

Refrigerants and Codes: Understanding the Impact of Refrigerants Requirements on Building Codes and Standards on the Path to Net Zero Greenhouse Gas Emissions

Building Energy Code Webinar Series

Building Technologies Office

August 15, 2024



Welcome

Building Energy Code Webinar Series



This webinar is being recorded. The video recording will be available on the webinar webpage next week.



A pdf of the full presentation is available now.



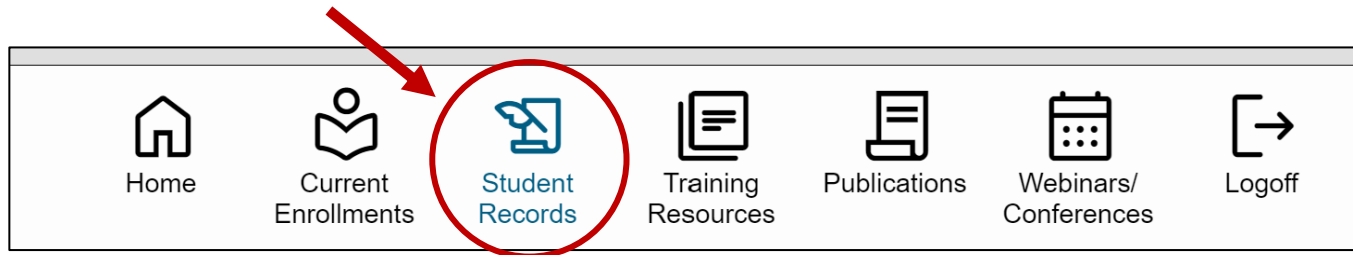
Please place all questions for the speakers in the **Zoom Q&A feature**. We will do our best to answer all questions during the Q&A at the end.



Certificates of completion and AIA LUs are available for participating in today's live session. **After the webinar is complete, you can access your certificate on the BECP Resource Hub.**

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Student Records

July 18, 2024
1-2:30pm ET

Inclusive Energy Codes: Bridging the Gap to Achieve Equity and Environmental Justice

Inclusive Energy Codes: Bridging the Gap to Achieve Equity and Environmental Justice

 ←

- **CEUs Offered:** 1.5 AIA LUs or 0.15 ICC CEUs
- **Duration:** 90.00 minutes
- **Format:** Webinar
- **Status:** Completed Satisfactorily
- **Grade:** 0.0
- **Class Start Date:** 7/18/2024
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 2024 Building Energy Code Webinars	 Energy Code Commentator Series	 Other Webinars	 Performance-Based Forms for Commercial Building Energy Code Compliance Training

Upcoming BECP Webinars

Catch the entire lineup of sessions the third Thursday of each month @ 1p ET.

- **8/15/24:** Refrigerants and Codes: Understanding the Impact of Refrigerants Requirements on Building Codes and Standards on the Path to Net Zero Greenhouse Gas Emissions
- **9/19/24:** What's in the Latest Residential Model Energy Code: Preparing for the 2024 IECC
- **10/17/24:** Beyond Zero Energy: Balancing Embodied Carbon and Operational Energy Solutions to Achieve Zero Emission Buildings
- **11/21/24:** Resources and Best Practices for Growing the Green Building Workforce
- **1/16/25:** New York City Case Study: Understanding the Relationship between Policy and Actual Building Energy and Emissions Data

> Learn more: www.energycodes.gov/becp-energy-code-webinar-series





Plug Into the Technical Assistance Network!

Facilitated by Pacific Northwest National Lab (PNNL), in coordination with the six Regional Energy Efficiency Organizations (REEOs) and additional technical assistance providers, the Network includes regional code professionals, building science experts, and experienced trainers to customize technical assistance to states and jurisdictions.

Get in touch: Contact your PNNL Regional Representative or Local REEO

More info: <https://www.energycodes.gov/technical-assistance/network>



Regional Energy Efficiency Org	REEO Energy Code Contact	PNNL Regional Representative
Northeast Energy Efficiency Partnerships (NEEP)	<u>Cornelia Wu</u>	<u>Mike Turns</u>
Southeast Energy Efficiency Alliance (SEEA)	<u>Maggie Kelley-Riggins</u>	<u>Kim Cheslak</u>
Midwest Energy Efficiency Alliance (MEEA)	<u>Alison Lindburg</u>	<u>Mark Lyles</u>
South-central Partnership for Energy Efficiency as a Resource (SPEER)	<u>Randy Plumlee</u>	<u>Paula Zimin</u>
Northwest Energy Efficiency Alliance (NEEA)	<u>Kevin Rose</u>	<u>Mark Lyles</u>
Southwest Energy Efficiency Project (SWEPP)	<u>Jim Meyers</u>	<u>Paula Zimin</u>

Learning Objectives

1. Learn about the benefits of low global warming (GWP) refrigerants
2. Understand how building codes and standards dictate the use of refrigerants
3. Hear about changes and new approaches to handling refrigerants in buildings
4. Understand how the use of low GWP refrigerants could aid with decarbonization goals

Today's Speakers

Moderator: Katharine Kaplan, U.S. Department of Energy (DOE)

Kristen Taddonio, Refrigerant Emissions Elimination Forum (REEF)

Cheryl Winfield, California Air Resources Board (ARB)

Tom Deary, Air-Conditioning, Heating, and Refrigeration Institute (AHRI)

U.S. DEPARTMENT OF
ENERGY

Office of ENERGY EFFICIENCY
& RENEWABLE ENERGY

Ultra-Low GWP Refrigerants for Refrigeration, Water Heating, and HVAC Applications

Katharine Kaplan, U.S. DOE
Chief Strategy Adviser,
Buildings and Industry

katharine.kaplan@ee.doe.gov

*Decarbonizing the U.S. Economy by 2050:
A National Blueprint for the Buildings Sector
([link](#))*



DOE Building Decarbonization Blueprint Goals



Reduce U.S. building emissions 60% by 2035 and 90% by 2050 vs. 2005 while enabling net-zero emissions economy-wide and centering equity and benefits to communities



Prioritize equity – Advance energy justice and benefits to disadvantaged communities

Prioritize affordability – Reduce energy burden and technology costs so all can benefit

Prioritize resilience – Increase the ability of communities to withstand and recover from stresses



Increase building energy efficiency

Reduce onsite energy use intensity in buildings 35% by 2035 and 50% by 2050 vs. 2005



Accelerate onsite emissions reductions

Reduce onsite GHG emissions in buildings 25% by 2035 and 75% by 2050 vs. 2005



Transform the grid edge at buildings

Increase demand flexibility potential 3X by 2050 vs. 2020 to maximize use of the distribution grid



