Better Buildings®
U.S. DEPARTMENT OF ENERGY

Better Buildings Residential Network
Peer Exchange Call Series

The Changing World of Residential Refrigerants on World Refrigeration Day (June 26)

June 27, 2024

U.S. DEPARTMENT OF ENERGY

Agenda and Ground Rules

- Moderator
  - **Jonathan Cohen,** Better Buildings Residential Network, U.S. DOE Residential Buildings Integration Program (RBI)
- Agenda Review and Ground Rules
- Residential Network Overview and Upcoming Call Schedule
- Opening Poll
- Featured Speakers
  - **Michael Deru,** National Renewable Energy Laboratory (NREL)
  - **Nick Harbeck,** Johnson Controls
  - **Dan Perunko,** Balance Point Home Performance
- Open Discussion
- Closing Poll and Announcements

Ground Rules:

1. **Sales of services and commercial messages are not appropriate** during Peer Exchange Calls.
2. Calls are a safe place for discussion; **please do not attribute information to individuals** on the call.

The views expressed by speakers are their own, and do not reflect those of the Dept. of Energy.

Join the Network

Member Benefits:

- Recognition in media, social media and publications
- Speaking opportunities
- Updates on latest trends
- Voluntary member initiatives
- One-on-One brainstorming conversations

Commitment:

- Members only need to provide *one number*: their organization's number of residential energy upgrades per year, or equivalent.

Upcoming Calls (2nd & 4th Thursdays):

- *7/11: DOE's New National Blueprint for the Buildings Sector – What it Means for the Residential Sector, a Nonprofit Panel*
- *7/25: Talkin' About Residential Efficiency Incentives – How Are Programs and Contractors Communicating?*

Peer Exchange Call summaries are posted on the Better Buildings website a few weeks after the call

