Next-Generation Transcritical CO_2 Refrigeration System

Brian A. Fricke, Senior R&D Staff

Research Challenge/Need/ Problem Addressed

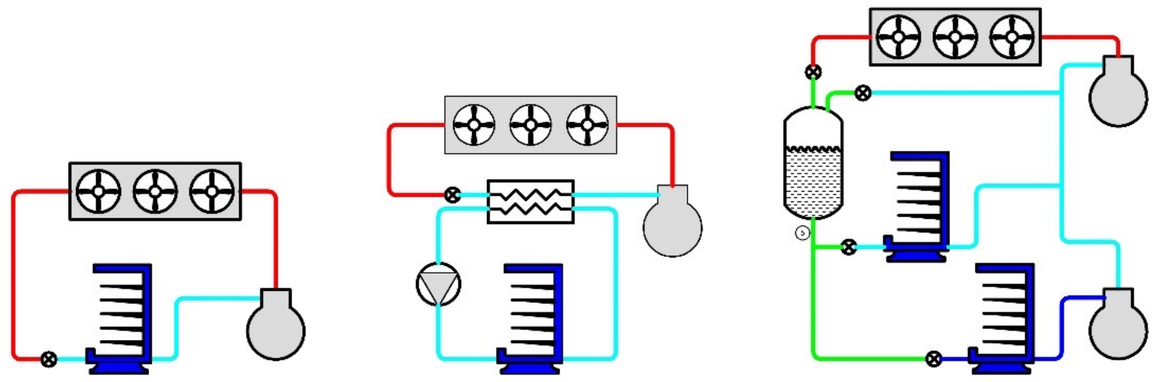
- Most supermarket refrigeration systems use high-GWP synthetic refrigerants
  - GWP > 1,300
- Encourage deployment of low-GWP refrigerants
  - Reduce direct emissions
  - Carbon dioxide: GWP = 1, nonflammable
  - CO_2 refrigeration system efficiency suffers at high ambient temperature

Current Research

- Solution: Provide subcooling to improve high-ambient performance
  - Less flash gas produced
  - More refrigerant participates in cooling process
  - Improved coefficient of performance (>10%)
- Current activities
  - Modeling of subcooler designs to optimize operating parameters and refrigerant selection
  - Detailed design for a modular, low-GWP subcooler solution for transcritical CO_2 refrigeration systems
  - Laboratory evaluation of subcooler to demonstrate >10% increase in energy efficiency

Major Impacts

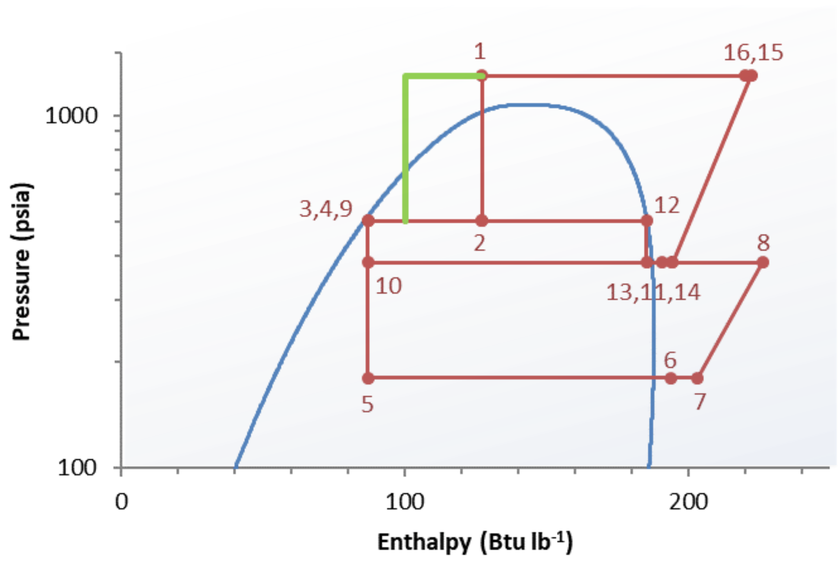
- Decrease CO_2 refrigeration system energy consumption by 10%
- Significantly reduce indirect and direct emissions (up to 50%)
- Promote wider use of CO_2 as a low-GWP refrigerant



Direct Expansion
High-GWP HFO

Cascade/Pumped
High-GWP HFO
Low-GWP CO_2

Transcritical CO_2
Low-GWP CO_2



Effect of subcooling (green line)

COP improvement