Save Energy, Cut Costs

Energy Efficient Warehouse Operation

Supported by the

CARBON TRUST

Foreword by the CEO of UKWA (Roger Williams)

I am delighted to write the Foreword to this publication. It represents the joint output of a collaborative project between UKWA and the Carbon Trust, and I believe it will become an essential tool for warehouse operators in achieving the shared aim of reducing carbon emissions in our workplace. The arguments for proactive measures to be taken to address the issue of carbon emissions in the workplace are growing. I believe also there is a growing understanding within the industry that investing in energy saving measures makes sound business sense.

This guide has been compiled by UKWA members, for all warehouse operators. Its case studies describe real scenarios involving UKWA members, and provide persuasive reasons why all warehouse operators – regardless of the size or age of their buildings, should engage in the challenge of saving energy and reducing carbon emissions.

I am indebted to the Carbon Trust for their strong, helpful and professional role in producing the guide, and I commend to you the range of supportive measures they have to offer our sector. I am also grateful for the professional input of UKWA's Environment adviser – Keith Wyatt, whose practical expertise has ensured the guide is 'user friendly'.

Roger Williams
CEO, UKWA
July 2010

Excellent opportunities to save energy and cut costs

The UK warehousing sector could cut energy costs by over £200million each year by adopting a range of cost effective energy efficiency measures. These are the findings of investigations carried out in UK warehouses by the UKWA and the Carbon Trust. A programme of site specific energy audits have confirmed that quick returns on no and low cost actions can often provide cost savings of up to 20% with further savings of up to 50% per year achievable through cost effective measures, delivering paybacks within three years, for example;

- A 200,000ft^2 ambient warehouse identified £25,000 of savings with a payback on investment of 3 years.
- A 10,000ft^2 ambient warehouse identified savings of almost £9,000 (37%) with a payback of 2.4 years

With the UK committed to moving towards a lower carbon future, now is an excellent time to take these opportunities to save energy, cut costs and reduce carbon emissions. Businesses which do not will face the ongoing cost of energy waste, which may well be compounded by legislation driven costs and fluctuating energy prices. On top of this they will continue to incur the ongoing costs of additional maintenance, often an issue with older, less efficient equipment. They will also run the risk of reduced competitiveness in the eyes of clients.

Meeting the future challenge

The UK is on the path to a low carbon economy and it has made firm commitments to achieve reductions of 80% by 2050 and 34% by 2020. Changes in legislation will affect the warehouse sector, which is responsible for 3% of total UK emissions. Emerging regulations will include the requirement from 2019 that all new buildings must be zero carbon. Further legislation such as the CRC Energy Efficiency Scheme will require many organisations to trade carbon and appear in a published league table with their peers. Additionally, increasing numbers of clients are requiring their suppliers to demonstrate improvements in their green credentials in order to meet their own environmental targets. To meet this challenge the warehouse sector will need to adopt new approaches to managing and reducing carbon emissions from their buildings.

This guide

This guide has been developed by the UKWA and the Carbon Trust to help businesses in the Warehouse Sector reduce costs, carbon dioxide emissions and their energy consumption. It aims to help owners and managers of warehouses to implement energy reduction opportunities now to save money, benefit from a 'greener' reputation and be best placed to meet future legislation.

The content of this guide is based upon a series of site surveys and workshops, representing a range of warehouse types from across the UK Warehousing Sector and identifies opportunities that are replicable across the sector. It provides a summary for key decision makers of the benefits and drivers for developing an energy management plan. It also brings together key information for those charged with delivering energy efficiency at a site level including useful guidance, tools and templates. This will enable organisations to identify prioritised opportunities, develop a business case and implement an energy reduction programme.

Further help from the Carbon Trust

The UKWA and the Carbon Trust recommends that all organisations within the warehousing sector adopt the approaches detailed in this guide in order to realise the benefits offered by good practice in energy management. The Carbon Trust offers a range of support including site audits, guidance documents and interest free loans to support investment in energy efficiency opportunities, more details are provided in this guide.

Save Energy, Cut Costs

Most businesses could use less energy, cut carbon and help the UK to achieve its CO_2 reduction targets (80% reduction in CO_2 by 2050, 34% reduction by 2020) and in the warehouse sector it has been found that there are good opportunities to cut energy costs and improve environmental performance.