Michael Deru

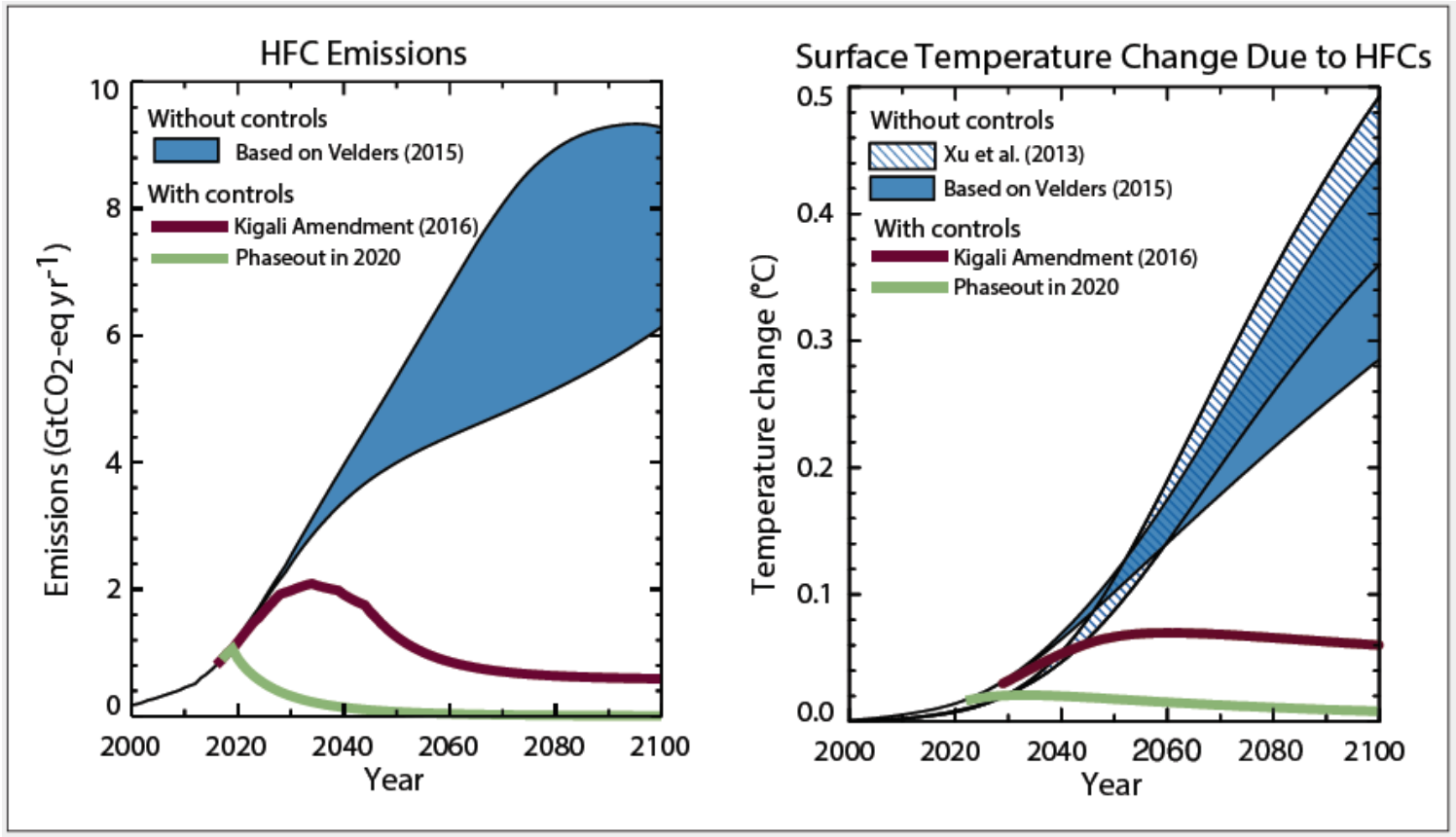
NREL

Navigating the Maze of HFC Phasedown Regulations

Michael Deru
michael.deru@nrel.gov
June 27, 2024

Why HFCs Matter

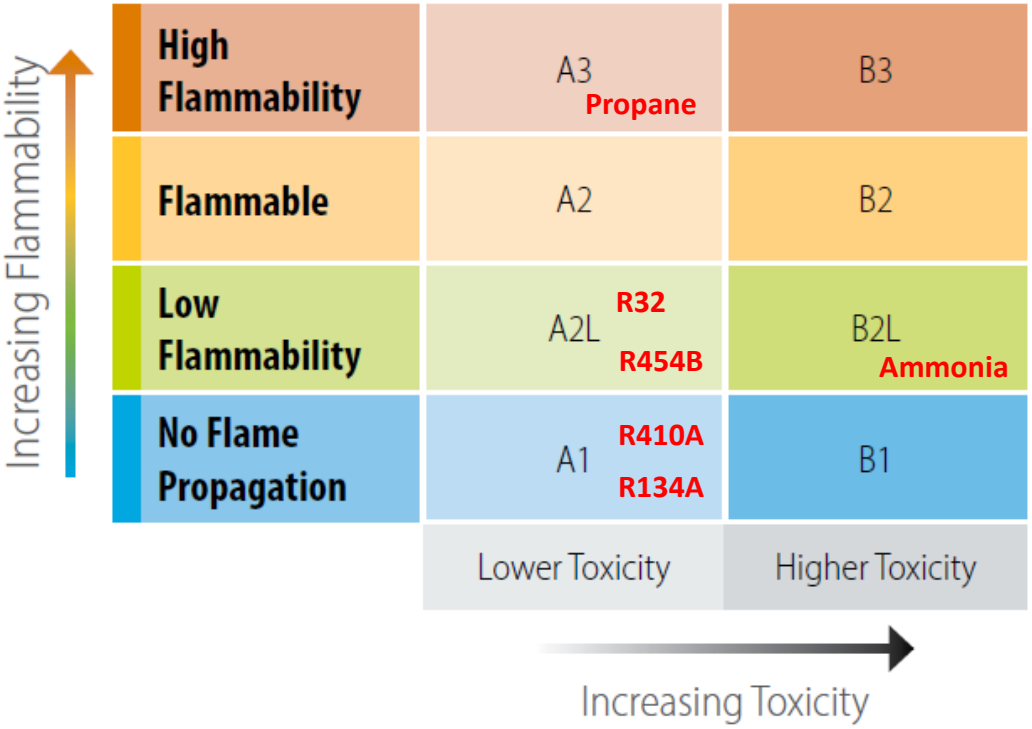
Global phasedown of HFCs is expected to avoid 0.45°C warming by 2100



World Meteorological Organization. 2018. Global Ozone Research and Monitoring Project—Report No. 58

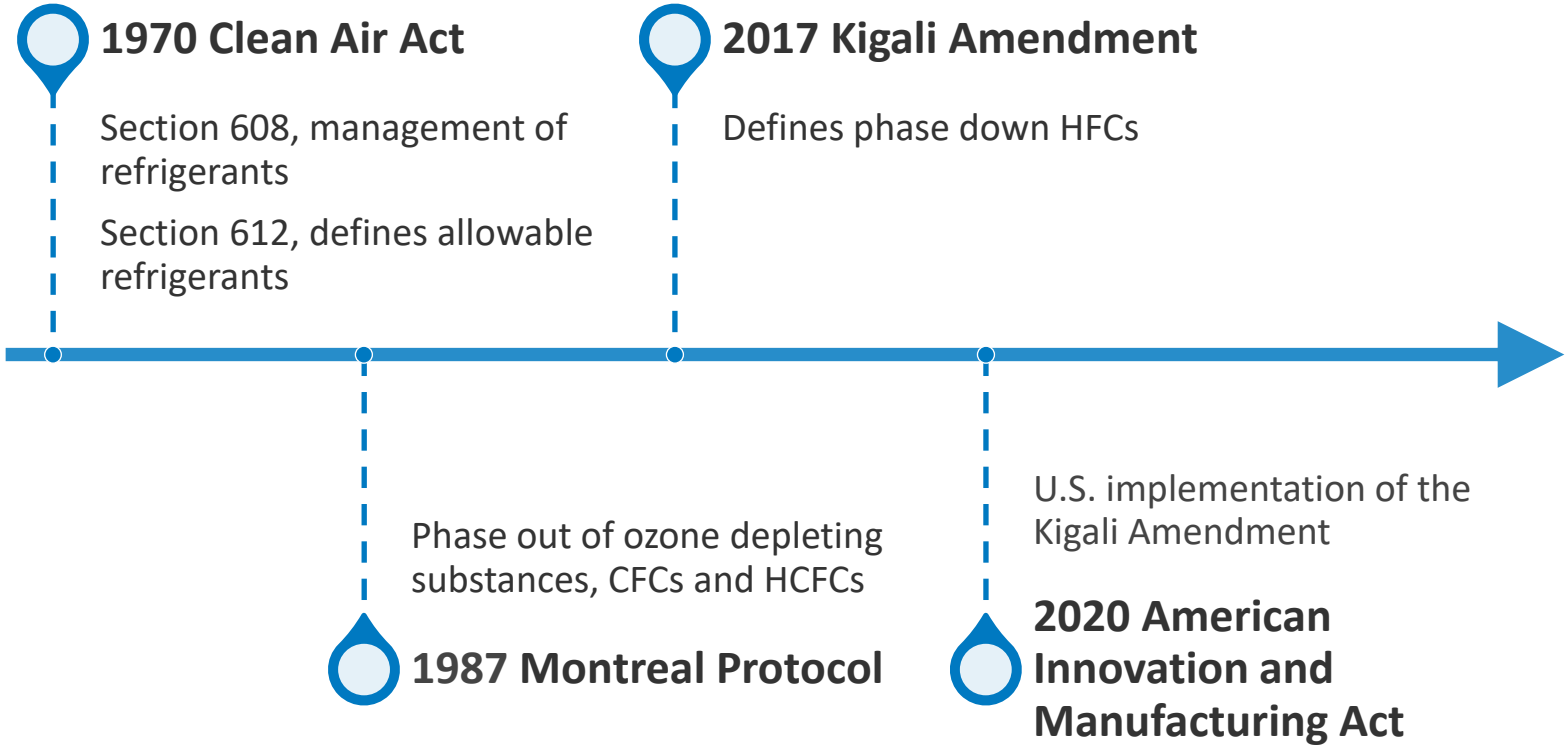
Refrigerant Safety

ASHRAE Standard 34 defines refrigerant safety classifications



https://www.nrel.gov/docs/fy23osti/85155.pdf

Major Refrigerant Regulations



Clean Air Act (1970)

Section 608

Regulations for refrigerant management for stationary refrigeration and air conditioning

EPA CAA Section 608 fact sheet

Clean Air Act (1970)

Section 612

Significant New Alternatives Policy (SNAP)