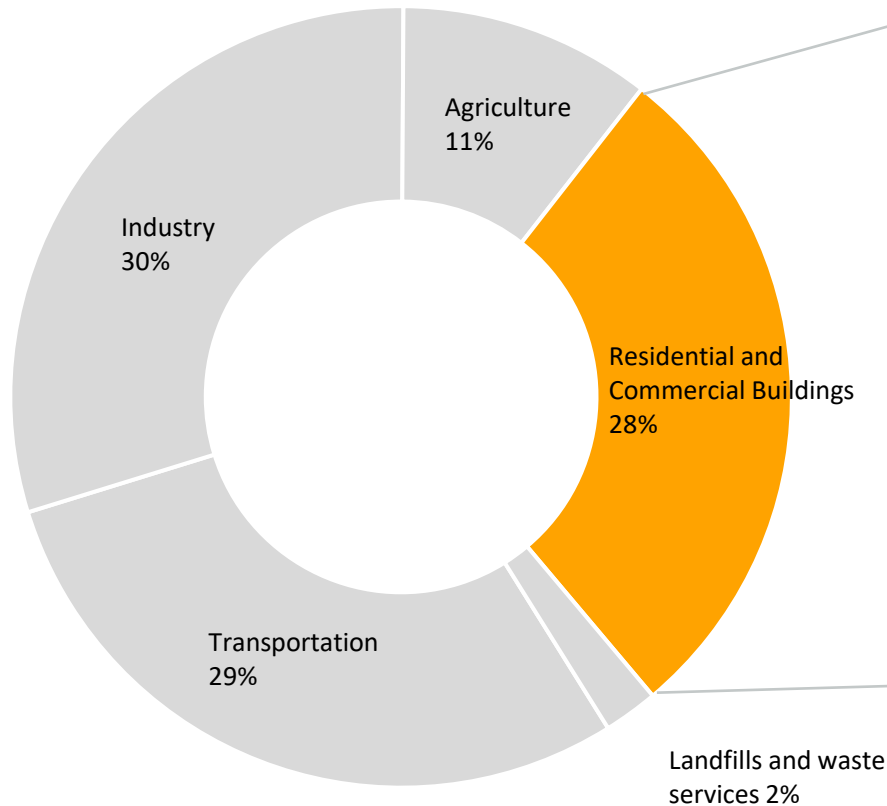
Minimize building life cycle emissions

Reduce embodied emissions from building materials and construction 90% by 2050 vs. 2005.



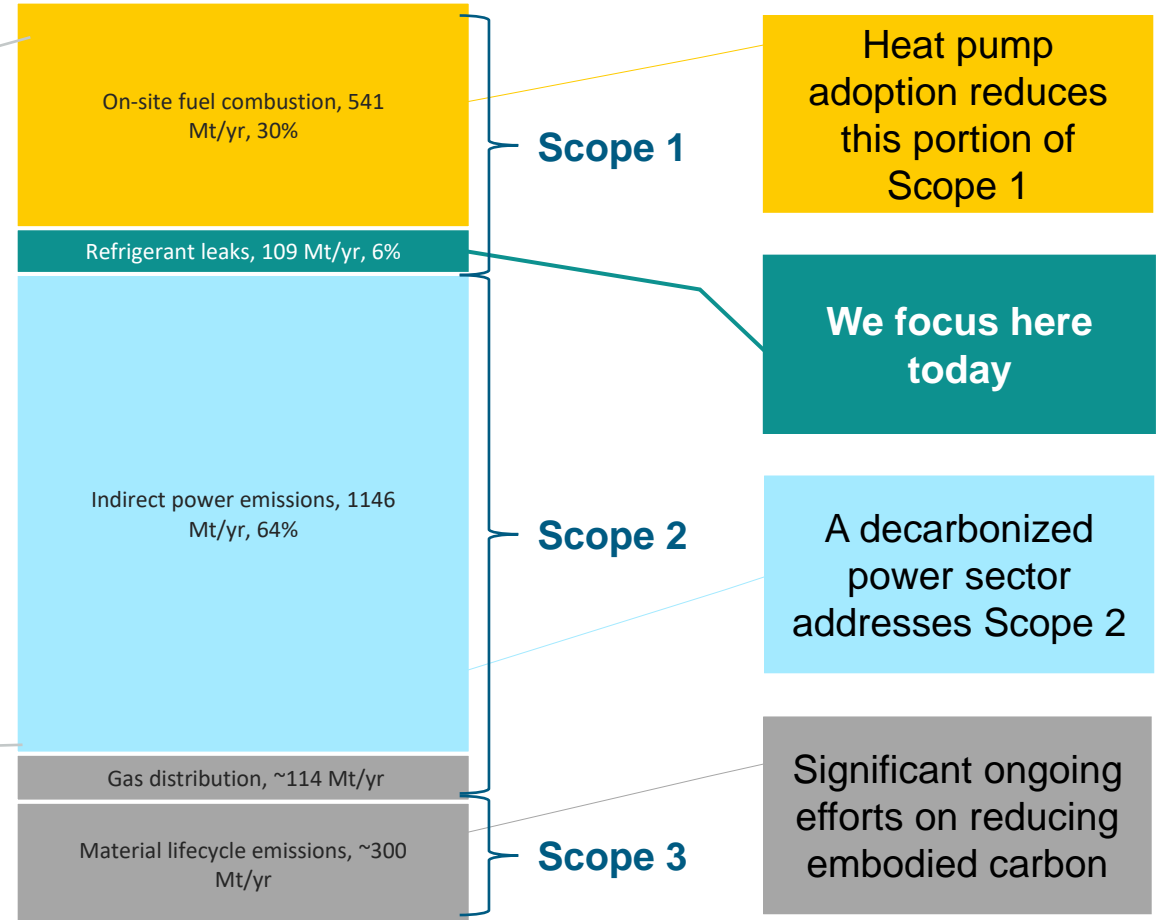
Trajectory of Building Emissions

Total U.S. Greenhouse Gas (GHG) Emissions by Sector with Electricity Distributed



Source: U.S. EPA, [Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2021](#), 2021 data

Total U.S. Buildings-Related GHG Emissions



Source: EPA data; internal DOE analysis. Mt/yr values are 100-year CO₂e

As grid gets cleaner, GHG emissions from HVAC systems will be predominantly from refrigerant leakage

Industry Coordination: Ultra-Low GWP Working



Groups

Scope and Goals of Each Working Group

Codes and Standards

- Codes and standards changes are needed to enable safe use of ultra-low GWP refrigerants, including A3 substances.
- This group will share best practices from previous refrigerant work and ensure stakeholder insights are considered in risk research and standards development.
- The process map will capture all steps and major players with the aim of condensing the codes and standards timelines.
- The group will enable stakeholders to join forces on updating codes and standards.

R&D

- Foundational R&D will enable us to begin to move the market to ultra-low GWP refrigerants in building HVAC applications.
- This group will work from a draft analysis methodology that Oak Ridge National Laboratory will develop and vet with stakeholders.
- The group will enable relevant parties to coordinate and expedite R&D efforts and identify remaining gaps in the research.

Takeaways

- Using voluntary levers to accelerate the adoption of ultra-low GWP refrigerants is key to meeting national goals to reduce U.S. building emissions 60% by 2035 and 90% by 2050.
- DOE is investing in R&D to support technological and market feasibility of using a range of ultra low GWP refrigerants across a wide variety of building appliances and use cases.
- DOE is convening interested stakeholders to:
 - Accelerate the review of risks of ultra-low GWP refrigerants so that viable use cases can be made allowable
 - Identify and prioritize R&D gaps
 - To join either group, please email Chyna Grant at chyna@akoyaonline.com

Understanding the Impact of Refrigerants Requirements on Building Codes and Standards on the Path to Net Zero Greenhouse Gas Emissions



Thursday, August 15, 2024 , 1 – 2:30 p.m. ET

Kristen Taddonio, REEF Board of Directors

www.reefclimate.org

Speaker Introduction



Kristen Taddonio

- Board of Directors, Refrigerant Emissions Elimination Forum
- Member of the Colorado Energy Code Board, energy efficiency appointee
- 20+ years advancing building efficiency and refrigerant emissions reductions at US Environmental Protection Agency, Department of Energy, and Institute for Governance & Sustainable Development
- Lives in a Solar Decathlon house in Fraser, Colorado that won the 2020 Build Challenge competition (go CU Boulder!)

