

NATURAL REFRIGERANTS

The 'Future-Proof' Refrigerant Choice



Department of
Environmental
Conservation

Natural refrigerants are **working substances** that can be found in the environment and have properties that allow them to carry thermal energy (heat) from one location to another. These refrigerants include **water, air, ammonia, carbon dioxide, and hydrocarbons**. Today, natural refrigerants are making a return as the most climate-friendly refrigerant options!

History of Refrigeration in New York

Before modern-day refrigeration, households used innovative strategies to preserve perishable foods. Many homes had cool underground basements called 'root cellars' for food storage and used ice collected during winter to keep cool throughout the warmer seasons.

Between 1840 and 1920, **ice harvesting** was one of the biggest industries in New York State, including in the Hudson Valley! Approximately 20,000 workers cut ice from the frozen Hudson River and transported it via horsepower to ice houses. There, blocks of ice more than 12 inches thick were covered in sawdust or hay and could last up to a year!

As New York's population grew, waste management struggles impacted the quality of ice during harvest season, and business began to decline. The industry completely melted away with the invention of vapor compression technology in the 1930s.



Workers preparing ice for harvest at Stuyvesant Landing, 1912. Credit: New York State Archives

Start of Modern Refrigeration

The earliest refrigerants are often referred to as 'natural refrigerants', which include **water, air, ammonia, carbon dioxide and hydrocarbons**. These substances were used because they were easily found in the environment and are effective at moving heat from one place to another. Limited safety and technology standards during the early 1900s presented challenges because some natural refrigerants have toxic or flammable properties.

Synthetic chlorinated and fluorinated refrigerants (also called chlorofluorocarbons, or CFCs) were developed to overcome these safety challenges. Today, CFCs are known as **ozone-depleting substances (ODS)** because they damage the Earth's ozone layer. The global response to this environmental hazard led to a landmark environmental agreement in 1987 called the Montreal Protocol to phase down these substances.

Hydrofluorocarbons (HFCs) were developed as a CFC alternative but are also significant climate pollutants and have global warming potentials hundreds to thousands of times more powerful than carbon dioxide (CO₂). To reduce emissions that cause or contribute to climate change, environmental policymakers across the world reached an agreement on the Kigali Amendment to the Montreal Protocol in 2016, internationally committing to phase down HFCs and climate-polluting substances.

Significant safety and technological improvements have allowed natural refrigerants to return with far more efficiency and applications than ever before. As natural refrigerants are non-synthetic and have well-understood physical and chemical properties, global **heating, ventilation, air-conditioning, and refrigeration (HVAC&R)** markets are using them again!

The **vapor-compression refrigeration cycle** is the most common system used in modern refrigerators and air conditioners.

The cycle refers to changing pressure on a refrigerant that allows it to absorb heat and transfer it elsewhere.

This process is why you might feel heat coming from the back of your refrigerator at home; your fridge is rejecting unneeded heat to keep your food cool.

What is Your Refrigerator Running On?

When shopping for your next fridge, look for climate-friendly natural refrigerants, such as propane (R-290) or iso-butane (R-600a). These climate-friendly alternatives are common and can be purchased at any home appliance store.

These natural refrigerants are more traditionally known for their use as fuel in cooking or space heating – but you may be surprised to learn that they are also very efficient refrigerants! When used in refrigerators, hydrocarbons – known specifically here as propane or iso-butane - are not combusted, but infinitely cycled in the appliance. As with all packaged refrigeration systems, they are ‘hermetically’ sealed, which means that the internal systems of the appliance are closed off from outside air. As hydrocarbons are extremely efficient, they are used in far smaller quantities than most other refrigerants.

ENERGY STAR & Environmentally Minded Products

ENERGY STAR® (energystar.gov) is a great resource to find consumer appliances available in the U.S. To search for the most climate friendly products available, choose the type of appliance you’re seeking and then select “**Lower impact on global warming**” under Refrigerant Type. If you are looking to upgrade heating and cooling loads larger than a residential refrigerator, DEC recommends discussing your natural refrigerant options with your preferred contractor. There are also resources offered by the Environmental Investigation Agency (EIA) such as cooltechnologies.org to browse for your desired equipment that uses natural refrigerants.

DEC also encourages local municipalities to develop appliance collection programs that safely remove HFC refrigerants before recycling the appliance. The **Climate Smart Communities (CSC) Program** includes a category for municipal projects that mitigate the impacts of fluorinated GHGs used in air-conditioning and refrigeration systems. If your local government is interested in applying for a CSC grant, please refer to this link for full information about the program: <https://www.dec.ny.gov/energy/109181.html#CSC>

Common Natural Refrigerants

Appliances that use refrigerants should have specific labels identifying the substances used. Check out some of the most common natural refrigerants below. You may find some of them throughout your home!

Common Name	ASHRAE Name*	Application(s)	Global Warming Potential (GWP)**	Properties
Ammonia	R-717	<ul style="list-style-type: none">Industrial Food RefrigerationIce RinksCold Storage Warehouses	0	<ul style="list-style-type: none">Excellent thermodynamic properties and low costNo impact on climate change (zero GWP)Subject to safety standards
Carbon Dioxide	R-744	<ul style="list-style-type: none">Commercial RefrigerationHeat Pump Water Heaters	1	<ul style="list-style-type: none">Low toxicity, non-flammable, ultra-low GWPLow cost, high efficiency
Propane	R-290	<ul style="list-style-type: none">Air-ConditioningHeat PumpsPropellants	<1	<ul style="list-style-type: none">Low cost and readily availableHigh flammability, but its efficiency allows far less to be usedCurrently available in residential and retail refrigeration in the US
Isobutane	R-600a	<ul style="list-style-type: none">Residential Refrigeration	<1	<ul style="list-style-type: none">Low cost and readily availableHigh flammability, but its efficiency allows far less to be usedCurrently available in residential and retail refrigeration in the US