Defines allowable refrigerants

AIM Act Dec 27, 2020

American Innovation and Manufacturing Act, 2020

Aligns with the Kigali Amendment to the Montreal Protocol

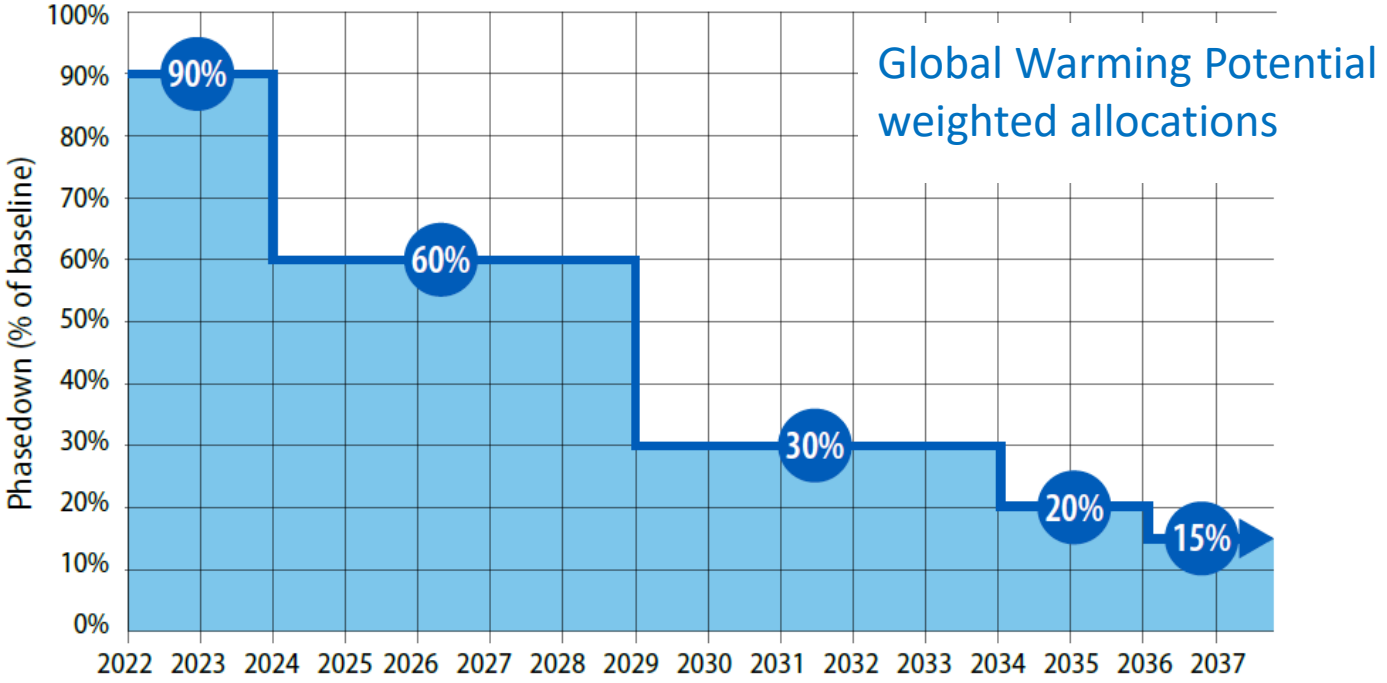
Implements Three Actions

1. Production and consumption phasedown of HFCs
2. Sector specific restrictions – Technology transitions
3. Maximize reclamation and minimize releases of HFCs

Does not restrict HFC use in existing systems

AIM Act: HFC Phase Down

- Production and consumption phase down 85% by 2036
- EPA issues allocations each year for the largest producers and consumers



https://www.nrel.gov/docs/fy23osti/85155.pdf

AIM Act: Technology Transitions

Sector Specific Regulations

Restrictions on Sales of New Equipment

Product	When	GWP limit	Prohibited	Allowed
Residential & Light Commercial HVAC	Jan 1, 2025*	700	R410A	R32, R454B, naturals
VRF	Jan 1, 2026**	700	R410A	R32, R454B, naturals
Chillers (comfort cooling)	Jan 1, 2025	700	R410A, R134A	R513A, R515B, R1234ze(E)
Refrigeration – stand alone units	Jan 1, 2025	150	R404A, R407A, HFC 134A …	R454C, R455A, naturals
Refrigeration (> 500 g of refrigerant)	Jan 1, 2027		R404A, R407A, HFC 134A …	R454C, R455A, naturals

*Equipment sales allowed through Jan 1, 2026, for equipment made prior to Jan 1, 2025

** Proposed rule signed 6/19/24 extends VRF installations through Jan 1, 2027

https://www.epa.gov/climate-hfcs-reduction/regulatory-actions-technology-transitions

AIM Act: Managing Use and Reuse of HFCs

Proposed rule published October 2023

- Leak repair for systems with > 15 lb of refrigerants (>53 GWP)
- Automatic leak detection for systems > 1,500 lb of refrigerants
- Use of reclaimed refrigerant for new installations and servicing of existing equipment after Jan 1, 2028
- Disposable cylinders must go to certified reclaimer after Jan 1, 2025
- Requires tracking of all HFC containers used for servicing or installation of refrigerant containing equipment

https://www.epa.gov/climate-hfcs-reduction/managing-use-and-reuse-hfcs-and-substitutes

State HFC Regulations

UNITED STATES CLIMATE ALLIANCE

About Members Policy Priorities Member Support Resources News & Events

https://usclimatealliance.org/

- 12 states have finalized regulations restricting high GWP HFCs (California, Colorado, Delaware, Maine, Maryland, Massachusetts, New Jersey, New York, Rhode Island, Vermont, Virginia, Washington)
- Most implemented EPA SNAP rules 20 and 21 with exceptions and/or additions
- EPA SNAP rules 20 and 21 banned high GWP refrigerants
- EPA SNAP rules 20 and 21 were released in 2016 and repealed in 2017 based on a federal lawsuit

Resources

- EPA certifications and regulations
  - https://www.epa.gov/section608
  - https://www.epa.gov/snap
  - https://www.epa.gov/climate-hfcs-reduction
- California SNAP
  - https://ww2.arb.ca.gov/our-work/programs/california-significant-new-alternatives-policy-snap
- NREL HFC Phasedown factsheet
  - English and Spanish versions
  - https://betterbuildingssolutioncenter.energy.gov/sites/default/files/attachments/HydrofluorocarbonPhasedown.pdf
  - https://betterbuildingssolutioncenter.energy.gov/sites/default/files/attachments/86844.pdf

Photo by Dennis Schroeder, NREL

The Hydrofluorocarbon Phasedown and Commercial Space Conditioning: A Guide to the Transition

Introduction

You may be aware of the hydrofluorocarbon (HFC) phasedown, but the details and its impact on your operations may still be unclear. Or perhaps this is the first you're hearing about the phasedown. In either case, this guide provides information to aid conversations with facility managers and engineers and provides an explanation of how the phasedown affects equipment in commercial buildings. It also includes actions you and your organization can take now to properly plan and prepare.