Across the UK carbon cuts must be made, this is not just in areas such a power generation or transport (although these are important areas) but in every other area of the UK operation. Carbon emissions from the UK non domestic building sector accounts for 18% the UK total emissions with the warehouse sector responsible for approximately 10.2 Million tCO_2 or 3% of the total UK CO_2 emissions. Research shows that the sector could potentially achieve a 16% reduction in emissions mostly from lighting and heating.

A programme of site energy surveys commissioned by the UKWA and the Carbon Trust throughout the UK have confirmed that quick returns on no and low cost actions can often provide cost savings of 10% to 20% with a further 10% to 55% per year saving achievable with simple payback periods ranging from one to six years. This could represent an annual saving to the sector in excess of £200 million per year compared with Business as Usual i.e. if the sector does not follow the recommendations put forward in this guide.

Legislation is changing in the UK and this change is likely to result in Carbon is becoming a 'new currency' within a new 'Carbon Economy'. This new economy will make all organisations aware of their 'carbon footprints' to and gain a better understanding of where their emissions come from and how they can reduce them. For all organisation reduced carbon emissions will result in reduced energy costs and increased competition.

In addition to the direct bottom line benefit of energy efficiency, it is clear that customer expectations are increasing in terms of the value that they place upon the environmental performance of their suppliers. An energy saving programme provides an opportunity to support customer requirements and improve their reputation and competitiveness. On a practical level they can also provide further gains associated with, for example, reduced maintenance costs and extended equipment life.

Emerging legislation will have an impact upon many organisations and will increasingly require new approaches to the management and reduction of energy and carbon reductions. These include

- Carbon Reduction Commitment Energy Efficiency Scheme (CRC). A penalty/incentive scheme that puts organisations into a league table according to their energy efficiency and in addition introduces mandatory carbon trading. It applies to businesses that spend over £500K per year on their electricity consumption.
- Tighter Building regulations in 2010 will affect new and refurbishment building projects demanding improved energy efficiency.
- Building regulations from 2019 require all new buildings to be carbon neutral.
- A range of European and UK targets to reduce emissions have been declared including The European Union's 20-20-20 and The Climate Change Acts (2008) which commits the UK to a reduction of 34% of UK CO_2 emission by 2020 and a reduction of 80% by 2050.

The UKWA working in partnership with the Carbon Trust commissioned 12 energy audits of their member sites across the UK. These sites represents a typical cross section of the organisation's membership and the recommendations that came from the reports represent typical opportunities available to all in the warehousing sector.

Case Study One

Large (210,000ft²) clothing warehouse comprising of three stories of mezzanine racking. Erected in 2002 of brick and block construction with steel roof. Operating times of 12 hours per day, five days per week.

Energy saving opportunities identified include lighting controls, lighting replacement and a reduction in lighting levels. These opportunities represent a £25,000 saving with a payback period of 3 years. This provided an addition benefit of reduced maintenance through increase lamp life.

Case Study Two

Ambient warehouse (10,000ft²) approx 60 years old with asbestos roof that has recently been over-clad with steel. Operating times of 11 hours per day Monday to Friday and 5 hours per Saturday. 7 opportunities identified, which will provide cost savings of 37% or £8,900 with a payback period of 2.4 years.

One specific identified opportunity was to upgrade existing lighting in one of the six warehouse chambers to modern fitting using daylight and PIR controls. This opportunity represents a £2,000 per year saving at a cost of £4,000 on a simple payback period of 2 years. This opportunity would be replicable across the site being paid for by the previous chambers savings.

Case Study Three

A number of brick and block constructed buildings with steel roof providing ambient storage (250,000ft²). The buildings age ranges from 10 years to 70 years old. Operating 24 hours a day, 7 days a week.

10 different energy saving opportunities identified which could save 51% of the sites energy consumption or £39,000 with a 1 years payback period. Specific opportunities include lighting controls, lighting replacement and a reduction in lighting levels, these specific opportunities represent a £25,000 saving with a payback period of 3 years. These lighting opportunities would provide the site with an addition benefit of reduced maintenance due to the recommended solutions increased lamp life.

Barriers and solutions for warehouses

The site investigations identified excellent opportunities which could be replicable in other organisations, these include;

- Actively manage energy on-site
- Replacing old, inefficient light fittings
- Install better lighting controls
- Improve space heating equipment and control
- Control small power loads

However, the site investigation also identified barriers to implementation of these opportunities; these are outlined below along with suggested solutions to overcoming these barriers.

1. Lack of senior commitment

A lack of clear senior commitment in order to drive forward the energy reduction programme and achieve staff engagement across the organisation.

