

The chill hunters activity sheet

39 Ways to Save the Planet

Refrigeration

This is a resource linked to the BBC Radio 4 programme 39 Ways to Save the Planet. Listen to the episode [The Chill Hunters](#) and complete the tasks below.

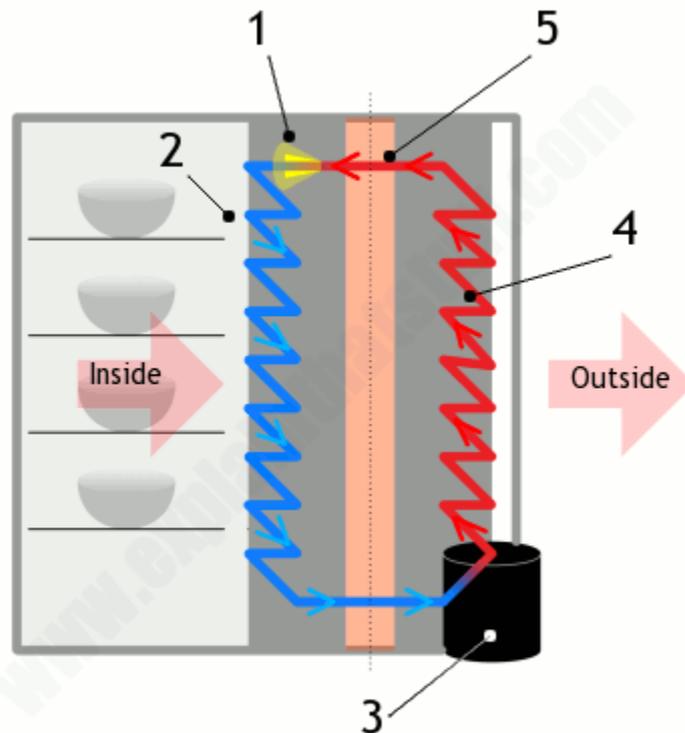
Refrigerators are increasingly the focus of environmental attention due to the fearsomely potent greenhouse gas they use in their cooling process: chlorofluorocarbons (CFCs). Once fridges are scrapped the little gas bottles to the rear of the fridge become 'ticking timebombs'.

How do fridges work?

Coolant (refrigerant) is released from the expansion nozzle in the evaporator tube within the fridge. Because there is low pressure in the evaporator tube some of the coolant evaporates and cools down, absorbing heat in the process. This takes heat from inside the fridge. The coolant continues to loop round as a gas until the compressor compresses it — heating it up before moving it on. The hot gaseous refrigerant now loses its heat to the tube walls which have been cooled by the surrounding kitchen air temperature. Now the refrigerant is a liquid once more as it passes through the refrigerator insulation, and begins the cycle again

1. Using the above description and key words below, label the 5 points on the diagram below.

Expansion valve	Chiller cabinet	Insulated cabinet	Compressor	Thin radiator pipes
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CFCs

The Montreal Protocol of 1987 banned the use of CFCs a gas which some refrigerators still emit when they are decommissioned. Whilst the Montreal Protocol is widely viewed as successful — and was the first example of global environmental collaboration, there are increasing levels of shredded foam from unwanted old refrigerators, causing continued pollution levels of chlorofluorocarbons. The NOAA define CFCs as:

CFCs are halocarbons that contain only the elements carbon, chlorine, and fluorine. The most common CFCs are small molecules containing only one or two carbon atoms. For example, a common refrigerant has the chemical formula of CCl_2F_2 , which in industry-invented shorthand is known as CFC-12.

The data below is taken from the [Chlorofluorocarbon-12 \(CCl₂F₂\) — Combined Data Set](#) NOAA web page and shows the global level of CFCs from 1978 to 2020.

Year	Global Mean CFC-12 (ppt)
1978	281.91
1979	298.97
1980	313.61
1981	330.60
1982	341.56
1983	357.71
1984	370.99
1985	387.51
1986	408.24
1987	428.81
1988	451.00
1989	472.89
1990	486.11
1991	496.12
1992	506.49
1993	513.18
1994	519.43
1995	526.06
1996	531.39
1997	535.05
1998	538.56
1999	540.78
2000	542.92
2001	543.24
2002	543.97
2003	543.51
2004	543.37
2005	542.87
2006	541.34
2007	538.74
2008	536.12
2009	534.23
2010	531.06
2011	527.78
2012	525.31
2013	521.99

2014	519.24
2015	515.99
2016	512.89
2017	509.12
2018	506.25
2019	502.26
2020	497.80

Sourced from NOAA www.gml.noaa.gov/hats/combined/CFC12.html

2. Draw a line graph showing CFC emission levels from 1978 to 2020.
3. How successful was the 1987 Montreal Protocol ban on CFCs? Did the parts per trillion (ppt) in our atmosphere decreased from that point onwards?

Part of the reason why there are still high levels of CFCs in the (497.80 ppt) atmosphere is due to refrigeration units not being properly disposed of. In Guatemala City the Chill Hunters have set out to tackle this problem.

Who are The Chill Hunters?

The chill hunters are a group of disposal experts in Guatemala City who specialise in the dismantling and disposal of refrigerators. A refrigerator consists of a cooling system which uses a coolant to run through a series of coils in a continuous closed loop, going inside, outside, and back into the fridge. Due to this coolant, it is the afterlife of a fridge that poses such a threat to us if CFCs leak out of discarded unit. A recent MIT article reported that when discarded or confiscated fridges are added to stockpiled fridges and other refrigeration pieces of equipment — these are understood to add 9 billion metric tonnes of carbon dioxide (CO₂) to the atmosphere.

If refrigerators are correctly disposed of and CFC gases are contained, global warming could be lowered by potentially 0.5°C. However, if a 14 kilogram can of the greenhouse gases from the rear of a fridge leaks, 131 tonnes of CO₂e can be released — a year's worth of driving 54 cars. Safe disposal of a refrigerator gas can is incredibly important.

Third generation fridges now contain HCFCs which, whilst less harmful than earlier CFCs, are still very potent and are much more damaging than CO₂. HCFCs remain incredibly dangerous due to their global warming potential — which is thousands of times greater than CO₂, with some HCFCs being up to 13,850 times more potent.

Further reading

- Explain that Stuff www.explainthatstuff.com/refrigerator.html
- How Does a Refrigerator Work? www.youtube.com/watch?v=EIP3pSio7-M
- Chlorofluorocarbon-12 combined data set www.gml.noaa.gov/hats/combined/CFC12.html
- Why Your Fridge Pollutes and How It's Changing www.nationalgeographic.com/science/article/150306-why-your-fridge-pollutes-and-how-its-changing
- BBC Smart Guide to Climate Change www.bbc.com/future/article/20201204-climate-change-how-chemicals-in-your-fridge-warm-the-planet

- Are CFCs responsible for global warming? www.theconversation.com/are-cfcs-responsible-for-global-warming-14962

Suggested questions for The Chill Hunters

- a. How many grams of CFCs does a fridge contain?
- b. What did a recent MIT article report?
- c. In Latin America, what are the challenges facing the chill hunters?
- d. How long does it take for the chill hunter to collect a 1,000 appliances?
- e. Why is this 'really interesting story of unintended consequences?
- f. What kind of scale could this solution save on human CO₂ emissions?

An RGS-IBG expert

Go to [What our experts say](#) to hear further analysis from Dr Luke M Western and Dr Daniel Say from the School of Chemistry in the University of Bristol and Professor John Pyle from the University of Cambridge.