Background

The American Innovation and Manufacturing (AIM) Act was enacted in December 2020 and gives the Environmental Protection Agency (EPA) authorization to manage HFCs,[1] a group of industrial chemicals primarily used as refrigerants in a range of commercial building applications, like space conditioning, water heating, and refrigeration. In addition, several states[2,3] have adopted refrigerant regulations of their own. While slightly different than those of the EPA, state regulations have similar goals and phasedown timelines.

HFCs released into the atmosphere through leaks or maintenance procedures pose a significant global warming impact that can be many times greater than carbon dioxide.[4] The AIM Act outlines a 15-year phasedown schedule to reduce the production and consumption of HFCs by 85% on a weighted global warming potential (GWP) basis. To achieve this, the EPA developed baseline levels and established the methodology to meet the AIM Act phasedown schedule.[1] **Figure 1** illustrates the HFC production and consumption phasedown schedule as outlined in the AIM Act.

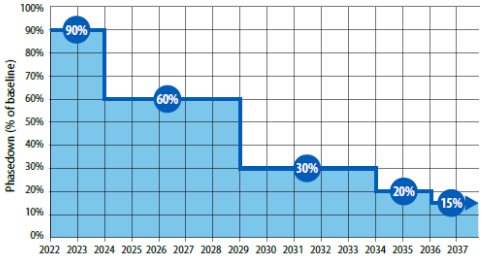


Figure 1. Phasedown Schedule[1]

Thank you

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Nick Harbeck

Johnson Controls

Johnson Controls

The Changing World of Residential Refrigerants

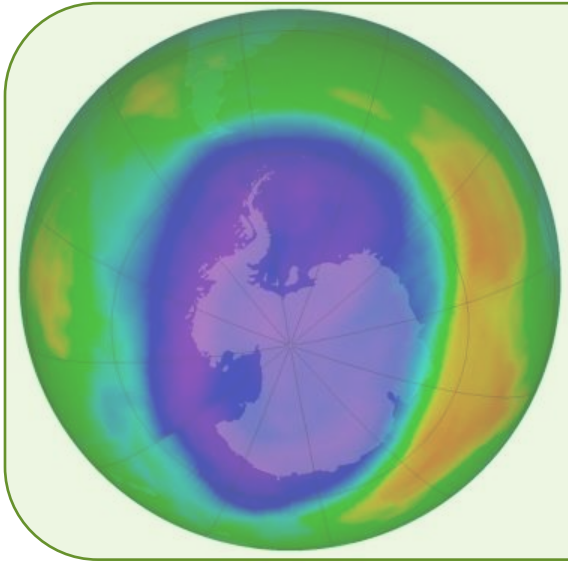
JUNE 2024

Today’s Agenda

- The Refrigerant Transition
  - Technology Transition Changes
  - Refrigerant Management Changes
  - Code Updates
  - Refrigerant Safety
  - Installation Changes

Johnson Controls

The Montreal Protocol and the Kigali Amendment



In 1987, Montreal Protocol on Substances that Deplete the Ozone Layer was signed, establishing the phaseout of chemicals such as chlorofluorocarbons (CFCs) and hydrochlorofluorocarbons (HCFCs)

In 2016, the Kigali Amendment to the Montreal Protocol updated the scope of substances covered to now include the phasedown of hydrofluorocarbons (HFCs), which are potent greenhouse gases (GHG).

Refrigerant Transition Deadline

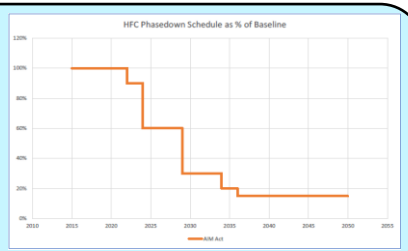
700 GWP limit: Jan 1, 2025

- Date of Manufacture
  - Some sell-through allowed
- Alternatives: R454B and R32 – ASHRAE A2L “mildly flammable”
  - R454B: 466 GWP
  - R32: 675 GWP
- State building codes must be updated

U.S. ENVIRONMENTAL PROTECTION AGENCY

HFC Phase-Down: American Innovation & Manufacturing Act

We are well into the phase-down and on the doorstep of equipment prohibitions

AIM Act Components for EPA to Execute	Status
1) Virgin Bulk Phase-Down & Allocations 	In Process – 40% Down
2) Technology Transitions (Equipment Prohibitions)	In Process – 2025 Start
3) Refrigerant Management (Reclaim & EPA Section 608 – No new licensing requirements - yet) 	Pending – 2024

Sector	Prohibition
Residential / Light Commercial AC	700 GWP, 1/1/2025
Chillers	700 GWP, 1/1/2025
VRF	700 GWP, 1/1/2026
Etc.	

AIM Act Rules are Changing

Packaged Systems:
Effective 1/1/2025


3 Year Sell-Through for Packaged Systems

Split Systems*:
Effective 1/1/2025


and

1 Year Sell-Through
for Split **Systems**


or

Indefinite Sell-Through
for Split **Components?**

*Components (including condensers) excluded from the definition of 'system.'

AIM Refrigerant Management

Aggressive Reclaim Mandate and renewed call for cylinder tracking but no 608 Licensing Changes (yet…)

Pending Rule

Bar Codes & Record Keeping

Starting 1/1/2025

Disposable Cylinders Allowed

But must remove residual refrigerant before destruction

Reclaim Refrigerant Mandate 1/1/2028

Includes new low GWP equipment with R32 or R454B

Leak Repair and Automatic Leak Detection

Systems with 15 – 50 lbs (60 days /1 year after final rule) & Systems > 1500 lbs

What Refrigerants are We Changing To?

