Technology information leaflet ECA769

Commercial and retail refrigeration equipment

A guide to equipment eligible for Enhanced Capital Allowances

Contents

Cover image courtesy of Foster Refrigerator.

Introduction

ECAs are a straightforward way for a business to improve its cash flow through accelerated tax relief. The scheme encourages businesses to invest in energy saving plant or machinery specified in the ETL to help reduce carbon emissions, which contribute to climate change.

The Energy Technology List (ETL) is a register of products that may be eligible for 100% tax relief under the Enhanced Capital Allowance (ECA) scheme for energy saving technologies[1]. The Carbon Trust manages the list and promotes the ECA scheme on behalf of government.

This leaflet gives an overview of commercial and retail refrigeration equipment specified on the ETL and aims to help businesses present a sound business case for purchasing energy saving equipment from ETL manufacturers and suppliers.

Background

The ETL comprises two lists: the Energy Technology Criteria List (ETCL) and the Energy Technology Product List (ETPL). The ETCL defines the performance criteria that equipment must meet to qualify for ECA scheme support; whereas the ETPL is a qualified list of products that have been assessed as being compliant with ETCL criteria.

Further information

For further information on refrigeration visit **www.carbontrust.co.uk/refrigeration** or download the Carbon Trust's Refrigeration technology overview (CTV002).

Setting the scene

It is estimated that commercial and retail refrigeration uses 16,000 million kWh of electricity per annum in the UK. This results in a cost of £1.3 billion and seven million tonnes of CO_2 ($MtCO_2$) emissions[1].

The proportion of electricity used by commercial and retail refrigeration equipment is significant for most end users. Examples[2] include:

- Around 30% of the electricity consumption of pubs and clubs
- Around 50% of the electricity consumption of supermarkets
- Around 70% of the electricity consumption of smaller shops
- Around 90% of the electricity consumption of cold store operators.

There is often a large variation in the energy consumption of refrigeration equipment. For many of the ECA categories, the most energy efficient products listed use half as much electricity as the least efficient, unlisted products.

Did you know?

Energy efficient systems are often more reliable. For example, all retail display cabinets and commercial service cabinets listed on the ETL meet retail temperature requirements and, if used correctly, will keep food at the optimum temperature. In addition, efficient systems tend to not work as hard, and therefore break down less frequently.

[1] 'UK emissions of PFCs, HFCs and SF6', Enviros, 1999.

[2] Based on author knowledge.

Benefits of purchasing ETL-listed products

Commercial and retail refrigeration equipment products listed on the ETL are energy efficient, particularly when compared to older versions of the same technology. An average site[3] can potentially achieve significant energy savings on refrigeration electricity use through the purchase of ETL-listed commercial and retail refrigeration equipment, when compared to non-listed equipment.

The cost savings that can be achieved vary with the type of product. Some listed products are components, such as night blinds, whereas others are complete systems, such as cellar cooling equipment. In the case of components, savings of up to 20% can be made when using ETL-listed products. For whole systems, it is possible to achieve savings of up to 50%.[4]

When replacing equipment, businesses are often tempted to opt for that with the lowest capital cost, however, such immediate cost savings can prove to be a false economy. Considering the life cycle cost before investing in equipment can help reduce costs and improve cash flow in the longer term.

The ECA scheme provides businesses with 100% first year tax relief on their qualifying capital expenditure. This means that businesses can write off the whole cost of the equipment against taxable profits in the year of purchase. This can provide a cash flow boost and an incentive to invest in energy saving equipment, which could carry a price premium when compared to less efficient alternatives.

Using this leaflet you can calculate the benefits of investing in ECA-qualifying energy saving equipment over non qualifying equipment. The calculation includes the benefits of accelerated tax relief, reduced running costs, increased efficiency, lower energy bills and reduced Climate Change Levy payments (if applicable), which in turn helps reduce payback periods.

Important

Businesses purchasing equipment must check the ETPL at the time of purchase in order to verify that the named product they intend to purchase is designated as energy saving equipment. Commercial and retail refrigeration equipment that meets the ETL eligibility criteria but is not listed on the Energy Technology Product List (ETPL) at the time of purchase is not eligible for an ECA.

Commercial and retail refrigeration equipment eligible under the ECA scheme

Cellar cooling systems

Cellar cooling systems maintain an indoor (cellar) environment at 10-12°C – a condition suitable for the storage of chilled beverages. They are used in public houses, restaurants and hotels, and can be packaged, split or remote. The equipment listed on the ETL has a capacity between 2kW and 12kW, and therefore encompasses most cellar applications.

