

Low-GWP Refrigeration Programs and Research: A California Perspective

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SF STATE

CA Agencies With Regulatory Oversight Over Commercial Refrigeration

California Environmental Protection Agency

-  **Air Resources Board** (ARB)
 - Tasked with reducing CA greenhouse gas (GHG) emissions
 - Assembly Bill 32 (2006) requires reduction of GHG emissions to 1990 levels by 2020

- **CALIFORNIA ENERGY COMMISSION** (CEC)
 - Primary CA energy policy and planning agency
 - Sets state's appliance and building energy efficiency standards



San Francisco State University School of Engineering



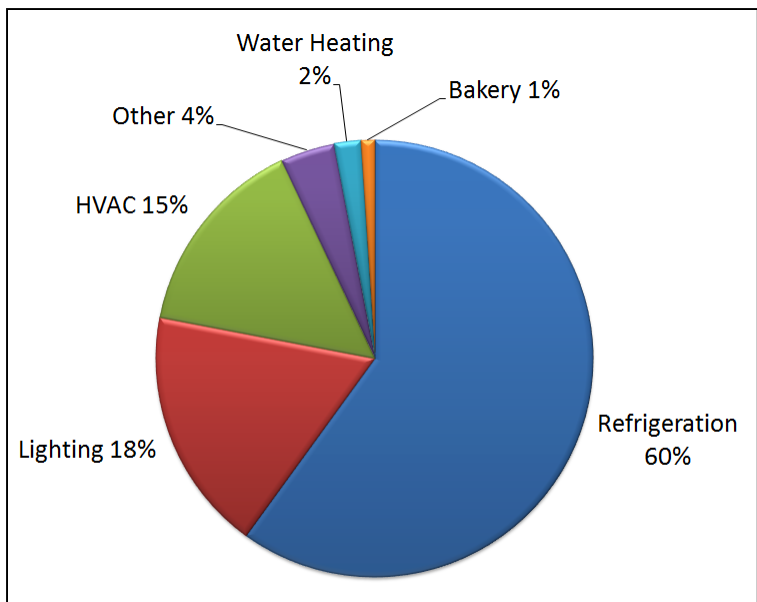
Industrial Assessment Center (IAC) provides energy-efficiency audits for small- to medium-sized manufacturing facilities

- Industry-focused education in HVAC engineering, building energy simulation; life cycle assessment (LCA) experience with bio-derived transportation fuels
- ARB contractor for project: *“Low-GWP Commercial Refrigeration Feasibility and Cost-Benefit Engineering Evaluation”* (2-year project, started September 2014)

Subcontractors:

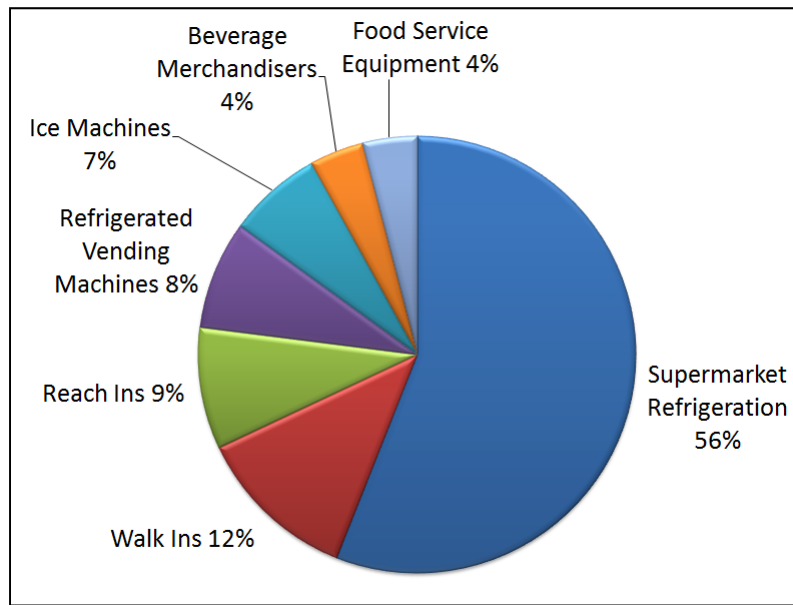


CA Regulatory Focus Is On Supermarket Refrigeration



← Supermarket electricity consumption

Commercial refrigeration energy usage →



CA Title 24, Part 6: Building Energy Efficiency Standards

- Section 120.6, subsection (b): Mandatory Requirements for Commercial Refrigeration
- Applies to “retail food stores” > 8,000 sq. ft.
 - Minimum specific efficiency for condensers; variable-speed condenser fans, with control based on T_{db} (air-cooled) or T_{wb} (evap)
 - Floating compressor suction pressure
 - Display case lighting control
 - Heat recovery for space heating