R410A Replacements: R454B vs R32

The lower the GWP the better

Fluid	ASHRAE 34	GWP	Component Mix - Ratio %	Exposure Limit	Operating Pressure	LFL	UFL	Burning Velocity	MIE	Auto Ignition	Hot Surface Temperature	Efficiency	Capacity
		CO_2e		ppm	psia	% v/v	% v/v	cm/sec	mJ	C	C	vs R410A	vs R410A
R410A	A1	2,088	R-32/R-125 - 50/50	140,000	434	-	-	-	-	> 750	-	-	-
R454B	A2L	466	R-32/R-1234yf - 69/31	30,000	405	11.8	21.5	5.2	100-300	498	700	=	<
R32	A2L	675	R-32 - 100%	36,000	444	14.4	29.3	6.7	21-40	648	700	+	+

LFL - Lower flamability limit

UFL - Upper flammability limit

MIE - minimum ignition energy

- Both R454B and R32 are A2L; mildly flammable
- R32's higher operating pressure requires special design considerations
  - R454B's characteristics are much closer to R410A
- Neither R32 nor R454B can replace R410A for service
- There is no non-flammable < 700 GWP drop-in for R410A…

ASHRAE 34

Increased flame propagation	Lower Toxicity	Higher Toxicity
Higher Flammability	A3	B3
Flammable	A2	B2
Lower Flammability	A2L	B2L
No Flame Propogation	A1	B1

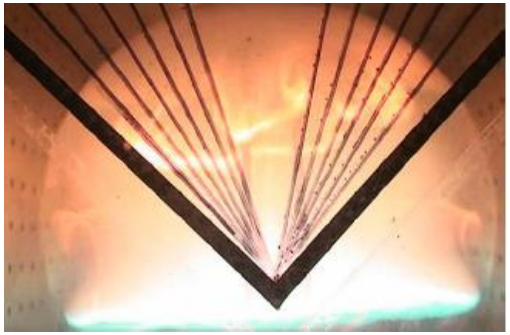
Increased toxicity

How Flammable Will the New Refrigerants Be?

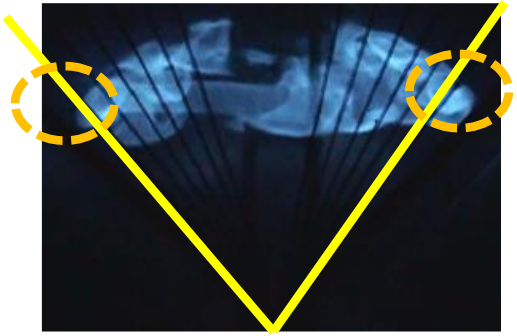
The Difference Between ASHRAE Refrigerant Flammability

There are "no" Hydrocarbons in A2L's…

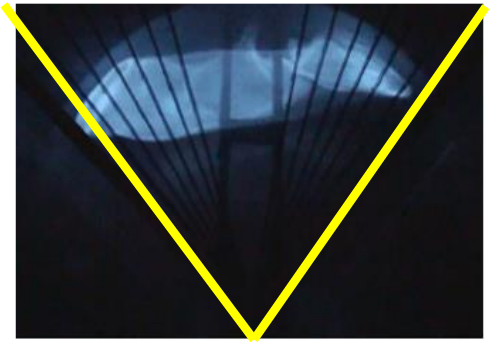
ASTM E681



Class 3 (Propane)



Class 2L (R454B / R32)



Class 1 (R410A no oil)

ASHRAE 34

Higher Flammability	A3	B3
Flammable	A2	B2
Lower Flammability	A2L	B2L
No Flame Propogation	A1	B1
	Lower Toxicity	Higher Toxicity

Increased flame propagation

- The difference between Class 1 & Class 2L is a few degrees
- A2L's like R454B / R32 have far less ignition energy than A3's
- Toasters, electric heaters, cigarettes and other common household products typically will not ignite an A2L.
- Even R410A will create a flame under the right conditions

A2L Ignition Temperature >1472°F

Codes & Standards for the New Flammable Refrigerants

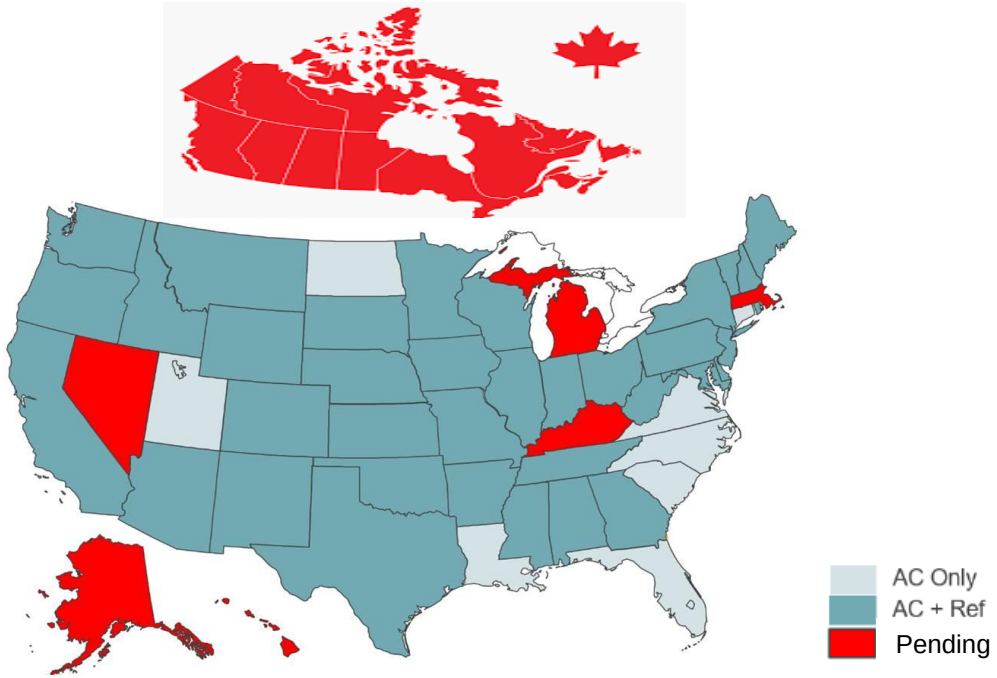
Most States Have Updated Building Codes or Legislation

Building codes are preferred if adoption timing supports, if not legislation is the fallback

