

World's First Adoption of R32, a Refrigerant With Low Global Warming Potential



R32 Used in Residential Air Conditioners in Japan

In November 2012, Daikin released for the first time in the world an air conditioner using R32, a refrigerant with just one-third the global warming potential of conventional refrigerants.

Dialogue with Environmental and Air Conditioning Experts around the World

The refrigerant circulates inside the air conditioner and carries heat: it is, for all practical purposes, the “lifeblood” of the product. At the same time, it is also the cause of problems like ozone depletion and global warming. As the world’s only company making both air conditioners and refrigerants, Daikin has adopted a new refrigerant for air conditioners, R32, that has just one-third the global warming potential of conventional refrigerants. To create greater understanding of the significance of this fact, we engaged in dialogue with environmental and air conditioning experts at numerous international conferences.



Urusara 7 Residential Air Conditioner

Urusara 7 with new R32 refrigerant has world's highest* energy efficiency. (See page 11 for more on the Urusara 7.)

* For residential wall-mounted room air conditioners (40-kW, 5.6-kW class) as of date of release (June 26, 2013). Seasonal power consumption: AN40PRP model: 1,145 kWh; AN56PRP model: 1,840 kWh



Newly Developing Countries in Urgent Quest for Next-Generation Refrigerants

HFCs such as R410A are the most commonly used refrigerants in industrialized countries. But developing countries are still using HCFCs because of the later date for their phasing out under the Montreal Protocol. These countries are thus still a source of these ozone-layer-depleting substances.

But starting in 2013, developing countries begin a schedule to reduce the amount of HCFCs used. Demand for air conditioners is rapidly increasing in these countries, and the amount of refrigerants is naturally expected to also increase. Because global warming will rise if developing countries follow industrialized countries in adopting R410A, there are increasing calls to bypass R410A and instead adopt a refrigerant with lower global warming impact. Industrialized countries are also aiming to reduce HFC emissions and like their developing country counterparts are on an intensifying quest for a next-generation refrigerant.

Background

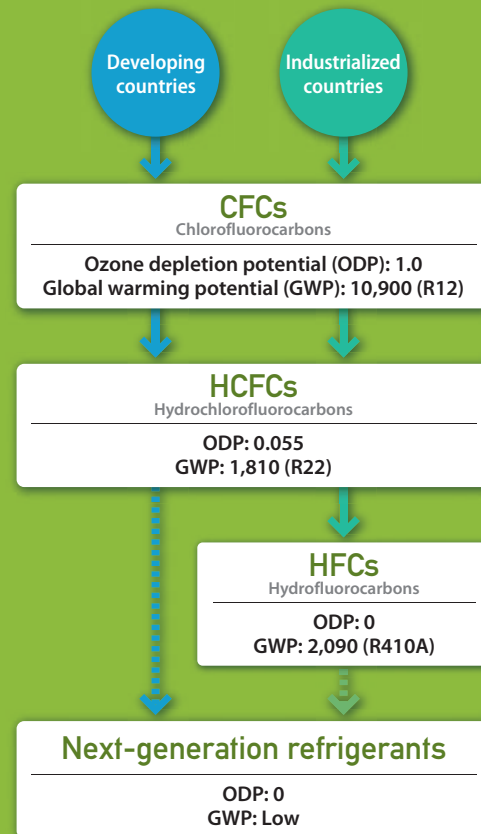
Refrigerants Must Not Harm the Ozone Layer or Contribute To Global Warming

There is growing worldwide interest in finding a next-generation refrigerant that does not harm the ozone layer or contribute to global warming.

At one time, CFCs were used as air conditioner refrigerants, but the 1987 Montreal Protocol designated CFCs as substances that seriously deplete the ozone layer and therefore called for their total phasing out. HCFCs became substitutes for CFCs; however, even they were later added to the list of banned substances under the Montreal Protocol since HCFCs also deplete the ozone layer. All HCFC production must be completely phased out in industrialized countries by 2020 and in developing countries by 2030.

Industrialized countries are in the process of replacing HCFCs with HFCs, which do not harm the ozone layer but which do contribute to global warming. The Kyoto Protocol, adopted in 1997, called for a reduction in HFC emissions.

Air Conditioner Refrigerants: Environmental Impact and Transition



Decision on Next-Generation Refrigerants Must Consider All Factors, Not Just Environmental Performance

Being the only manufacturer in the world making both air conditioners and refrigerants, Daikin is going full speed ahead to realize the practical application of next-generation refrigerants.

A number of substances are being considered as a next-generation refrigerant: R32, a type of HFC with a relatively low GWP; HFO refrigerants, which have a low GWP; and natural substances such as CO₂ and propane, which have refrigerating characteristics.