Solution – Senior directors need to clearly declare a commitment to staff and communicate aims, objectives and responsibilities for the programme, along with an ongoing plan for review.

2. No defined responsibility for energy use

A lack of defined responsibility for energy use and delivery of a reduction programme within your organisation can be a significant barrier to implementation and performance monitoring.

Solution – Appoint a member of staff with responsibility for energy use. This person needs to have sufficient time and influence within the organisation in order to be able to implement plans. Individuals also need to be given ownership of specific measures to help make it happen.

3. A lack of technical knowledge

Many organisations do not have the resources to investigate the energy efficient options and technologies available. This can represent a barrier to action, due to fear of the unknown and can result in people choosing what they know, a like for like view of replacement and procurement. This does not tend to lead to the adoption of new more efficient technologies.

Solution – This guide provides advice and the Carbon Trust offer further help on the correct choice of new technologies. This report has been produced by the UKWA and Carbon Trust and provides independent recommendations as to which energy saving technology should be installed and when (information correct as at June 2010).

4. Lack of expertise to develop a business case

In many organisations the skills do not exist to formulate and communicate a robust business case for action to reduce energy use. This can act as a fundamental barrier to action.

Solution – This guide includes technical support on how to put together a business case, in addition the Carbon Trust also offer further support in this area.

5. No coherent approach to investing in energy efficiency

Many organisations do not have a coherent approach to investing in energy efficiency technology e.g. links do not exist between maintenance budgets and improvement budgets. Energy efficiency is not explicitly considered as part of the procurement process.

Solution – Many energy efficiency opportunities are cost effective and can provide good returns on investment. Organisations need to put in place the mechanisms to incorporate energy efficiency into procurement decisions, asset plans and financial appraisals

In addition the Carbon Trust can provide 0% loans to allow organisations purchase energy saving technologies

Carbon Trust Loan Case studies (www.carbontrust.co.uk/loans)

- Maxim Logistics Group Ltd used a 0% business loan to install new energy saving lighting for its main warehouse. The changes have improved working conditions by making the warehouse brighter, while cutting the company's annual energy bill by almost 41%.
- Express Engineering asked the Carbon Trust to carry out an on-site Carbon Survey to identify carbon and energy saving projects. The company then applied for two 0% business loans to fund the installation of a new variable speed compressor, and a monitoring and control system for their heating.
- For optronics maker Davin, the benefits of a Carbon Trust 0% business loan were a real eye-opener: the savings generated by replacing the company's old compressors would recover the purchase price in less than three years.
- A 0% business loan from the Carbon Trust allowed property management company Boon & Sons to turn the lights out without leaving their tenants in the dark – and save up to £3,600 on their annual energy costs
- For Toughglass, manufacturer of toughened safety glass, energy bills at £500,000 a year were the biggest outlay after raw materials and wages. The company used a 0% business loan to purchase variable speed drives - creating instant savings of £45,000, exceeding the monthly loan repayments three times over.

Additional help from the Carbon Trust

Enhanced Capital Allowances (ECAs) enable businesses to buy energy efficient equipment using a 100% rate of tax allowance in the year of purchase.

Businesses can claim this allowance if the equipment is on the Energy Technology List see www.eca.gov.uk

Interest free loans from the Carbon Trust are a cost effective way to replace or upgrade existing equipment.

There are no arrangement fees, applying is straight forward and loans of up to £100,000 can be repaid over 4 years.

Contents

Energy Use in Warehouses

This section outlines how warehousing contributes to the UK's energy and carbon dioxide emissions. It outlines the role of the industry, where energy is used within warehouses and how this energy use translates into carbon dioxide (CO_2) and other greenhouse gases.