Updates

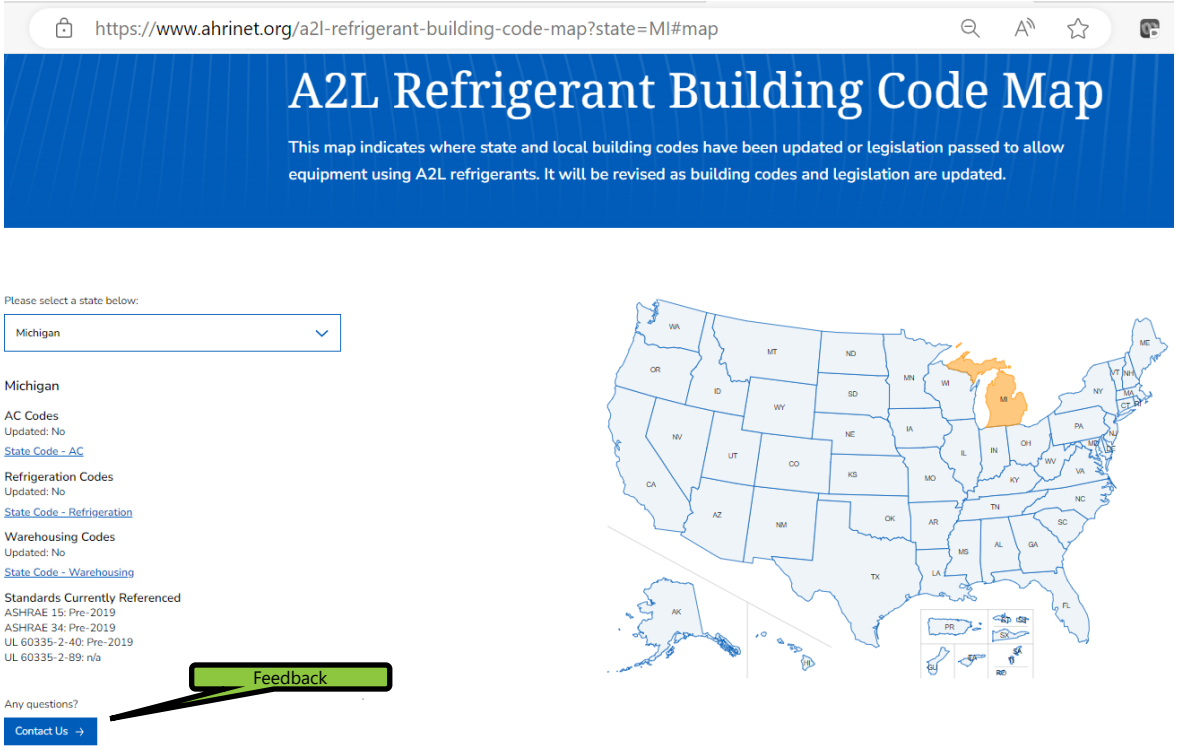
- Still working on updates in AK, HI, KY, MI & NV, etc.
- Expecting a high volume of AHJ / Inspector questions for initial installation of A2L's

A2L Codes & Legislation Status



New AHRI A2L Interactive Website Now Live

Permits Public Access to State Level Building Code Status, shows adoption of A2L Standards



- Initial launch January 2024
- Public, interactive, state level
  - Cities for home rule states being added
- A2L Standards Adoption Status
  - UL 60335-2-40 & …-2-89
  - ASHRAE 15 & 34
  - NFPA 1 & 55, etc.
- Equipment Categories
  - AC
  - Refrigeration
  - Warehousing
- Updated as information changes
- Canadian provinces to be added in 2024; adoption of B52-2023

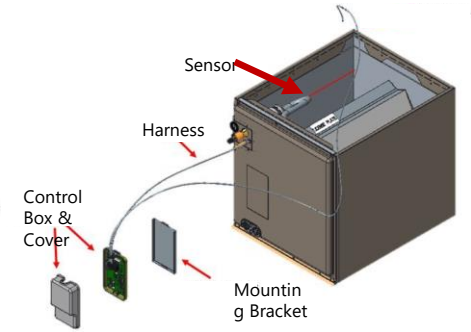
https://www.ahrinet.org/a2l-refrigerant-building-code-map

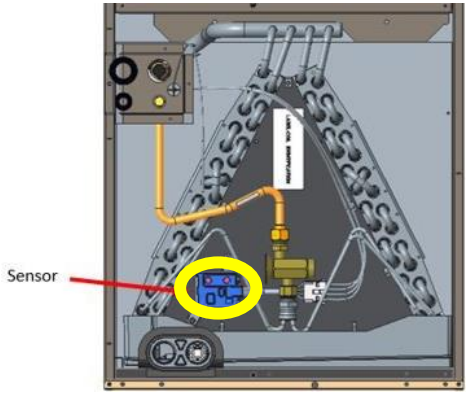
What Safety Precautions are Required for the New Flammable Refrigerants?

A2L Equipment – Refrigerant Detection Systems

- RDS can be factory mounted or field installed – location pre-determined
- "Generic" RDS "kits" not allowed
- All RDS will be listed by a safety agency for the specific units to which they are applied
  - Per UL 60335-2-40, ASHRAE 15 & 15.2
  - Set to activate at 25% of the Lower Flammability Limit
- RDS not required in all applications
  1. Below LFL - large zones / small charges
  2. Below minimum's charge size (< 4 lbs)
  3. Constant Airflow above minimum cfm

Split System Product





Packaged Product

RDS function is to turn on the blower to dilute any leak from reaching the LFL

RDS - Refrigerant Detection Systems / LFL – Lower Flammability Limit

WARNING This information is unique to Johnson Controls, information may vary by specific model, always consult the manufacturers specific installation and safety instructions prior to service or maintenance

Installation, Service & Repairs of A2L's

ACTION	A1s	A2Ls
Safely remove refrigerant following local & national regs	Required	Required
Purge circuit with inert gas (e.g., oxygen-free nitrogen)	Best Practice	Required
Evacuate circuit	Best Practice	Required
Open circuit by cutting or brazing	Required	Required
Make repairs, purging with nitrogen while brazing	Required	Required
Leak and Pressure Test	Best Practice	Required
Evacuate the system	Required	Required
Charge the system	Required	Required

A2L Equipment: Servicing Very Similar to A1's

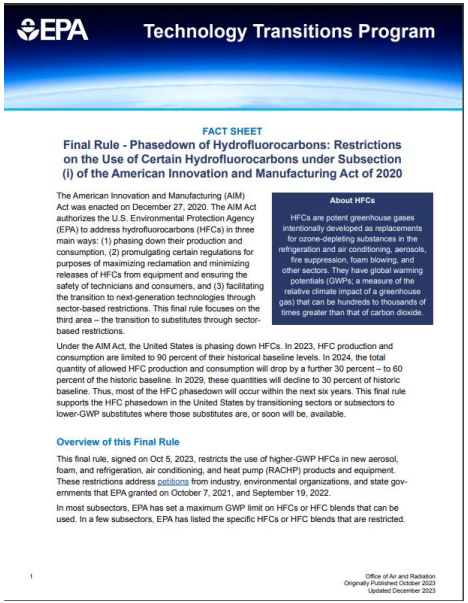
Many installation & service tools are similar; however, you need to confirm they have been approved.