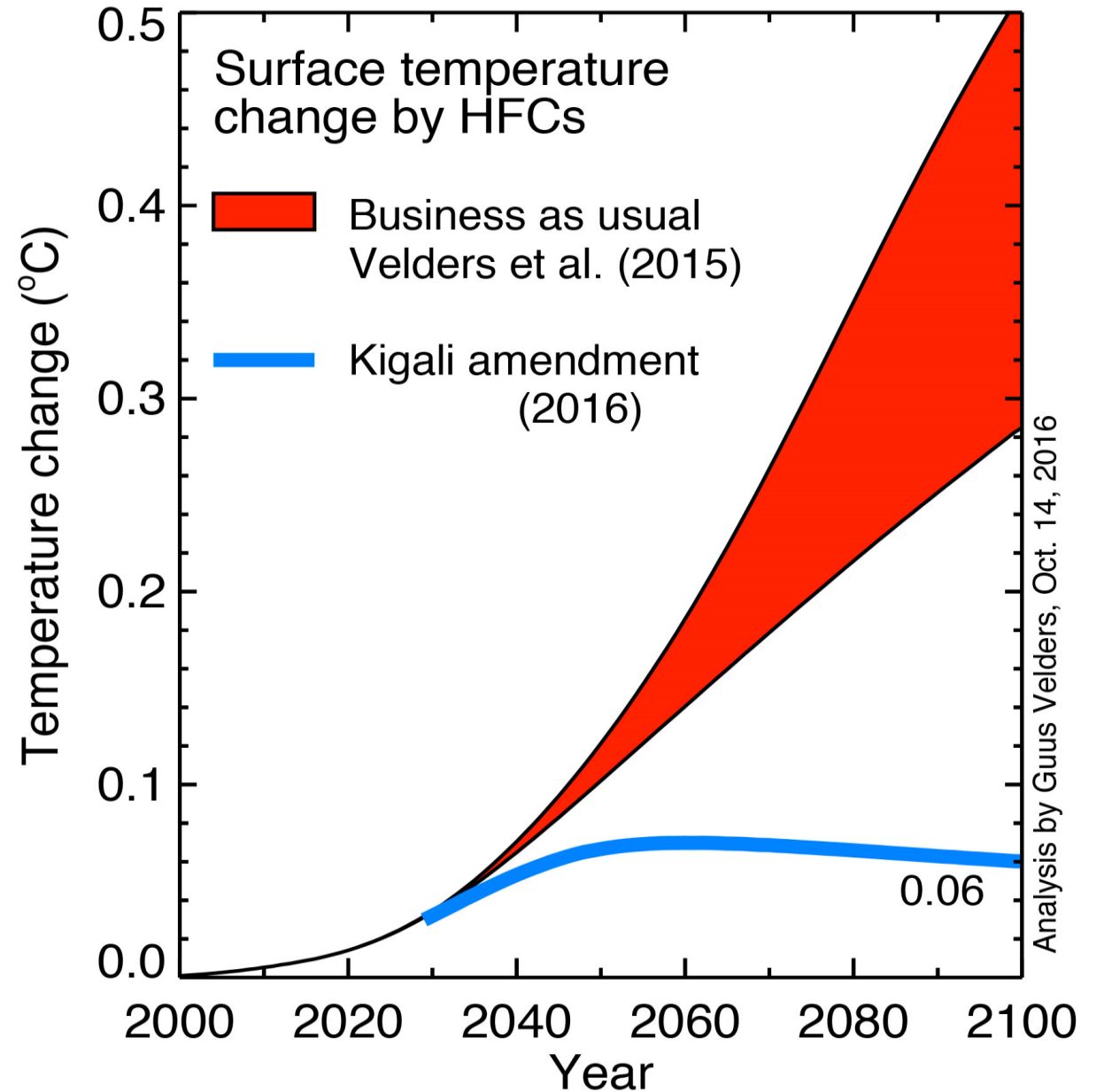
Refrigerants: A Crucial Part of Building Decarbonization

- Decarbonizing our buildings requires a multi-pronged approach.
- Increasing the mechanical efficiency requirements of equipment like heat pumps, air conditioners and water heaters is one way to decrease greenhouse gas emissions.
- Another approach is by incentivizing the replacement of traditional refrigerants with low global warming potential (GWP) refrigerants.



Yes, Refrigerants Really Matter

HFC refrigerants are far better for the earth's ozone layer and climate than the CFCs they replaced. However, HFC emissions were growing so fast that they were on track to cause nearly 1 degree F (0.5 degrees C) of warming this century!



Global Action to Reduce HFC Refrigerant Emissions

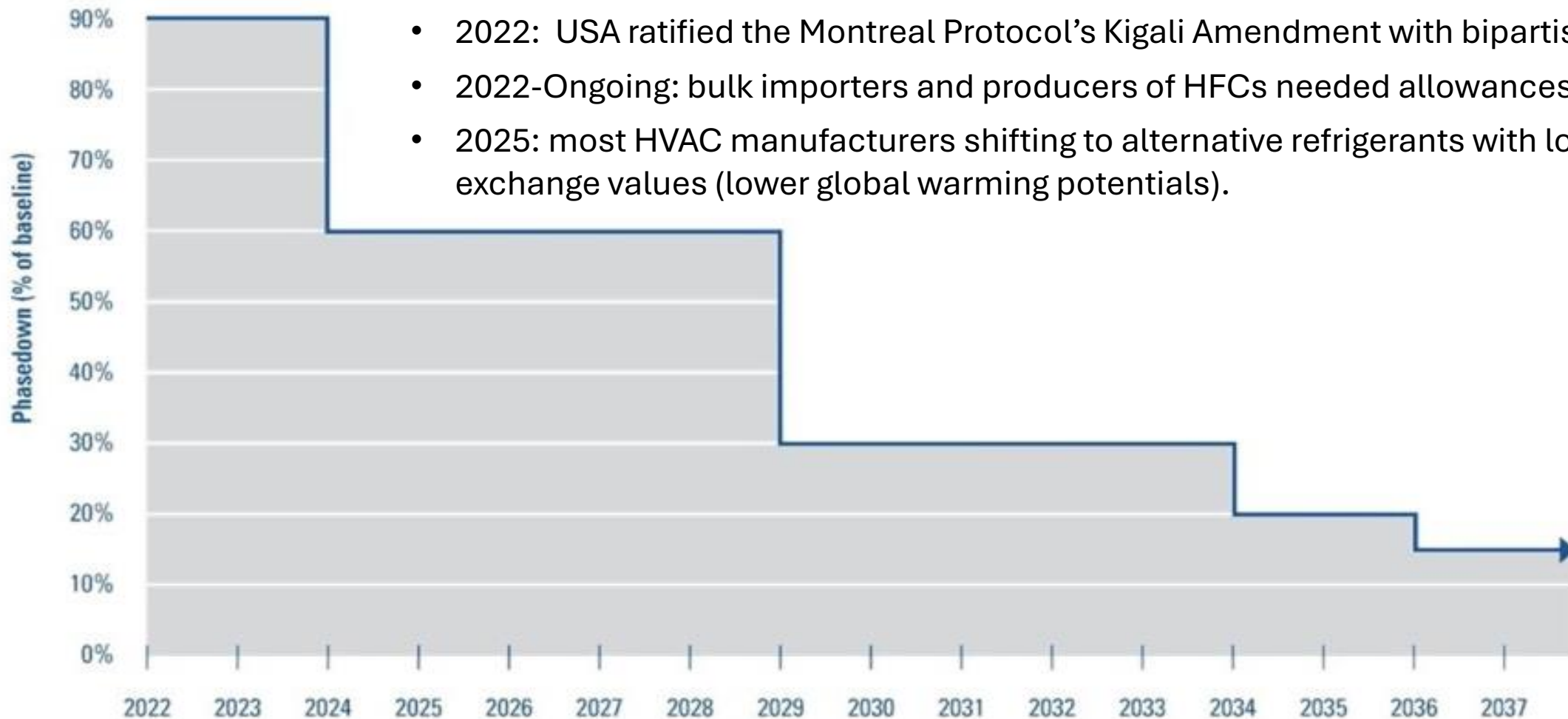
In 2016, the Kigali Amendment to the Montreal Protocol On Substances that Deplete the Stratospheric Ozone Layer set in motion a global phase-down of HFC production and consumption.