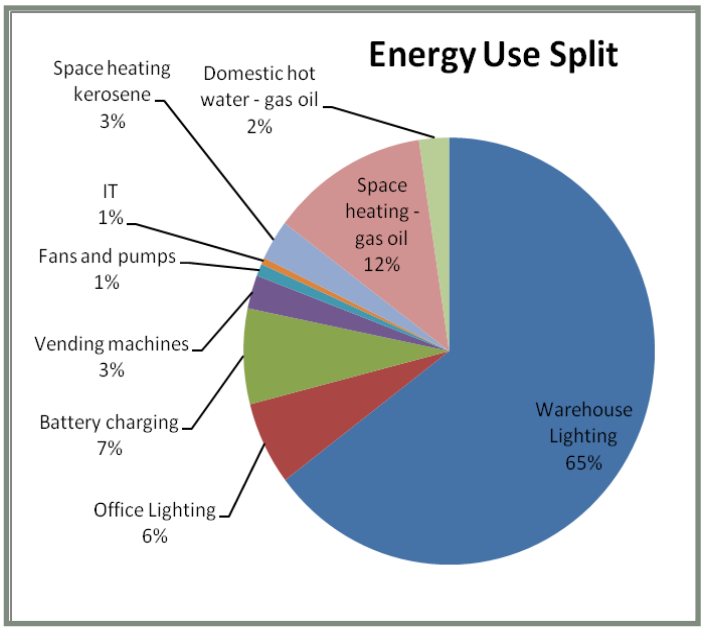
The Role of the Warehouse Industry

The UK consumed 224 million tonnes of oil equivalent of primary energy in 2008. This energy consumption contributes to the total release of 628.3 million tonnes of carbon dioxide equivalent ($MtCO2_e$). The Government has a legal requirement to reduce these total emissions by 34% by 2020 and 80% by 2050 (from a 1990 baseline).

The warehouse sector emits approximately 10.2 Million tCO_2 or 3% of the total UK CO_2 emissions. Research shows that the sector could potentially achieve a 16% reduction in emissions mostly from lighting and heating.

Energy Use in a Warehouse

The following chart gives an overview of where energy is consumed in a warehouse. This example is taken from an average sized (approximately 15,000m^2), ambient (i.e. no heating and no chillers) warehouse incorporating a built in office. The energy consumption is represented as a percentage of the total site energy consumption (electricity, gas and other fuels) and will vary from site to site.



The Energy Use Split Chart below shows that the largest energy consumption area from a "typical" UKWA site is the **warehouse lighting** which suggests that this should be a priority area for energy management.

Energy Use and Carbon Dioxide Emissions

Using energy, whether it is electrical energy or fossil fuels like gas, oil or coal, results in the release of carbon dioxide (CO_2) emissions into the atmosphere. In addition to these CO_2 emissions a warehouse may also contribute to climate change and global warming by the release of indirect greenhouse emissions from waste, staff transportation and the use of refrigerants.

Greenhouse Gases

There are six main greenhouse gases regulated by the international agreement the Kyoto Protocol, these are;

- carbon dioxide (CO_2),
- methane (CH_4),
- nitrous oxide (N_2O),
- hydrofluorocarbons (HFCs),
- perfluorocarbons (PFCs)
- sulphur hexafluoride (SF_6)

For more information on greenhouse gases and carbon dioxide see the glossary.

A carbon footprint is an inventory of all of the emission sources from an organisation, product, process or person. It enables measurement, monitoring and reduction. The carbon footprint of a warehouse should include the following emissions source

- Transportation
- Buildings
- Refrigeration

About this guide

To help UK warehouses move towards a low energy future the UK Warehouse Association has partnered with the Carbon Trust to produce this guidance and to offer further support and help.

The UKWA Save Energy, Cut Costs guide explains how to identify opportunities to save energy and costs in warehouses by providing you with information regarding what you should be asking your organisation to do.

It details the measures which can deliver easy wins with little or no cost, as well as the opportunities which might require investment and how to access government support and interest free loans to help with the business case.

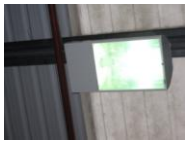
The guide is designed to help those on site to understand the opportunities and the practical steps needed to take them. The information contained in the guide has been gathered during a programme of site surveys and workshops commissioned by the UK Warehouse Association and supported by the Carbon Trust.

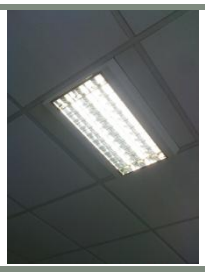
For many businesses a 20% cut in energy costs represents the same bottom line benefit as a 5% increase in sales

Energy Consumption Comparison Table

The Energy Comparison table below offers reference examples of the relative cost, CO_2 and energy consumption of different types of equipment found at UK Warehousing Association members sites. It is presented to provide site energy managers with an illustration of what typical equipment may cost to run each year to help highlight areas to prioritise.

* NOTE: Energy costs are based on 10hrs per day, 5 days per week.

