Sustainable
Refrigeration Summit

Connecting the Pieces for
Supermarket Refrigeration Solutions

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Sustainable
Refrigeration
Council

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Summit Program

Day 1: Monday, October 24

9AM-10AM PST
Keynote: Industry & Regulatory Trends

11AM-2PM PST
Technology Focus: Driving CO2 Performance

1PM-2PM PST
CO2 Systems: What Retailers Need to Know

Day 2: Tuesday, October 25

9AM-10AM PST
Distributed and Self-contained Systems

11AM-12PM PST
Technology Focus: Total Cost of Ownership

1PM-2PM PST
Measuring Performance of Natural Technologies

Day 3: Wednesday, October 26

9AM-10AM PST
Integrating Naturals into Existing Stores

11AM-12PM PST
Technology Focus: Modular Tech. for Existing Stores

1PM-2PM PST
Funding for Naturals

Day 4: Thursday, October 27

9AM-10AM PST
Solving the Technician Shortage

11AM-12PM PST
Technology Focus: Natural Innovations

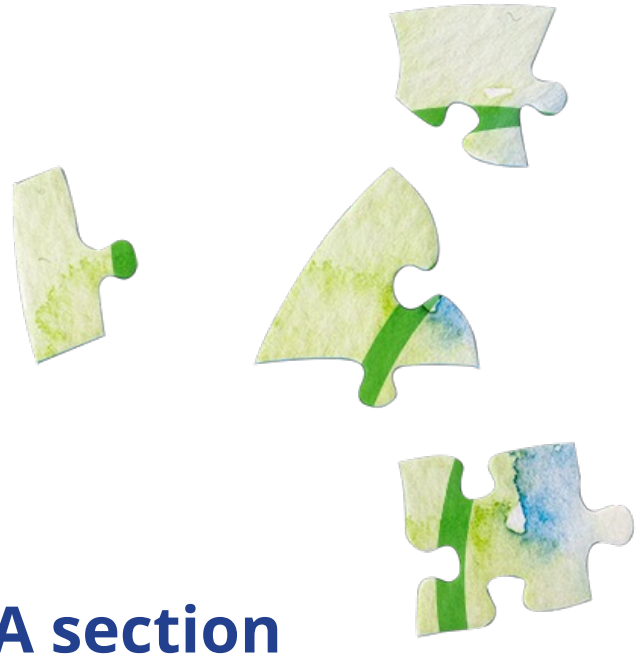
1PM-2PM PST
Reducing Refrigerant Emissions

Day 5: Friday, October 28

9AM-10:30AM PST
State & Federal HFC Regulations

11AM-12:30AM PST
Workshop: Utility Incentives for Refrigerant GWP

Housekeeping & Logistics



Question and Answer Session

- Participants are muted
- Questions will be moderated at the end
- To ask a question, enter your comment into the **Q&A section**

Need Help? Click the Support button on sustainablerefrigeration.com

Missed a Session? Session recordings and slides will be available on the platform

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Contact us at info@nasrc.org

Distributed and Self-contained Systems

Retailers and their partners share experience with distributed and self-contained systems, including Propane (R290) and alternative options.

Michael Dellecave
Manager of Mechanical Services
The Kroger Co.

Andrew Beall
Director of Refrigeration and Energy
WinCo Foods

Ben Rosenzweig
Vice President and General Manager
CoolSys Energy Design

Distributed and Self-Contained Systems

Ben Rosenzweig, PE

October 25, 2022

CoolSys | ENERGY DESIGN CONSULTING ENGINEERS

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Topics

- Definitions to frame the conversation
- Summary, Pros, and Cons of macro- and micro-distributed systems
- Micro-Distributed Deep Dive:
  - Commercially available options for micro-distributed systems
  - What refrigerants are being used
  - Ways to apply in existing stores

Definitions

(Traditional) Macro-Distributed System

Several small to medium sized compressor racks distributed throughout a store, located strategically near their case and coil loads. Can be designed and specified with low-GWP refrigerants like CO2 and typically have remote condensers or gas coolers per rack.

