



Europe's Propane Refrigeration Proliferation

As R-290 based refrigeration becomes more commonplace in the E.U., is the U.S. far behind?



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The use of propane (R-290) as a refrigerant in commercial refrigeration is the subject of much debate in the U.S. Its A3, flammable classification conjures up negative connotations in the minds of operators, technicians and public officials alike — beliefs that when examined closer are largely unfounded. But in Europe, the use of R-290 based equipment is well into its second decade and continues to play a big role. Some leading retailers are even making it a cornerstone of their refrigeration portfolio. How this may influence R-290 perceptions and its subsequent adoption in the U.S. remains to be seen. We can, however, evaluate R-290’s early adoption in Europe and speculate on its path toward commercialization in the U.S.

Environmental and energy efficiency drive R-290 adoption in the E.U.

When it comes to adherence to environmentally sound practices, the European Union (E.U.) and its member countries have consistently been ahead of the curve. The E.U.’s F-gas regulations were among the world’s first actions to phase down hydrofluorocarbon (HFC) refrigerants in favor of low global warming

potential (GWP) natural alternatives. At the same time, consumer, OEM and retailer preferences for sustainable goods and eco-friendly systems contributed to driving compliance with these regulations. It’s no surprise then that Europe has led the way in the adoption of natural refrigerants in commercial refrigeration — including R-290.

From an environmental perspective, R-290 is among an elite class of viable green alternatives to many of the industry’s most common high-GWP refrigerants. It’s a naturally occurring hydrocarbon (HC) with a GWP of 3 and 0 ozone depletion potential (ODP). R-290 is a highly refined grade of the fossil fuel propane, and although flammable,

R-290: Separating fact from fiction

Characteristics:

- Naturally occurring, hydrocarbon
- GWP = 3, ODP = 0
- Readily available and affordable
- EPA-approved in commercial refrigeration applications
- High-efficiency, high-performance, reliable
- Flammable, A3 classification
- Safe to use when proper protocols are followed
- Globally mandated charge limit of 150g

Commercial refrigeration applications:

- Reach-in bottle coolers
- Reach-in freezers and refrigerators

- Integrated display cases
- Ice machines (in current EPA SNAP proposal)
- Under countertop
- Beverage dispensers

Challenges to wider adoption:

- Classified A3 Flammable Refrigerant
- Not a “drop-in” refrigerant; equipment and components must be designed for R-290
- Globally mandated low-charge limits of 150g restrict application range
- Difficulty getting approved in fire and building codes
- Lack of trained and certified technicians
- Absence of product and safety training

it is non-toxic in nature.

R-290's green potential doesn't stop there. Its excellent thermodynamic properties — such as pressure, low back pressure, volumetric capacity, capacity and coefficient of performance — are very similar to R-22, even outperforming it in certain parameters. In Emerson Climate Technologies' test labs and published studies alike, R-290 consistently outperforms R-404A in energy efficiencies.

For more than 15 years, retailers in Europe have included R-290 based equipment as part of their refrigeration portfolio. Those who sought to meet environmental objectives and establish green market positions began field trials and deployed R-290 chillers before the regulatory actions to limit HFCs were in place. Estimates vary about the degree of R-290 proliferation, but according to a 2014 study on HC refrigerants in Europe, nearly 0.5 million plug-in supermarket cabinets were in the European supermarket arena alone at the end of 2013, with many calling this a conservative estimate. The same study states that more than 2 million bottle coolers and ice cream freezers were in use throughout the European light commercial refrigeration market at the time research was conducted.

