CARBON TRUST

Refrigeration

A guide to energy and carbon saving opportunities

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Preface

Reducing energy use makes perfect business sense; it saves money, enhances corporate reputation and helps everyone in the fight against climate change.

The Carbon Trust provides simple, effective advice to help businesses take action to reduce carbon emissions; the easiest way to do this is to use energy more effectively.

This overview introduces the opportunities available to businesses to reduce energy use and the emissions associated with refrigeration systems. The guide aims to support the understanding of refrigerant systems, how savings can be delivered and the regulation relevant to this topic area.

Contents

Introduction

Benefit from reducing the energy demand of your refrigeration systems.

Simply put, refrigeration is a process by which heat is moved from one location to another. This is a mechanical process which enables the temperature in a given space to be reduced. In a commercial context this is often used to extend the life of certain products and in industries such as food and drink and chemicals, refrigeration accounts for a significant proportion of overall site energy costs.

When responsible for high costs, even a small reduction in refrigeration energy use can offer significant cost savings. The table below offers an insight into the proportion of overall energy use which refrigeration accounts for by sector.

Table 1: Energy use for refrigeration by sector

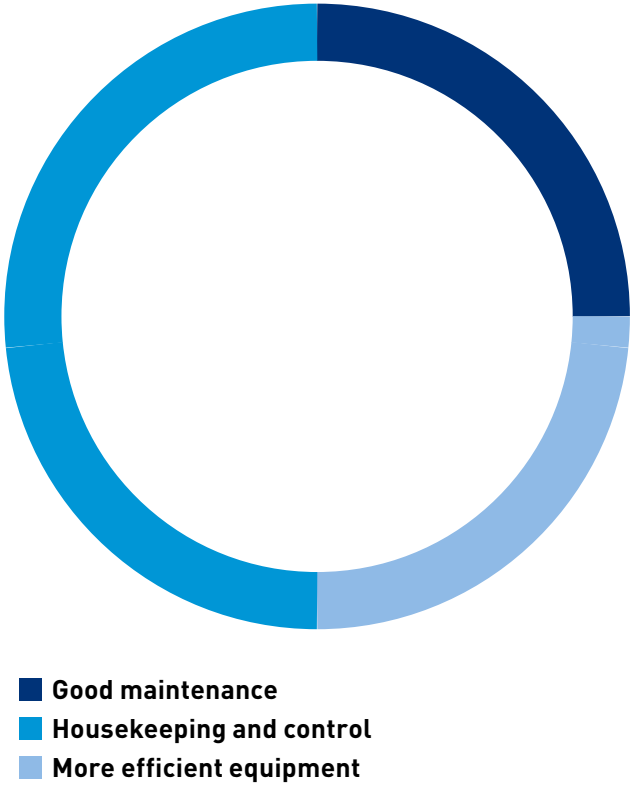
Sector	Typical proportion of energy used by refrigeration
Meat, poultry and fish processing	50%
Cold storage	90%
Food supermarkets	50%
Small shops with refrigerated cabinets	70% or over
Pubs and clubs	30%

It is important to remember that energy savings of up to 20% can be made inexpensively, through actions requiring little or no investment. Also, aside from energy and cost savings, improving efficiency and reducing the load on refrigeration plant can result in increased reliability and reduce the likelihood of a breakdown. Figure 1 illustrates how for a typical organisation, the split between the key areas for saving energy could save energy and money in refrigeration systems.

Who is this publication for?

This guide will be useful for any business that uses refrigeration equipment and is especially applicable for businesses that use large amounts of energy for refrigeration plant and therefore stand to see large savings as energy use is reduced. Examples of types of business which may find information detailed here useful include supermarkets, grocery stores, food processing plants and organisations in the hospitality sector.

Figure 1: Typical sources of savings in refrigeration equipment



Refrigerated display cabinets

Understand the best ways to utilise and manage your refrigerated display cabinets.

Energy savings of up to 30% could be realised by selecting the most efficient model of refrigerated display cabinet for your business. These savings will vary depending on the size and model of the system and also on the existing system that is replaced. Cabinets should be tested under the European Test Standard, EN 23953 for temperature performance and energy consumption. Manufacturer's performance information from this standardised testing allow you to compare the efficiency of different cabinets.

