



Understanding Refrigerant Leak Detection and Implementing Effective Leak Detection Programs

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Emerson Climate Technologies

Discussion Topics

Introduction

What Do We Mean by “Refrigerant Leak Detection”?

Regulatory Overview

What Are the Current and Proposed Regulations That Govern Refrigerants?

Keys of an Effective Program

What Elements Should a Refrigerant Leak Detection Program Include?

Technologies

What Technologies Are Available, and What Are the Trade-offs?



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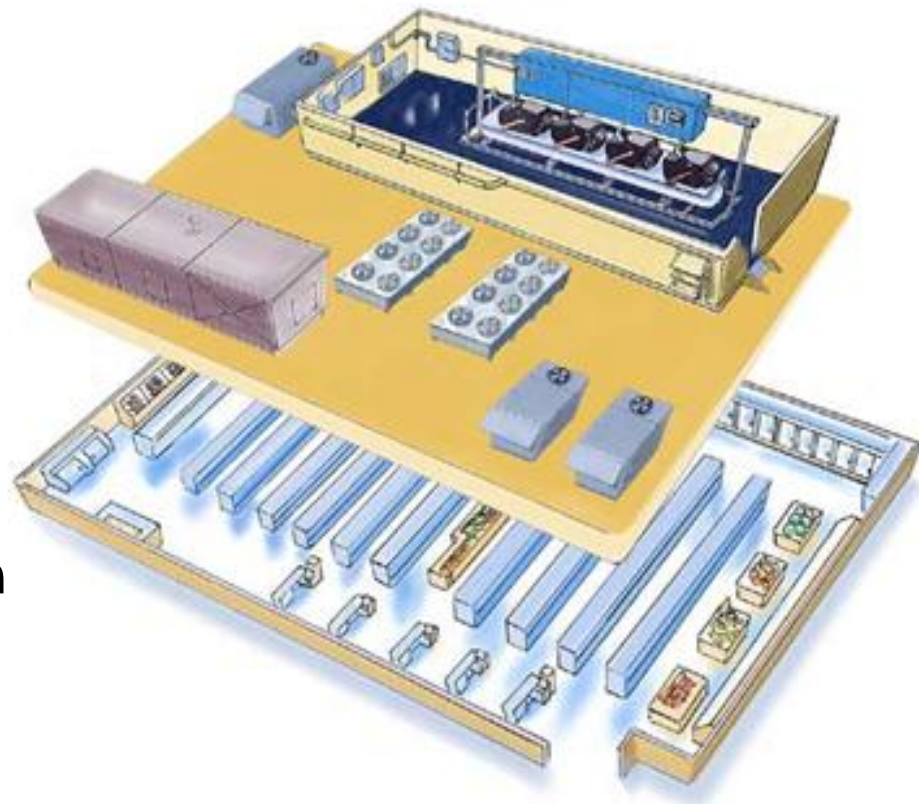
Technologies

What Technologies Are Available, and What Are the Trade-offs?



Refrigerant Profile of a Supermarket

- 46,000 Square Feet
- 2–4 Refrigeration Racks
- 100+ Display Cases
- 16 Walk-In Evaporators
- R-404A (Typical)
- Refrigeration Charge Approximately 3,500 Pounds
- Annual Electricity Consumption 2.4 M kWh
- Average Leak Rate 35%¹
- Yearly Volume of Refrigerant Leaked 875 Pounds



¹2005 Data; Focused Efforts (GreenChill) on Reducing Leak Rates



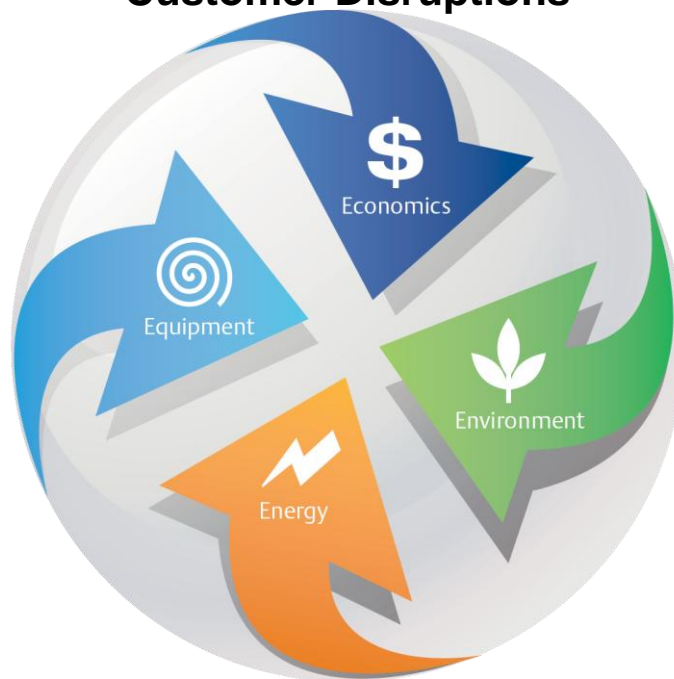
Refrigerant Leaks Have a Broad Impact

Based on:

- Yearly Calculations
- 100-Site Chain
- R-404A
- 3,500 Pounds per Site
- 20% Leak Rate (vs. 0%)
- Leak 700 Pounds/Year
- Avg. \$7/Lb for R-404A

Equipment Impact Life Cycle Cost

Economic Impact \$500K+ Refrigerant Customer Disruptions



Energy Impact Potential Based on Amount of Loss

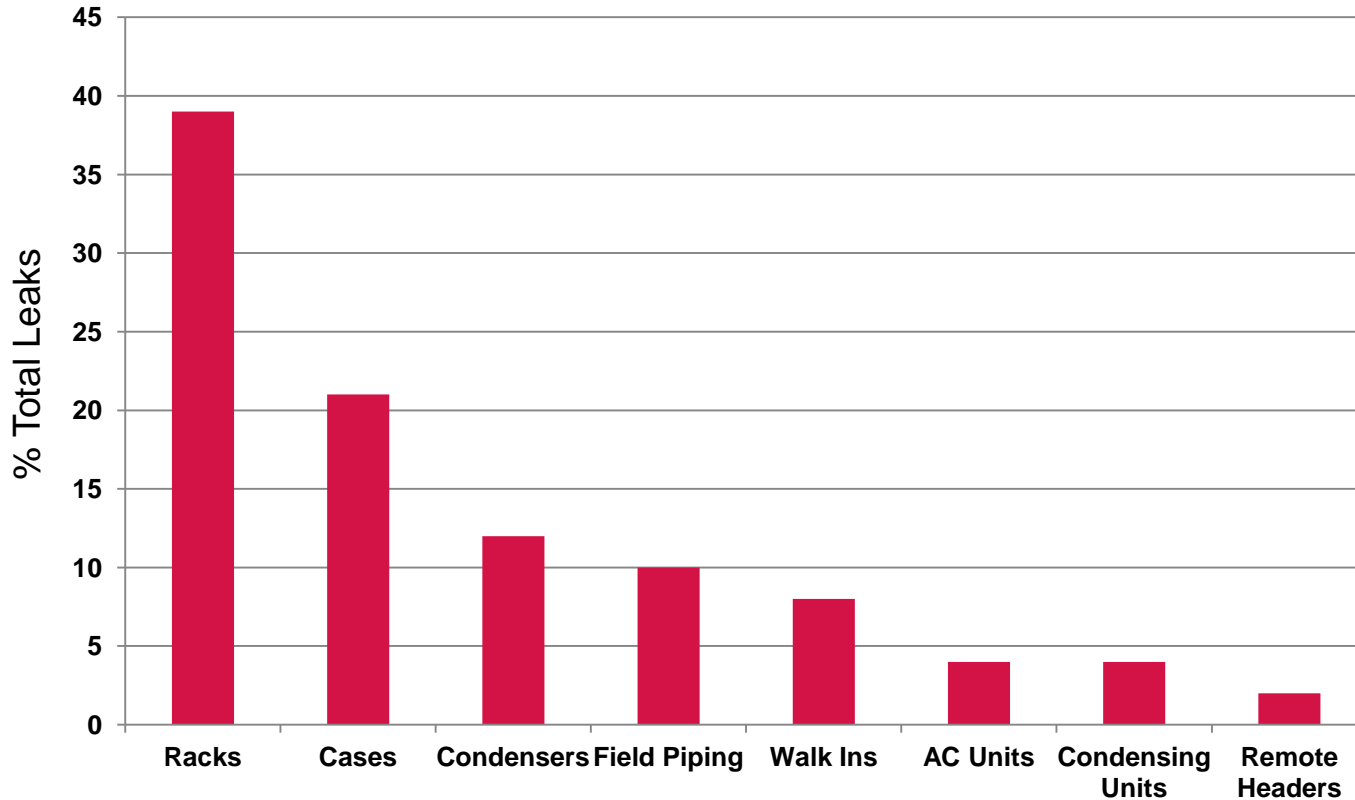
Climate Impact (Direct)

124,500 M Tons CO₂
Equal to
24,000+ Cars
or
10,600 Homes

Use the EPA
Calculators for
Your Specific
Circumstances



Where Are the Leaks?



Major Causes of Leaks

- Vibration
- Corrosion
- Flare Nuts
- Valve Fittings
- Thermal Stress
- Installation Techniques



Poll Question

- **Are You Aware of the Details of the EPA's Proposal to Update Section 608?**
 - Yes
 - No



Reference and Disclaimer

- **Reference: EPA and California Air Resources Board (CARB)**
- **Read the Regulations and Seek Legal Help as Needed to Clarify**
- **Contact the EPA/CARB for Details About the Regulations and Proposals and to Confirm Impact on Your Particular Operations**
- **The Opinions Expressed Are Those of the Presenter and May Not Reflect Those of Emerson**

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EPA Is Serious About Enforcing Regulations, and the Consequences Can Be Major