Self-Contained Systems

General term covering packaged refrigeration equipment/fixtures that typically do not require remote equipment to operate other than requisite electrical and sometimes plumbing drain connections. Like beverage merchandizers at check stands.

Micro-Distributed System

Many small compressor systems distributed throughout a store, typically located along case lineups and in place of traditional walk-in evaporator coils. In many cases these are comprised of interconnected and/or independent self-contained equipment.

Macro-Distributed Systems

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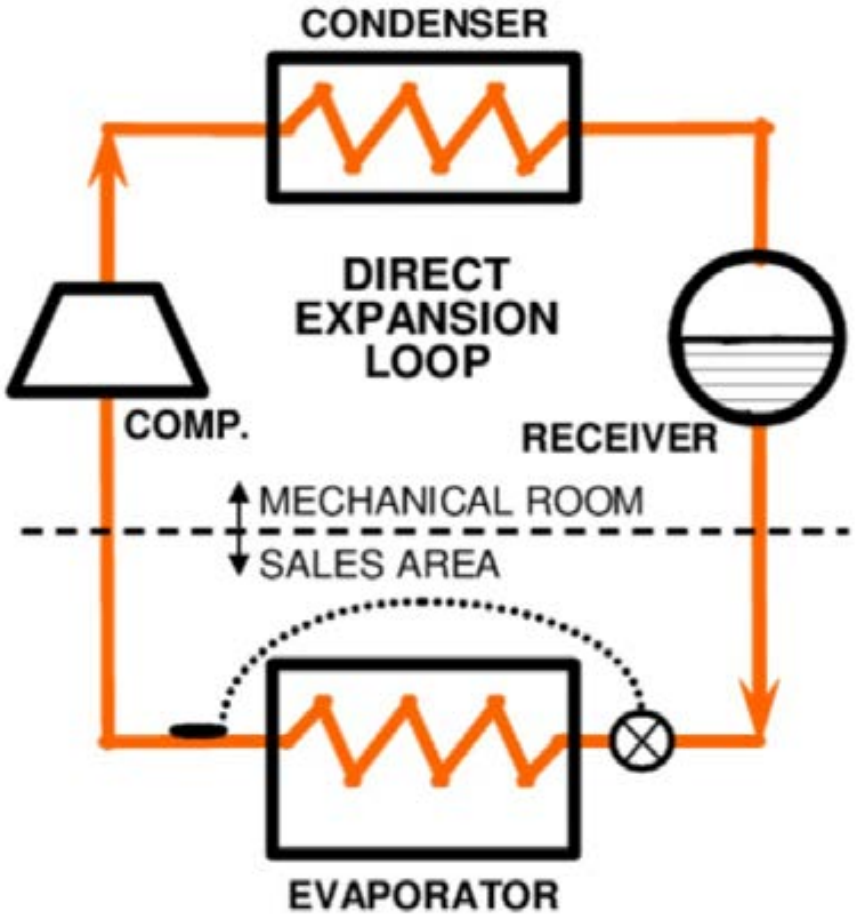
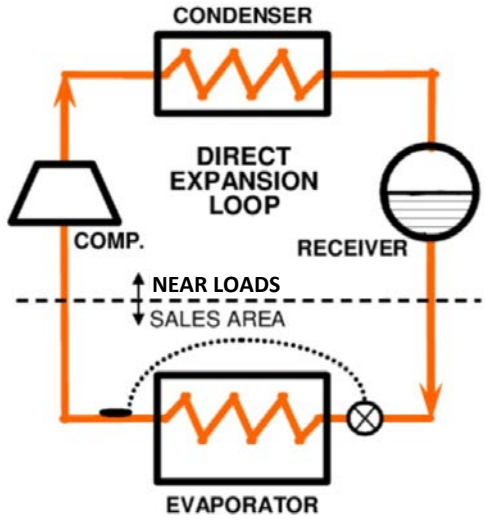
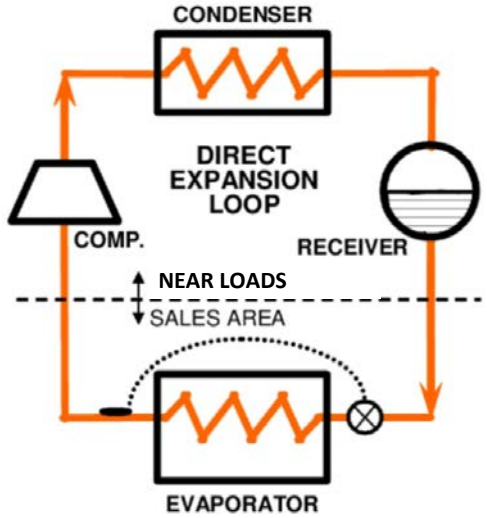
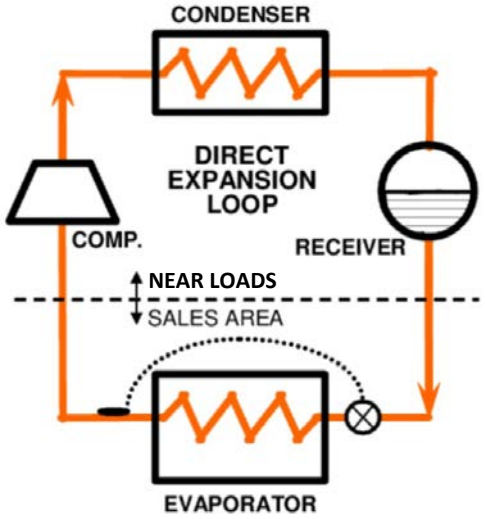
Traditional, Central DX Refrigeration System