Service Item (versus R-410A)	A2L
Refrigerant Recovery Cylinder	Flammable (GHS label, left-handed threads)
Vacuum Pump	Check with manufacturer (switch located away from work zone)
Recovery Machines	Move to 2L compatible
Gas Detector	Move to 2L compatible
Electronic Leak Detector	Move to 2L compatible
Scales	No changes
Ventilation Fan	Similar (may be differences in machine rooms)
Electrical Hand Tools	Non-sparking preferred (AHRI – 8017)
Dry Chemical/CO_2 Fire Extinguisher	Chemical compatible

Best Practices and Resources

Refrigerant Resources

- JCI Public Refrigerant Resources
  - https://www.johnsoncontrols.com/navigating-the-refrigerant-transition
- ESCO A2L On-Line Training
  - https://www.escogroup.org/training/lowgwprefrigerant.aspx
- EPA Technology Transition Fact Sheet:
  - https://www.epa.gov/system/files/documents/2023-10/technology-transitions-final-rule-fact-sheet-2023.pdf
- EPA Technology Transition Frequent Questions (updated)
  - https://www.epa.gov/climate-hfcs-reduction/frequent-questions-phasedown-hydrofluorocarbons#technology-transitions-program
- AHRI Safe Refrigerant Transition Research and Testing
  - https://www.ahrinet.org/advocacy/safe-refrigerant-transition
- ACCA A2L On-Line Training
  - https://www.acca.org/education/a2ltraining



EPA Technology Transitions Program

FACT SHEET

Final Rule - Phasedown of Hydrofluorocarbons: Restrictions on the Use of Certain Hydrofluorocarbons under Subsection (i) of the American Innovation and Manufacturing Act of 2020

The American Innovation and Manufacturing (AIM) Act was enacted on December 27, 2020. The AIM Act authorizes the U.S. Environmental Protection Agency (EPA) to address hydrofluorocarbons (HFCs) in three main ways: (1) phasing down their production and consumption, (2) promulgating certain regulations for purposes of maximizing reclamation and minimizing releases of HFCs from equipment and ensuring the safety of technicians and consumers, and (3) facilitating the transition to next-generation technologies through sector-based restrictions. This final rule focuses on the third area – the transition to substitutes through sector-based restrictions.

About HFCs

HFCs are potent greenhouse gases intentionally developed as replacements for ozone-depleting substances in the refrigeration and air conditioning, aerosols, fire suppression, foam blowing, and other sectors. They have global warming potentials (GWPs; a measure of the relative climate impact of a greenhouse gas) that can be hundreds to thousands of times greater than that of carbon dioxide.

Under the AIM Act, the United States is phasing down HFCs. In 2023, HFC production and consumption are limited to 90 percent of their historical baseline levels. In 2024, the total quantity of allowed HFC production and consumption will drop by a further 30 percent – to 60 percent of the historic baseline. In 2029, these quantities will decline to 30 percent of historic baseline. Thus, most of the HFC phasedown will occur within the next six years. This final rule supports the HFC phasedown in the United States by transitioning sectors or subsectors to lower-GWP substitutes where those substitutes are, or soon will be, available.

Overview of this Final Rule

This final rule, signed on Oct 5, 2023, restricts the use of higher-GWP HFCs in new aerosol, foam, and refrigeration, air conditioning, and heat pump (RACHP) products and equipment. These restrictions address petitions from industry, environmental organizations, and state governments that EPA granted on October 7, 2021, and September 19, 2022.

In most subsectors, EPA has set a maximum GWP limit on HFCs or HFC blends that can be used. In a few subsectors, EPA has listed the specific HFCs or HFC blends that are restricted.

1

Office of Air and Radiation
Originally Published October 2023
Updated December 2023

Dan Perunko

Balance Point Home Performance

The Changing World Of Residential Refrigerants

balance point home performance

R32 GWP is 675

While this is about 70% better than R410 we still can not release it to the atmosphere.

Three problems!

The Service/Rating problem

The Structural problem

The practice problem

Refrigerant leaks and how to minimize them

The Structural Problem

Refrigerant leaks and how to minimize them

R410a and other HFC refrigerants are not banned.

By 2036 production has to be reduced by 85%

ENVIRONMENT · 2 minute read

Mills, national climate leaders announce goal of installing 20 million heat pumps by 2030

By Evan Popp
September 21, 2023

Share

Refrigerant leaks and how to minimize them

Let's Say the 1st 10% of these installs are R410a

That’s 2,000,000 machines

That is conservatively 4,000,000 pounds of R410A

Refrigerant leaks and how to minimize them

1 pound R410a is 2088 lbs of carbon equivalent at 100 year

We will be puting 4,176,000 tons of carbon equivalent out

Refrigerant leaks and how to minimize them

How much of that will Leak?

Refrigerant leaks and how to minimize them

It's all predictions and there is no really good tracking done currently.

CPUC predicts a 150% life cycle charge loss

Other research projects are suggesting 50 to 85%

Refrigerant leaks and how to minimize them

We can expect 2,088,000 to 6,264,000 tons of carbon equivalent from that 10% sample of the published goal

OR

We can improve our practices

Refrigerant leaks and how to minimize them

The service and rating problem

balance point
home performance

One technician x 1oz R410A per service call x
5 service calls per day x 5 days a week =

1.63 tons of carbon equivalent -R410a

(1 oz R410 x 5 jobs x 5 days x 2088 lbs carbon eq ÷ 2000lbs per ton = 1.63 tons)

(.529 tons of carbon equivalent – R32)

Exceptionally Good Practice, one tech per week

Refrigerant leaks and how to minimize them

The Practice Problem

- Flare or Braze
  - When?
  - Are flare fittings problematic?

balance point
home performance

Leakage is very Prevalent we have to do better

2018 ASHRAE study found significant leakage rates in Flare and Compression type fittings.

Leak testing under pressure is a critical step to identifying failed fittings.