EPA United States Environmental Protection Agency

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Newsroom

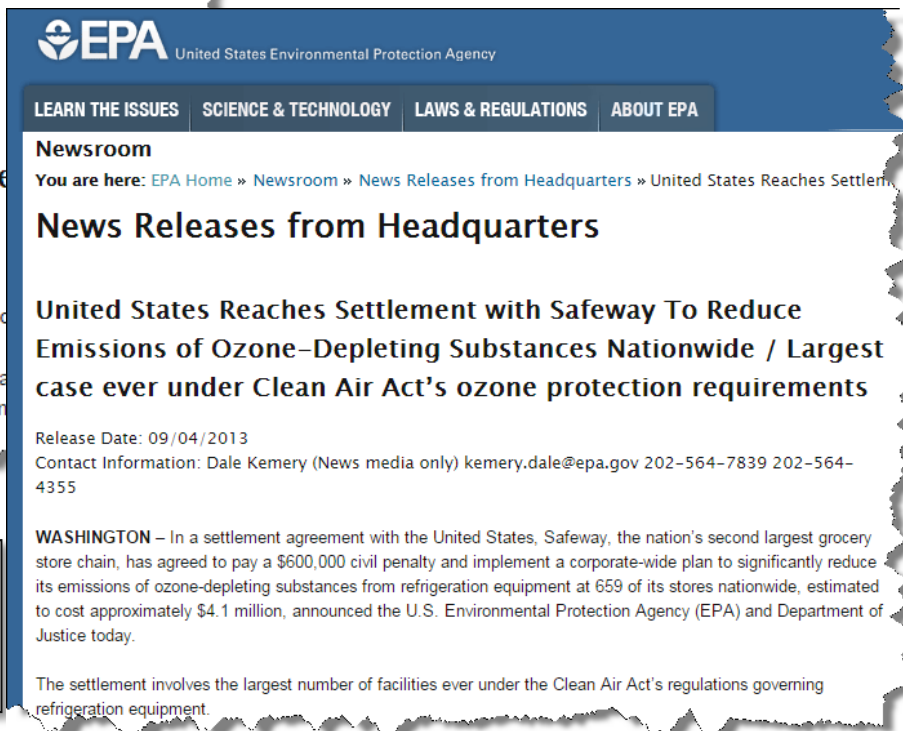
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News Releases By Date

United States settles with Costco to cut ozone-depleting greenhouse gas refrigerant emissions nationwide

Release Date: 09/03/2014
Contact Information: Suzanne Skadowski, 415-972-3165, skadowski.suzanne@epa.gov

SAN FRANCISCO – Costco Wholesale Corporation, one of the nation's largest retailers, has agreed to reduce its emissions of ozone-depleting and greenhouse gases from leaking refrigeration equipment at its stores nationwide.



EPA United States Environmental Protection Agency

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News Releases from Headquarters

United States Reaches Settlement with Safeway To Reduce Emissions of Ozone-Depleting Substances Nationwide / Largest case ever under Clean Air Act's ozone protection requirements

Release Date: 09/04/2013
Contact Information: Dale Kemery (News media only) kemery.dale@epa.gov 202-564-7839 202-564-4355

WASHINGTON – In a settlement agreement with the United States, Safeway, the nation's second largest grocery store chain, has agreed to pay a \$600,000 civil penalty and implement a corporate-wide plan to significantly reduce its emissions of ozone-depleting substances from refrigeration equipment at 659 of its stores nationwide, estimated to cost approximately \$4.1 million, announced the U.S. Environmental Protection Agency (EPA) and Department of Justice today.

The settlement involves the largest number of facilities ever under the Clean Air Act's regulations governing refrigeration equipment.

Enforcement

EPA performs random inspections, responds to tips, and pursues potential cases against violators of the Section 608 regulations. EPA is authorized to assess fines of up to \$37,500 per day for any violation of these regulations.

EPA Is Serious About Enforcing Regulations, and the Consequences Can Be Major

Department of Justice

U.S. Attorney's Office

Southern District of Ohio

FOR IMMEDIATE RELEASE

Tuesday, June 24, 2014

Air Conditioner Thief Pleads Guilty To Violating Clean Air Act

CONTACT: Fred Alverson
Public Affairs Officer

COLUMBUS, OHIO – Martin C. Eldridge III, 35, Columbus, pleaded guilty in U.S. District Court to violating the Clean Air Act when he cut the tubing on air conditioning units he was stealing and released a regulated refrigerant into the environment.