The HFC Phasedown in the USA is Already Underway

- Pre-2020: A dozen + states, including California, take action to prohibit high global warming potential HFCs. Manufacturers call for uniform, national phasedown.
- 2020: then-President Trump signed into law the American Innovation & Manufacturing (AIM) Act, which phases down HFCs in the USA.
- 2022: USA ratified the Montreal Protocol's Kigali Amendment with bipartisan support.
- 2022-Ongoing: bulk importers and producers of HFCs needed allowances from EPA.
- 2025: most HVAC manufacturers shifting to alternative refrigerants with lower AIM Act exchange values (lower global warming potentials).



Technology Transitions Rules (HVAC example)

Refrigeration, Air Conditioning, and Heat Pump Systems*			
Subsector	Systems	Global Warming Potential Limit or Prohibited Substances	Installation Compliance Date ⁵
Stationary air conditioning and heat pumps	Residential and light commercial air conditioning and heat pump systems	700	January 1, 2025 ⁶
	Variable refrigerant flow systems	700	January 1, 2026
Chillers	Industrial process refrigeration with exiting fluid below -50 °C (-58 °F)	Not covered	Not covered
	Industrial process refrigeration with exiting fluid from -50 °C (-58 °F) to -30 °C (-22 °F)	700	January 1, 2028
	Industrial process refrigeration with exiting fluid above -30 °C (-22 °F)	700	January 1, 2026
	Comfort cooling	700	January 1, 2025

See: [epa.gov/climate-hfcs-reduction](https://www.epa.gov/climate-hfcs-reduction)

Refrigerants & Building Codes

Top line take-aways:

- *Pre-existing equipment:* Yes, HVAC professionals can continue to use the old HFC refrigerants for servicing. No, you don't have to go switch out systems that are already installed.
- *New equipment:* Thanks to the combined efforts of code officials, product manufacturers, efficiency advocates, and building trades professionals, manufacturers can sell the latest and greatest energy efficient HVAC products containing new refrigerants in your state. (Unless you're in Massachusetts. Soon, we hope.)

Energy Codes:

- Yes, equipment that uses new refrigerants will meet or exceed federal efficiency performance standards (in many cases, shift to low-GWP refrigerant comes with efficiency performance boost).
- New low-GWP refrigerant "points" option may be available in states like Colorado in the process of adopting the 2024 IECC.

Mechanical, Building & Fire Codes & Standards:

- We're ready. Lots of effort has taken place over the last few years to get these updated and ready for the refrigerant transition. More from Tom Deary, AHRI, on that!
- In some states where codes updates take a long time, legislation assures that new equipment can be installed.



CALIFORNIA
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California HFC Policy and Regulatory Landscape

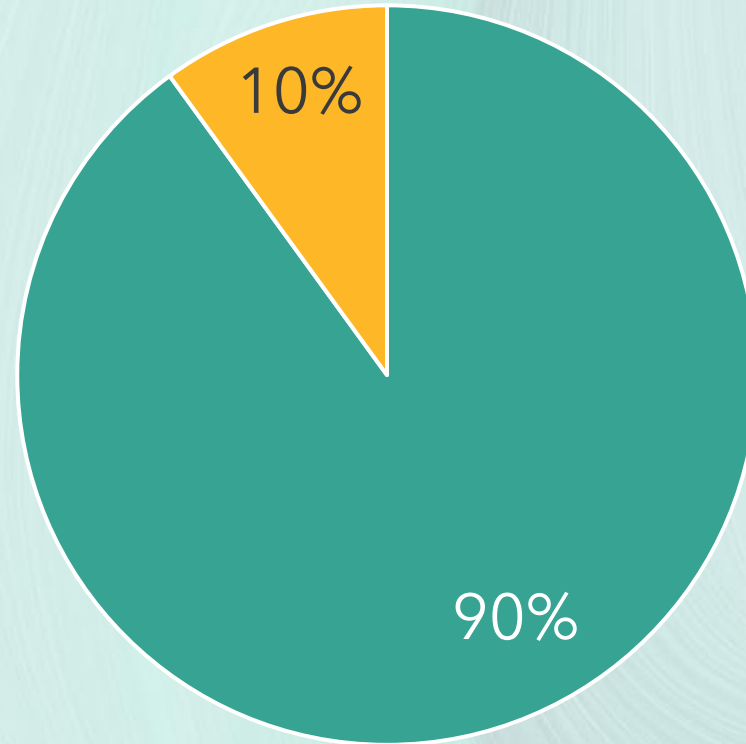
Cheryl Winfield, MS, EIT
F-gas Reduction Strategy
August 15, 2024

Presentation Outline

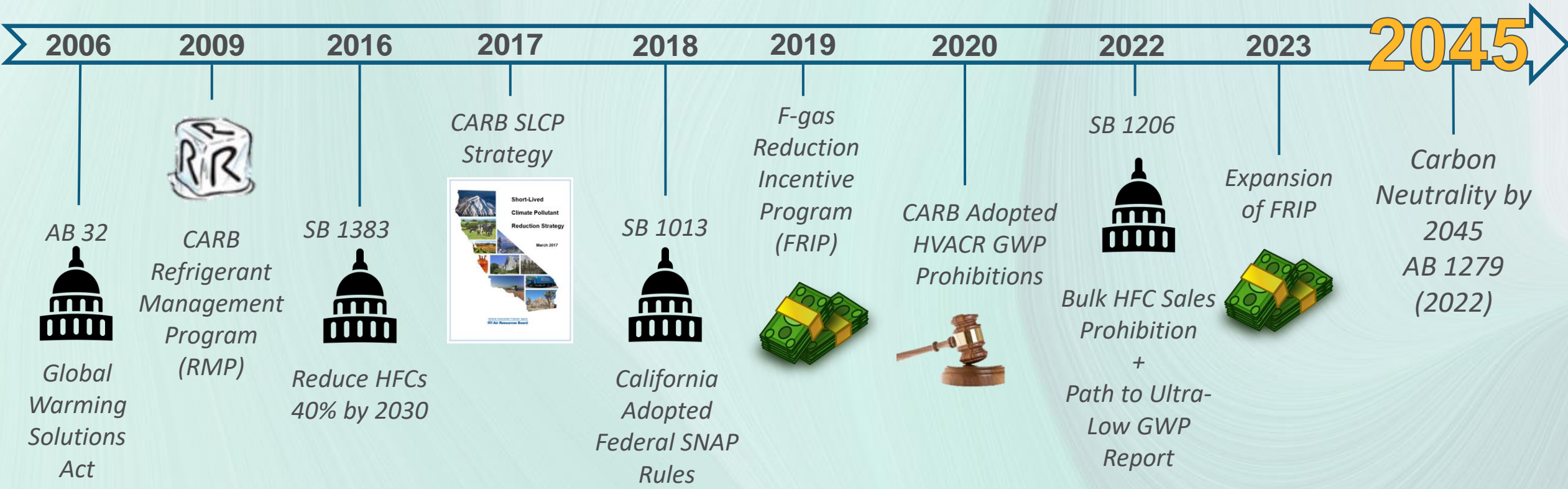
- California Regulatory and Legislative History
- Comparison between HFC and energy use emissions from appliances
- The future of HFCs in California