Traditional Distributed Refrigeration System







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Macro-Distributed Systems

Pros

- Air- and water-cooled options
- More flexible than a single, central system
- <50 lb. low-charge systems with synthetic refrigerants
- Natural refrigerant options including CO_2
- Similar controls to traditional, central systems

Cons & Challenges

- Equipment installation can be complicated depending on building architecture and structure
- High-side piping system almost always required
- More, distributed items to maintain
- Not necessarily energy saving

Micro-Distributed Systems

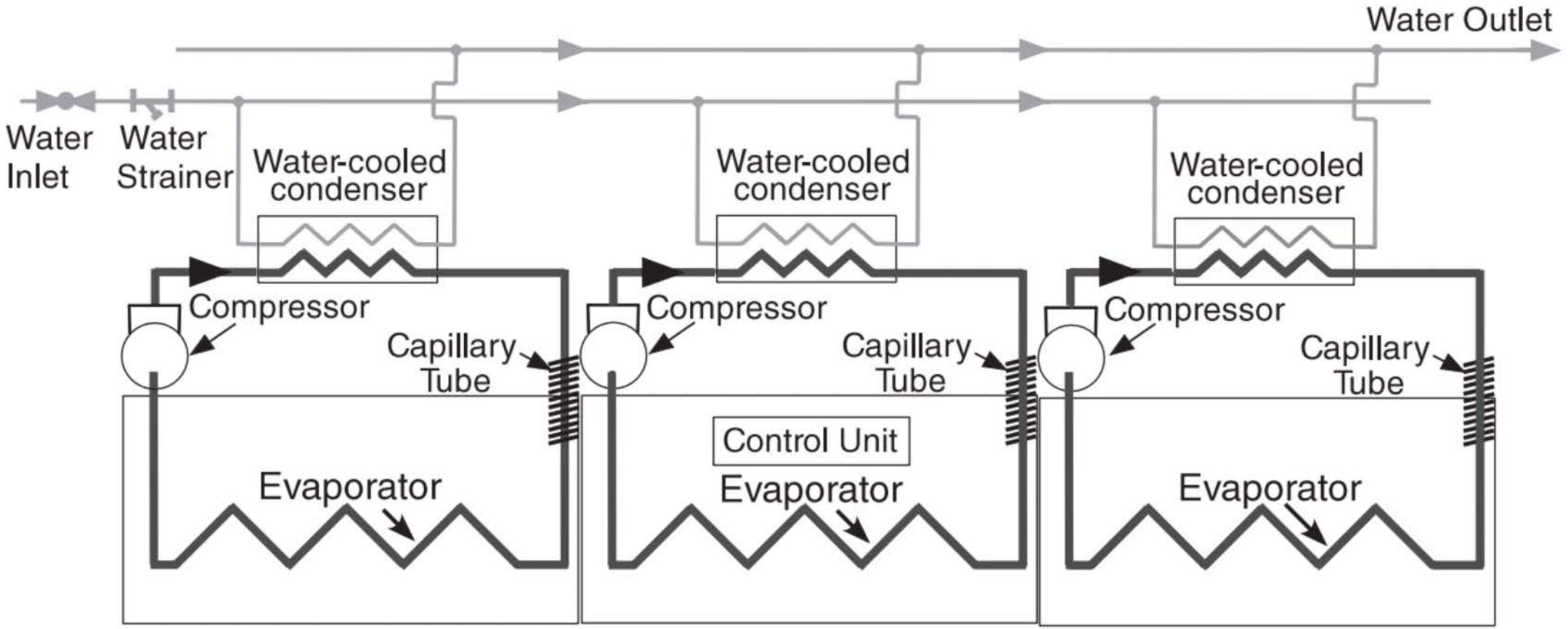

Diagram Credit: ASHRAE

Micro-Distributed Systems

Diagram Credit: ASHRAE

Highlights

- Can be applied to whole or part of a store
- Air- or water-cooled
- Natural and synthetic refrigerant options
- Flexible

Micro-Distributed Systems

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Pros

- Air- and water-cooled options
- Flexible - not piped to central rack
- <50 lb. low-charge systems with synthetic refrigerants
- Natural refrigerant options, typically R290, future CO_2
- Most water-cooled units have a wide inlet water temperature range
- Less complicated controls

Cons & Challenges

- Primary natural refrigerant option, R290, limited to 150 grams/charge
- Air-cooled rejects significant heat into store
- More, distributed items to maintain
- Not necessarily energy saving