There are three types of cellar cooling system. Split systems with the evaporator in the cellar and the condensing unit external (usually outside) are the most common type. The second type are packaged systems, where all the components are in one unit that is fitted through the wall. Remote systems are the least common type and comprise an evaporator in the cellar connected to an external compressor unit (often located in a plant room), with the heat rejected via a remote condenser outside.

Condensing unit in which the compressor and condenser are located, mounted outside the cellar

Image courtesy of Hubbard Products Ltd

Evaporator and expansion device located inside the cellar

Image courtesy of Hubbard Products Ltd

[3] An average site would possess a range of equipment, particularly including remote equipment, which is usually bespoke, with components bought separately and installed and commissioned on site.

[4] ECA-listed product information.

Using the baseline scenario below, the potential financial (£), energy (kWh) and carbon savings (tonnes CO_2) have been calculated for the installation of an ETL-listed split-type cellar cooling system.

Baseline scenario:

- Installation of a 6kW ETL-listed cellar cooling system in place of a non-listed system of the same size
- Electricity price of 7.9p/kWh.

For the installation of an ETL-listed cellar cooling system the potential annual savings are calculated as:

- £501
- 6,346kWh
- 2.7 tonnes CO_2.

Commercial service cabinets

Commercial service cabinets are appliances which have one or two solid doors and are used for the storage of food and beverages in commercial kitchens. They hold chilled food at between -1°C and +5°C and frozen food at between -18°C and -15°C.

Commerical service cabinets are integral systems. The evaporator is either inside the cabinet, or immediately above it so that the cooled air flows directly into the cabinet. The evaporator is coupled to the condensing unit which is usually located at the top of the cabinet. Cabinets with single and double doors, larder-type and under counter models for the storage of chilled and frozen food are listed on the ETL.

Courtesy of Foster Refrigerator.

Using the baseline scenario below, the potential financial (£), energy (kWh) and carbon savings (tonnes CO_2) have been calculated for the installation of an ETL-listed commercial service cabinet.

Baseline scenario:

- Installation of an ETL-listed single door cabinet for chilled food in place of a non-ETL-listed equivalent
- Electricity price of 7.9p/kWh.

For the installation of an ETL-listed commercial service cabinet the potential annual savings are calculated as:

- £70
- 880kWh
- 0.37 tonnes CO_2.

Refrigerated display cabinets

Refrigerated display cabinets exhibit food and beverages to best effect for retail purposes. The cabinet incorporates one or more evaporator/expansion device combinations which are either supplied by liquid refrigerant from an integral condensing unit, or from a remote system.

All the common types of cabinet are listed on the ETL, including multi decks, chest freezers, upright freezers with glass doors and serve-over cabinets. They cover a wide range of storage temperatures from frozen food at -18°C, to chilled food at +5°C and at +10°C.

Multi deck display case connected to a remote system

Using the baseline scenario below, the potential financial (£), energy (kWh) and carbon savings (tonnes CO_2) have been calculated for the installation of an ETL-listed refrigerated display cabinet.

Baseline scenario:

- Installation of an ETL-listed 2.5m open-fronted chilled food cabinet in place of a non-listed product of the same size
- Electricity price 7.9p/kWh.

By installing an ETL-listed refrigerated display cabinet the potential annual savings are calculated as:

- £159
- 2,044kWh
- 0.88 tonnes CO_2.

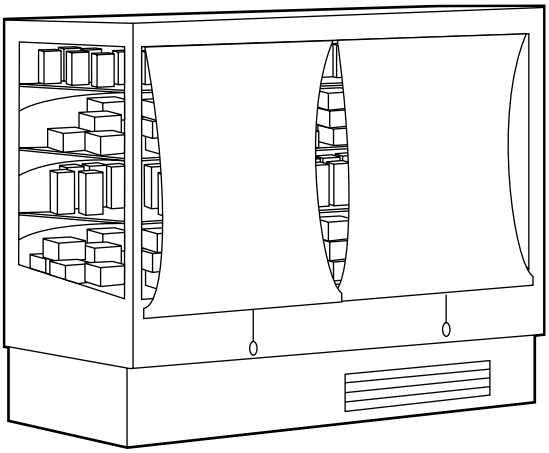
Curtains, blinds, sliding doors and covers for refrigerated display cases

Many refrigerated display cases are open-fronted, which significantly increases the heat load on the refrigeration system. There are various components available that can be added to reduce the heat load. These include:

- Strip curtains – overlapping, transparent plastic strips that fit permanently to the open front of display cases.
- Sliding doors – transparent doors that fit permanently to the open front of display cases.
- Covers (bubble lids) – rigid plastic covers that fit permanently to the top of open freezers.
- Night blinds – roller-type blinds fitted to the front of open cabinets which are closed when the store is not trading.