Assessment of Leakage Rate and Durability of Field-made Mechanical Joints for Systems Using Low-GWP Flammable Refrigerants (ASHRAE RP-1808)

Navac cordless flaring tool

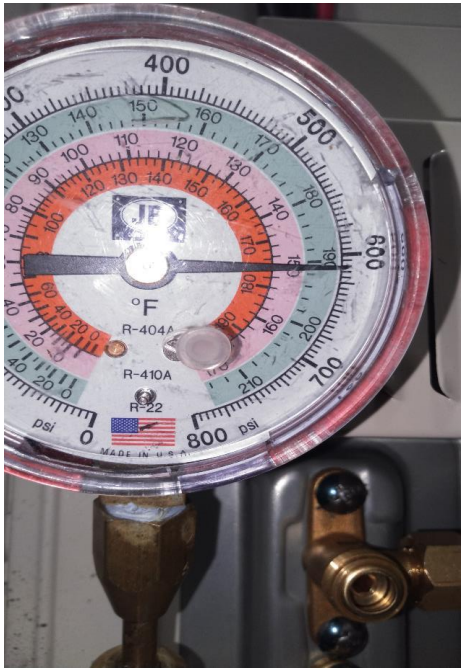
This tool has good reviews and helps improve the quality and durability for field manufactured flare connections.

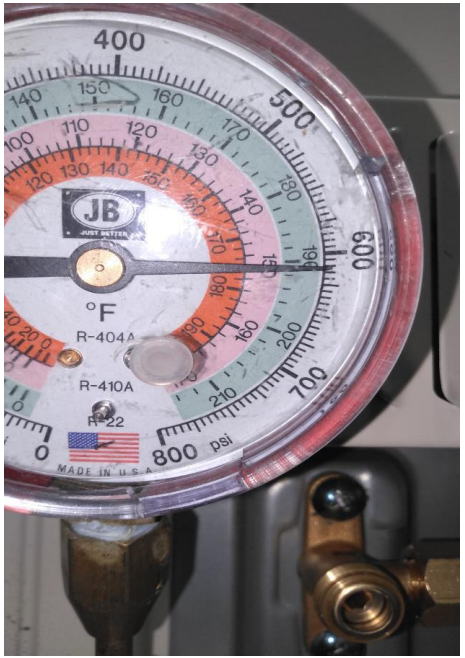
I purchased one for my employees to use to create a repeatable result.

Consistent quality outcome

balance point
home performance

balance point
home performance





balance point
home performance


WHITLAM
BIG BUBBLE
GAS
LEAK
DETECTOR
NONTOXIC
NON-CORROSIVE
NON-FREEZING
STOCK CODE# LD8
8 FL. OZ. (237 ml)


AccuTrak
AccuTrak
Model VPE
USER'S MANUAL

balance point
home performance

Commissioning
New Lineset

- 500+ PSI nitrogen pressure test
  - Wait 15 minutes and watch drift
- Make sure it stops moving or 1 psi over 60 minutes
- Ultrasonic leak detector at all connections
- Vacuum to 100 micron and hold to 200 after 10 minutes (New line set)
  - Note: Time starts when reading has stabilized
- Charge system
- Ultrasonic leak detector at all connections
- Refrigerant leak tester.

Commissioning
Existing Lineset

- 500+ PSI nitrogen pressure test
  - Wait 15 minutes and watch drift
- Make sure it stops moving or 1 psi over 60 minutes
- Ultrasonic leak detector at all connections
- Vacuum to 200 micron and hold to 500 after 10 minutes (Existing line set)
  - Note: Time starts when reading has stabilized
- Charge system
- Ultrasonic leak detector at all connections
- Refrigerant leak tester.

You have to do what others won’t, to achieve what others don’t.

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Smart Tools for Efficient HVAC Performance (STEP) Campaign

Pacific Northwest NATIONAL LABORATORY

STEP CAMPAIGN

Scan this QR code to visit our website

Contact: christian.valoria@pnnl.gov

The STEP Campaign aims to increase adoption of smart diagnostic tools to streamline HVAC system performance testing and troubleshooting, reducing energy-wasting faults and improving occupant comfort.

To join the STEP Campaign, visit: bit.ly/3DFmEaE

HVAC Contractors and Technicians

- Reduce callbacks, improve consistency and quality, streamline processes
- Find out where to get training on smart diagnostic tools
- Be recognized for successful adoption of smart diagnostic tools!

Utilities and Program Implementers

- Streamline quality installation and quality maintenance programs
- Improve engagement with your contractors
- Be recognized for programs that utilize smart diagnostic tools!

HVAC Training Organizations

- Offer qualified training on System Performance with smart diagnostic tools
- Promote your training events
- Be recognized for providing training!

Weatherization Organizations

- Ensure your ASHP/CAC installations are operating at optimized efficiency
- Develop pilot with PNNL team
- Be recognized!

ORGANIZING PARTNERS

ACCA · BUILDING PERFORMANCE ASSOCIATION · CEE Working Together, Advancing Efficiency · HVAC Excellence · NATE · neea · U.S. DEPARTMENT OF ENERGY

Explore the Residential Program Guide

Resources to help improve your program and reach energy efficiency targets:

- Handbooks - explain *why* and *how* to implement specific stages of a program.
- Quick Answers - provide answers and resources for common questions.
- Proven Practices posts - include lessons learned, examples, and helpful tips from successful programs.
- Technology Solutions NEW! - present resources on advanced technologies, **HVAC** & **Heat Pump Water Heaters**, including installation guidance, marketing strategies, & potential savings.
- Health + Home Performance Infographic – spark homeowner conversations.

https://rpsc.energy.gov

Health + Home Performance Infographic

DOE's Health + Home Performance Infographic reveals the link between efficiency and health – something everyone cares about. Efficiency programs and contractors can use the question-and-answer format to discover a homeowner's needs.

The infographic is ideal for the "kitchen table" conversations where people decide what to do – and who they want to do it. It also has links for homeowners to find a qualified contractor if they do not already have one.

Download this infographic from DOE's Better Buildings Residential Network.

Looking for photos to help tell your energy efficiency story? Visit our image libraries: https://www.energy.gov/eere/better-buildings-residential-network/articles/image-libraries

Thank You!

Follow us to plug into the latest Better Buildings news and updates!

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Please send any follow-up questions or future call topic ideas to:
bbresidentialnetwork@ee.doe.gov