- Fewer controls options

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Micro-Distributed Systems

What Refrigerants are Being Used?

- R290, propane, is the most popular low-GWP, natural refrigerant choice for micro-distributed systems
- R448 and other synthetics are popular amongst other <50 lb. qualifying micro-distributed system architectures
- Other A1 and A2L refrigerants are being tested and developed for used in MD systems
- CO_2 is an option for macro-distributed systems and soon should be for micro-distributed systems as well

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Micro-Distributed Systems

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Most Widely Used Commercially Available Options

- Hussmann microDS: water-cooled, R290
- Hussmann microSC: air-cooled, R290
- Hillphoenix SoloChill: water-cooled, DX, <50 lbs.
- Hillphoenix Second Nature: air-cooled, SC R290 fixtures
- AHT Cooling Systems: air- and water-cooled, R290
- Emerson Copeland Indoor Modular Solution: R448, R290
- Novum LEAP: air-cooled, R290

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**Not all micro-distributed and low-GWP self-contained options are listed.*

A Look Into The Future

Micro-distributed, subcritical CO_2 with a chilled water loop

- CO_2 as the refrigerant (GWP = 1)
- Chilled water loop:
  - Low-GWP chiller options
  - CO_2 condensing unit use
  - HVAC system use
- No charge limit means more fixture options and flexibility