Refrigerated display cabinets are a technology included in the Energy Technology List (ETL). This sets a benchmark for high-efficiency cabinets. Purchasing cabinets (or any other technology) from this list ensures that the product is among the most efficient available in its class.

It is worth keeping in mind that new efficiency standards will be outlined as part of the EU eco-design requirements. These standards will set minimum efficiencies for all chilled display cabinets and it is possible that these standards could rule out the sale of cabinets without doors. From January 2021 commercial display cabinets within the scope of regulation must comply with the Energy Efficiency Index (EEI) Limits of < 110. EEI is an indication of annual power consumption compared with a reference consumption based on volume and appliance type. This regulation essentially calls for cabinets to have a minimum efficiency rating of 'D'.

Table 2: Energy saving options for display cabinets

Energy Saving Options	Typical Energy Savings
Aerofoils on display shelves	10% to 20%
Cleaning and maintenance	Up to 10%
Recommissioning	Up to 10%
Transparent doors	20% to 50%
LED lights	5% to 10%
EC motor fans	3% to 10%
Strip curtains	5% to 30%
Night blinds	5% to 35%
Correct cabinet loading	10% to 20%
Riser or weir plates	1% to 2%
Anti-sweat heater controls	2% to 7%
Night covers	10% to 20%
Defrost controls	2% to 10%
Anti-fogging glass	Up to 5%
Air curtain optimisation	Up to 5%

There are also several steps than can be taken to reduce the energy consumed by existing display cabinets. Examples of these measures are shown in Table 2 and discussed further below. The savings shown are typical for a 5,000m^2 supermarket but serve as a good indication of potential savings for smaller premises as well.

General housekeeping measures

- **Do not overstock.** Air grills should be kept clear of products and merchandising. An appropriately stocked cabinet will maintain optimum temperatures with minimum energy consumption.
- **Do not allow products to warm in transfer** by making sure that product is not left in an ambient temperature area. A warmed product can negatively impact the efficiency of the cabinet.
- **Switch off lighting and anti-condensation heaters** out of hours to save energy.
- **Check defrost settings are appropriate** and match the conditions to avoid unnecessary heating.

Maintenance and low cost energy savings measures

- **Regular cleaning.** Scheduled cleaning ensures the best efficiency and temperature control.
- **Make use of night blinds and/or strip curtains** when premises are closed. Covers such as these can be effective in reducing the plant load, out-of-hours.
- **Auto controls on anti-sweat heaters.** Ensure all trim and anti-sweat heaters are pulsed or switched off automatically when not needed.
- **Properly commission expansion valves** and ensure an electronic type is used where possible.
- **Auto controls on defrost systems.** Use defrost controls with temperature cut-out to avoid unnecessary heating. If you're using electric defrosting on a chill cabinet, check whether you need it. Natural or off-cycle defrost might be an option.
- **Installing aerofoils along the display shelves** is an effective way to reduce cold air losses from open cabinets, and an alternative to doors.

Investment measures

- **Install LED canopy lighting.** Use high-efficiency LED canopy lighting.
- **Install transparent doors to open cabinets.** Customers can still see and access products but the load on the cabinet is reduced. In situations where the cabinets are used very frequently, doors may save little energy when retrofitted compared to an open fronted cabinet, and in this case aerofoils provide an alternative. However, doors offer good benefits where there are periods of low usage.
- **Replace fans with low power alternatives.** If you plan to keep the cabinets for at least five years, look at replacing the fans with lower power alternatives.
- **Whole cabinet replacement.** The greatest savings can be achieved from investing in the newest, most energy efficient equipment. Select your equpment from the Energy Technology List (ETL) to ensure it is amongst the most energy efficient available. Based on the typical energy consumption of older, standard models, purchasing the most efficient cabinets can provide a better return on investment than retrofitting transparent cabinet doors.