The use of curtains, sliding doors and covers reduces the heat load on the system at all times, while the use of night blinds reduces the heat load out of trading hours. In all cases the variation in product temperature will be less when such items are fitted. To be effective in reducing the heat load, and therefore improving energy efficiency, they should be fitted correctly.

Refrigerated unit with night blinds



Using the baseline scenario below, the potential financial (£), energy (kWh) and carbon savings (tonnes CO_2) have been calculated for the installation of ETL-listed night blinds.

Baseline scenario:

- Installation of ETL-listed night blinds fitted to a 2.5m open-fronted multi-deck system storing chilled products in a typical independent store.
- The daily energy use of the system before night blind installation is 35.3kWh.
- Store assumed to be open for 12 hours per day.
- Night blinds used when the store is not trading.
- Electricity price is 7.9p/kWh.

For the installation of ETL-listed night blinds, the potential annual savings are calculated as:

- £407
- 5,154kWh
- 2.22 tonnes CO_2.

Refrigeration compressors

The compressor in a refrigeration system compresses the refrigerant gas from the low pressure of the evaporator to a higher pressure so it can condense in the condenser, thus rejecting heat to ambient air or water. It is the major energy user in a refrigeration system.

The most common compression methods are included on the ETL:

- Reciprocating – where pistons in bores compress the refrigerant gas.
- Rotary scroll – where an orbiting scroll moves against a fixed scroll, thus continually compressing the gas.
- Screw – where one or two screws mesh together to continually compress the gas.

The compressor and motors are housed either in a hermetic enclosure which is welded tight, or in a semi hermetic enclosure which has gasketed removable cylinder heads, base plates and end covers.

The efficiency of the different types of compressor vary. One that is most efficient on a frozen food system may not be the most efficient for chilled food. The actual energy consumption of a compressor will vary from that shown because the compressor will be operating at different conditions. To get the best efficiency it must be matched appropriately with the evaporator and condenser, and must be correctly controlled.

Using the baseline scenario below, the potential financial (£), energy (kWh) and carbon savings (tonnes CO_2) have been calculated for the installation of ETL-listed refrigeration compressor.

Baseline scenario:

- Installation of an ETL-listed compressor with the highest available coefficient of performance[5] (COP) to meet a load of 12kW in a commercial refrigeration system.
- Electricity price is 7.9p/kWh.

By installing an ETL-listed compressor, the potential annual savings are calculated as:

- £556
- 7,047kWh
- 3.03 tonnes CO_2.

Evaporative condensers

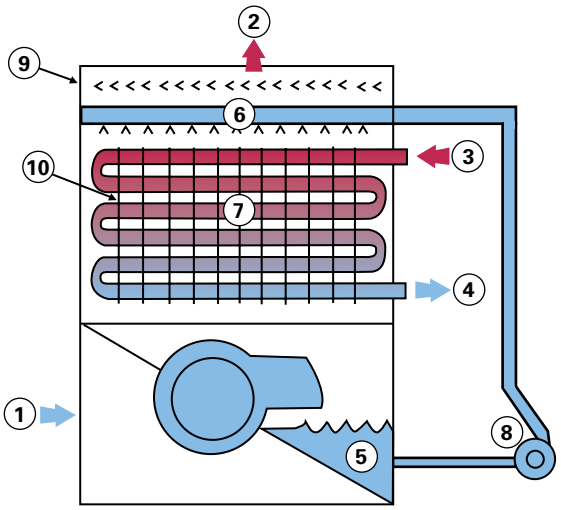
Condensers are used in a refrigeration system to liquify the refrigerant gas discharged by the compressor. Most condensers used are air-cooled – i.e. ambient air is used to remove the heat from the condensing refrigerant. In an evaporative condenser, the gas to be condensed flows through a coil which is continually wetted on the outside by recirculated water. 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.

An evaporative condenser has two advantages over an air-cooled type:

- The evaporation of water is more effective at removing heat than dry air.
- The heat is rejected against the wet bulb ambient temperature rather than the dry bulb. The wet bulb temperature is up to 8°C lower than the dry bulb in hot weather.