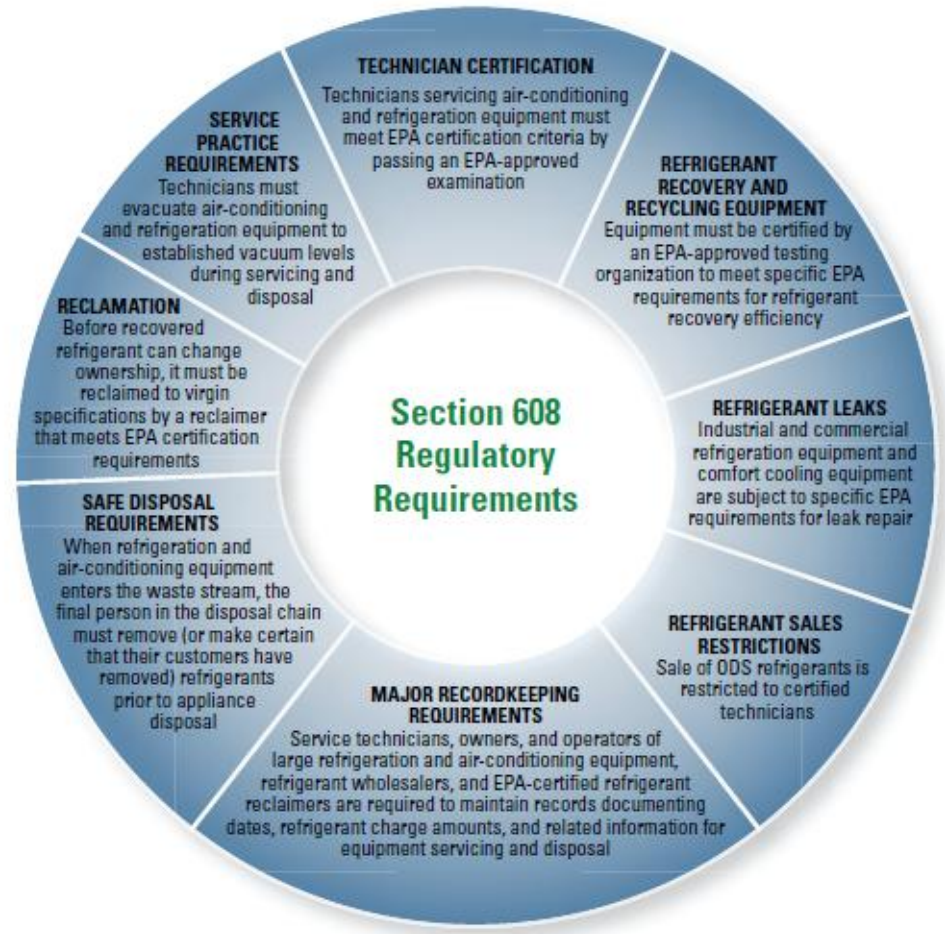
CONTACT: Stewart,

“The release of ozone depleting substances can cause serious harm to public health, including skin cancer, cataracts, and suppression of the immune system,” said Randall K. Ashe, Special Agent in Charge of EPA’s criminal enforcement program in Ohio. “The defendant’s continual theft of air conditioner parts was illegal and a clear violation of the Clean Air Act. As this defendant has learned, anyone who thinks that breaking the law is worth the risk should think again.”



Existing Section 608 Key Elements

- Part of the Clean Air Act
- Addresses Stationary Refrigeration and Air Conditioning (CFCs, HFCs)
- Key Elements
 - Prohibits Venting
 - Requires Certification
 - Provides for Safe Disposal
 - Requires Record Keeping
 - Corrective Actions Required for Leak Rates Above 35%



CA Air Resources Board (CARB)

Regulations Built on and Extended 608

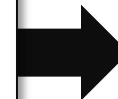
- **Refrigerant Management Program Introduced by CA for the Purpose of Reducing Leaks and Emissions of High-GWP Refrigerants**
- **Requires Periodic Leak Inspections and Follow-up Actions**
 - Registration, Record Keeping and Reporting
- **Categorized Refrigeration Systems by Amount of Refrigerant**
 - Small: 50 to 200 Pounds
 - Medium: 200 to 2,000 Pounds
 - Large: > 2,000 Pounds
- **Mandated Automated Leak Detection Equipment for Large Systems**
 - Direct or Indirect Methods Acceptable



CARB Clarification on Automated Leak Detection Systems

When is an Automatic Leak Detection (ALD) system required?

An [ALD](#) may be required if the refrigeration system is a [large system](#); i.e. it contains 2,000 pounds or more of a high-GWP refrigerant. If the large refrigeration system is indoors and operates, or is intended to operate year-round an ALD is required. If only part of the system is indoors an ALD is required on those parts that are indoors that have a high potential for leaks; i.e. compressors, evaporators, condensers, etc. The components of the system that are not indoors must be inspected for leaks at least once every three months.



**Large Systems
Require Leak
Detection**

What types of ALDs are available?

There are two primary types of ALD: those that monitor the concentration of refrigerants in air ([direct monitoring systems](#)) and those that monitor and interpret the status and operation of the system ([indirect, or parametric, monitoring systems](#)). Both types of monitoring systems should be calibrated or audited annually to assure that they are performing properly. The calibration or audit should be recorded as a service record in the R3 tool and reported on the Annual Report. Alternatives to the conventional direct and indirect ALD systems may be considered if they can be demonstrated in an approved written request to be equally or more effective.



**Direct or Indirect
Systems OK**



EPA Has Proposed an Update to 608



The screenshot shows the EPA website's 'Significant New Alternatives Policy (SNAP)' page. The header includes the EPA logo and navigation links for 'Learn the Issues', 'Science & Technology', 'Laws & Regulations', and 'About EPA'. A search bar is visible on the right. The main content area features a breadcrumb trail: 'You are here: EPA Home » Significant New Alternatives Policy (SNAP) » 608 Proposal'. The title '608 Proposal' is prominently displayed. Below the title, a paragraph explains that the EPA Administrator, Gina McCarthy, signed the proposed rule on October 15, 2015, and it is being submitted for publication in the Federal Register. It notes that this is an internet version and not the official one, providing links to the official versions on the GPO's FDsys website and Regulations.gov. A sidebar on the left contains links for 'SNAP Home', 'Overview of SNAP', 'SNAP Regulations', 'Substitutes by Sector', and 'Submit a Substitute'.