Cold rooms

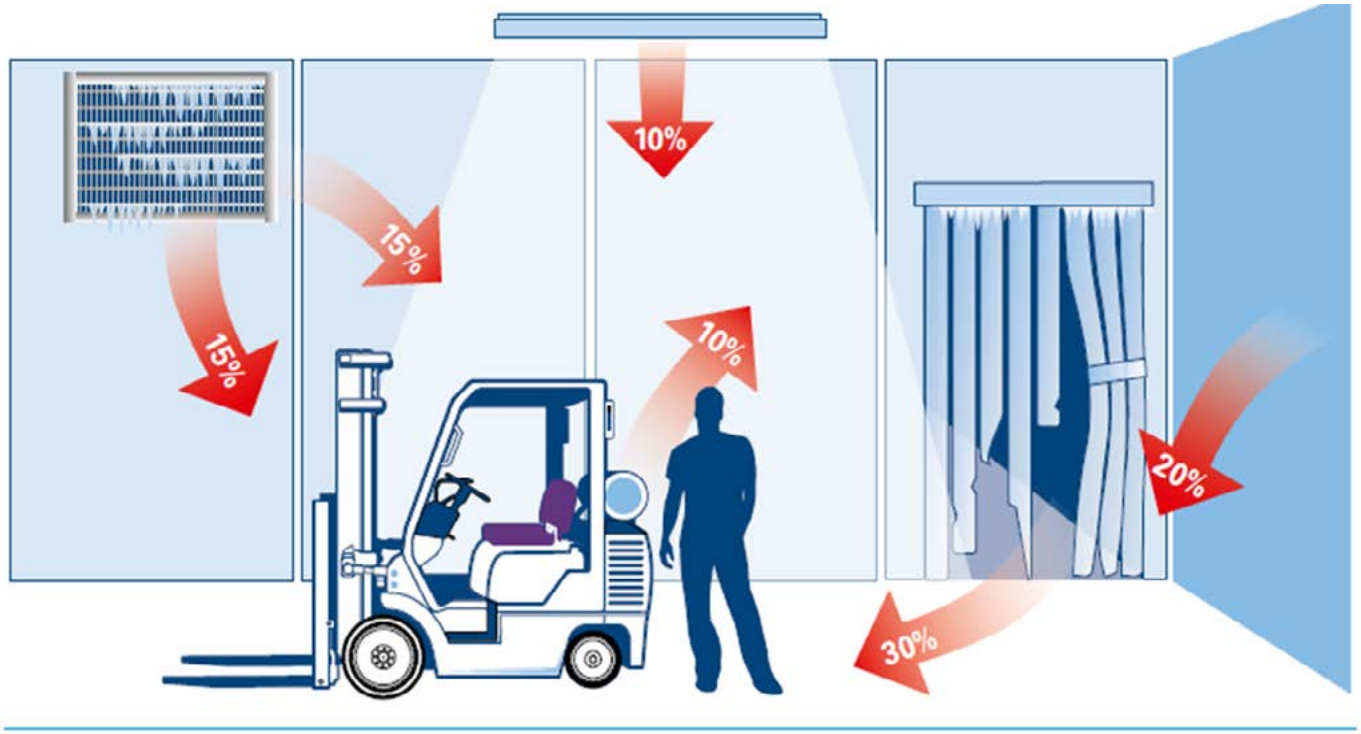
How is energy wasted in cold rooms and how can this be reduced?

Both chiller rooms and freezer rooms are covered in this section and in particular the fabric and operation of cold stores. Warm air entering through open doors is the biggest way that a cold room load is impacted. The heat gains of a cold room are illustrated in the below Figure 2, and as can be seen, typically 30% of the heat gain comes from open doors.

Even small gaps such as those between insulated panels or where pipes penetrate walls can allow a small but constant stream of warm, moist air into the store. Where this can be limited, the load on the store itself can be lessened and energy saved. Ideally, cold rooms should meet best practice by adhering to the criteria of the ATTMA (Air Tightness Testing and Measurement Association) Technical Standard TS1.

Steps which can be taken to reduce the energy consumed by cold rooms are discussed below, grouped into no cost housekeeping, maintenance and low-cost, and investment measures.