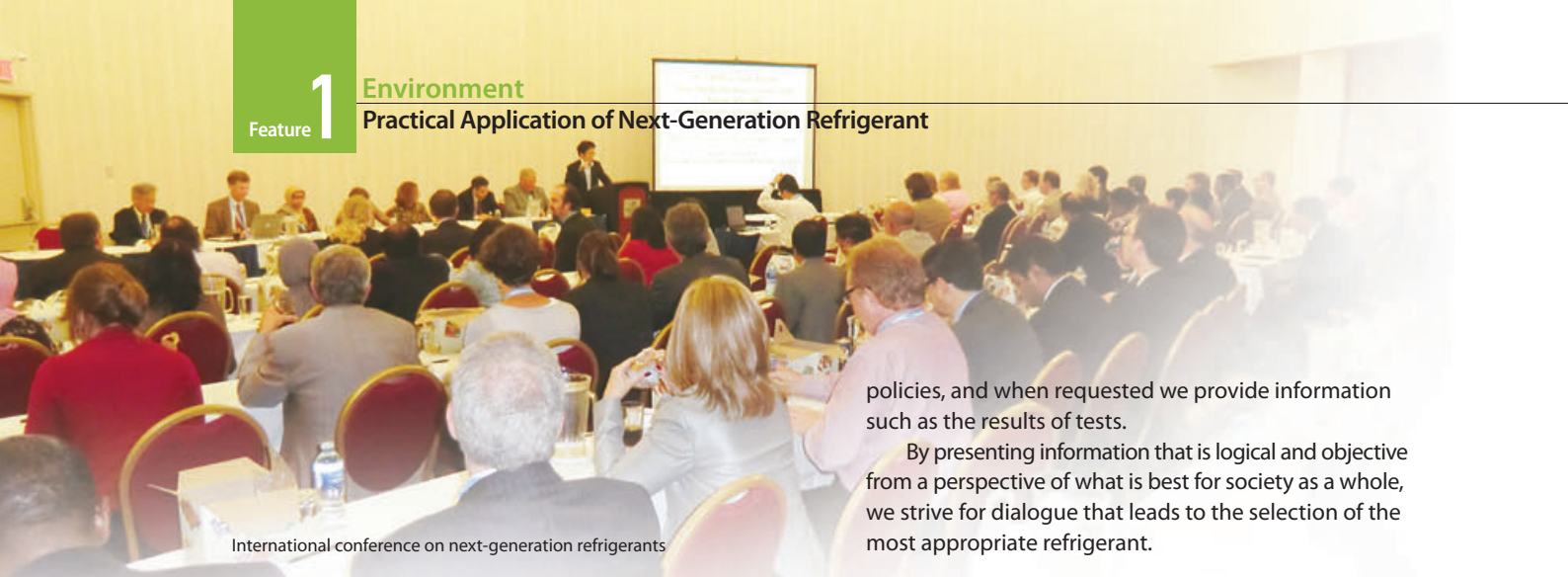
A refrigerant may have a low GWP, but if its production requires large amounts of energy, or if the air conditioner using it exhibits poor energy efficiency, then the result will be a greater contribution to global warming. There are also safety considerations: the lower

a refrigerant's GWP, the higher its flammability tends to be. Furthermore, besides the high cost of a refrigerant, the high cost of making an air conditioner using that refrigerant will make the product more expensive to buy. This means fewer people will buy it. In short, a decision on which next-generation refrigerant to adopt must take into account all relevant factors, including its contribution to global warming, its safety, economic viability, and efficiency.

Similarly, the functions needed in a refrigerant vary depending on the size and type of the air conditioner it will be used in, so it's necessary to select the most suitable refrigerant for each particular application.

Characteristics Needed in a Next-Generation Refrigerant





International conference on next-generation refrigerants

International Discussions For Next-Generation Refrigerants

In changing to a new refrigerant, there are numerous matters to be considered, such as standards of the International Organization for Standardization (ISO) and the International Electrotechnical Commission (IEC), national regulations and standards, safety standards, installation and maintenance methods, refrigerant supply, and disposal of equipment. Choosing a refrigerant is not the work of one single company, but rather an exercise in international collaboration.

This is why Daikin takes part in discussions involving worldwide governments, regulatory organizations, industry groups, and air conditioner and refrigerant manufacturers. We also provide the information needed to make decisions on international rules and government

policies, and when requested we provide information such as the results of tests.

By presenting information that is logical and objective from a perspective of what is best for society as a whole, we strive for dialogue that leads to the selection of the most appropriate refrigerant.

Commercialize R32 Products and Demonstrate Daikin's Direction

After the numerous aforementioned activities in which we considered and evaluated refrigerants from all possible angles, Daikin determined R32 to be the most suitable refrigerant for air conditioners. One reason is that its GWP is just one-third that of R410A (an HFC mixture), the most common refrigerant in use in industrialized countries at present. In addition, R32's superb energy efficiency means that air conditioners using it emit fewer greenhouse gases and require less refrigerant volume to operate. And since it is not a mixture of different types of refrigerants like R410A, R32 will be ideal in the near future when the international community plans to have refrigerant recycling systems in place.