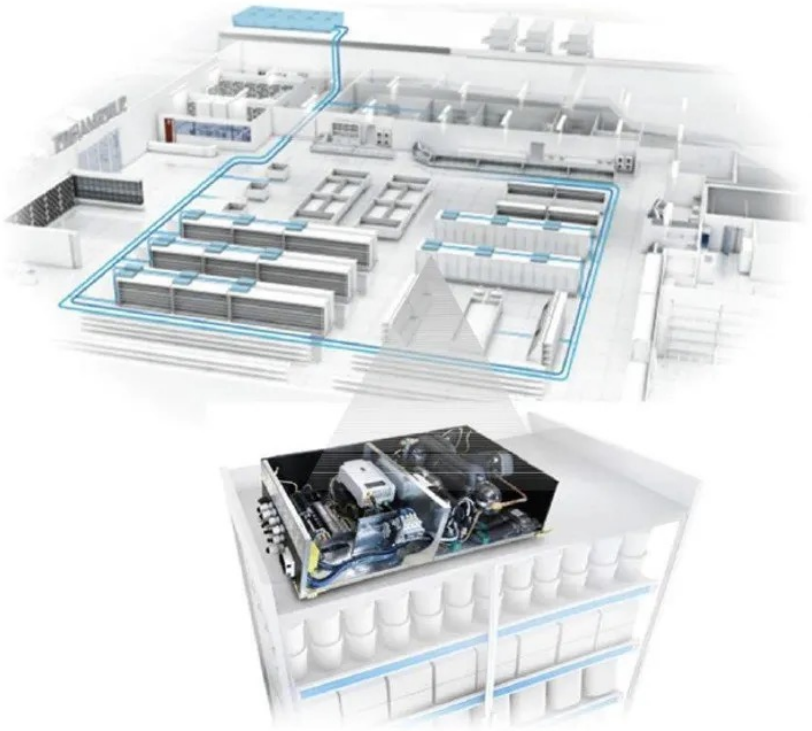

Photo Credit: Carel Heosbox CO_2

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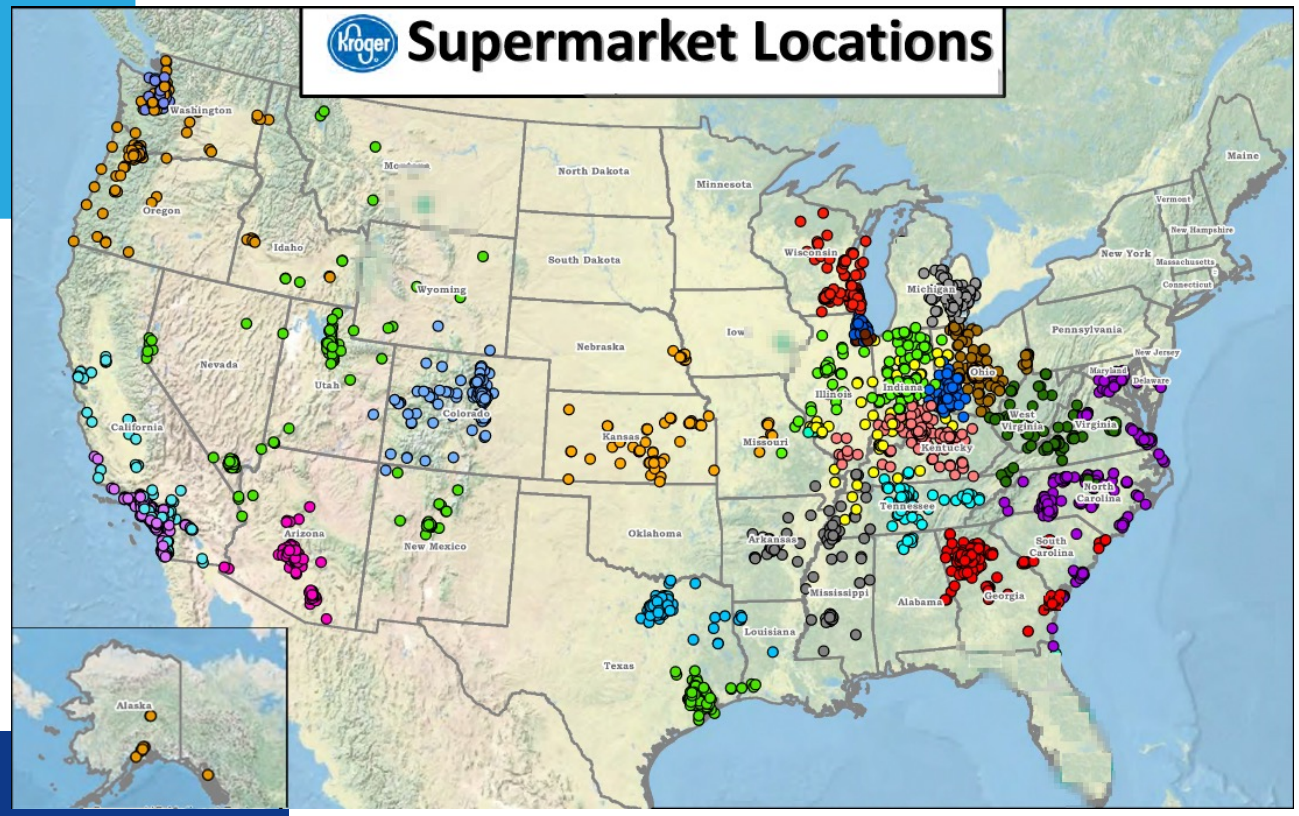
Micro-Distributed Systems