- **Incorporates Some of the Key Elements of CARB**
- **Changes in Leak Rate Triggers**
- **Mandates Inspections or Monitoring**
- **Expected Implementation Date **TBD** (Rule Making Process)**



Key Elements of the Proposal

- **Lowering the Leak Rate Threshold Above Which Owner/Operators of Refrigeration and Air-conditioning Equipment Normally Containing 50+ Lbs. of Refrigerant Must Repair Leaks:**
 - Lower From 35% to 20% for Industrial Process Refrigeration (IPR) and Commercial Refrigeration Equipment
 - Lower From 15% to 10% for Comfort Cooling Equipment
- **Requiring Regular Leak Inspections or Continuous Monitoring Devices for Ref/AC Systems:**
 - Annual Inspections for Systems Normally Containing 50+ Lbs. of Refrigerant
 - Quarterly Inspections for Commercial Refrigeration and IPR Systems Normally Containing 500+ Lbs. of Refrigerant
- **Prohibiting Operation of Systems Normally Containing 50+ Lbs. of Refrigerant That Have Leaked 75% or More of Their Full Charge for Two Consecutive Years**
- **Allowing the Purchase of Cans Containing Two Pounds or Less of Non-ODS Refrigerant for Motor Vehicle Air Conditioner (MVAC) Servicing Without Technician Certification as Long as the Small Cans Have a Self-sealing Valve to Reduce Refrigerant Releases**
- **Requiring Technicians to Keep a Record of Refrigerant Recovered During System Disposal From Systems With a Charge Size From 5–50 Pounds**
- **Extending the Requirements of the Refrigerant Management Program to Cover Substitute Refrigerants, Such as HFCs**