Hydrofluorocarbon (HFC) Emission Sources

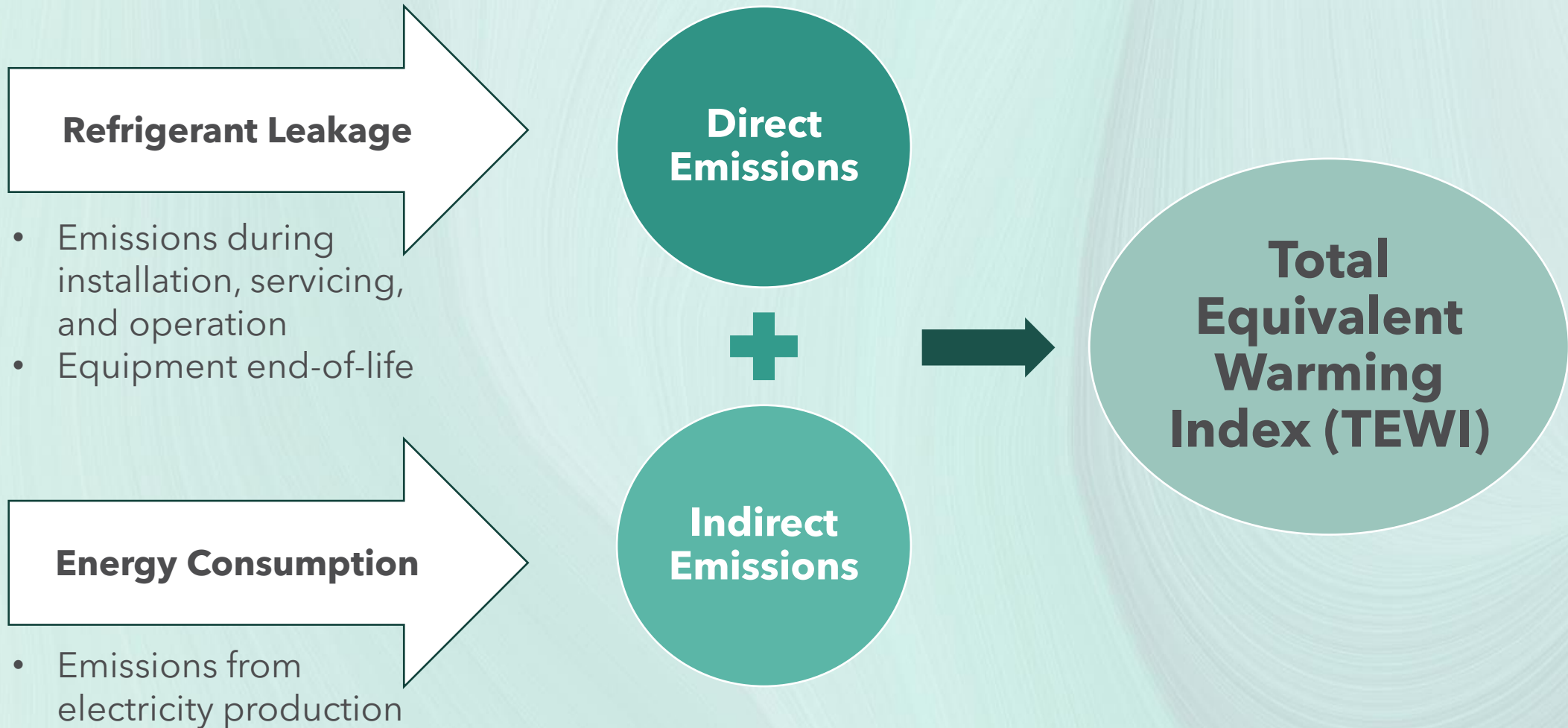
- Refrigerant End-Uses
(Commercial and Industrial Refrigeration, Air Conditioning, Heat Pumps, Cold Transport, etc.)
- Non-Refrigerant End-Uses
(Aerosol Propellants, Foams, Solvents, etc.)



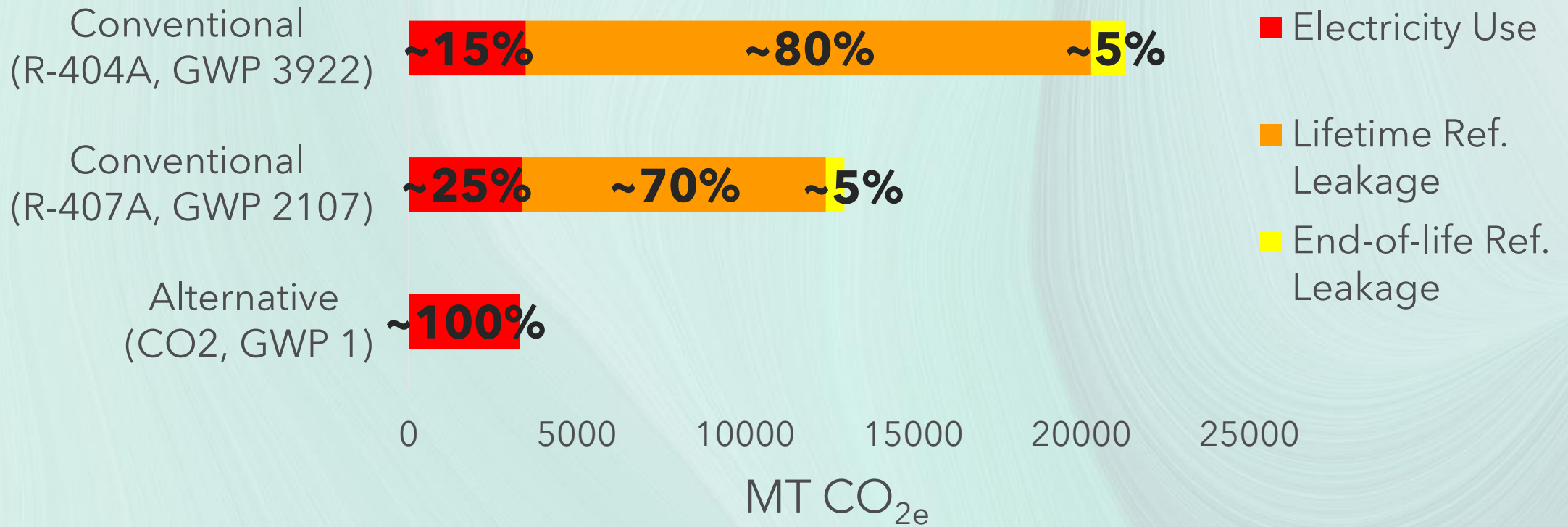
California's Commitment to HFC Reductions