Lighting equipment		Power per unit (Watts)	Cost per Year (£)*	tCO_2/ year
SONs		250	£71	0.43
Metal Halide		400	£112	0.68
T12 – Fluorescent (warehouse)		100	£33	0.20
T8 – Fluorescent (warehouse)		70	£18	0.11
T5 – Fluorescent (warehouse)		54 per lamp (typical luminaires contain 4 or 6 lamps)	£13	0.08
T8 –Fluorescent (office)		18 per lamp (typically 4 lamps per luminaire)	£5	0.03

T5 –Fluorescent (office)		14 per lamp (typically 3 lamps per luminaire)	£3	0.02

Equipment		**Power / consumption**	**Cost per Year (£)***	**tCO_2/ year**
Electric Vehicles – battery charge		4,339 kWh charged daily	£4,336	2.4
Vending Machines		810W	£96	0.6
P.C.		50W per PC 30W per LCD screen 70W per CRT screen	£13 for PC and LCD Screen £20 for PC and CRT screen	0.08 0.12

Energy waste

The term “Energy Waste” describes energy that is used unnecessarily, by understanding the causes of energy waste costs and CO_2 emissions can be reduced.

How energy waste occurs

Energy waste occurs when three simple factors are not properly and regularly considered. Tackling energy waste requires us to consider:

- Efficient Operation
- Inefficient Equipment
- Building Energy Efficiency

Energy waste is a simple concept, with a pragmatic and questioning approach savings can be realised.

Efficient Operation

Is equipment in operation longer than required?

All equipment including lights, computers, heaters and catering equipment should only be switched on when needed. If equipment is left switched on when it is not in use then it is wasting energy.

Are controls set correctly?

Timers and thermostats should be set to switch equipment on when it is not needed. Examples of this include heating left on after an area is closed or when thermostats are set to the wrong level.

Is the equipment still required?

Often warehouses equipment is installed when built to satisfy the highest potential demand i.e. hot water tanks for domestic hot water supply. However, if the actual occupation profile differs from that designed, or if the warehouse use changes over time, this can result in energy wastage as equipment is switched on but is not required.

Energy Efficiency of the Equipment

Is equipment or plant rated as energy efficient?

Generally with each new model comes an improvement in energy efficiency. Energy efficiency should be considered when the site purchases any new equipment. Often the savings made by replacing older, but still working, equipment with newer models will pay for the purchase and installation costs. This can be especially relevant if tax incentives or Carbon Trust interest free loans are used.

Is equipment maintained to ensure energy efficiency?

All site equipment will eventually require repairing or replacement. In some cases when equipment becomes dirty, damaged or develops a fault it can result in energy waste. For example a dripping hot tap, a broken window or a faulty thermostat or switch.

Building Energy Efficiency

Is heated or cooled air lost from the building?

Heated or cooled air can be lost from un-insulated building or though gaps in the building fabric. Leaving these issues unattended results in excess treated air to be lost unnecessarily and so wastes energy.

Does the building allow natural light to be used?

Warehouses should use daylight where possible to reduce the amount of electrical energy required. Covering over roof lights or blocking windows with stored goods increases the demand for electrical light.

NOTE: Lighting should be installed so that it can be controlled for specific areas or zones and not just the whole warehouse.

Key Cost Reduction Opportunities

Below is a summary table outlining the key no and low capital cost actions to reduce energy consumption and carbon dioxide emissions on site. These opportunities were observed during a series of energy audits of UKWA members sites.

* NOTE: Energy savings base consumption are based on 10hrs per day, 5 days per week.

Key Carbon Reduction Actions	Typical Savings – all based on 10 fittings except where stated		
	£	CO_2 Tonnes	Based upon
Turn lights off in warehouse when an area is unoccupied	£700	4.26	50% reduction in lighting
Turn lights off in warehouse when daylight is sufficient	£300	4.92	18% reduction in lighting
Replace 250W & 400W SON or 400W Metal halide lights	£550	3	
Install lighting controls	£70	0.4	T8 having controls added
Clean or replace roof lights	£300	4.92	18% reduction in lighting
Turn off external lights used for loading/ unloading when daylight is sufficient	£420	2.5	50 reduction in lighting over 12 months
Control space heating systems efficiently	10-15% saving	10-15% saving	
Ensure efficient control of air conditioning	£120 based on one unit	0.72	
Ensure hot water supply is sized in relation to site occupancy	10% of site fossil fuel	10% of site fossil fuel	

Turn warehouse lights off when an area is unoccupied

DO YOU HAVE?

- Discrete areas that are lit but not always occupied?
- Zone based switching?

