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# Chilling energy costs

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A guide to implementing tangible energy saving opportunities for independent retailers in Northern Ireland.



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**NIIRTA** 

NORTHERN IRELAND INDEPENDENT RETAIL TRADE ASSOCIATION

NIIRTA, Northern Ireland Independent Retail Trade Association, is the representative body for the independent retail sector in Northern Ireland. With over 1,300 retail members from wholesalers to independent retailers and a wide variety of suppliers within the sector, the collective membership employs more than 30,000 staff and has an annual turnover of over £3 billion.

## The Significance of Refrigeration

Annual refrigeration energy cost to NIIRTA Members **£7.5million**

Average annual refrigeration energy spend per site **£9,750 to £22,500**

The average opportunity to reduce retail display energy **40%**

# 1. Introduction

## Refrigeration costs are higher than you may think

NIIRTA members spend an estimated £15 million per year on energy. This equates to an annual energy spend of £19,500 for a 2,000 ft<sup>2</sup> sales area convenience store, going up to £25,000 or even £45,000 if the store uses more than the average amount of energy, or is open 24 hours a day.

Refrigeration has been identified as the largest energy user in convenience stores. Considering 50-70% of a supermarket's energy costs can be attributed to refrigeration, a conservative estimate indicates that £7.5 million is spent by NIIRTA members on refrigeration. This equates to between £9,750 and £22,500 per year per store.

## Refrigeration Savings

More energy is used for refrigeration at retail outlets than in any other part of the food industry ([CTG024](#)). It is estimated that 30-50% of the energy used in retail display could be saved through energy efficiency improvements\*.

## How to Use this Guide

This guide will allow NIIRTA members to implement efficiency improvements through 41 opportunities classified by scale of implementation from:

- Day to day operations.
- At the Next Engineer Service.
- Part of Refurbishment/Retrofit.
- Full Replacement.

The following four sections list opportunities to reduce energy spend on refrigeration, give an indication of percent energy saved as well as a note on how implementation will take place. In the Next Steps section of this guidance document details on further information are listed as well as what financial support may be available.



\* Swain, M. (2008) Energy use in food refrigeration. Calculations, assumptions and data sources FRPERC JOB NO. 2006013

## 2. Saving energy on a day-to-day basis

Energy savings within day-to-day operations are heavily associated with implementing and maintaining good practice measures within the store. The following opportunities can be undertaken immediately, have no or minimal financial cost yet can provide between 1% and 5% saving (or even higher) in energy consumption.

Opportunity to Save Energy	Action	% Energy Saving	Guideline Saving £
Optimise air flow for refrigeration equipment	Undertake a visual survey of the refrigeration units and components. If refrigeration equipment is unable to operate efficiently it will consume higher than normal quantities of energy. Remove debris where possible; maximize air flow.	5%	490-1,130
Correctly stock display cabinets	Pay attention to the maximum fill lines; blocking air flow can add 3% to a store's refrigeration costs.	3%	290-680
Optimise the use of air curtains	Ensure air curtains are in place and in good working order, i.e. there are no gaps etc.	1%	100-230
Fan controls on large refrigeration units	For large refrigerated units, turn the fans off when the door is open for an extended period.	1%	100-230

Opportunity to Save Energy	Action	% Energy Saving	Guideline Saving £
Correct refrigeration temperatures	Run the unit at the highest possible temperature for the product. <ul style="list-style-type: none"> <li>• Sandwiches 5°C</li> <li>• Produce 8°C</li> <li>• Drinks 10°C</li> </ul>	1-2%	100-450
Operate lighting controls	Switch lights off when not needed.	2%	200-450
Defrost optimisation.	Only defrost units when it is needed by keeping evaporation set points as high as possible.	2% for each °C	200-450 /°C
Correct the use of anti-condensation controls	Anti-condensation spray applied to the freezer doors removes the need for electrical anti-condensation methods.  When using anti-condensation heaters, set controls as low as possible, only heat when needed and at the lowest possible temperature.	2%	200-450

## How to Implement

1. Use the above schedule of opportunities as a weekly checklist.
2. Measure energy meter readings at store opening and closing a day before making changes.
3. Implement changes.
4. Measure energy meter readings at store opening and closing the following day to see the impact of changes.



## 3. Saving energy at the next engineer service

Your service engineer should be visiting site at least twice a year. At the next service, review the day-to-day opportunities as well as the following more technical measures that could be actioned during the service visit. Energy saving opportunities that can be addressed with the help of a qualified engineer at your next scheduled service can lead to savings in the range of 2%-15%.