Application in Existing Stores

- Option to install a store-wide water loop with capacity for progressive remodel and low-GWP conversion
- Replacement of traditional case line-ups and walk-in systems with low-GWP alternatives without replacing entire systems
- Many like-for-like island and specialty merchandizers now available
- Carefully consider impact of air-cooled equipment on existing HVAC systems

The Kroger Co.

- Operate over 2,700 stores under many banners.
- 35 States



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Goals and Refrigerant Role

- Kroger's current target is to reduce greenhouse gas (GHG) emissions by 30% by 2030, from a 2018 baseline.
- Refrigerants play an important role in achieving that goal.
- In our stores, we use a four-pronged approach:
  - Proactive leak monitoring, mitigation and reduction
  - Replacing aging refrigeration systems to improve energy efficiency and reduce refrigerant charge/emissions
  - Proper management of refrigerant inventory, to reduce waste and ensure responsible reclaim practices
  - Transition to refrigerants with lower global warming potential (GWP)

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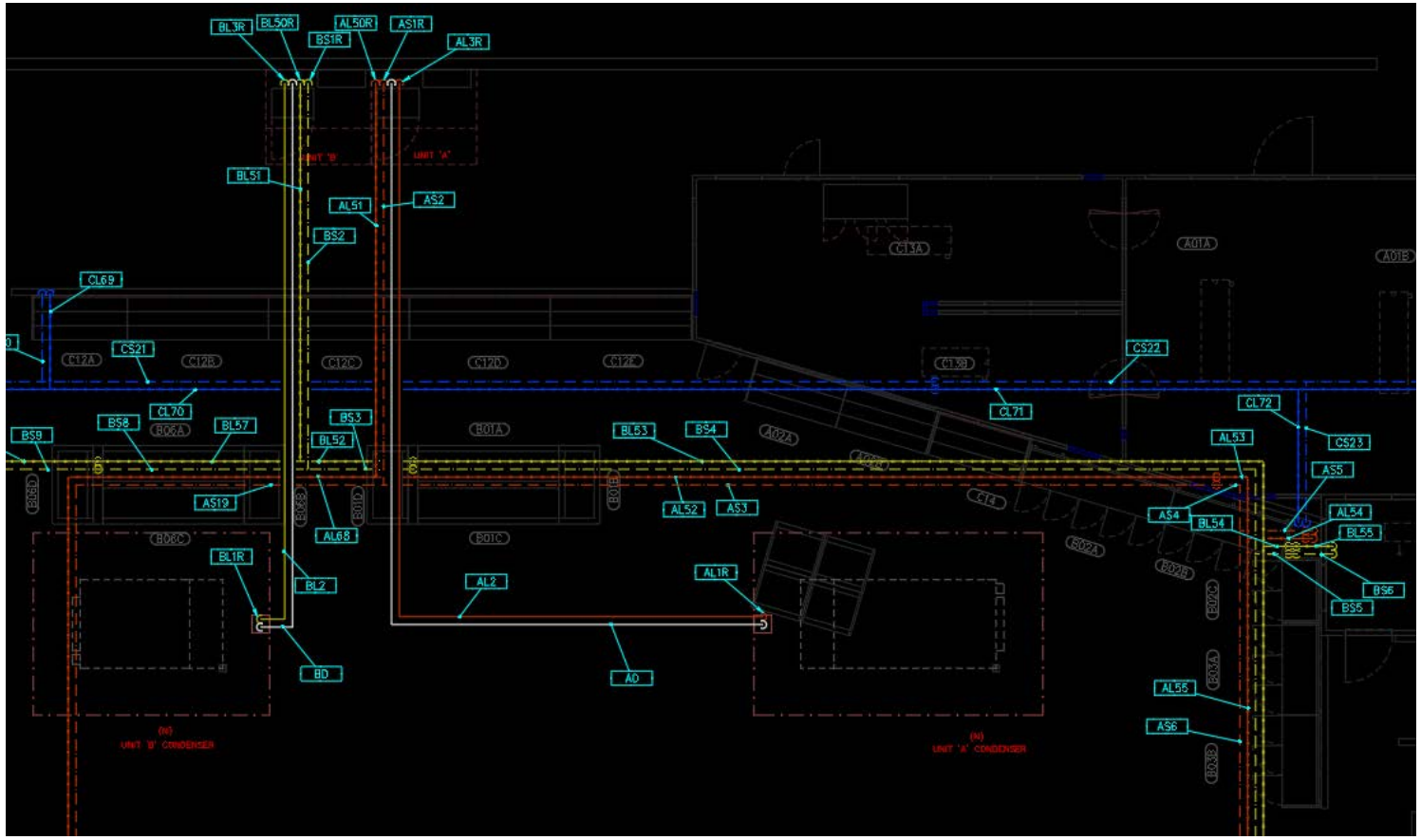
Current System Architecture