The Opportunity

The site surveys show that a number of warehouses have storage areas that are not used all the time or are lit but not occupied; for example, production areas that end operation at 15:00 but remain lit until the rest of the site shuts down at 20:00.

Overflow bays or long term storage are areas that often have switches that would allow for lighting to be turned off, but this behaviour rarely occurred because switches are badly labelled and the current culture is for unnecessary lighting to remain on.

The Energy Costs

Ten 250W Son Lamps operating 10 hours a day, five days a weeks will cost £700 in electricity each year, turning these off costs nothing.

Making it Happen

- Undertake a lighting survey to assess which lights are controlled by which switches
- Label the switches so that people know which switch controls which lighting
- Advise shift supervisor and/or team members that they need to turn these lights off when the area is unoccupied

Good Practice

If areas are unoccupied then all opportunities should be taken to switch off as many lights as possible.

Whenever possible warehouse lighting should be switched off at the end of a shift.

Whenever possible lighting should remain switched off during site downtimes and until new shifts commence.

NOTE: It is possible to observe warehouse lighting switch off times by reviewing a sites half hourly electricity consumption – this data is available from your electricity supply company.

Barriers

SON & Metal Halide have long restrike times which can limit the scope for switching off lamps for short periods.

Lighting being switched off when the area is still occupied

Lack of interest in changing current behaviour

Lack of knowledge about what can and cannot be turned off

Lack of understanding about the cost implications of not turning lighting off

Turn lights off in warehouse with natural lighting

DO YOU HAVE?

- Areas with roof windows that are artificially lit during daytime operation?
- Zone based switching?

The Opportunity

The site surveys show that a number of warehouses have storage areas that are naturally lit either via their roof lights or wall windows but still have their artificial lighting operational.

These areas often had switches that would allow them to be turned off but rarely are because they are badly labelled or that nobody within the organisation would take the responsibility to turn them off.

The Energy Costs

Ten 400W Metal Halide Lamps operating 10 hours a day, five days a weeks will cost £1,120 in electricity each year. If these were manually turned off when natural daylight was sufficient this could be reduced to around £800 per year at no cost.

Making it Happen

- Undertake an internal lighting survey assessing which lights are controlled by which switches.
- Label the switches so that people know what controls what.
- Advise the shift supervisor that they need to turn these lights off when the area is sufficiently naturally lit.
- Purchase a lux meter so that staff members can recognised what is the minimum level of lighting that is required.

Good Practice

Lights should be switched off when daylight is sufficient.

Shift managers should be aware of the natural light available and understand which switches operate lighting.

Consider purchasing a light (lux) meter to check H&S lighting levels are being met.

Good practice states that lighting levels should be:

- Loading bays 150 lux
- Racking areas 150 lux
- Packing and dispatch 300 lux (see GPG 319)

NOTE: If lighting uses automatic light sensitive controls then check to ensure that these are calibrated correctly and that lights do not remain switched on when daylight is adequate.

Barriers

SON & Metal Halide have long restrike times which can limit the scope for switching off lamps for short periods.

Fear of not achieving lux levels required to achieve H&S requirements.

Replace 250W & 400W SON or 400W Metal halide lights

DO YOU HAVE?

- Lighting that has not been replaced for 10 years?
- Son or metal halide fittings?
- Discrete areas of warehouse space not permanently occupied?

The Opportunity

The site surveys show that most warehouses are lit by 250W or 400W SON or Metal Halide lighting. The site surveys showed that areas of warehouses are unoccupied for long periods of time and the lights could be turned off.

The long restrike time of these fittings means that people are unwilling to turn lights off because of the length of time it takes them to get back to full light output when turned on.

The fittings should be replaced with high bay, fluorescent T5 luminaires in either 4 or 6 lamp configurations. These will give a better light output, consume less energy and are able to be controlled by automated controls, such as PIR motion detectors or daylight controls, without any restrike concerns.

The Energy Costs

A 400W SON lamp will use 480W once controls losses are taken into consideration.

Ten 400W Son operating 10 hours a day, five days a week will use £1,120 worth of electricity per year whereas ten T5 (quad) high bays will use £550 per year.

If installed with automated controls these T5 consumption costs could reduce further to £330 per year.

Making it Happen

- Assess number of luminaires in the warehouse
- Obtain quotes
- Apply for Carbon Trust 0% loan
- Install suitable controls and luminaires

Good Practice

All lamps should be replaced with an energy efficient lamp, check lamp life, light levels and energy consumption per lamp.