CA Title 24, Part 11: California Green Building Standards Code

- Section 5.508: Outdoor Air Quality
- Requirements
 - No CFCs or halons
 - Leak reduction measures for systems using refrigerant with GWP > 150; measures address
 - Refrigerant piping and valve design
 - Corrosion resistance of evaporator coils
 - Refrigerant level indicators
 - Pressure testing and system evacuation



ARB Refrigerant Management Program (RMP)

- Applies to facilities with refrigeration systems having > 50 lbs of high-GWP refrigerant
 - Requirements
 - Conduct and report on periodic leak inspections
 - Repair leaks promptly
 - Maintain on-site service records
 - Affected facilities meet requirements using R3 tool
- ⇒ RMP data may be of particular value in informing the calculation of direct refrigerant emissions in IIR LCCP evaluation methodology*

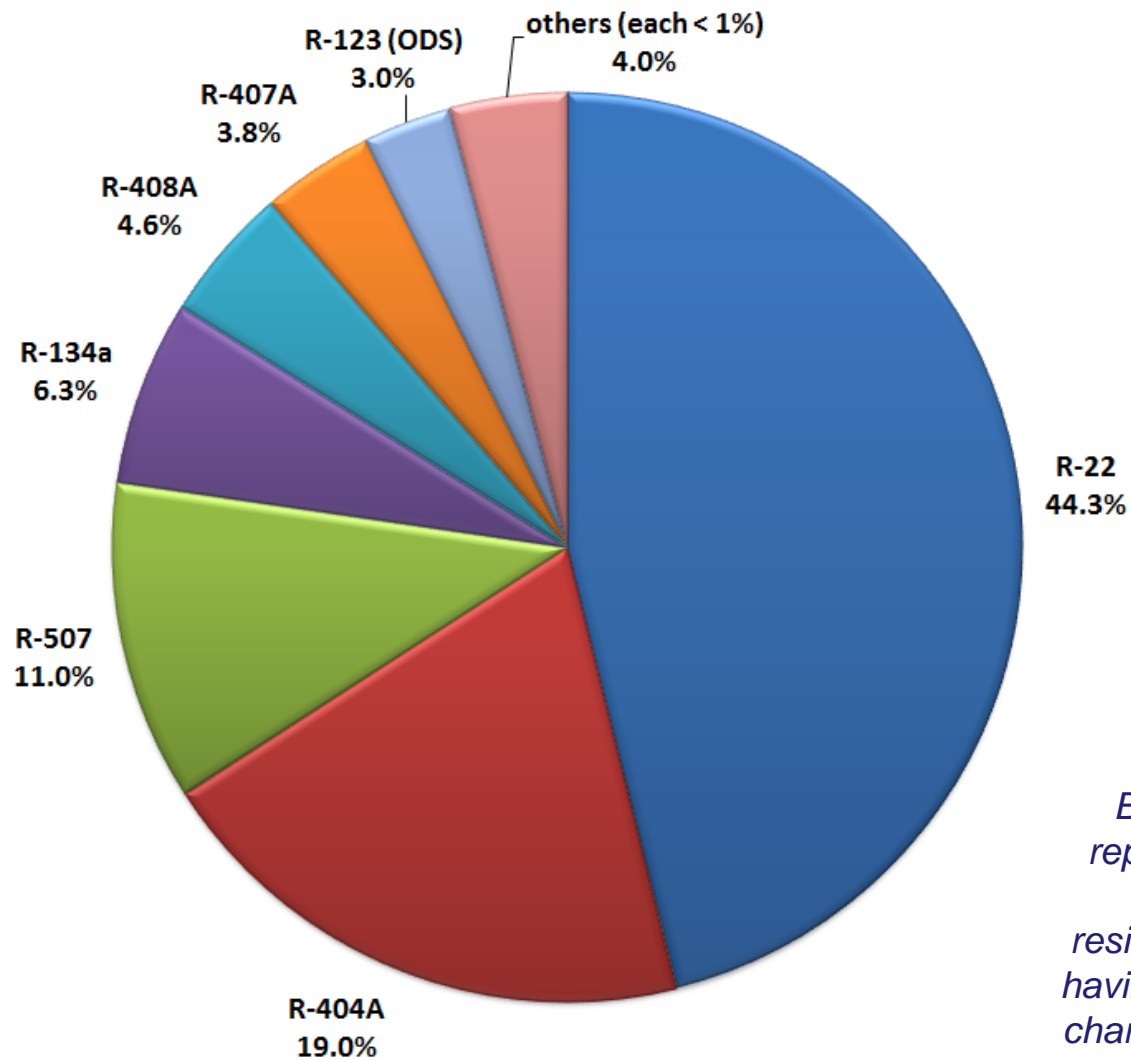


Refrigerant Registration
& Reporting Tool (R3)