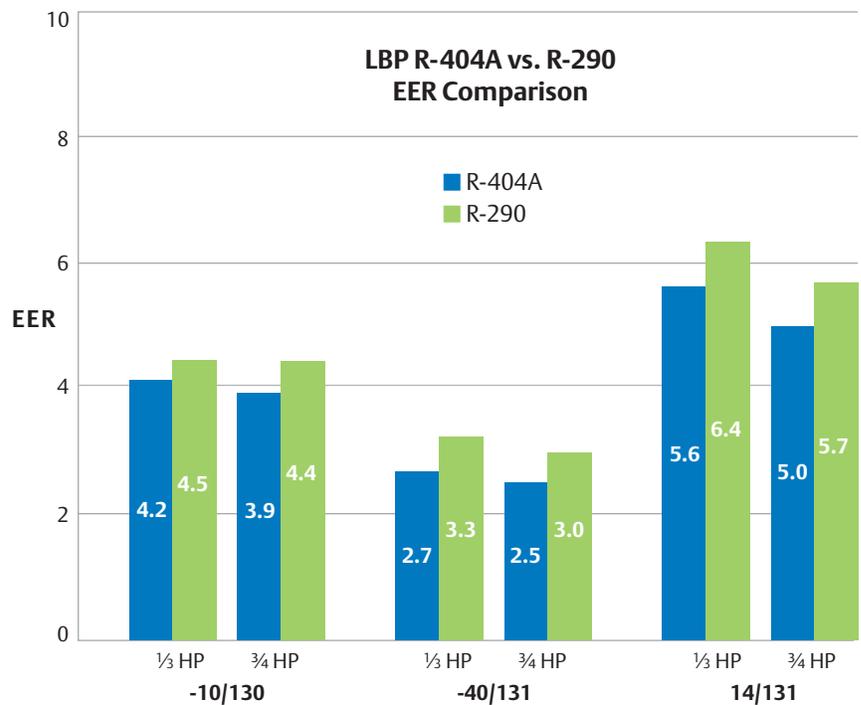
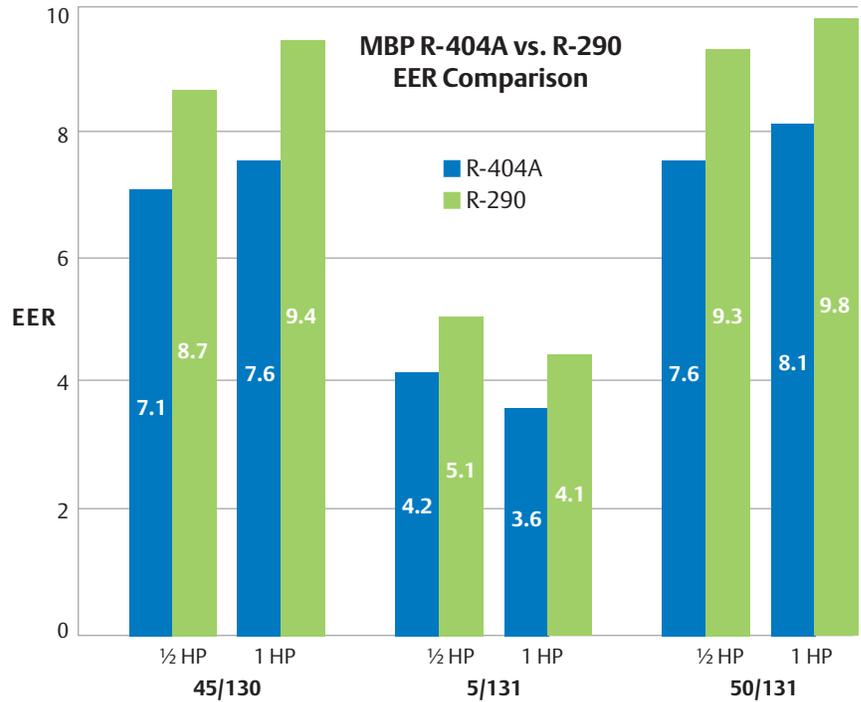
In a region where 150 GWP is the aspirational standard for green refrigerants, R-290 allows retailers to comply with both environmental and energy efficiency requirements.