Replace 250W or 400W & 400W Sons with fluorescent T5 high bay luminaires.

Replace incandescent tungsten filament (GLS) lamps with CompaCarbon TrustFluorescent or energy saving halogen lamps.

Replace halogen spot (tungsten halogen dichroic) lamps with lower energy, longer life energy

Barriers

Installation has the potential to be disruptive to operations; however, this is very site specific and would need to be investigated before installation.

Requires management commitment to implement

Install lighting controls

DO YOU HAVE?

- Fluorescent lights in the warehouse?
- Aisle lighting that operate irrespective of the amount of daylight or occupancy?

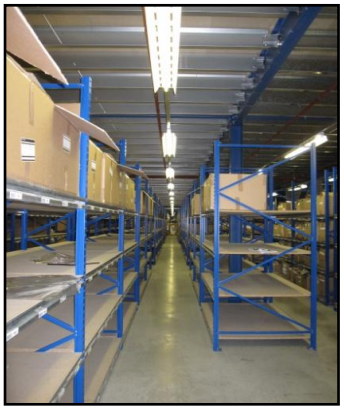
The Opportunity

The site surveys show that a number of warehouses are lit by fluorescent lights that operate irrespective of the areas occupancy or natural lighting levels.

These lights should be zoned and controlled, the best practise way of controlling this type of lighting is via PIR and daylight controls, however, this may not always be appropriate if areas are racked or natural light cannot penetrate. In this situation aisle by aisle light switching may be appropriate which can be manually operated or may be on timers (ensuing sufficient master lights are left to comply with H&S requirements).

The Energy Costs

A typical aisle of ten 70W HF fluorescent luminaires operating 10 hours a day, five days a weeks will cost £180 per aisle per year.



This can be reduced by using appropriate controls to £108 per year, if the original fittings were replaced with T5 fluorescent fittings and automated controls this could be further reduced to £80 per year.

Making it Happen

- Assess number of fluorescents in the warehouse
- Obtain quotes to install controls
- Apply for Carbon Trust 0% loan
- Install suitable controls (replace luminaires if financially viable)

Barriers

In an area that already contains racking controls may be very capital intensive to retrospectively install.

If storage is not permanent, i.e. pallet stacking, there may be a requirement to install many sensors to ensure there are no ‘dead’ areas.

Clean or replace roof lights

Do you have?

- Roof lights which are dirty or damaged?
- Lights which are on irrespective of the amount of daylight?

The Opportunity

The site surveys show that a number of warehouses have roof lights or wall lights that are either dirty or damaged and that warehouses are lit with artificial lights when natural lighting levels are sufficient.

If it is possible to clean the roof lights this should be done on a yearly basis. Lights should be turned off whenever light levels are adequate; day light controls should be installed with all new lighting installations to shut lights off if natural lighting is sufficient.

The Energy Costs

Ten 400W Metal Halide Lamps operating 10 hours a day, five days a weeks will cost £1,120 in electricity each year. If these were automatically turned off when natural daylight was sufficient this could be reduced to around £800 per year.

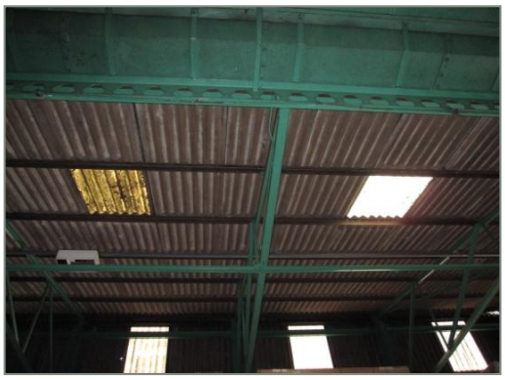
Making it Happen

- Assess number and state of roof lights in the warehouse
- Obtain quotes to clean or replace
- Assess number of luminaires in the warehouse
- Obtain quotes
- Apply for Carbon Trust 0% loan
- Install suitable controls and luminaires

Good Practice

All roof lights should be cleaned on a regular basis to ensure maximum available natural lighting levels are achieved.

When re-roofing or over-roofing care should be taken to fit metric roof panel into imperial frames whilst retaining original roof light spaces and re-glaze with 'self cleaning' materials



Barriers

Ensure cleaning is undertaken by qualified contractors to meet H&S considerations.

Daylight can cause label fade on long term stored products.

Daylight can encourage wildlife into warehouse if doors are left open.

Turn off external lights during daylight

DO YOU HAVE?