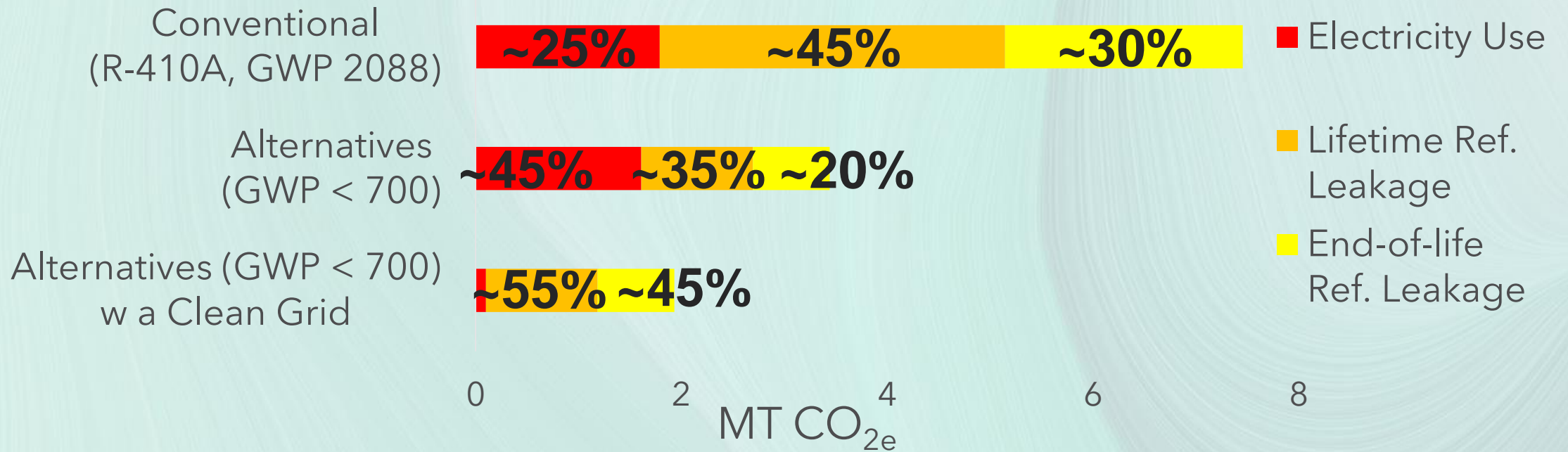
A Holistic Approach to Evaluate Technologies



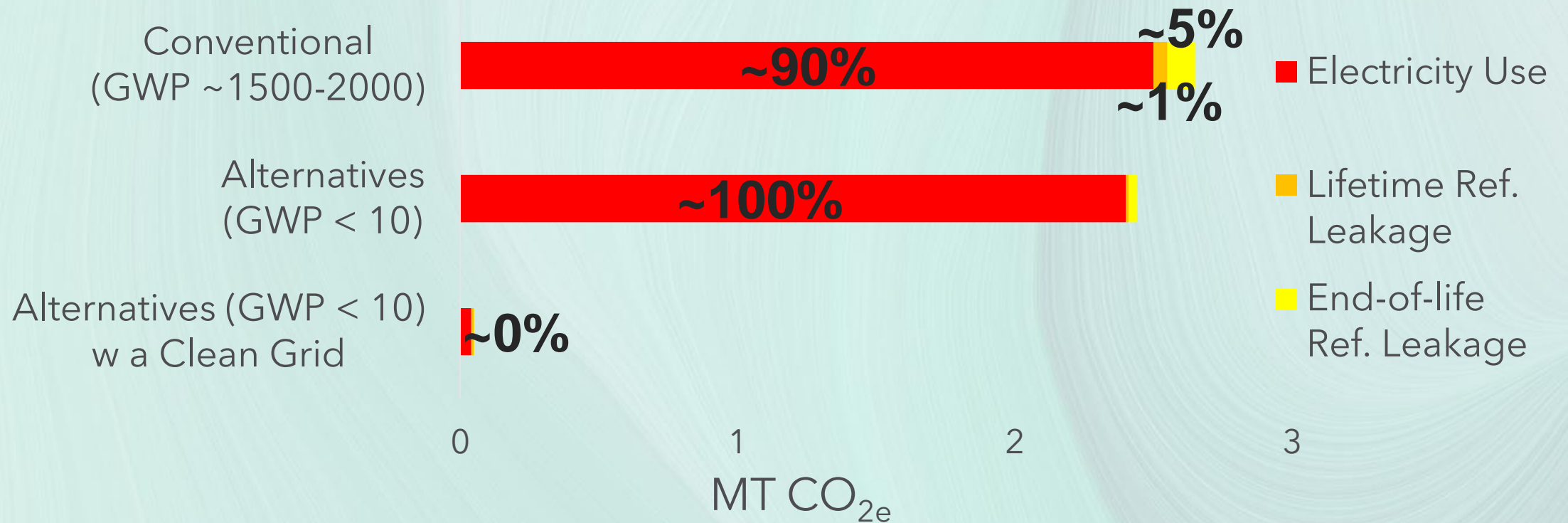
Estimated Distribution of Direct and Indirect Emissions for Commercial Refrigeration



Estimated Distribution of Direct and Indirect Emissions for HVAC Equipment



Estimated Distribution of Direct and Indirect Emissions for Smaller Appliances



CARB's Adopts GWP Limits: Stationary Air/Space Conditioning and Refrigeration (2020)

First-of-its-kind in the Nation

New Room, Wall,
Window, Portable
AC and Small
Equipment



January 1, 2023
GWP < 750

New Other
Residential and
Commercial AC
Equipment



January 1, 2025
GWP < 750

New Variable
Refrigerant Flow
(VRF) Systems



January 1, 2026
GWP < 750

New Refrigeration
Equipment (> 50lb)



January 1, 2022
GWP < 150

Company-Wide
Reduction
Targets for
Existing Food
Retail Facilities
by **2030**

Similar standards have been adopted nationally by the US EPA in their final Technology Transitions Rule under the AIM Act in 2023.

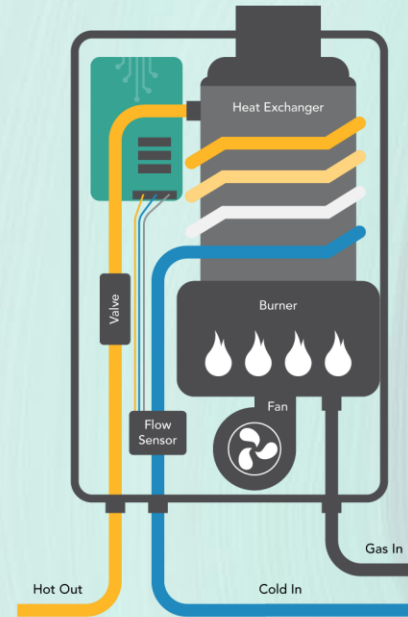
A2L Code Adoption in California

- Mildly Flammable Refrigerants (A2L) were Successfully Adopted in the CA Building Standards effective July 1, 2024.
- Critical for CARB's first in the nation GWP limits for AC equipment.

