

TRANSITIONING TO LOW-GWP ALTERNATIVES in Residential & Light Commercial Air Conditioning

Background

This fact sheet provides current information on low global warming potential (GWP) alternatives for new equipment in residential and light commercial air conditioning (AC), in lieu of high-GWP hydrofluorocarbons (HFCs). HFCs are powerful greenhouse gases (GHG) thousands of times more potent per pound than carbon dioxide (CO₂), but more climate-friendly alternatives are becoming available.

Residential and light commercial AC equipment contain one or more factory-made assemblies that normally include an evaporator or cooling coil(s), compressor(s), and condenser(s). These systems include most equipment that cool enclosed spaces in households and commercial industries, with the exception of chillers. These AC systems have a typical lifetime of 15 years and generally fall into four categories:

Room AC Units

- Window-mounted, portable, and through-the-wall types of self-contained AC equipment with hermetically-sealed compressor
- Capacities generally range from 5,000 to 24,000 BTU/hour, but heavy-duty units can reach 30,000 BTU/hour
- Average systems in the U.S. contain about 1 lb. of refrigerant



Packaged Terminal AC /Heat Pumps (PTAC/PTHP)

- Through-the-wall, self-contained units with hermetically-sealed compressor
- PTHPs perform both heating and cooling functions
- Capacities of 7,000–15,000 BTU/hour
- Average systems in the U.S. contain less than 2 lbs. of refrigerant



Other Residential AC and Heat Pumps

- AC and heat pumps used in residential buildings ducted (central AC) or ductless (e.g., mini-splits, multi-splits) systems
- Capacities typically 17,000–65,000 BTU/hour
- Average systems in the U.S. contain about 10 lbs. of refrigerant

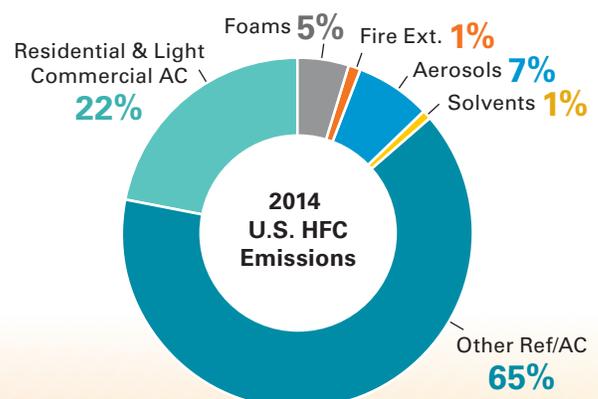


Other Commercial AC

- Electrically operated AC systems used for commercial applications
- Conditioned air can be distributed with ductwork (similar to residential AC) or sent directly into a building (e.g., from rooftop units into the space below)
- Capacities of 65,000–135,000 BTU/hour for small units and 135,000–240,000 BTU/hour for larger units
- Average systems in the U.S. contain about 15–50 lbs. of refrigerant depending on capacity



In 2014, U.S. emissions from residential and light commercial AC equipment were estimated at 36.7 million metric tons of carbon dioxide equivalent (MMTCO₂eq.), or roughly 22% of total national HFC emissions.



U.S. HFC Emissions: 166 MMT CO₂Eq.
U.S. HFC Emissions in Residential & Light Commercial AC: 36.7 MMT CO₂Eq.

Low-GWP Alternatives & Market Trends

Today, many residential and light commercial AC systems in use contain HCFC-22, which is being phased out globally and was banned for use in new AC systems in the U.S. beginning in 2010. The vast majority of units sold today contain R-410A, an HFC mixture with a GWP—a measure of its climate warming compared to CO₂—of 2,088.

EPA's Significant New Alternatives Policy (SNAP) program ensures the smooth transition to alternatives that pose lower overall risk to human health and the environment. In April 2015, three lower GWP alternatives (propane, HFC-32, and R-441A) were listed as acceptable by the SNAP program for use in room AC units. Submission reviews of blends of other low-GWP alternatives, such as hydrofluoroolefins (HFOs) and HFCs, are also expected in the near future.

Propane (R-290)

- Used in small (low-charge) units produced in China and India; further R&D needed for larger residential and light commercial AC applications
- Performs very similarly to fluorinated refrigerants but charge size is about 50% of an R-22 unit
- Successfully used in small units with <2 lbs. of refrigerant

HFC-32

- Used in AC units sold in Europe and Asia, with manufacture in Japan, India, Indonesia, and soon in China
- Higher capacity and efficiency than R-410A

Blends using HFO-1234yf and HFO-1234ze

- Potential use in small and medium AC units; would require system redesign of conventional R-410A systems due to lower pressure
- Research and development as well as testing with equipment manufacturers are underway to identify lower GWP blends using these compounds (e.g., ARM-70a, DR5, Solstice L-20, L-40, and L-41) to match performance of R-410A

Carbon Dioxide (CO₂, R-744)

- High operating pressure; research to overcome potential efficiency barriers underway
- Other custom built applications are available outside of the U.S.

SNAP Facts

- Authorized under Clean Air Act Title VI
- Evaluates substitutes and lists as acceptable those that reduce overall risk to human health and environment; lists acceptable with use conditions if needed to ensure safe use; or lists as unacceptable.
- Industrial sectors include: Refrigeration & Air Conditioning, Foam Blowing, Solvent Cleaning, Fire Suppression, Aerosols, Sterilants, Adhesives, Coatings & Inks, and Tobacco Expansion.
- Since it was established in 1994, SNAP has reviewed over 400 substitutes.
- SNAP considers:
 - Ozone Depleting Potential (ODP)
 - Global Warming Potential (GWP)
 - Flammability
 - Toxicity
 - Occupational & Consumer Health/Safety
 - Local Air Quality
 - Ecosystem Effects

Refrigerant	GWP*
HCFC-22	1,810
R-410A	2,088
R-407C	1,774
HFO Blends	<1,032
HFC-32	675
HFO-1234ze	6
HFO-1234yf	4
R-441A	4
Propane (R-290)	3.3
CO ₂ (R-744)	1

Note: HCFC-22 is no longer used in new equipment because of its ozone depletion potential.

* GWP values are from the Intergovernmental Panel on Climate Change Fourth Assessment Report: Climate Change 2007.

Emerging Use of Alternatives Internationally

The use of climate-friendly refrigerants in residential and light commercial AC equipment is expanding in many countries around the world. Portable AC units using R-290 are widely available and window units are now in production in Asia. Some companies are developing and producing split AC units using R-290 on a larger scale, with numerous production lines being completed in China, the largest manufacturer of AC equipment in the developing world. AC products with R-32 have also entered the global marketplace, as most Japanese companies have commercialized mini-split AC systems using R-32.

Future Outlook

Together, the suite of known alternative chemicals, new technologies, as well as better process and handling practices, can significantly reduce HFC use in both the near and long term. Although much work remains to fully adopt these chemicals, technologies, and practices, and some unknowns still remain, the equipment manufacturers and chemical producers for the

residential and light commercial AC industry are working on developing new alternatives. Over the next few years, EPA is expecting to finalize rules potentially adding several options for new, climate-friendly residential and light commercial AC products.

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