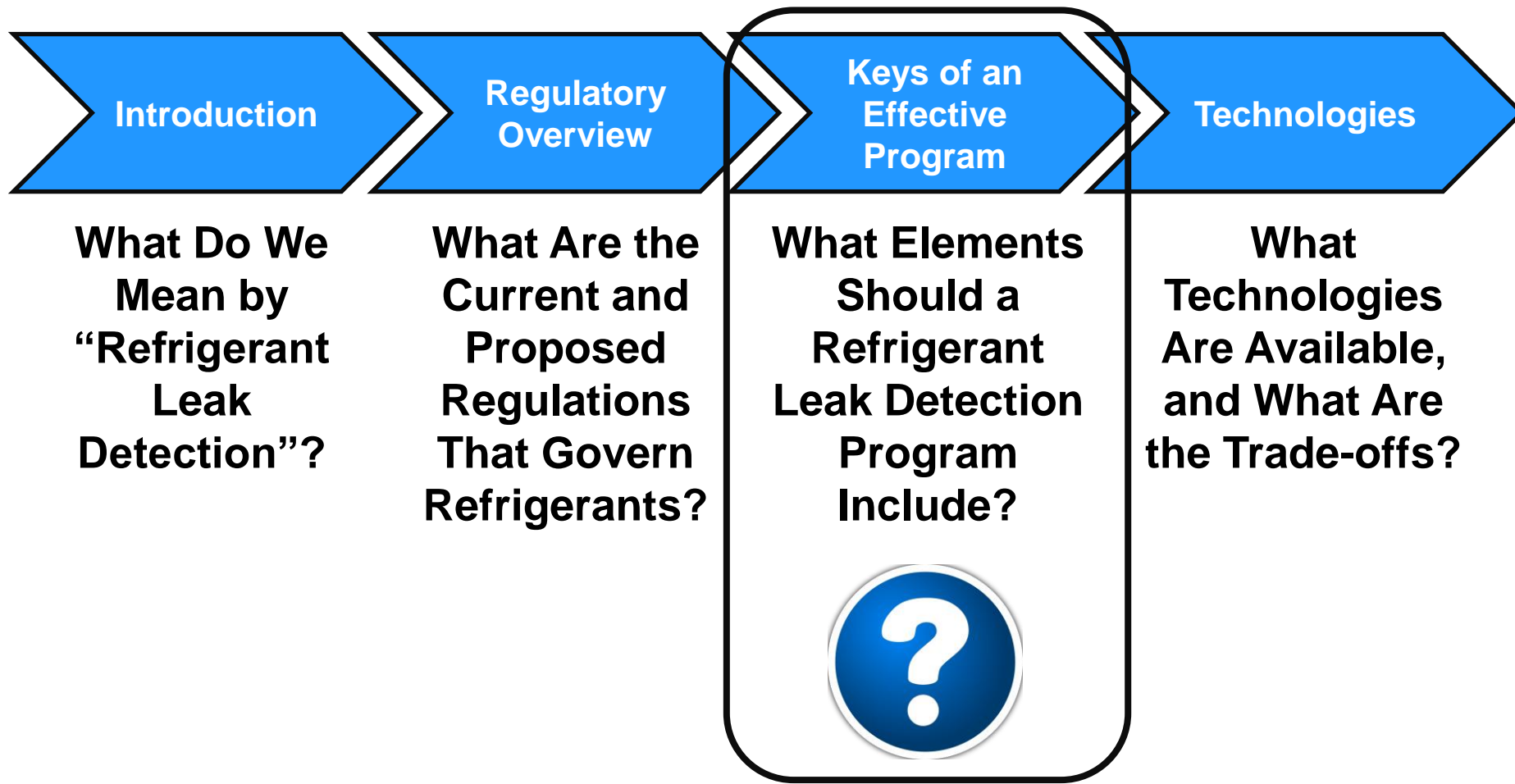


Poll Question

- **Do You Currently Use Leak Detection Systems as Part of Your Refrigerant Management Plan?**
 - No
 - Yes, Fixed (Permanently Installed) Systems Used
 - Yes, Portable
 - Yes, Fixed + Portable (as Needed)



Discussion Topics



Key Elements of a Leak Detection Program

Monitoring

- Receiving and Recording Events
- Taking Appropriate Actions
- Correlating With Fill Events, etc.
- Calculating Leak Rates
- Understanding Overall Impact
- Focus Programs to Eliminate Leaks



Notification

- Local Versus Remote Notification
- Importance of Thresholds and Alarming



Detection

- Technology Choice Based on Requirements
- Installation of Leak Detectors
- Location



Best Practices

- **No-Tolerance Policy**

- Stress Importance of Detecting and Minimizing Leaks Throughout Organization
- Highlight and Communicate Savings

- **Track Leaks**

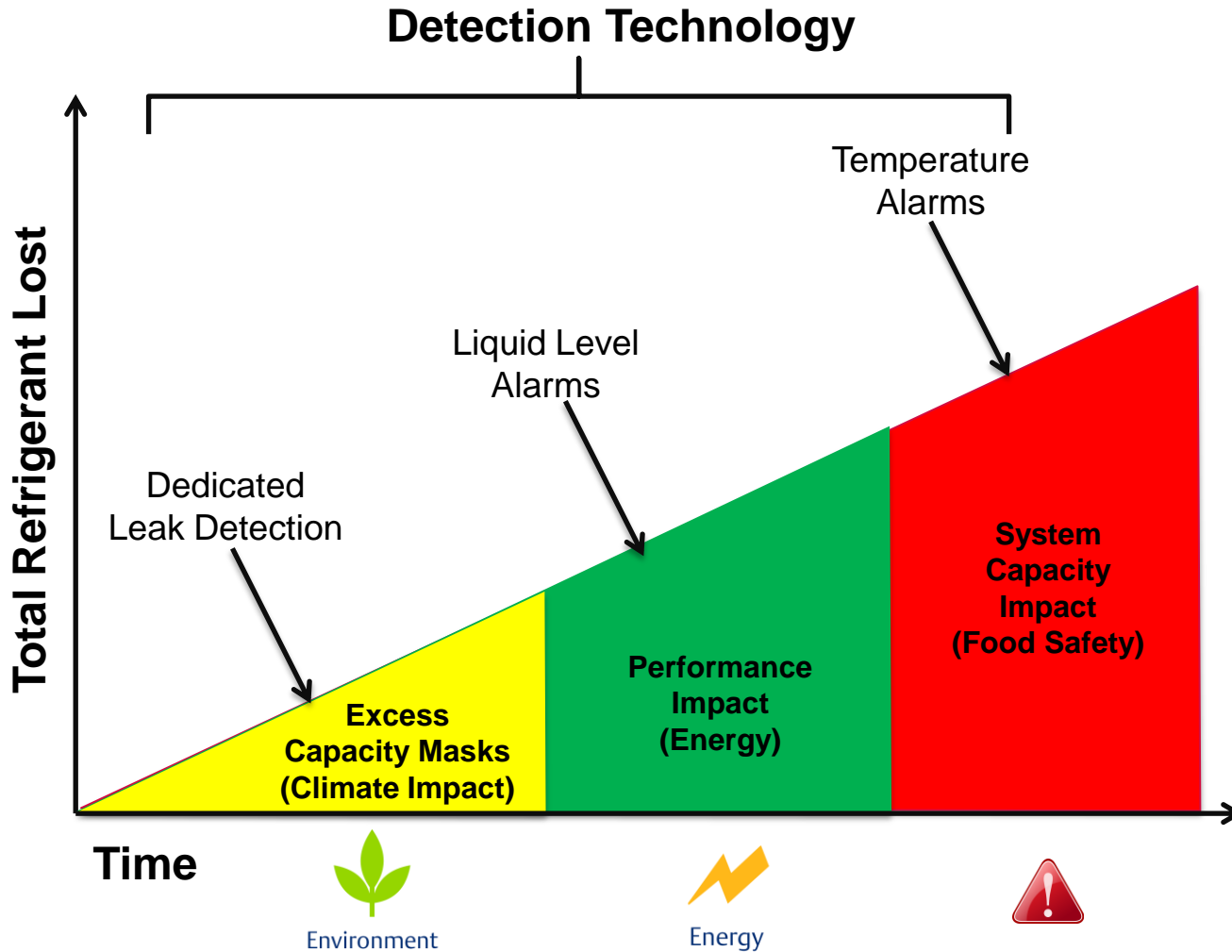
- Utilize Automatic Detection to Identify
- Correlate Leaks to Equipment
- Analyze Data to Detect Trends, Decide on Replacement Actions, etc.