- Currently, Systems in New Construction are a Distributed design.
- Typically, 4 or 5 units.
- Air cooled unless the design ambient dictates adiabatic.
- Refrigerant Piping and Charge are significantly reduced compared to conventional systems.
- Utilizing an HFO blend with a GWP below 1,400.



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New Architecture Options

- Self-Contained
- CO2
- A2L Distributed

- We do not see any one solution being suitable for all scenarios.
- A combination of technologies is likely.
- We **need** options.

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A2L Distributed Option

- Similar to the design we use today with a few changes
  - Need to use A2L refrigerants to get below 150 GWP.
  - Charge limits due to the A2L designation will require more, smaller distributed units.
  - Design considerations such as system location, condenser type and receiver size will be important in further reducing charge size and number of systems needed.
  - More sophisticated leak detection requirements and mitigation.

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A2L Distributed Potential Benefits

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A2L Distributed Challenges

- Code Adoption
- Timeline
- Components
- Leak Detection/Mitigation

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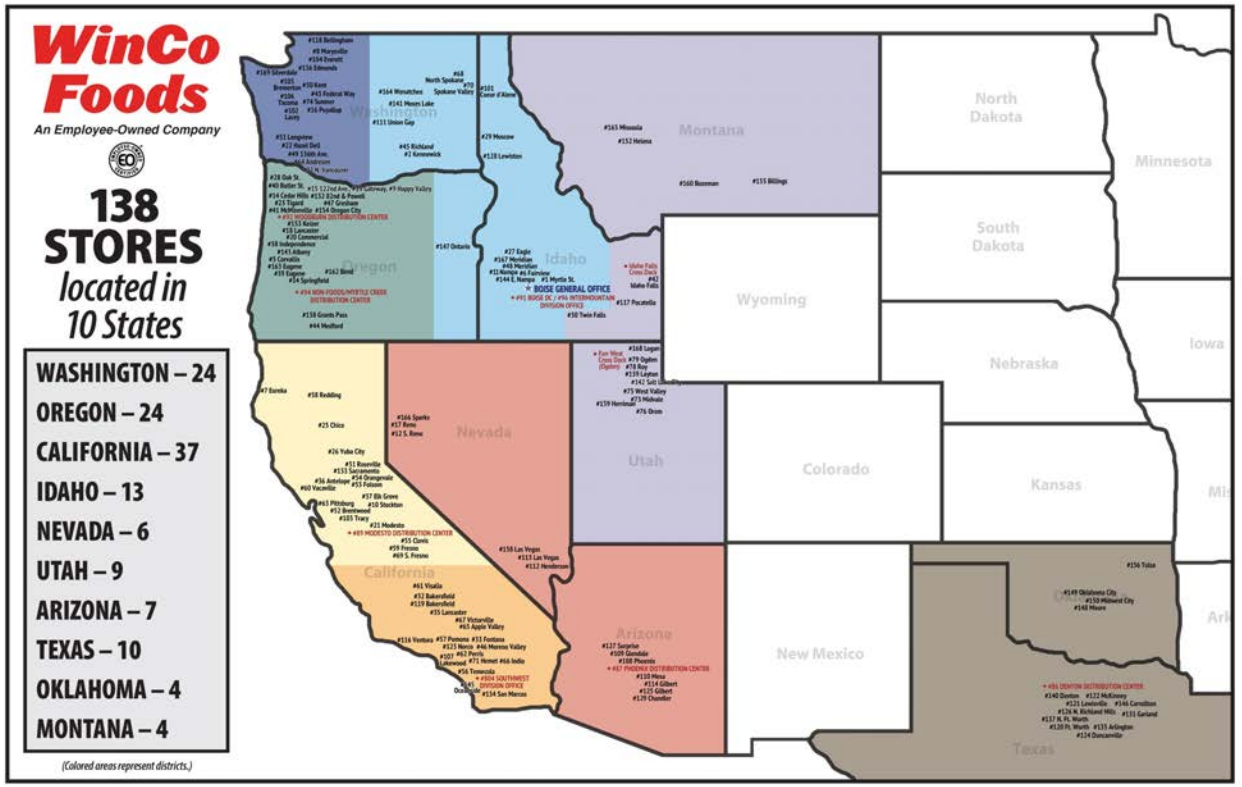
MDS – WinCo Overview



WinCo Data

- Typical store ~85,000 square feet
- ~145 cases & walk-in evaporators
- 13 stores are MDS stores
- All MDS stores use R-448A

- Refrigeration Goals for MDS – stay below 50 lb Full Charge Amount (FCA)
  - Meet CARB 2026 and 2030 Greenhouse Gas Potential (GHGp) reduction targets
  - Allow to meet Future WA reduction targets

- Currently Multi-Year Remodel Program in CA
  - 39% towards 2026 GHGp Target/ 18% towards 2030 GHGp Target
  - Future WA Remodel program

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WinCo – Technology