Figure 2: Cold room heat gains



General housekeeping measures

- **Keep door closed.** Introduce good door management procedures and keep the door of your cold store closed whenever possible. This will keep warm air and moisture out, and energy costs down.
- **Do not obstruct evaporators.** Make sure airflow from the evaporators is not obstructed.
- **Run at the highest temperature for product.** Run your cold store at the highest possible temperature for the product. The Food Standards Agency provides helpful information on the appropriate ways to store chilled or frozen food.
- **Don't allow warming in transfer.** Ensure the product loaded into your cold room has not warmed up by being left in an ambient temperature area.
- **Switch off lights when not needed** out of hours to save energy.
- **Ensure the cold room is appropriately stocked.** Overstocking can cause the refrigeration system to work harder to keep things at an appropriate temperature, using more energy.

Maintenance and low-cost saving measures

- **Repair any damaged door seals.** If you have automatic or rapid-closing doors, make sure they are not overridden and are maintained in good working order.
- **Install strip curtains** and make sure they are well-maintained. This will keep warm air and moisture out, and energy costs down. Insulated curtains are available, offering an improved thermal barrier.
- **Upgrade lighting to LED with auto control.** Consider low-power, instant-on lighting which switches off automatically if the store is unoccupied.
- **Maintain and repair all wall panel seals.** Ensure the outside of the cold store is sealed air-tight, with no gaps at panel joints, and is well insulated throughout. This will keep air infiltration and heat gain to a minimum.
- **Interlocking doors with evaporator fans.** Installing interlocks so that the fans are switched off when the doors are opened, so that cold air is not blown out of the unit.

Investment measures

- **Fit automatic/rapid close doors**, if regular access is required.
- **Install defrost on demand system** – This system will keep the evaporators in top condition.
- **For larger forklift accessible stores, install a dehumidifying airlock.** This will reduce ice build-up and the need for defrosting.
- **For new stores, specify sliding doors.** These have better seals and are less prone to damage.

Maintaining the overall thermal integrity and air tightness of a cold store can save you over 10% of the energy costs. Simply introducing an element of control to cold store doors can provide you with a financial saving of around £2 per hour for chill rooms and £6 per hour for freezer rooms.

Compressors

Optimising the efficiency of compressors.

Compressors are the most energy intensive part of the refrigeration process. Reducing the work needed here should be considered an important focus for any refrigeration based energy saving initiative.

The role of a compressor is to raise the pressure of a refrigerant to a level whereby the heat can be rejected at the condenser. The difference between the refrigerant temperature in the evaporator (evaporating temperature) and the condenser (condensing temperature) is often referred to as the temperature lift of the system. This temperature lift determines how hard the compressor has to work. The larger the lift, the more work will be required by the compressor and the more energy it will consume.

Again, there are a number of steps which can be taken to reduce energy consumption from compressors.

Maintenance and low cost saving measures

- **Set the condensing temperature at lowest possible level.** Ask a technician to do this. Once the limit is reached, it may be possible to upgrade control valves or condensing capacity to allow a further reduction.
- **On multi-compressor systems, make sure the compressor suction pressure is set only as low as is required.** Often the winter set point can be higher than in summer.
- **Compressors should be checked regularly.** Refrigerant loss is a major cause of direct emissions and system inefficiency. When refrigerant charge becomes critically low, energy use can increase by between 11% and 15%. Undercharged systems need to operate for longer in order to achieve the same cooling capacity, and systems that have lost refrigerant are likely to operate at higher suction temperatures. This can cause a reduction in compressor efficiency and higher discharge temperatures, often leading to oil breakdown and overheating problems that generate acid formation in the compressor.

Investment measures

- **Liquid pressure amplification (LPA).** If the condensing temperature can not be reduced for system reasons. This measure offers typical savings of up to 25% (for larger plant 300kW) and a payback of three to five years. LPA involves the addition of a pump to provide stable pressure to the expansion valve. Condensing pressure is allowed to 'float' with ambient temperatures.
- **Speed controllers for one or more compressors**. If your cooling load varies across a wide range. The cost of variable speed drives (VSDs) depends on the size of the unit. These can be retrofitted to existing units or new compressor packs can be bought that include variable speed drives. Consider both options when looking into VSDs.

For every degree that temperature lift is reduced, you will save around 4% of the compressor energy for chill temperature systems and 2% for low temperature systems.