Opportunity	Action	% Energy Saving	Guideline Saving £
Optimise compressor set points.	<p>A compressor removes heat through the evaporator and is the most energy consuming element within a refrigeration unit.</p> <p>To ensure optimum efficiency, set the compressor to the lowest condensing temperature possible and keep suction pressure only as low as is required.</p>	15%	1,460-3,380
Expansion valve optimisation.	An expansion valve is the component that controls the amount of refrigerant flow into the evaporator thereby controlling the heat expelled at the outlet of the evaporator. Opportunities exist to calibrate Thermal Expansion Valves (TEV) or Electronic Expansion Valves (EEV) for efficiency.	<10%	970-2,250

Opportunity	Action	% Energy Saving	Guideline Saving £
Ensure efficient operation of condensers and evaporators	<p>To optimise the efficiency of a refrigeration unit, all of its elements must be able to function properly. If a condenser, which rejects heat to the atmosphere, is not able to function properly, the compressor will need to compensate at a rate of 2-4% for each 1°C.</p> <p>Undertaking maintenance, cleaning and leak repair is a sure way to minimise the energy spend for refrigeration.</p>	5-7.5%	490-1,690
Optimise evaporator set points	Evaporators are the components which create the cooling effect. Keeping set points as high as possible will ensure the evaporator only defrosts when needed; maintaining the temperature at optimal levels and keeping costs low.	2% /°C	200-450 /°C
Reduce refrigerant leakage	Check for and repair any refrigerant leaks. Most refrigeration systems have some leakage. An annual average leakage rate within the UK is 20% equating to an 11% reduction in efficiency and a direct increase in energy cost. In addition, European law imposes strict requirements to limit refrigerant leaks ( <a href="#">CTG024</a> ).	<11%	1,070-2,480

## How to Implement

1. Observe a practice of taking weekly energy readings from your electricity meter – that way changes can be tracked especially before and after a service.
2. At your next refrigeration service address the following opportunities with your service engineer, most of which should be carried out as a part of your routine service arrangements, although in some cases additional costs may be charged.
3. Monitor the impact using electricity meter readings.

## Example Application

A sample food retail business with a refrigerant leakage rate below industry norm, still found that the leakage had a significant carbon equivalent impact and resulted in decrease equipment efficiency leading to equipment failure. To detect leakages, refrigerant dosing is a recent technology that gives an early indication of a refrigerant leak by adding a 'scented' additive to the current refrigerant charge. With the introduction of a dosing agent, early detection of refrigerant loss could improve the system's overall carbon equivalent impact and could also minimise the potential effect on equipment efficiency.





## 4. Saving energy at retrofitting

Your refrigeration service engineer will be able to support you in providing retrofitting services to your existing refrigeration system either at service or as part of a retrofitting project. Savings can range from a 2% to 30% reduction in energy consumption. Energy saving opportunities accessible with a retrofit/refurbishment project are listed below.

Opportunity	Action	% Energy Saving	Guideline Saving £
Fit night blinds and covers	Where full transparent doors are not possible, install night blinds and covers on refrigeration units for use out-of-hours.	6%	590-1,350
Fit transparent doors on display units	Fit transparent doors on open fronted chilled display cases.	30%	2,930-6,750
Fit thermopane/glass riser	Closing the gap between the air discharge grill and the air return grill reduces the movement of ambient air into the display case thereby lowering the operational load of the unit and saving energy without affecting the trading conditions of the display case. Where no doors are fitted, install low risers on open display cases.	2-4%	200-900

Opportunity	Action	% Energy Saving	Guideline Saving £
Air tightness repairs	Maintain air tightness and thermal integrity by sealing leaks within cold rooms.	<13% of Energy Cost	1,270-2,930
Lighting Overhaul	Replace light fixtures with high efficiency T5 and LED lights. By optimising the location within and around the refrigeration unit, the new light fixtures will not cause an additional load on the refrigeration unit – i.e. reduce the need for additional cooling simply to compensate for the heat from the lamps.	2%	200-450
Electronic Expansion Valves	<p>Expansion valves are the components that control the amount of refrigerant flow into the evaporator, thereby controlling the superheat at the outlet of the evaporator. Electronic Expansion Valves (EEV) have the ability to adjust remotely through a bureau type operation to maximise the performance of the heat exchange of the evaporator.</p> <p>Change of type from TEV (Thermostatic Expansion Valves) to EEV is seen as a minimal capital cost burden for significant performance improvement and in some instances can be cost neutral to capital equipment.</p>	10%	980-2,250
Retrofit DC Fan motors and HE fans	Upgrade/replace current fans and motors with new, high efficiency models.	4%	390-900
Fit compressor control valves or upgrade condensing capacity	Once your contractor has set the compressor condensing temperature at the lowest possible level, further improvements may be made through an upgrade in control valves (such as floating head pressure control, see below) or an improvement in condensing capacity.	1°C overcooling is 3% energy penalty	290-680 /°C
Liquid pressure amplification	If the condensing temperature cannot be reduced for system reasons, liquid pressure amplification can be used to reduce energy consumption by the compressor.	20-30%	1,950-6,750