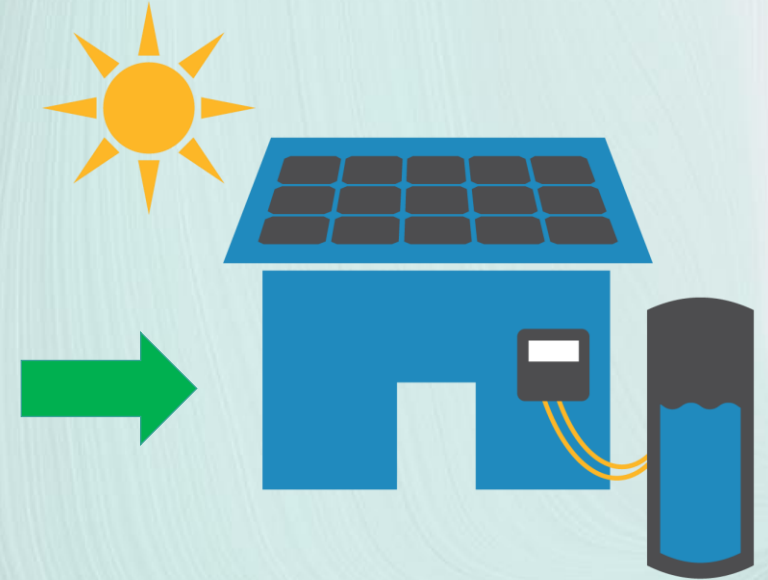


Building Electrification: An Opportunity to Leapfrog to Low-GWP Solutions

- Heat pumps (generally HFC reliant) are a key strategy for building electrification.
- Adoption of heat pumps are expected to increase as demand for cooling increases due to a warmer climate and growing populations.



Uses Fossil Gas



Uses Refrigerants

California SB 1206 (2022): The Future of HFCs in California

Newly Produced HFC Sales Prohibition Aligns with AIM Act Phasedown

2025	2030	2033
> 2,200 GWP	> 1,500 GWP	> 750 GWP

Assessment Report - Plan to transition CA to ultra-low GWP (<10 GWP) and no-GWP alternatives by 2035.

- Identify barriers to and maximize recovery and reclamation (California Energy Commission conducting an analysis)
- Increase the adoption of new ultra-low-GWP technologies
- Workforce training and certification recommendations
- Role of incentive funding to transition the market

HVAC: Path to Ultra-low GWP (<10 GWP)

SB 1206 RFI (Industry feedback): Received a lot of general support from the HVAC industry on California's goals and ultra-low-GWP initiative.

Challenges and Barriers

Building Codes and Safety Standards

Time for Research and Development

Cost to Reach Economies of Scale

Emerging and International Technologies

R-290 Monobloc Units

R-290 Window/Portable/Mini Splits

Indirect Cooling Systems

Integrated Space Conditioning & Water Heating Heat Pumps

Addressing Market Barriers with Incentives



FRIP

**F-gas Reduction
Incentive Program**

- Total of \$66 million from CA Legislature to reduce HFCs and increase climate-friendly alternatives
- North American Sustainable Refrigeration Council (NASRC) selected as FRIP Administrator
- FRIP Round 2 Launching Soon!
 - Focused on commercial and industrial refrigeration sector on ultra-low-GWP (< 10 GWP) technologies
 - Workshop happening later today (1:00-3:00pm PDT): https://us06web.zoom.us/webinar/register/WN_GfBgCXzrQh-8r6KXVFb7Fg#/registration

Success Stories from FRIP Round 1



Stater Bros. Markets opened the company's first CO₂ refrigeration system across fleet of 171 stores

Stater Bros. Markets Opens New Location In Whittier, CA

© November 2, 2021 2 Min Read



Costco opened a store in Murietta with the largest transcritical CO₂ system



Whole Foods Markets converted existing high-GWP HFC systems to hybrid lower-GWP HFC and CO₂ systems while keeping stores operational



To Summarize

- HFC/refrigerant emissions are a key component of building emissions and crucial to achieving carbon neutrality.
- As buildings electrify, the contribution of HFC emissions will become even more significant.
- California is leading the nation towards an ultra-low-GWP future, but more work is needed to make that possible.

CARB Resources & Contact Information

- [SB 1206 Request for Information Comments](#)
- [HFC Regulation Rulemaking](#)
- [F-gas Reduction Incentive Program \(FRIP\)](#)
- [Zero-Emission Appliance Standards Website](#)

Contact Info:

- HFCReduction@arb.ca.gov
- Aanchal.Kohli@arb.ca.gov

Regulatory Updates for A2L Refrigerants

Tom Deary

Director of Codes

Air-Conditioning, Heating, and Refrigeration Institute (AHRI)

Air-Conditioning, Heating, and Refrigeration Institute (AHRI)



Globally Recognized. Industry Respected.

Advocate for 330+ HVACR and
water heating manufacturers

Developer of 100+ international
industry standards and guidelines

Administrator of 40+ performance
certification programs



Standards & Codes Updated for A2Ls

STANDARDS

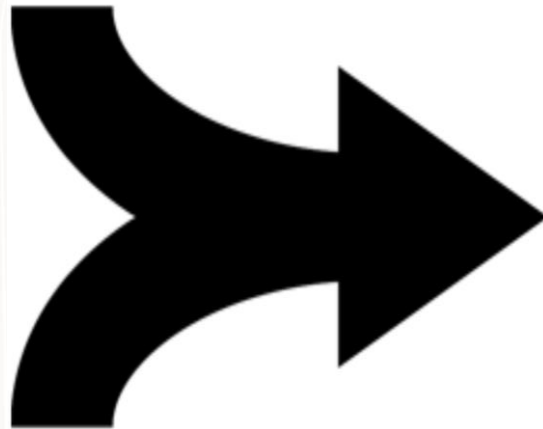
- EQUIPMENT SAFETY STANDARD:
 - UL-60335-2-40
 - UL-60335-2-89
- APPLICATION SAFETY STANDARDS
 - ASHRAE 15, 15.2

CODES

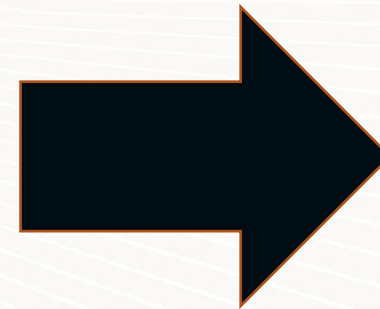
- NATIONAL MODEL CODES
 - ICC (IRC, IMC, IFC, et al)
 - IAPMO (UMC)
- STATE & LOCAL CODES