CA High-GWP Refrigerant Stock (2013)

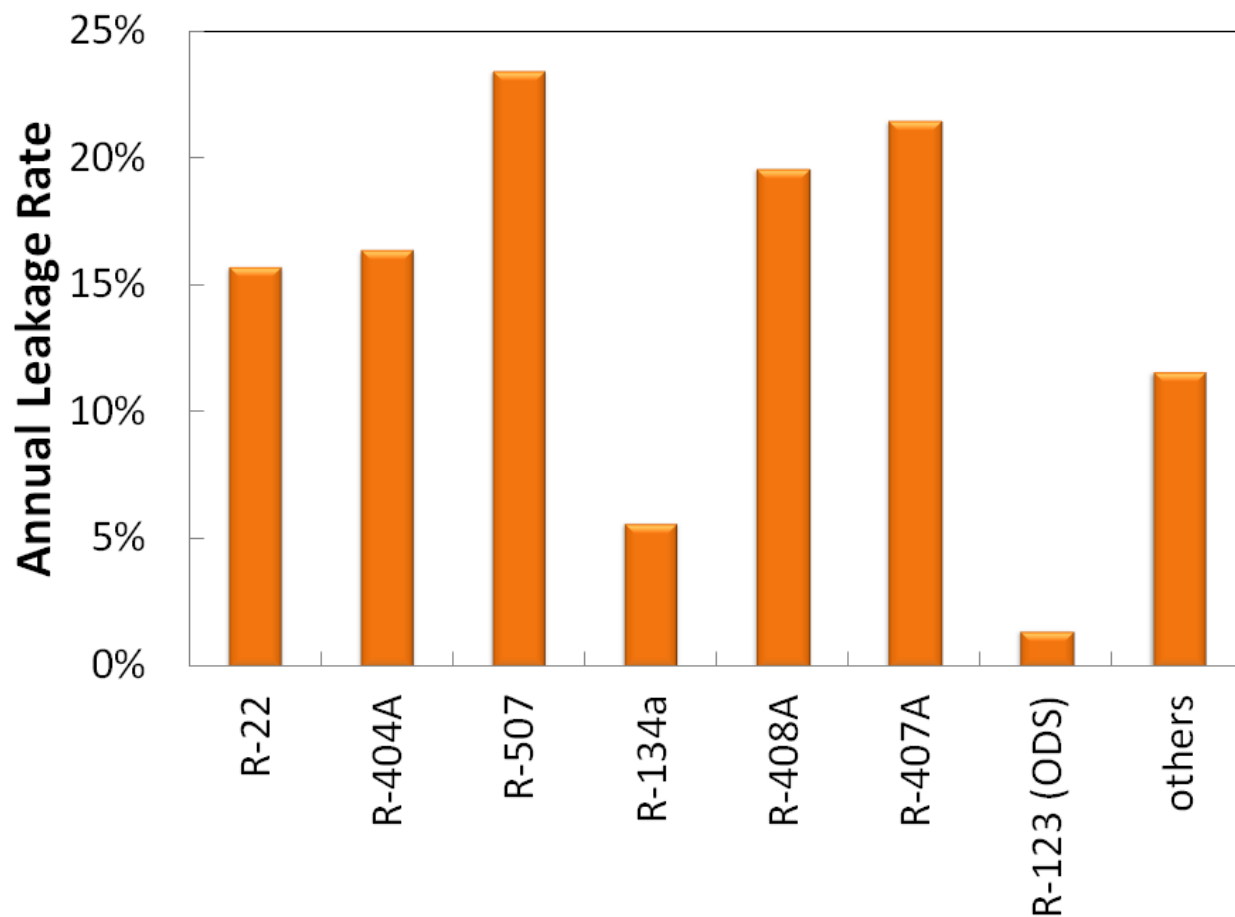
(as percentage of total = 11 million pounds)



Based upon self-reported data from stationary, non-residential facilities having systems with charge size \geq 50 lbs



Annual Leakage Rate Varies With Refrigerant Type



Self-reported data for 2013 from stationary, non-residential facilities having systems with charge size \geq 50 lbs

Leakage rate also varies with system type, charge size, ...