- **Proper Maintenance Procedures**

- **Utilize Resources and Information to Educate**

- Included as Part of Presentation

The Benefits of Detecting a Leak Early



Poll Question

- **Are You Familiar With the Different Types of Leak Detection Systems and Understand How to Apply the Technologies?**
 - No
 - Somewhat
 - Yes, Familiar With Direct (Hardware On-Site) Systems
 - Yes, Familiar With Both Direct and Indirect Systems



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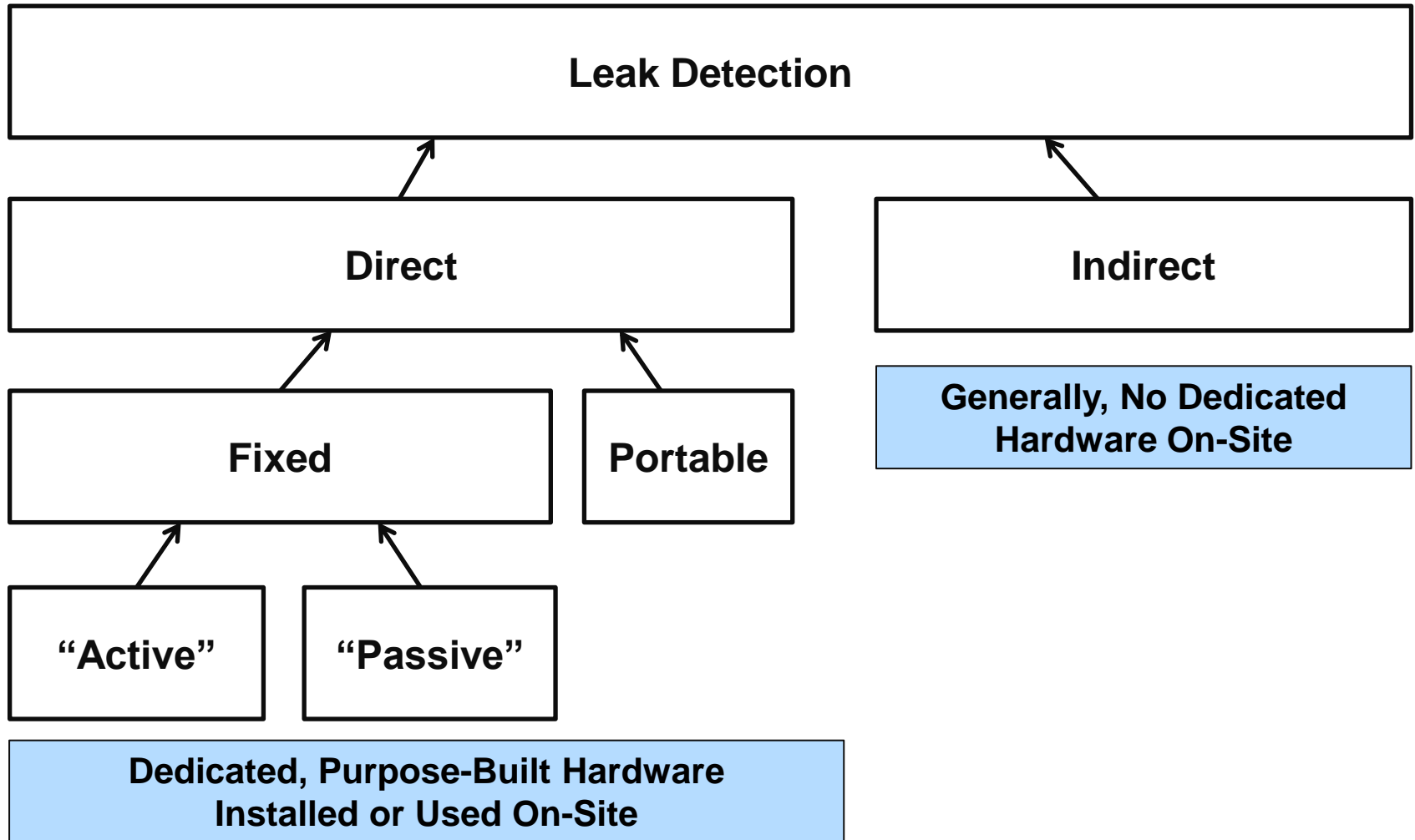
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Types of Leak Detection Technologies

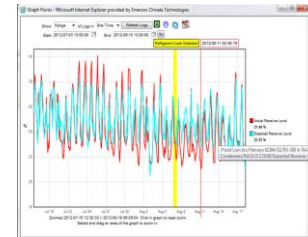


Characteristics of Leak Detection Technologies

“Active”

“Passive”