A charged issue on both sides of the pond

Adhering to proper R-290 safety protocols is imperative when considering potential applications. In the E.U., the 150g charge limit recommendation set forth by the International Electrotechnical Commission's (IEC) safety standards for the use of propane is widely accepted. As a result, Europe has seen a proliferation of R-290

R-404A and R-290 EER Comparison

R-290 yields 20%+ better EER efficiency than R-404A



Results from Emerson's test labs, comparing Energy Efficiency Ratio (EER) of R-404A to R-290 in medium back pressure (MBP) and low back pressure (LBP), show a significant improvement when using R-290. Testing takes place in a controlled environment designed to simulate typical operating conditions.

based equipment in the light commercial refrigeration segment.

This small charge limit also curbs the size of the refrigeration application. Some E.U. retailers have made attempts to extend the charge limits to enable larger applications and further expand their green footprint. But when charges exceed 150g, E.U. retailers are subject to the approval of national, regional and local governance standards and codes for building occupancy and fire safety. Achieving this approval requires a mandatory risk assessment and third party certification of safe operation —

a potentially lengthy process that can be costly and difficult for both OEMs and retailers.

It's also interesting to note that R-290 adoption varies widely among E.U. member countries. The U.K., for example, has a more flexible stance toward R-290, even approving charges up to 500g for retailers committed to green refrigeration practices. Meanwhile, some territories in France and Italy have yet to employ even light commercial systems, dispelling the notion that R-290 based refrigeration equipment is accepted in all corners of the E.U.

On the other side of the pond in the U.S., the R-290 picture is quite different. The U.S. is generally much more hesitant to view the IEC standard for the 150g charge limit as a rubber stamp to move forward with R-290 commercial refrigeration installations. In the absence of national R-290 safety standards, even applications with small charge limits are subject to the authority of state and local governance, as well as fire marshal jurisdiction — and these differ drastically from region to region.

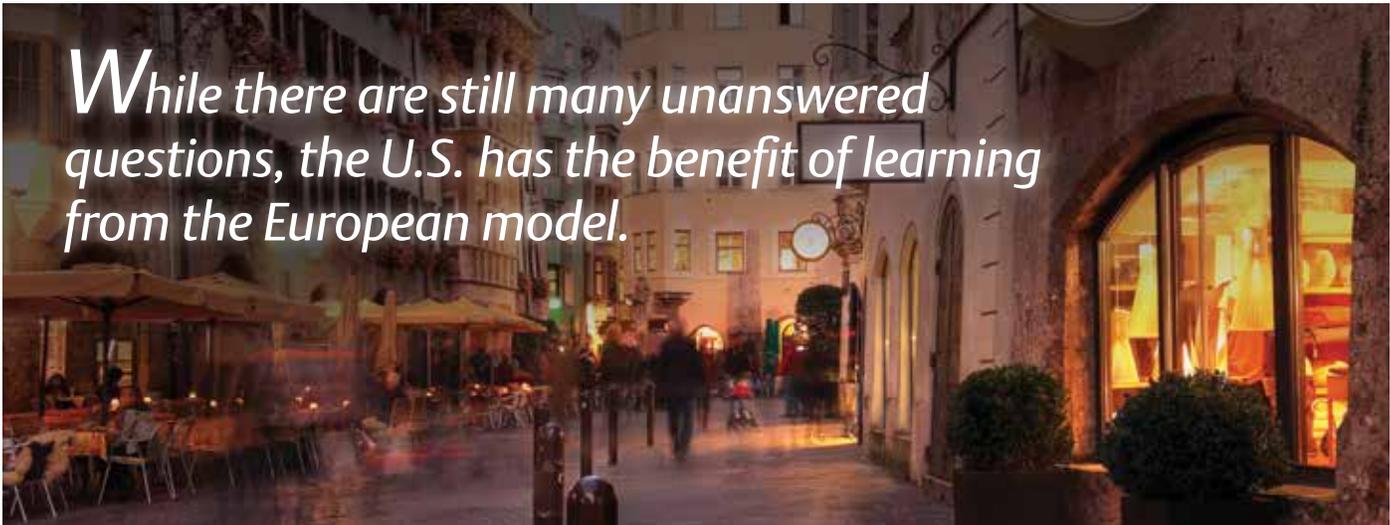
As a result, commercial adoption has been limited primarily to the most