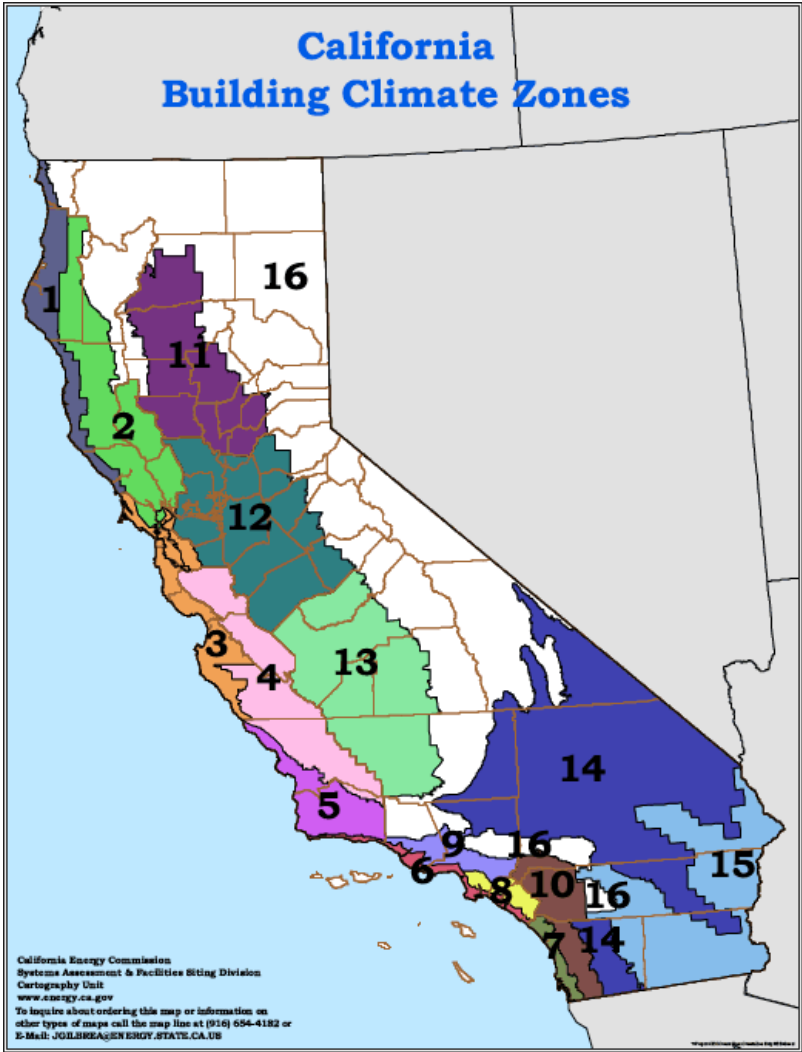
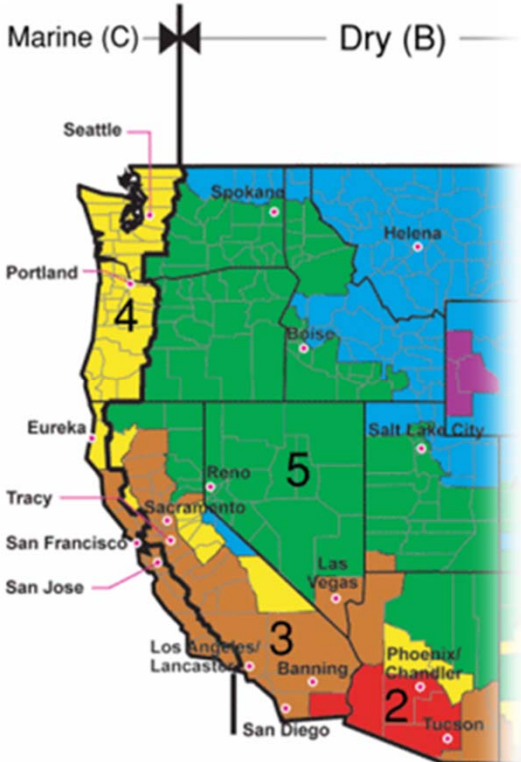


ARB Low-GWP Refrigeration Project: Methodology (Preliminary)

- TEWI < LCCP < LCA
 ↑ ↑
 ???
- DOE-2.2R or EnergyPlus to evaluate energy consumption
- Overall model to evaluate various:
 - Facility sizes
 - Refrigeration system types
 - Refrigerant types
 - Condenser types
 - Levels of effectiveness for leak prevention
 - Electricity CO₂ emissions factors
 - *and ...*



16 California Climate Zones



Synergy between SFSU / ARB and IIR WP on LCCP Evaluation

- California-specific data can be provided to guide development of IIR LCCP evaluation methodology
- Cases selected for modeling by SFSU / ARB can serve as IIR LCCP case studies
- IIR LCCP evaluation methodology can guide and validate SFSU / ARB efforts



Thank you

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