A typical condensing temperature in a refrigeration system is 40°C all year round. Setting this to float down to 20°C when the weather allows, would typically reduce compressor energy consumption by 25% to 35% for a chill temperature system.

Condensers

Optimising the efficiency of condensers.

In a refrigeration system, the condenser is where super-heated refrigerant vapour is passed from the compressor to reject the heat. Here it is cooled, typically by air or by water, rejecting latent heat. Often refrigerant vapour is passed to the condenser at a higher temperature than the external ambient temperature to make it easier to reject that heat.

There are two typically two types of condenser; air-cooled condensing units and evaporative condensers. Air-cooled units use ambient air to remove the heat from a condensing refrigerant. In comparison an evaporative condenser uses a coil which is continually wetted on the outside. Gas to be condensed flows through this coil and air is drawn over the coil, evaporating some of the water. This improves the rate at which heat is rejected from the refrigerant gas, allowing it to condense at a lower temperature relative to the air temperature.

Evaporative condensers have advantages over air-cooled systems. They can be more effective at removing heat through evaporation of water, compared with dry air. Heat is rejected against a wet bulb ambient temperature rather than a dry bulb. The wet bulb temperature is up to 8°C lower than the dry bulb in hot weather.

This can mean that evaporative condensers can work more efficiently than air-cooled types. Air-cooled condensers are used for most commercial systems, and evaporative for larger industrial systems. Water-cooled condensers are used on some larger systems, usually in conjunction with cooling towers.

In a domestic fridge, the condenser is the warm grille at the back. For plug-in commercial fridges and domestic cabinets, the condenser is usually packaged with the compressor below or above the fridge. Refrigeration systems can also have remote condensers, located outside or in a plant room.

Energy savings can be found where you are able to make it as easy as possible to reject heat. When the condenser is not working effectively, due to poor maintenance for example, it is forced to work at a higher temperature. This means that the compressors have to work harder. For every 1°C that the condensing temperature rises, the compressor uses between 2% and 4% more energy.

To reduce energy consumption from the condensers try to follow some or all of the following steps.

General Housekeeping measures

- **Keep condensers clean.** Find out where your condensers are, and check them regularly. If the condensers are dirty or blocked with debris, they are costing you money. Keep your condenser area clear of leaves, litter and vegetation.

Maintenance and low cost saving measures

- **Have condenser fins and filters professionally cleaned** by competent technicians as part of regular maintenance and make sure cleaning does not just push dirt deeper between the fins.
- **Check that the fans are operational.** Bear in mind that some may be switched off at times by the head pressure controls.

Investment measures

- **Install removable condenser screens.** This is useful if your condenser is likely to accumulate dirt. These can be hosed down or replaced.
- **Consider additional condensers** if your current condenser struggles to meet demand at peak times.
- **Replace fans with high efficiency EC (electronically communicated) alternatives.** These offer fan power savings and control flexibility over AC alternatives.
- **Consider a larger condenser than normal** if you are buying a new refrigeration plant. Increasing the size of the condenser by 30% could save you around 10% of energy use.

Evaporators

Another part of the system to maintenance and simple measures to improve efficiency.

Low pressure liquid refrigerant absorbs heat and evaporates into a gas. Efficiency gains can be achieved at this stage of the process when you are able to make it easier for the evaporator to gain heat. Evaporation occurs at low pressure during the 'vapour compression cycle'.

Evaporators are located inside your chiller or cold room and must be large enough to support the needs of the system. When an evaporator is too small, the compressor must work harder and for longer. Defrosting also occurs more frequently in this case. This results in an overall increase in energy use.

General Housekeeping

- **Watch for ice build-up.** This indicates that something is wrong with the evaporator. Look at the defrost settings.
- **Switch off evaporators in rooms not in use.** Consider rooms such as production areas where evaporators aren't needed when the room is not in use.
- **Ensure room thermostat is located as high as possible** without compromising food or process quality.

Maintenance and low cost saving measures

- **Evaporator coil cleaning.** Ask your technician to do a regular deep clean to maintain performance.
- **Check fans are functioning correctly.** Some may be off at times if there is a controller for the evaporator fans.
- **Evaporator fans should have traps.** This prevents air being drawn in from outside.
- **Heat and insulate evaporator drains in freezer rooms.** This prevents them from freezing and blocking.
- **Install a defrost-on-demand system on freezer cabinets.** This can save upto 9% on cabinet energy consumption.

