Super Solutions for Super Pollutants
The Commercial Refrigeration Dream Team

Danielle Wright
Executive Director
NASRC
The NASRC

OUR MISSION
NASRC is an environmental 501c3 nonprofit taking action to advance natural refrigerants in order to shape a more sustainable future for refrigeration.

OUR MEMBERS
24,000 supermarket locations
+125 supermarket stakeholders
Equipment manufacturers, contractors, Eng. & design firms, consultants, utilities

OUR GOALS
• Natural refrigerants are ON PAR with other refrigerant options
• Leverage stakeholder collaboration to drive action
• Provide information, tools, & resources for the industry
NASRC Stakeholders

GOALS
- Technology
- Energy
- Training
- Standards
- Data

Government
Service Contractors
Utilities
OEMs/Manufacturers
End Users
Consultants
Eng/Design
Climate Impacts of Refrigerants

Hydrofluorocarbons (HFCs) are Powerful Greenhouse Gases (GHGs):

• +1,000 times more heat-trapping power than CO2
• Short Lived Climate Pollutants (SLCPs)
• Fastest growing GHG globally
• Mitigation can avoid 0.5 degree C of warming by 2100
Supermarket Refrigeration

SYSTEMS
Direct Expansion
Centralized or Distributed

Condensers
Evaporators
Expansion Valve
Compressors

EQUIPMENT
Self-contained or Plug-in

38,000+
US Locations

41,000
Avg. Square Ft.

3,500
Avg. Refrigerant Charge (lbs)

25%
Avg. Annual Leak Rate

Food Marketing Institute Supermarket Facts: https://www.fmi.org/our-research/supermarket-facts
Supermarket Systems Emissions

Annual Direct Emissions

38,000

× 25%

× R-404A GWP

152,000,000,000 lbs. of CO2e Annually

Electricity Use vs. Refrigerant Emissions

Typical Supermarket


EPA Average Supermarkets GHG Impact: https://www.epa.gov/greenchill/average-supermarkets-greenhouse-gas-impacts
Refrigerant Regulations

INTERNATIONAL

Ozone Depleting Substances

- Montreal Protocol 1987

Global Warming HFCs

- Kigali Amendment 2016
- 85% Reduction HFCs 2036

UNITED STATES

Title VI Clean Air Act 1990

SNAP 20 & 21 2016

- 2017 Arkema Lawsuit
- 2019 US Climate Alliance State Action
The US Climate Alliance

55% of US POPULATION

$11.7 trillion economy

HFC Regulations

<table>
<thead>
<tr>
<th>HFC Commitment</th>
<th>SNAP Rules 20 &amp; 21</th>
<th>Section 608 Refrig. Mgmt.</th>
<th>&lt;150 GWP Limit - New Systems</th>
<th>&gt;1500 GWP Sales Ban</th>
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US Refrigerant Transitions

Montreal Protocol

- CFCs: Phased out
- HCFCs
  - High GWP HFCs: Being phased out
  - Medium GWP HFCs
- Lower GWP HFO Blends
  - Very Low & Zero GWP Naturals and HFOs

Kigali Amendment

- EPA SNAP?

State Action?

Future Proof Solution?
What Refrigerants are Compliant?

Supermarket Refrigerants

Global Warming Potential (GWP)

- **Ammonia**
- **CO2**
- **Propane**
- **R449a**
- **R448a**
- **R407a**
- **R404a**
- **R507a**

**Natural Refrigerants**
- <150 GWP

**HFO Blends**
- <1500 GWP

**High GWP HFCs**
- >1500 GWP
# What are Natural Refrigerants?

<table>
<thead>
<tr>
<th></th>
<th>GWP</th>
<th>US Installations</th>
<th>Applications</th>
<th>Advantages</th>
<th>Challenges</th>
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<tr>
<td>Ammonia (R717)</td>
<td>0</td>
<td>4</td>
<td>Industrial sector Remote systems</td>
<td>Energy efficient Low-charge Long history, well-known safety features</td>
<td>High initial costs Public perception – toxic if not handled properly</td>
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<td>Carbon Dioxide (R744)</td>
<td>1</td>
<td>400</td>
<td>Remote systems Transcritical or Cascade</td>
<td>Potential for efficiency gains Non-toxic, non-flammable</td>
<td>High pressures Initial costs North/South divide</td>
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<tr>
<td>Hydrocarbons (R290)</td>
<td>3</td>
<td>500,000+</td>
<td>Self-contained cases</td>
<td>Energy efficient Low-charge Flexibility</td>
<td>Charge limit of 150 grams Flammable if used improperly</td>
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Natural Refrigerant Challenges

- Case studies & best practices
- Scale production

Low Volume / Demand

Increased First Cost

NASRC Solutions
- Incentives
- Offset first costs

- Demonstration projects
- Total Cost of Ownership Study

Energy Performance
ROI Concerns

Contractor Training

- Training resources
- Core Curriculum
California Supermarket Options

New Construction

- Natural Refrigerants <150 GWP

Existing

- <1500 GWP Refrigerant
- <50 lbs. Refrigerant

Opportunity for Energy Savings!!

Utility Questions
- What is the baseline?
- How to measure savings?
- Modeling capabilities?
**Supermarket Total Emissions**

TEWI = Total Equivalent Warming Impact

Indirect GHG (Energy) + Direct GHG (Refrigerant)

**TEWI Comparison**

- HFC DX
- Nat Ref Baseline
- Nat Ref Optimized

- Indirect
- Direct
Thank You!

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