Evaporative condensers must be kept clean and the fans and water pumps must be operational to ensure optimum performance. In addition, the water must be treated to prevent legionella formation.

Diagram showing typical evaporative condenser operation



1. Air in
2. Air out
3. Vapour in
4. Liquid out
5. Cold water basin
6. Water distribution system
7. Coil
8. Spray water pump
9. Eliminators
10. Optional extended surface.

[5] The coefficient of performance (COP) is the ratio of the cooling capacity of the compressor (in kW) to its power input (in kW).

Using the baseline scenario below, the potential financial (£), energy (kWh) and carbon savings (tonnes CO_2) have been calculated for the installation of an ETL-listed evaporative condenser.

Baseline scenario:

- Installation of an evaporative condenser in place of an air-cooled condenser on a system with 500kW heat rejection.
- The minimum condensing temperature in both systems is 20°C.
- Fan and pump power are assumed to be the same for both condenser types.
- The cost of water treatment for the evaporative condenser is not included.
- Electricity price is 7.9p/kWh.

By installing an ETL-listed evaporative condenser, the potential annual savings are calculated as:

- £6,467
- 81,866kWh
- 35.2 tonnes CO_2.

Refrigeration system controls

Refrigeration system controllers vary enormously in function and complexity. The simplest control is a thermostat that just controls the temperature of the cooled space. More complex systems, such as those with multiple compressors, require more sophisticated control. When used in the right way, these controls can significantly reduce the amount of energy a refrigeration system uses.

The ETL currently includes system manager controls (with optimisation and energy log) and anti-condensation heater controls. System manager controls are computer-based systems that integrate and monitor the other control devices in the system to optimise performance and monitor energy consumption. For example, some controls monitor ambient temperature and/or load to determine optimum condensing and/or evaporating pressure.

Anti-condensation heater controls save energy by ensuring anti-condensation (trim) heaters are only used when necessary. Tests have shown that these can reduce the energy consumption of the heaters by:

- 6% for grocery store display cases
- 14% for a reach-in freezer
- 20% for a reach-in chill cabinet[6].

Using the baseline scenario below, the potential financial (£), energy (kWh) and carbon savings (tonnes CO_2) have been calculated for the installation of refrigeration system controls.

Baseline scenario:

- Installation of system manager controls with suction optimisation at a supermarket running 25 cabinets and three cold rooms.
- Electricity price is 7.9p/kWh.

For the installation of system manager controls, the potential annual savings are calculated as:

- £3,250
- 4,1133kWh
- 17.7 tonnes CO_2.

[6] Energy Savings Potential for Commercial Refrigeration Equipment Final Report Prepared by Arthur D. Little, Inc. 1996. http://www.aps.com/main/services/business/WaysToSave/BusWaysToSave_59.html

Calculating the payback of your investment

Based on the operating conditions above, indicative savings can be calculated for replacing your existing equipment with either ETL-listed equipment or non-ETL-listed equipment.

The accelerated tax relief and cash flow benefit provided by the ECA, together with the life cycle cost savings from ETL-listed equipment, aid in bridging the price premium and shortening the investment payback period[7].

To calculate the payback period for ETL-listed equipment and non-ETL-listed equipment for comparison you will need:

- The unit price (kWh) of the fuel your business consumes.
- Estimated fuel usage (kWh) for the ETL proposed equipment solution(s), which the manufacturer or supplier should be able to help you with.
- Estimated fuel usage (kWh) for the non-ETL proposed equipment solution(s), which the manufacturer or supplier should be able to help you with.
- Estimated annual maintenance costs incurred by your business for the ETL-listed equipment (your manufacturer or supplier should be able to help you with estimates).
- Estimated annual maintenance costs incurred by your business for the non-ETL-listed equipment (your manufacturer or supplier should be able to help you with estimates).
- The value of the proposed capital expenditure.
- Your business's corporation tax rate.

In addition, the following information is also required:

- A copy of the Carbon Trust fact sheet *Energy and carbon* conversion (CTL004).
- Incorporation of the fact that capital allowance (CA) tax relief for non ETL equipment is 20% (10% if allocated to the 'special rate' pool) and that enhanced capital allowance (ECA) tax relief for ECA equipment is 100%.

Step 1: To prepare your business case for investment you first need to estimate annual energy consumption of the ETL-listed equipment and non-ETL-listed equipment.