Opportunity	Action	% Energy Saving	Guideline Saving £
Floating head pressure control	<p>Installing a floating head pressure control on the compressor will allow the condensing temperature to adjust in accordance with the outside temperature, ensuring the compressor is only working as hard as it needs to.</p> <p>Often compressors are programmed to run in summer conditions. Allowing the temperature to float down in cooler weather is a great potential saving in NI.</p>	2-4% of compressor power/°C	200 -900 /°C
Removable condenser screen	If the condenser is likely to accumulate dirt, consider a removable condenser screen which can be hosed down or replaced. A condenser that isn't functioning efficiently will require the compressor to compensate unduly raising energy consumption.	5%	490-1,130
Intelligent defrost controls	Installing intelligent defrost controls will ensure evaporator units are only defrosted as and when needed.	>10%	980-2,250
Trap evaporator drains	Evaporator drains should be trapped to prevent air being drawn in from outside. Heat and insulate evaporator drains in freezer rooms.	2%/°C	200-450 /°C
Pipe Insulation	All refrigerated pipework should be insulated to prevent unwanted heat gain. Ensure insulation is thick enough to prevent condensation forming and if pipework is outside, protect against weather and sunlight.	15%	1,460-3,380

## How to Implement

1. Monitor energy consumption on a weekly basis.
2. Arrange a meeting with a reputable refrigeration contractor and ask them to review the above opportunities and to provide quotations for those opportunities that are relevant to you.
3. Ask the refrigeration contractor to advise on energy savings so that you can understand the financial benefit.
4. Monitor the impact using electricity meter readings.

## 5. Saving energy at full replacement

Improvements in technologies, techniques and a greater importance placed on minimising energy consumption have resulted in lower energy spend with new equipment. Full replacement improvements targeted to maximise energy savings range are as follows.

Opportunity	Action	% Energy Saving	Guideline Saving £
Replace condensing units	Replacing condensing units with central plant.	20%	1,950-4,500
Install heat recovery	Refrigeration systems remove heat from one area and expel it into the atmosphere where it can be recovered and used to heat air or water. Recovered heat is categorised into high-grade and low-grade. High-grade can be used for domestic hot water for washing and cleaning, while low-grade is used for pre-heating boiler feed water, underfloor heating and space heating. The breakdown of recovered heat will depend on the size of refrigeration system within your store.	4%	390-900
Desuperheater	A desuperheater is a heat recovery unit fitted to a refrigeration system able to generate hot water.	Reduce boiler energy consumption by 30%	2,930-6,750
Air lock cold room	Create an air lock cold room with humidification.	30%	2,930-6,750

Opportunity	Action	% Energy Saving	Guideline Saving £
Condenser re-sizing	It is rarely possible to have too much condensing power. If a condenser is unable to function properly the cost is the extra work the compressor will have to undertake to compensate. If your condenser struggles at peak times, consider an additional unit. If you are purchasing new equipment, simply increasing the size of condenser by 30% will provide a 10% saving.	10%	980-2,250
Integrating a sub-cooling section	With the purchase of new refrigeration plant and the larger than normal condenser, integrating a separate sub-cooling section will offer further savings of at least 8%.	8%	780-1,800
Free Cooling	Free cooling makes use of the natural cool temperatures of NI. Investigate the use of free cooling if you use chilled water at 10oC or higher and have a frequent or constant energy requirement year round.	2-4% of compressor power for every 1°C reduction	200-900 /°C

## How to Implement

1. Monitor energy consumption on a weekly basis.
2. Arrange a meeting with a reputable refrigeration contractor and ask them to review the above opportunities and to provide quotations for those opportunities that are relevant to you.
3. Ask the refrigeration contractor to advise on energy savings so that you can understand the financial benefit.
4. Monitor the impact using electricity meter readings.

## 6. Glossary of terms and technical explanations

### Compressor

The most energy consuming element of the refrigeration system; removes heat through the evaporator.

### Condenser

Rejects the displaced heat to the atmosphere. If the condenser isn't working properly, the compressor will have to compensate at a rate of 2-4% for each 1°C.

### Desuperheater

A small heat recovery unit attached to a refrigeration system to generate hot water.