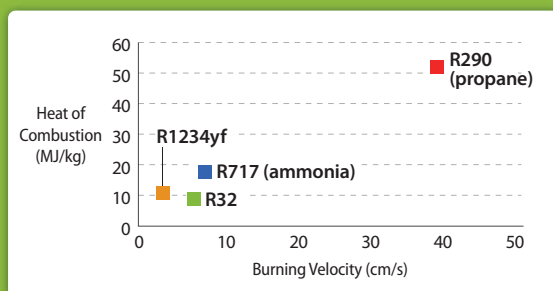
Characteristics of Possible Next-Generation Refrigerants (for Residential and Light Commercial Air Conditioners)

	Environmental performance		Safety		Economic performance	Efficiency
	ODP	GWP*	Flammability	Toxicity	Equipment cost	Efficiency
Refrigerants currently used in developing countries						
R22 (HCFC)	0.055	1,810	○	○	○	○
Refrigerants currently used in industrialized countries						
R410A (HFC)	0	2,090	○	○	○	○
R1234yf (HFO)	0	4	△	○	△	×
Possible next-generation refrigerants						
R32 (HFC)	0	675	△	○	○	○
R744 (CO ₂)	0	1	○	○	×	×
R717 (ammonia)	0	0	△	×	×	○
R290 (propane)	0	3.3	×	○	○	○

* GWP is quoted from the Fourth Assessment Report of the IPCC.

Note: × indicates a condition not met. △ indicates a condition partially met. ○ indicates a condition met.

Flammability of Possible Next-Generation Refrigerants



■ GWP of R32 Compared to Current Refrigerant (R410A)

Approx. **1/3**

■ Effect if Daikin Air Conditioners for the Japanese Market Used R32 Instead of R410A

Reduction of **46,000** tons-CO₂ per year
(Reduction during one year after installation)

Although a number of industrialized countries have been proposing next-generation refrigerants with consideration for factors like their own competitiveness and economic performance, it has proven hard to come up with new technologies and actually release products. Daikin believes that its job as the leading air conditioner company is to first commercialize products and show developing countries the direction it is taking.

World's First R32 Air Conditioner Released In Japan and India

R32 has a slight degree of flammability, and until November 2012, it had not been commercialized as a refrigerant. However, countries around the world have begun to accept refrigerants that are mildly flammable with the goal of reducing global warming. Even the International Organization for Standardization (ISO) is currently revising safety standards for refrigeration and air conditioning equipment.

In November 2012, for the first time ever Daikin began using R32 for residential air conditioners for the Japanese market. In October 2012, prior to market release, we held seminars for our installation contractors all over Japan to explain the characteristics of mildly flammable R32 and to talk about the procedures for handling it. Our goal was to ensure that our contractors were qualified to install R32 air conditioners and that all installation work would be of the highest quality.

In March 2013, India began the sale of residential air conditioners using R32. Our next step is to release R32 air conditioners in other countries and have R32 employed in commercial air conditioners.



Manufacturing R32 air conditioners in India



R32 briefing for trainees from 7 Asian countries

Open Licensing of Basic Patent to Promote Refrigerant Shift in Developing Countries

Daikin does everything it can to contribute to the shift to refrigerants with minimal environmental impact. Specifically, to promote adoption of R32 in developing countries nearing conversion to next-generation refrigerants, in September 2011 Daikin began giving free access to its "Basic Patent Indispensable for the Manufacture and Sale of Air Conditioners Using R32 Single Component Refrigerant." Daikin also participated in a developing country support program sponsored by Japan's Ministry of Economy, Trade and Industry and the Japan International Cooperation Agency (JICA), in which Daikin hosted trainees from seven Asian countries to provide them with detailed information on next-generation air conditioners.

Daikin continues to work towards the practical application of next-generation refrigerants. We continue to carry out research. And like our successful launch of water heaters using the natural refrigerant CO₂, we are on the lookout for other suitable uses of next-generation refrigerants beyond air conditioners.

We will continue to provide support upon request from various countries as we contribute to the switch to refrigerants with lower environmental impact in the process of helping to protect the ozone layer and mitigate the effects of global warming.

What Stakeholders Are Saying

Outstanding Example of Safeguarding the Ozone Layer and Climate System

With their high global warming potential, HFC refrigerants have proven to be a double-edged sword. In products such as refrigerators and air conditioners, they are much needed substitutes in the movement to phase out CFCs and HCFCs, which are ozone-depleting gases. At the same time, however, HFC refrigerants are extremely powerful global warming gases. Their widespread and continued use would jeopardize the success of the Montreal Protocol.

Good news comes from Daikin: the company has successfully brought to market air conditioners using R32, a refrigerant with a relatively low global warming potential and shorter atmospheric life. It is also focusing on enhancing the energy efficiency of air conditioning systems that use R32. This is an outstanding example of safeguarding the ozone layer and the climate system.



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