Indirect



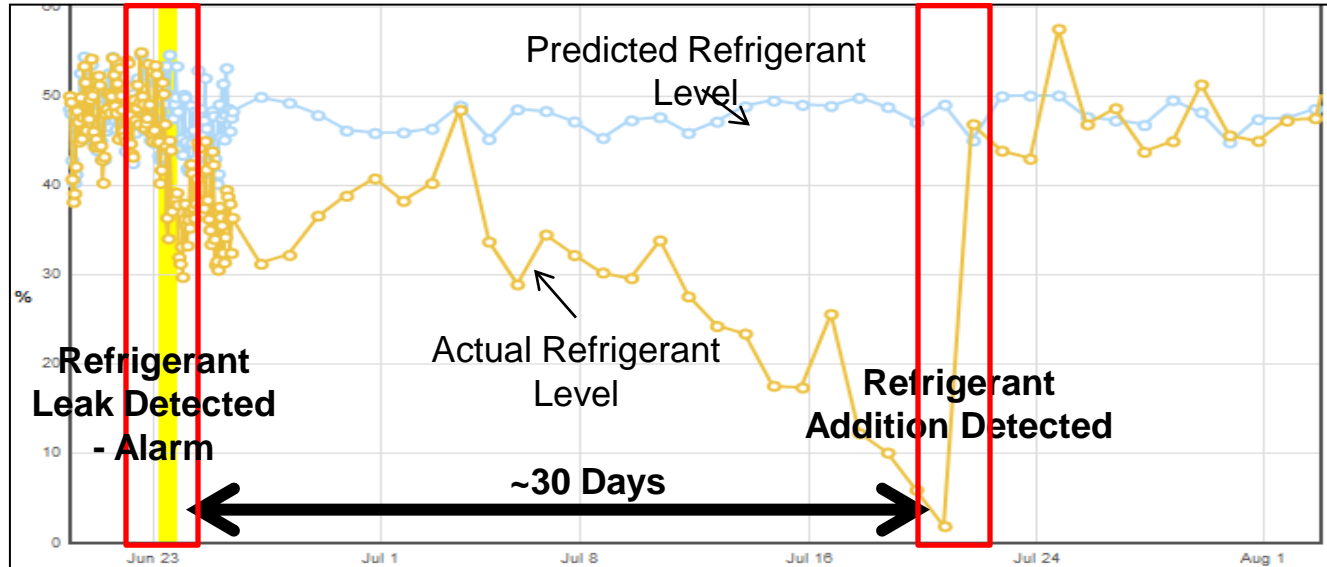
- “Sniffer Technology”
- Multiple Zones
- Tubing to Each Zone
- Multiple Refrigerants
- Connection to Monitoring System for Notification
- Potential to Use for CARB Automatic Leak Detection (ALD)

- Passive Infrared Technology
- Single Zone
- Multiple Refrigerants
- Connection to Monitoring System for Notification
- Potential to Use for CARB Automatic Leak Detection (ALD)

- Generally Uses Existing Sensors and HW
- Site- or “Cloud”-Based
- Analyzes Data (i.e., Temperatures, Pressures, etc.) to Detect Leaks
- Potential to Use for CARB Automatic Leak Detection (ALD)



Indirect Example: ProAct™ Leak Detection



Customer Motivations

- Reduce Refrigerant Leaks
- Drive Oversight Across Enterprise
- Predictive Approaches
- Avoid regulatory issues

Results

- Leak Reduction \$2,500/Store/Year
- ~ \$1M/Year In Savings



Summary



- **Leaks Can Occur Anywhere; High Percentage Are in Racks/Cases**
- **Leaks Impact Not Only the Climate But Your Bottom Line**
- **Existing Regulations Address Handling and Reporting of Refrigerants and Refrigerant Leaks**
- **CARB Extends on Clean Air Act; Proposed Update for 608 Would Require Inspections or Monitoring and Lower Trigger Rates**
- **Leaks Can Be Reduced; Information and Resources (E360, EPA, GreenChill, etc.) Available to Help You**
- **Leak Detection Technologies Should Be Utilized as Part of an Effective Program**





Additional Information

General References:

EmersonClimate.com

EmersonClimate.com/e360

EmersonClimate.com/en-us/products/electronics_systems/leak_detection/

<http://www3.epa.gov/>

<http://www2.epa.gov/greenchill>

<http://www.arb.ca.gov/cc/rmp/rmp.htm>

Specific Information Used in This Webinar:

<http://www2.epa.gov/sites/production/files/documents/leakpreventionrepairguidelines.pdf>

http://www2.epa.gov/sites/production/files/documents/gc_averagestoreprofile_final_june_2011_revised_1.pdf

<http://www2.epa.gov/sites/production/files/greenchill/downloads/FinancialImpactCalculator.xls>

<http://www2.epa.gov/sites/production/files/greenchill/downloads/GreenChillCalculator.xlsx>

<http://www3.epa.gov/ozone/enforce>

http://www3.epa.gov/ozone/title6/downloads/Section_608_FactSheet2010.pdf

<http://www3.epa.gov/ozone/title6/608/leak.html>

<http://www.arb.ca.gov/cc/rmp/rmp.htm>

http://www.arb.ca.gov/cc/rmp/RMP_QA_Guidance_Document.pdf

<http://www2.epa.gov/snap/608-proposal>

<http://www2.epa.gov/sites/production/files/2015-10/documents/608factsheet.pdf>



Thank You!

Questions?

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