

ENABLING R-290 FOR NET-ZERO, NEAR-ZERO-GWP BUILDINGS

EXECUTIVE SUMMARY

Building decarbonization is essential to reducing climate-warming emissions, with heat pumps central to replacing fossil-fueled systems. Yet leaked fluorinated refrigerants—especially hydrofluorocarbons (HFCs) used in heating, cooling, hot water, and refrigeration—remain a major but often overlooked climate risk. With global warming potentials thousands of times higher than CO₂, HFCs routinely escape through leaks, equipment failures, and improper end-of-life practices. Near-zero-GWP refrigerants such as R-290 (propane) offer a promising solution and align with the decarbonization commitments of leading commercial real estate players. However, despite widespread international use, R-290 heat pump technologies remain limited in the United States due to unresolved flammability considerations in federal safety standards and building codes. National code updates are underway but will take years, while end users need clarity within the next five years to guide capital planning. Recent state actions enabling A2Ls show jurisdictions can move quickly. States must now prepare their codes for A3 refrigerants to send clear market signals and ensure access to ultra-low-GWP technologies needed to meet emissions-reduction and net-zero goals.

ABOUT PROPANE



Propane (R-290) is a safe, climate-friendly, natural refrigerant with tremendous potential to reduce greenhouse gas emissions from supermarket refrigeration, but current U.S. charge-size limits prevent it from reaching full potential as a climate solution. As a nontoxic hydrocarbon with no ozone-depleting properties, an ultra-low global warming potential, and strong thermodynamic performance, propane is more energy efficient than many HFC refrigerants, representing one of the most effective pathways for reducing HFC emissions in grocery stores.

Name	Classification	Ozone Depleting Potential (ODP)	Global Warming Potential (GWP)	ASHRAE Refrigerant Class
Propane (R-290)	Hydrocarbon Refrigerant	0	3	A-3 (non-toxic, flammable)

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TIMELINE FOR ACTION

While no single refrigerant will serve all HVAC and refrigeration applications, this should not slow investment in the innovative, ultra-low-GWP solutions available today, including R-290. The A2L transition took more than fifteen years; applying lessons from that process can accelerate the adoption of new refrigerants. The timeline below outlines what an accelerated state pathway to enabling A3s could look like, aligned with other regulatory deadlines:



The time to act is **now.**

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HEAT PUMP DESIGNS

Heat pumps transfer heat rather than generate it, using refrigerants to move thermal energy between spaces. Their configuration varies based on the heat source, refrigerant circuit design, and how heat is delivered inside the building. For space heating and cooling, systems can be ducted (e.g., unitary split systems distributing air through ducts) or ductless (e.g., wall-mounted mini-splits delivering conditioned air directly into rooms). Split systems are the most common and use outdoor air as a heat source or sink, with refrigerant line sets connecting outdoor and indoor units. In commercial settings, Variable Refrigerant Flow (VRF) systems may extend refrigerant piping over long distances, requiring careful management of safety and efficiency.

Air-to-water heat pumps (AWHPs) operate similarly but also provide water heating. These monobloc units contain a sealed, factory-charged refrigeration circuit outdoors, transferring heat indoors using a secondary fluid—typically water-glycol—circulated through the building.

REFRIGERANT SAFETY

Safety is essential for all refrigerants, regardless of GWP. Any refrigerant released into an enclosed space can pose an asphyxiation hazard, and exposure can create risks of fire or physical harm, including frostbite. ASHRAE's Standard 34 classifies refrigerants by toxicity and flammability, while Standard 15 outlines design and approval requirements for equipment using those refrigerants. Most low-GWP alternatives to high-GWP HFCs fall into the A2L or A3 flammability classes, reinforcing the need for appropriate safeguards.

WHY AWHPS MAY TRANSITION TO R-290 FIRST

AWHPs are strong candidates for early adoption of R-290 because their monobloc design keeps all refrigerant piping outdoors, reducing risks associated with flammable refrigerants. Units can be installed at a designated lower-risk distance from buildings, further minimizing ignition potential. AWHPs provide a 3-in-1 electrification solution—heating, cooling, and hot water—capabilities air to-air systems cannot match. While still less common in the U.S, AWHPs dominate the European market.

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ENABLING R-290 AS A REFRIGERANT IN HEAT PUMPS

Many major U.S. HV AC and water-heater manufacturers already use or are evaluating R-290 in equipment sold internationally, but broader domestic adoption requires clarity on U.S. safety standards, building codes, insurance and transportation requirements, and EPA approval. Ongoing ASHRAE and UL committee work through 2026 aims to address these barriers.

States looking to integrate ultra-low-GWP refrigerants into building-decarbonization strategies can accelerate progress by convening stakeholders to develop an A3 refrigerant roadmap. Relevant stakeholders include state code offices, air resource boards, fire marshals, manufacturers, labor unions, trade associations, and other private groups. Collaborative work among these entities is needed to create a regulatory environment that enables safe R-290 use, prepares the workforce for the transition away from high-GWP refrigerants, and ensures continued enforcement of refrigerant recovery and leak-management best practices.

KEY ACTIONS MOVING FORWARD

TAKE STOCK	
BENCHMARK CURRENT USE & APPLICATIONS Review U.S. & international uses of R-290 across HVAC, refrigeration, & water-heating applications.	
CLARIFY AUTHORITY FOR PERMITS Determine local & national code officials' authority to permit A3 heat pump & refrigeration installations through alternate means & methods.	
ENABLE THE MARKET	CREATE STRUCTURE & CERTAINTY
ENGAGE STAKEHOLDERS Convene code officials, fire safety professionals, industry representatives, & contractors early to plan pathways for the safe use of R-290.	CONSIDER STATE REGULATORY APPROACHES Regulatory objectives provide manufacturers with needed planning signals.
DEVELOP THE WORKFORCE Train code officials on safe installation practices & require technician training on A3 refrigerants with periodic refreshers.	DEVELOP TIMELINE FOR ACTION Establish clear timeline for enabling R-290 adoption.
SUPPORT DEMONSTRATION PROJECTS Fund and evaluate demonstration projects in state buildings with structured data collection & annual performance reports.	ENFORCE REFRIGERANT RECOVERY & REPORTING Require reporting on refrigerant purchases & recovery returns with 3-year record-keeping & recovery-rate audits.
	SUPPORT SAFETY STANDARDS & INSURANCE COVERAGE Participate in developing safety standards, building code updates, & insurance requirements related to A3 refrigerants.