- System Type:
  - R-448A
  - Most Cases Operate as Self-Contained Connected to Central Hydronic Condensing Loop
- Advantages
  - Ability to Utilize the Same Case Manufacturer as DX Stores
  - Availability of R-448A versus CO2
  - R-290 Charge Limits do not Allow for High Volume End Users
  - Simplicity of the MDS System Compared to Natural Refrigerants

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WinCo – Tech Cont'd

- Performance Metrics
  - GHGp Reduction for CARB Compliance
  - Energy? Still Evaluating… Normalizing Data can be Difficult
  - Reduced Maintenance?
    - Needs more time, all systems look good until Year 5…

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WinCo – Opportunities

- Technician Considerations
  - Refrigeration Installer
    - Need all skill sets for installation from case setter, pipefitter, controls installer, startup tech
    - The Installer needs to have a true Startup Tech
    - Needs to be competent at troubleshooting communication and programming issues and willing to get into the weeds
    - All techs need to know what questions to ask and when to ask the questions
    - MUST BE WILLING TO LEARN!!!
    - Knows that the Owner wants the system to work and will support techs who want to learn and challenge the design team and programming

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WinCo – Opportunities

Hydronic System

- Best to have a mechanical piping installer, preferable to have an installer with large commercial and industrial experience with Polypropylene (PPR) Piping experience
- For Remodels, the hydronic loop will dictate phasing of the project
- Pipe placement is key, keep it out of the way of operations
- Structural considerations for the larger Adiabatic Fluid Coolers
- Must have pipe flushing experience
- Must know manufacturer's installation process for PPR Pipe

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