Turning the thermostat up by just 1°C can reduce energy use by up to 2%

Heat Recovery

How can energy be recovered in order to help you save on your energy bills?

Businesses who use refrigeration systems also often have a heating requirement. This heating requirement can manifest as space heating, heating for processes or for hot water. Refrigeration systems produce a lot of heat which is usually 'dumped' externally. Some or all of the heat that is normally wasted by the refrigeration system can be recovered and used to reduce existing gas or oil bills.

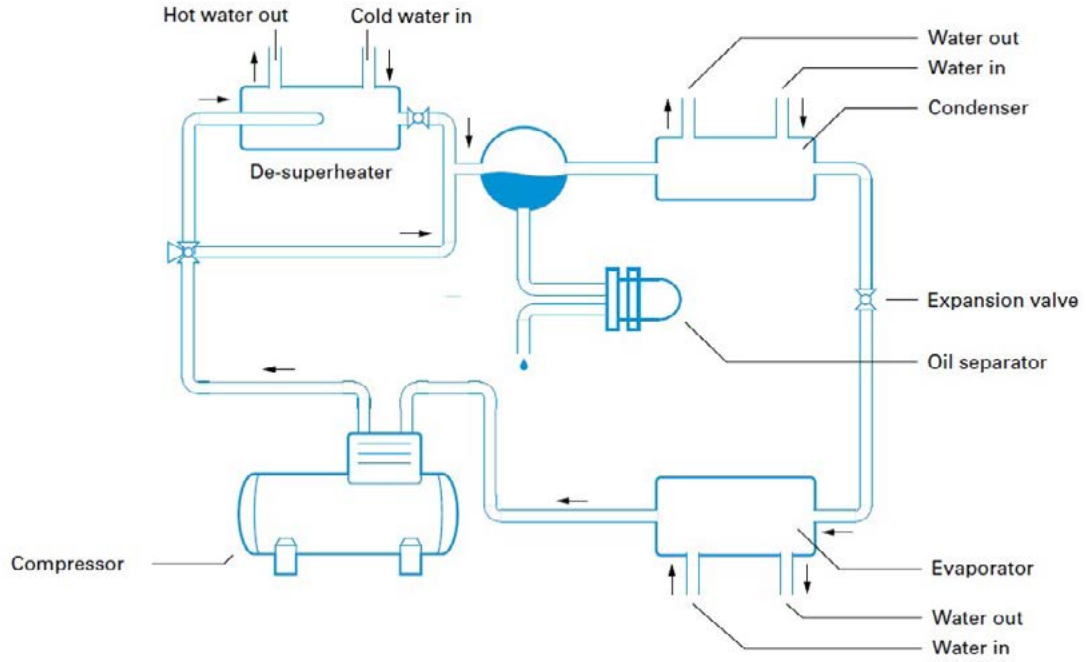
The heat available from heat recovery can be described as either High Grade or Low Grade heat and this refers to the temperature of that heat. Around 10% of the heat that is wasted by a refrigeration system is High Grade heat or Superheat (50-60°C) and the remainder is categorised as Low Grade (20-30°C).

The High Grade heat can be used to support hot water systems and thermal processes. The Low Grade heat can be beneficial for pre-heating hot water, supporting space heating, or underfloor heating in cold or dry good stores.

It is recommended that experienced contractors, familiar with heat recovery, are used if you are planning on moving forward with a heat recovery project. The Green Business Directory can act as a useful resource for finding Carbon Trust Accredited suppliers. If you are interested in receiving a free supplier shortlisting service, please enquire here. Further information on the Green Business Fund and Green Business Directory is discussed later on in this guide.

Figure 3 illustrates a typical process for recovering high grade heat from a refrigeration system.

Figure 3: High Grade Heat Recovery



Case Study - A Ready Meals Manufacturer

This organisation had a hot water requirement which was being met by a hot water tank. The site also contained a sizeable chiller unit, with a cooling capacity of 2.1MW. Up to 30% of the heat rejected by this system could be recovered and used to help meet the large hot water requirement on site.