### Electronic Expansion Valve (EEV)

EEVs have the ability to be adjusted remotely through a bureau type operation. Remote application of change has shown significant improvement in operation, reducing the load on the compressor and maximising the efficiency of the heat exchange of the evaporator.



Above: Electronic Expansion Valve (EEV)

### Evaporator

Component that creates the cooling effect through the evaporation of liquid refrigerant at low pressure.



Above: Freezer room with defrosted evaporators and a well insulated drain

### Expansion valve

Component that controls the amount of refrigerant flow into the evaporator thereby controlling the superheating at the outlet of the evaporator.



Above: TEV – Thermostatic Expansion Valve

### Floating head pressure control

Allows for the adjustment of condensing set points in accordance with external temperature. The condensing temperature can be lower in cooler weather; a reduction of between 2-4% of compressor power for every 1°C reduction.

### Full glass doors

The application of doors to open fronted chilled display cases has an immediate benefit on power and subsequent carbon reductions and can be as high as 30% from original base condition.



Above: Full glass doors

### Glass riser on display cabinets

Closing the gap between the air discharge grill and the air return grill reduces the movement of ambient air into the display case thereby lowering the operational load of the unit and saving energy without affecting the trading conditions of the display case.



Above: Glass riser on display cabinets

### LED Light Emitting Diode

An emerging new light source being used as an alternative to halogen, fluorescent and discharge lighting.

### Night blinds

Display case night blinds in operation have significant operational impacts on kWh & carbon reductions when adopted and which can be in excess of 30% of system design.



Above: Night Blinds

### Pipe insulation

All refrigerated pipework should be insulated to prevent unwanted heat gain. Ensure insulation is thick enough to prevent condensation forming and protect against weather and sunlight.



Above: Pipe Insulation

## 7. Next steps

For retailers CT can provide:

- Carbon Trust interest-free Energy Efficiency Loans– unsecured, four-year interest-free loans with, no arrangement fee. You can borrow between £3,000 and £400,000, and the project needs to meet set energy/carbon saving criteria.
- Publications – visit [www.carbontrust.co.uk](http://www.carbontrust.co.uk) for free, downloadable, independent, authoritative advice, how to guides, technical publications and DVDs.

For information on Enhanced Capital Allowances – the first year tax write off for qualifying energy saving equipment – please visit [www.eca.gov.uk](http://www.eca.gov.uk)



CT Publications of particular interest to the retail sectors are:

**[CTL044 – Walk around checklist – retail and distribution](#)**

**[CTL084 – Energy Efficiency in Retailing](#)**

**[CTV001 – Retail sector overview](#)**

**[CTV002 – Refrigeration technology overview](#)**

**[CTG010 – Display lighting – focus on energy](#)**

**[CTS008 – Case study – Henderson Group](#)**





# Go online to get more

The Carbon Trust offers a range of services to help businesses measure, communicate and reduce their carbon emissions. These include:

## ↘ Interest-free energy efficiency loans

Unsecured, interest-free loans with no arrangement fee. These can help provide upfront capital to invest in energy efficient technologies. The payback period will depend on the amount borrowed, and the likely savings from the new technology.

## ↘ Publications

We have many other free downloadable publications, factsheets, case studies, how to guides, technical publications and DVDs to help businesses manage their energy use more effectively.

## ↘ Carbon Trust standard

Focused on reduction, it is awarded to organisations that measure, manage and reduce their carbon footprint. It is managed by the Carbon Trust Standard Company, which was set up by the Carbon Trust in June 2008. Find out more at [www.carbontruststandard.com](http://www.carbontruststandard.com)

## ↘ Carbon reduction label

This is managed by the Carbon Trust Footprinting Company, which was set up by the Carbon Trust in 2007. Any product that has had its carbon footprint calculated and verified by an accredited verifier can have the label on its packaging or marketing material. It shows the total greenhouse gas emissions arising from every stage of the product's life cycle, including production, transportation, preparation, use and disposal. Find out more at [www.carbon-label.com](http://www.carbon-label.com)

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The Carbon Trust is a not-for-profit company with the mission to accelerate the move to a low carbon economy. We provide specialist support to business and the public sector to help cut carbon emissions, save energy and commercialise low carbon technologies. By stimulating low carbon action we contribute to key UK goals of lower carbon emissions, the development of low carbon businesses, increased energy security and associated jobs.

**We help to cut carbon emissions now by:**

- providing specialist advice and finance to help organisations cut carbon
- setting standards for carbon reduction.

**We reduce potential future carbon emissions by:**

- opening markets for low carbon technologies
- leading industry collaborations to commercialise technologies
- investing in early-stage low carbon companies.

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