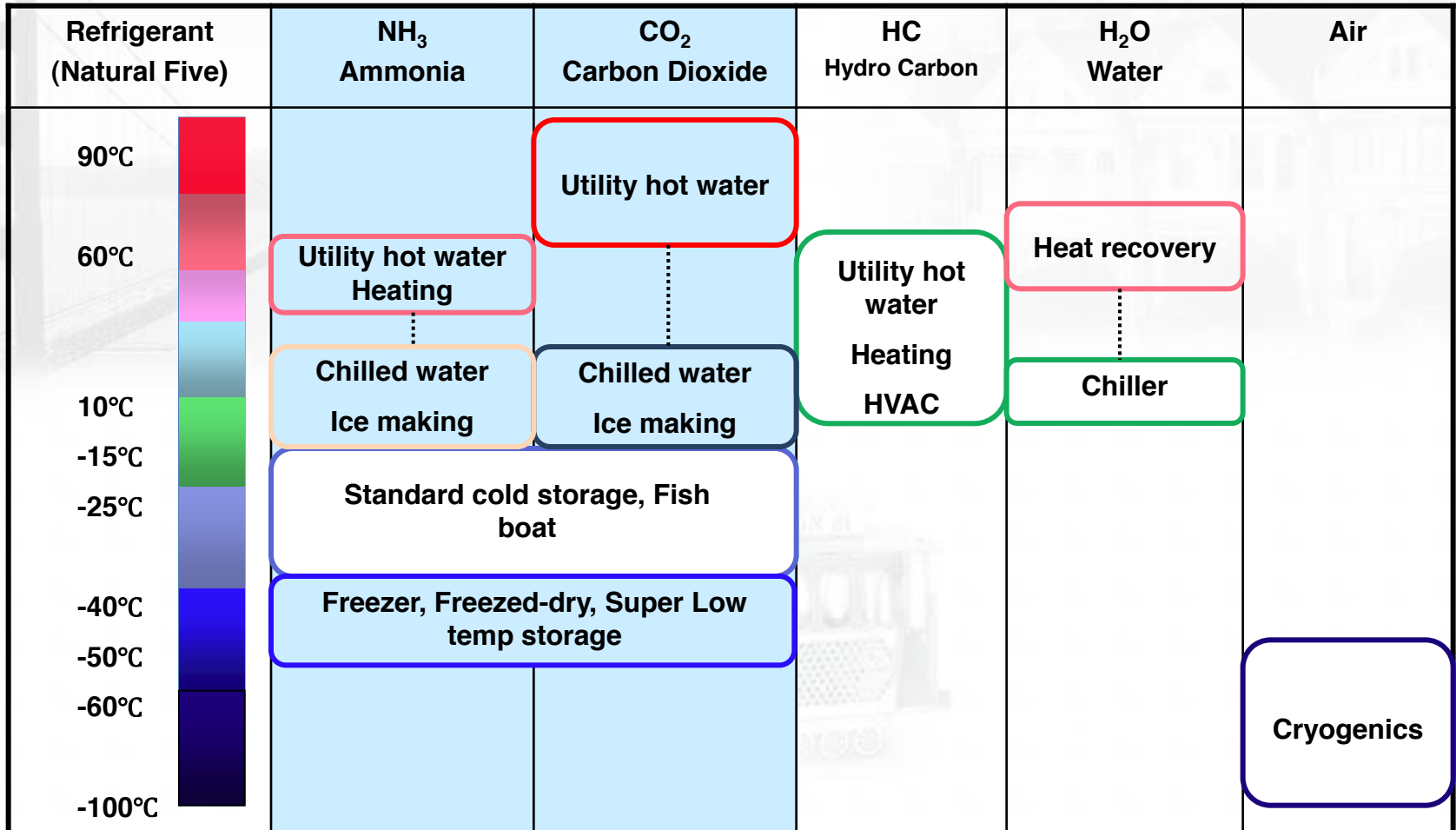
Compact Systems

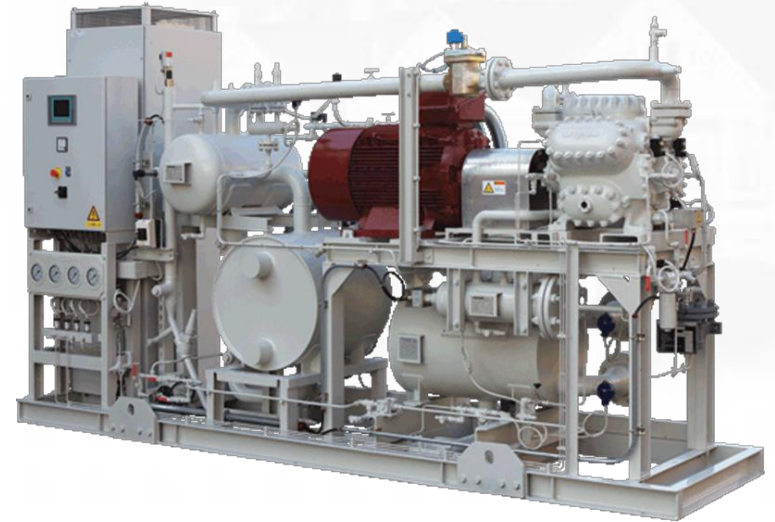
Next Generation

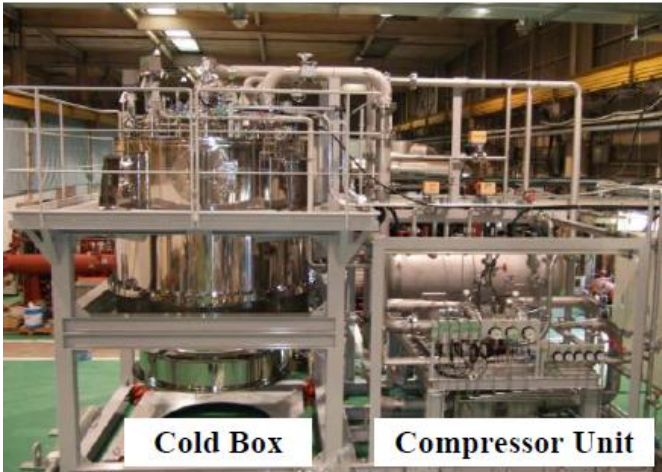


- Redundancy in components
- Size & Weight Reduction
- ~15% Price Reduction

#8







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ASHRAE Journal December **2020**





business case

natural refrigerants

June 18-19, 2014 - San Francisco

Thank you very much!

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