Annual energy consumption (kWh/y) = Equipment consumption (kW) x Number of operating hours/year

Additionally, you can calculate the carbon emissions associated with the energy consumption using either the Carbon Trust fact sheet *Energy and carbon conversion* (CTL004) or by using the tool at **www.carbontrust.co.uk/conversionfactors** by simply multiplying the energy consumption by the carbon emission factor for that fuel type.

Carbon emissions = Annual energy consumption (kW) x Emission factor (kg CO_2/kWh)

Step 2: Calculate the annual running cost (ARC) of ETL-listed equipment and non-ETL-listed equipment.

ARC = Annual energy consumption (kW) x Pence/kWh + Annual maintenance cost

Step 1 and 2 can also be done for your existing equipment to calculate an ARC, in order to allow comparisons of the annual saving (step 3) between the existing equipment, the ETL-listed equipment, and the non-ETL-listed equipment.

Step 3: Calculate the annual saving between the ETL-listed annual running costs and non-ETL-listed annual running costs.

Annual saving = ARC of ETL listed equipment - ARC of ETL non-listed equipment

[7] The values used in the examples given are for illustrative purposes only and do not reflect specific case studies. Anyone considering purchasing this type of equipment would be advised to also analyse the benefits that would be available based on their own circumstances. It should also be noted that the use of formally trained heating, ventilation and air conditioning equipment technicians can provide significant energy saving benefits.

Step 4: Calculate the tax allowance for ETL-listed equipment and non-ETL-listed equipment which will be business-specific based on the following:

- The value of your capital expenditure.
- Capital allowance (CA) tax relief for non-ETL equipment is 20%. If allocated to the special rate pool it is reduced to 10%.
- Enhanced capital allowance (ECA) tax relief for ECA equipment is 100%.
- The rate of corporation or income tax for your business.

CA tax allowance = Capital expenditure x 20%* x Rate of corporation tax

ECA tax allowance = Capital expenditure x 100% x Rate of corporation tax

To calculate the available CA tax allowance on capital expenditure beyond Year 1 you need to decrease the capital expenditure by 20% per year (10% if allocated to the special rate pool) on a reducing balance basis. Over the nine years the available CA tax allowance are shown in the table below.

Step 5: Calculate the pay back for ETL-listed equipment and non-ETL-listed equipment.

$$\textbf{Payback period} = \frac{\text{Tax allowance} + \text{Annual saving}}{\text{Capital expenditure}}$$

Table 1 *The cash flow boost to your business of an ECA over a CA for a capital investment of £10,000*

	Year								
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Capital Expenditure (£)	10,000	8,000	6,400	5,120	4,096	3,277	2,621	2,097	1,678
Capital Allowance (CA) @ 20% (£)	2,000	1,600	1,280	1,024	819	655	524	419	336
CA Tax Allowance	560	448	358	287	229	184	147	117	94
Enhanced Capital Allowance @100% (£)	10,000	0	0	0	0	0	0	0	0
ECA Tax Allowance	2,800	0	0	0	0	0	0	0	0

Calculations are based on 28% corporation tax/income tax and a capital allowance rate of 20%.

*Replace with 10% if allocated to the special rate pool.

Go online to get more

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.

Carbon Footprint Calculator – Our online calculator will help you calculate your organisation's carbon emissions.

→ **www.carbontrust.co.uk/carboncalculator**

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Our Customer Centre provides free advice on what your organisation can do to save energy and save money. Our team handles questions ranging from straightforward requests for information, to in-depth technical queries about particular technologies.

* Subject to terms and conditions.

The Carbon Trust was set up by Government in 2001 as an independent company.

Our mission is to accelerate the move to a low carbon economy by working with organisations to reduce carbon emissions and develop commercial low carbon technologies.

We do this through five complementary business areas:

Insights – explains the opportunities surrounding climate change
Solutions – delivers carbon reduction solutions
Innovations – develops low carbon technologies
Enterprises – creates low carbon businesses
Investments – finances clean energy businesses.

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The Carbon Trust is funded by the Department for Environment, Food and Rural Affairs (Defra), the Department for Business, Enterprise and Regulatory Reform, the Scottish Government, the Welsh Assembly Government and Invest Northern Ireland.

The Carbon Trust is a company limited by guarantee and registered in England and Wales under Company number 4190230 with its Registered Office at: 8th Floor, 3 Clement's Inn, London WC2A 2AZ.

Printed on paper containing a minimum of 75% recycled, de-inked post-consumer waste.

Published in the UK: December 2008.

ECA769

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