Assuming a 30% recovery rate and a system utilisation factor of 75%, this heat recovery system produces 473kW or 4,143,480kWh/year.

The cost saving associated with gas consumption on this investment (based on 3.5p/kWh) would be around £145,022/year.

Potential Savings

In general, a quality heat recovery system should payback within three to five years. This is based on the high initial capital costs associated with heat exchanger, pipework and controls. However, due to significant savings, heat recovery is an attractive investment for many businesses as the recovered heat can be considered essentially free.

The largest savings can be seen by those who refrigerate down to very low temperatures (those with deep freeze units). These systems provide the most useful high temperature heat from recovery.

Refrigerant leakage and regulation

Regular maintenance is required on refrigeration systems and urgent action in the event of refrigerant leakage.

This section of the guide discusses the importance of continuous maintenance of refrigeration systems and the importance of keeping up to date with refrigerant gas regulation.

Hydrofluorocarbon (HFC) refrigerants are known to cause significant environmental damage. These are known to have a high global warming potential (GWP), which can be over 3000 times greater than that of carbon dioxide. Most refrigeration systems leak refrigerant gases. The average leakage rate in UK systems is around 20% per year[1]. This would equate to a reduction in efficiency of around 11%. This inefficiency would translate directly into increased energy costs.

In addition, if a leak is not repaired promptly, the ability of the system to cool to the appropriate temperature may be lost. If this is the case then product could be affected, impacting business finances.

There are significant regulatory responsibilities on users of refrigerant systems to maintain these systems, test for leaks and keep records. The FGas regulations have had, and will continue to have a significant impact on businesses.

At Present

- Operators are responsible for stopping leaks from their equipment.
- Contractors that install, maintain or dispose of equipment share responsibility for trying to stop leaks from the operators equipment.
- Leak tests must be carried out at certain intervals and this is determined by CO_2 equivalent thresholds. (See Figure 4)
- Larger systems are expected to be tested more frequently.
- If equipment contains F Gases equivalent to more than 500 tonnes of CO_2 then leak detection equipment **must** be installed. This equipment would alert the operator or service company if a leak is detected.

Figure 4: CO_2 equivalent thresholds for common HFC refrigerants and specified leaks check intervals[2].

Maximum interval between leak checks	CO_2(tonnes)	HFC 23 (kg)	HFC 227ea (kg)	HFC 404A (kg)	HFC 410a (kg)	HFC 134a (kg)
1 year	5	0.3	1.6	1.3	2.4	3.5
6 months	50	3.4	15.5	13	24	35
3 months	500	34	155	127	240	350

[1] Gartshore J. Energy Efficiency and Leakage Reduction. Refrigeration: Optimising refrigeration systems for building services engineers. CIBSE 2008

[2] https://www.gov.ukguidance/f-gas-in-refrigeration-air-conditioning-and-fire-protection-systems

Future proof your business

The UK is in the process of phasing out HFCs. The aim is that by 2030 the use of HFCs will have reduced by 79% from the average use between 2009 and 2012[3,4].

It is important for businesses to keep up to date and fully understand regulation surrounding refrigeration. New legislation means companies must think carefully about the refrigerants and refrigeration equipment they use moving forward.

The 2020 ban[5]

Legislation coming into effect on the 1st of January 2020 means that refrigerants with a GWP greater than 2500 being used to service or refill refrigeration systems will be banned. The ban affects systems containing hydrofluorocarbons (HFCs) equivalent to over 40 tonnes of CO_2.

Operators of refrigeration systems will be subject to enforcement action should they not comply with the service ban. Regulators in England and Scotland will be able to issue penalties of up to £200,000 should operators breach the regulation. Notices and fines can also be applied in Northern Ireland and Wales.

In general, regulation will make some refrigerants harder to obtain and more expensive. Your refrigeration manufacturer or certified technician will be able to tell you which refrigerant your system uses if you do not already know.

It is vital for businesses to understand the CO_2 equivalent of existing refrigerants. Your manufacturer or technician may be able to tell you but you can also find out for yourself . Service providers and technicians can offer advice on the appropriate steps to take to manage the impacts of these regulations.