Major E.U. grocer deploys large R-290 display cases, keeps low refrigerant charge

Some E.U. retailers have worked closely with their OEMs to develop larger R-290 based refrigeration equipment that still adheres to the 150g charge limit. Although this helps accelerate the commercialization process, it does add to system complexity. One such example of a successful implementation involved a very prominent retailer who sought to deploy a large integrated display case design that could replace their centralized rack system architecture.

The retailer tapped a preferred OEM to develop new integrated cases based on three individual 150g, R-290 circuits in the same case. The design requires three separate R-290 compressors, each with its own supporting system components (fans, valves, piping, etc.). The plan is to install 10 cases per store in up to 1,000 stores each year. The retailer also plans on expanding its operations in the U.S. in the near future.





While there are still many unanswered questions, the U.S. has the benefit of learning from the European model.

established grocers, foodservice outlets and small format retailers who are 1) willing to absorb the cost required to achieve requisite safety assessments and certifications, and 2) seeking to meet corporate sustainability objectives.

In recent years, the U.S. regulatory climate has brought R-290 back into industry and public awareness. First, in 2011 the EPA listed R-290 as acceptable, subject to use conditions, for use in certain commercial refrigeration regulations, keeping the IEC recommendation for a 150g charge limit. More recently, the EPA also instituted the phase-down of R-404A and other common refrigerants over the next several years. On a parallel timetable, the DOE has mandated significant energy reductions in commercial refrigeration equipment, thereby favoring the use of systems and refrigerants that produce high energy efficiencies.

The combination of these two regulations is motivating OEMs and the entire refrigeration supply chain to try and meet both objectives in a single design cycle. While R-290 is one of the few approved refrigerants capable of satisfying both regulatory actions, the lack of a national safety standard is still a barrier toward wider U.S. adoption.

Efforts to establish national standards are in motion, not only for R-290, but

potentially for a new class of A2L, (mildly flammable) hydrofluoroolefin (HFO) refrigerant blends — some of which have yet to be EPA approved. UL, ASHRAE, ISO and IEC are all working to develop and evolve their standards to align with market trends, some of which may be finalized in the coming year.

Even with the existing barriers to R-290 adoption, the EPA approval of R-290 in 2011 prompted some of the larger foodservice and small format retailers to work through their OEMs to introduce light commercial equipment to the market. And with the promise of a true national standard, more OEMs are in the process of developing complete lines of R-290 based equipment.

Following in the E.U.'s footsteps

The path toward broader commercialization of R-290 based equipment and wider adoption in the U.S. is largely dependent upon the development of national standards. While there are still many unanswered questions, the U.S. has the benefit of learning from the European model — from the introduction of environmental regulations and development of standards to R-290 field trials, countless installations and wide commercial acceptance.

As the E.U.'s international standards continue to evolve, the industry is appealing for the option to increase the 150g refrigerant charge limit to much higher allowable charges. Should this become enacted, there's no question it will influence the emerging standards in the U.S., where the possibility of increasing the charge limit to 300g is already being discussed. This would add flexibility to system design and help transition R-290 to larger commercial applications.

Finally, it's important to remember that there's no such thing as a perfect refrigerant. For decades R-22 was considered ideal until it was discovered to contribute to holes in the ozone layer. Its replacement was a class of widely used HFCs that were later found to have high global warming potential. And both of these were man-made compounds. Aside from its potential flammability, which can be managed with proper system design and safe protocols, R-290 is very similar (or better) in performance to its now-prohibited predecessors.

One very important question remains to be answered: will the U.S. refrigeration industry allow the many benefits of R-290 to outweigh its perceived risks? 🌐