The Code Adoption Process for New Technology

New or Revised
Product Safety
Standard



Updated
Model Code



State Code
Adopts
Model Code*

*usually with
modifications

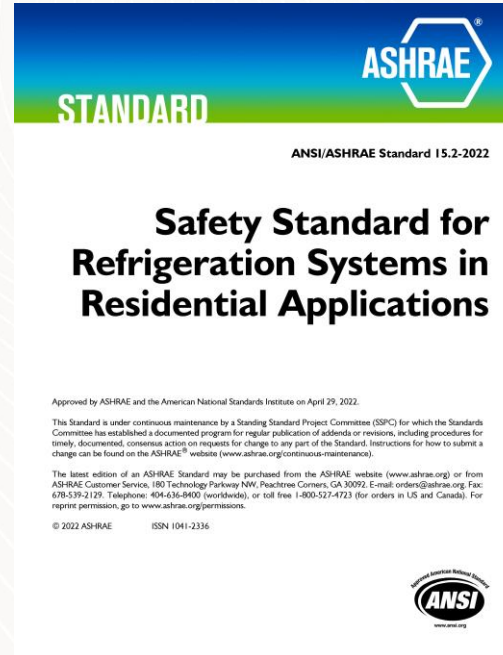
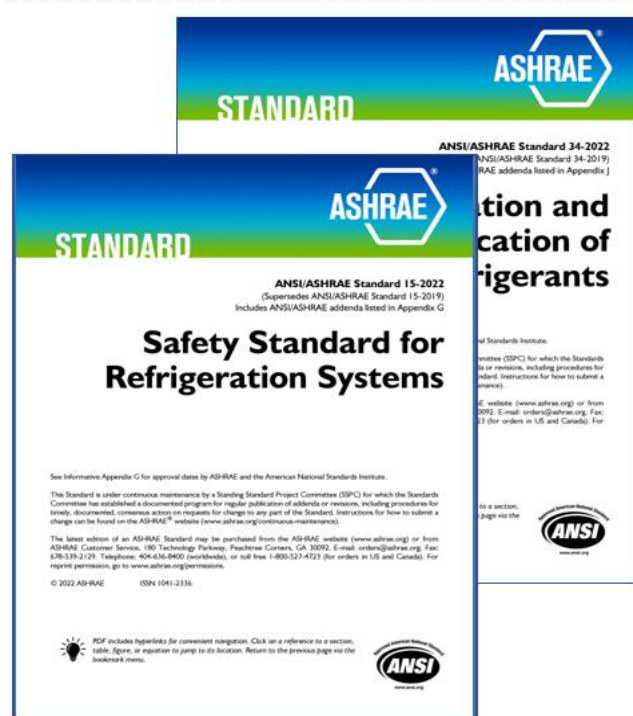
Updated
Application
Safety Standard

A2L Extensive Research

- AHRTI-9007: Benchmarking Risk by Whole Room Scale Leaks and Ignitions Testing
- AHRTI-9008: Investigation of Hot surface Ignition Temperature (HSIT) for A2L Refrigerants
- AHRTI-9009: Leak Detection of A2L Refrigerants in HVACR Equipment
- AHRTI-9012/Oak Ridge National Laboratory (ORNL): Real-world Leak Assessments of Alternative Flammable Refrigerants
- AHRTI-9015: Assessment of Refrigerant Leakage Mitigation Effectiveness for Air Conditioning and Refrigeration Equipment
- AHRI-8017: Investigation of Energy Produced by Potential Ignition Sources in Residential Application
- ASHRAE-1806: Flammable Refrigerants Post-Ignition Simulation and Risk Assessment Update
- ORNL: Investigate the Proper Basis for Setting Charge Limits of A2L, A2, and A3 for Various Types of Products
- NIST: Modeling tools for low-GWP Refrigerant Blends Flammability
- ASHRAE-1808: Servicing and Installing Equipment using Flammable Refrigerants: Assessment of Field-made Mechanical Joints
- AHRI 8028: A2L Refrigerants and Firefighter Tactical Considerations

Safety Standards for HVAC Equipment

- Standards important for AHJs and code officials during plan review and inspection:



Where to find these standards?

- ASHRAE provides free, read-only access: <https://www.ashrae.org/technical-resources/standards-and-guidelines>
- ICC digital codes subscription.

Mechanical/Residential Code Updates

- Requirements in the 2024 International Mechanical Code (IMC), 2024 Uniform Mechanical Code (UMC), 2024 International Residential Code (IRC)
 - These code editions have been updated to align with ASHRAE 15-2022
 - Updates affecting the use of A2Ls in direct systems and in machinery rooms

Equipment Listing Requirements

- UL 1995 is being sunsetted, with UL 60335-2-40 now covering such appliances and equipment – Updated sunset date is 1/1/2025
- Air conditioners and heat pumps tested in accordance with UL 60335 Part 2-40 (2022 edition)
- Unit coolers and commercial refrigerators & freezers tested in accordance with UL 60335 Part 2-89 (2021 edition)

Refrigerant Classification Tables

- Tables have been updated to include all refrigerants in ASHRAE 34-2022
 - Class 2Ls are no longer a subset of Class 2 Flammability Classification after the 2016 edition of ASHRAE 34, but are now their own class

Fire Code Updates

- Requirements in the 2024 International Fire Code (IFC), 2024 International Building Code (IBC), 2024 National Fire Protection Association (NFPA) 1, and the 2023 NFPA 55
 - These code editions also recognize A2L refrigerants as its own class, separate from A2 refrigerants
- Increased maximum allowable quantities (MAQs)
 - Allows for increased quantities of A2L refrigerants and charged equipment to be stored when additional requirements have been met

State Code and Legislative Updates

- 48 states allow A2L refrigerants in some capacity:
 - Massachusetts has approved amendments allowing A2L refrigerants and is completing internal review of the 10th edition of the Massachusetts State Building Code
 - Nevada's counties are currently adopting the 2024 model codes and will have the process completed by the end of 2024
 - Several states only allow A2L refrigerants in certain applications (i.e., only HVAC or only commercial refrigeration) – Florida, Louisiana, Michigan
- AHRI is working with the U.S. territories to update their codes

Transportation/DOT Special Permits

- DOT special permits have been acquired by AHRI member companies and other companies can sign on as parties by submitting a specific application
 - AHRI has created a one-pager outlining this information

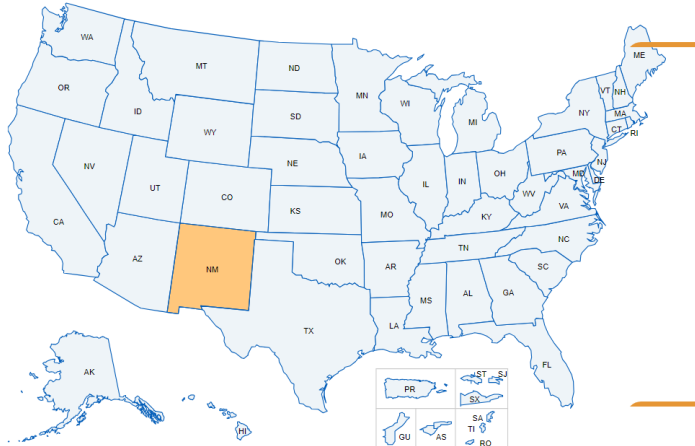
Available Resources

A2L Building Codes Interactive Map

A2L Refrigerant Building Code Map

This map indicates where state and local building codes have been updated or legislation passed to allow equipment using A2L refrigerants. It will be revised as building codes and legislation are updated.

Please select a state below:



Saferrefrigeranttransition.org

Safe Refrigerant Transition

The HVACR Industry is implementing a transition to next-generation refrigerants in accordance with the Kigali Amendment to the Montreal Protocol and the American Innovation and Manufacturing (AIM) Act of 2020

Resources and Fact Sheets

AHRI's Safe Refrigerant Transition resources provide information about the transition to low-global warming potential refrigerants.

- **A Guide to the Safe Refrigerant Transition:**
 - [The Changing World of HFC Regulations](#)
 - [Chemical Physical and Environmental Properties of A2L Refrigerant](#)
- **Safe Transition Terms of Use**
- **Low-GWP Refrigerant Fact Sheets:**
 - [Vibration Durability Considerations for HVAC Equipment and Piping](#)
 - [Retrofit Do's and Don'ts of Class A Refrigerants in Stationary Equipment](#)
 - [The HVACR Industry Is Taking a Responsible Approach to Ensure the Safe Use of Flammable Refrigerants](#)

See Our New A2L Video Series!

Ask the Experts

Send us your questions or comments regarding the safe refrigerant transition!

Support

Thanks!

Building Energy Code Webinar Series

For more information on today's topic, as well as a range of additional training materials and technical assistance resources, visit:

> energycodes.gov

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- If you provided your AIA number when you registered, your attendance will be reported to AIA.