> CO_2 equivalent is a measure of how much a gas contributes to global warming, relative to carbon dioxide. Each refrigerant is given a global warming potential (GWP) and this is multiplied by the mass of the gas used (tonnes).

Information on the GWP of different refrigerants can be found here.

Actions that can be taken by a business include:

- Using reclaimed HFC refrigerants (These are exempt from the ban until 2030).
- Using recycled HFC refrigerants. These can be recycled by the operator or the company servicing the equipment. (These are exempt from the ban until 2030).
- Switching to refrigerants with a low GWP that are not covered by the service ban.

If you decide to move to low GWP refrigerants this will involve replacing or retrofitting your existing system. The Energy Technology List (ETL) is a government-managed list of energy-efficient plant and machinery. This list can help you identify the most efficiency refrigeration equipment .

CO_2 can be used as a refrigerant gas, referred to as R744. The GWP of CO_2 is negligible when compared with other refrigerants commonly used in refrigeration systems. The use of this refrigerant is now becoming more widespread, particularly for larger systems.

However, there have been developments in the technology and understanding of R744 (CO_2) refrigerant systems. R744 can be considered to be efficient at small, medium and large scale and despite some variability it has been suggested that, due to these systems using less refrigerant compared to other systems, energy savings can be achieved of between 3% and 37% compared to HFC refrigerant systems.

Most CO_2 systems still have a slight price premium on HFC systems, such as R404a for example, and maintenance can be more expensive due to the higher pressures involved, but this can be offset by the higher efficiency of CO_2 systems.

[3] https://www.gov.uk/government/collections/eu-f-gas-regulation-guidance-for-users-producers-and-trader
[4] http://www.legislation.gov.uk/uksi/2018/98/made
[5] https://www.gov.uk/guidance/bans-on-f-gas-in-new-equipment

Your next steps

There are many easy low and no-cost options to help save money and improve the operation of your refrigeration equipment

Step 1: Evaluate your refrigeration energy usage

Identify areas of high energy consumption within your operations and also consider the refrigerants being used on site and how legislation may impact you.

Step 2: Identify your opportunities

Build the business case for implementing any energy savings opportunities, considering likely payback and other effects including those on staff. A number of opportunities may be achieved at low or no cost.

Step 3: Prioritise your actions

Try and identify measures that will reduce the most significant areas of your refrigeration consumption, first looking for low or no cost opportunities and then scaling up to those that would require more capital input if the likely savings and paybacks are favourable.

Step 4: Implement your action plan

Implement the most material and most applicable projects to your operations that will create the greatest energy savings and be the most cost effective.

Step 5: New refrigeration equipment

When replacing existing refrigeration equipment or adding new systems to your business make sensible and informed choices by selecting the most efficient refrigeration equipment available on the market (using the Energy Technology List - ETL).

Step 6: Refrigerants

Review all refrigerant use across your business and develop a refrigerant management and replacement strategy with your refrigeration equipment contractor.

Go online for more information

The Carbon Trust provides a range of tools, services and information to help you implement energy and carbon saving measures, no matter what your level of experience.

Website – Visit us at www.carbontrust.com for our full range of advice and services.

www.carbontrust.com

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www.carbontrust.com/events

Green Business Directory – A directory to find Carbon Trust accredited suppliers and installers of energy efficiency and renewable energy technology.

www.carbontrust.com/resources/green-business-directory

Our client case studies – Our case studies show that it's often easier and less expensive than you might think to bring about real change.

www.carbontrust.com/our-clients

The Carbon Trust Green Business Fund – is an energy efficiency support service for small and medium-sized companies in England, Wales and Scotland. It provides support through free training workshops, webinars, and online resources.

www.carbontrust.com/greenbusinessfund

The Carbon Trust is an independent company with a mission to accelerate the move to a sustainable, low-carbon economy. The Carbon Trust:

- **advises businesses, governments and the public sector on opportunities in a sustainable, low-carbon world;**
- **measures and certifies the environmental footprint of organisations, products and services;**
- **helps develop and deploy low-carbon technologies and solutions, from energy efficiency to renewable power**

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