- External lighting controlled by time clocks?

The Opportunity

The site surveys show that external lighting controlled by time clocks for site security may sometimes be left switched on during the day. An opportunity exists for energy consumption to be reduced through installing daylight controls to work in conjunction with time clocks to ensure that even if the time clock fall out of sync the daylight controls will shut lights down during the day.

The Energy Costs

Ten 250W Sons luminaire operating 12 hours per 24 hour period, seven days a week will cost £1,180 per fitting per year. With daylight controls to ensure that these fittings are turned off whenever daylight levels allow this can be reduced to £760 per year.

Good Practice

Sites should switch off external lights outside of shift operating hours and when natural light is available.

Automatic lighting controls should be regularly checked to ensure that lighting is switched off during daylight hours.

Making it Happen

- Assess number of lights still operating in the morning as part of simple energy survey.
- Assess number of external lights on site
- Obtain quotes to install daylight controls
- Apply for Carbon Trust 0% loan

Barriers

Some CCTV systems require a level of external lighting to function properly even during the day.

Office space heating systems

DO YOU HAVE?

- Office heating provided by fuelled by kerosene, fuel-oil or gas?
- Heating that is controlled by time clocks?

Good Practice

Each site should have a regular maintenance programme in place for heating, ventilation and air conditioning.

The Opportunity

The warehouse surveys show a number of heating opportunities that include:

- The control of space heating on site can be improved - space heating should be controlled utilising a programmer or timer and thermostats,
- On-site fuel storage has a higher carbon impact than grid storage but that some on-site fuel, such as LPG, can be used for heating and forklift recharging
- One office area that requires 24 hour heating i.e. transport rooms should use local heating rather than heating the entire office block
- On site boilers can be old and not as efficient as modern units.
- Offices can be hot and employees are likely to open windows rather than turn temperatures down

The Energy Costs

The site surveys showed that typically warehouse areas are not heated but offices are. *Typically modern boilers and good quality controls can save 10-15% on the fossil fuel consumption.* Where a number of LPG fuelled forklift trucks are on site it could be viable to self fuel the forklifts from a shared tank.

Making it Happen

- Obtain quote to replace boiler if it is over 10 years old
- Install adequate controls if not already present
- Install local heating in 24hour occupied offices
- Apply for Carbon Trust Loan

Barriers

Some sites are off the mains gas grid so need to use on site fuel storage

Some office accommodation is required for 24 hour operations.

Ensure efficient control of air conditioning

Do you have?

- Office cooling provided by split units?

The Opportunity

Surveys show that some sites could benefit from better control of comfort cooling systems. Where these systems operate separately it is has been found that energy waste occurs from simultaneous centralised heating and localised cooling and units being left operating when offices are unoccupied.

There is an opportunity to implement a standard control system to prevent simultaneous heating and cooling and turn units off outside of core hours.

The Energy Costs

A typical 3.5kW office split unit will cost approximately £240 per year to operate. This can be reduced to around £120 a year if correctly controlled with appropriate setpoints and operational schedules.

Good Practice

Cooling controls should be checked regularly to ensure that they match the building occupancy.

Buildings should not be cooled any lower than 24oC.

Where possible cooling should be switched off during the cooler months of October to March.

Spilt units should be serviced once a year to check that they are not leaking refrigerant

Making it Happen

- Identify heating and cooling controls
- Adjust to energy efficient set points (20°C max for heat and 24°C minimum for cooling)
- Discourage staff from adjusting heating/cooling controls and state why

Barriers

Some offices are constructed in previously open plan areas that do not have access to natural ventilation and therefore require comfort cooling, however, these should still be controlled appropriately.

Ensure hot water supply is sized in relation to site occupancy

Do you have?

- Hot water for hand washing, canteen and kitchenette provided by a hot water tank (calorifier).

The Opportunity

The site surveys showed that a number of warehouse sites have hot water storage provided for hand washing in toilets and kitchenettes and for canteens, most showers seen were electric units.

Depending upon the number of staff on site these could be replaced with electric point of use units. CIBSE GUIDE G suggests 1 litre of hot water per person per day.

Good Practice

Switch off hot water during holiday or shut down periods

Percussion taps or Infra-red controls can prevent hot water taps being left on and wasting heated water.

Hot water circuits should be isolated from centralised boilers during the summer and immersion heaters used instead.

The Energy Costs

Typically for a warehouse style office hot water represents 10% of fossil fuel consumption. This can be reduced if the following are undertaken:

- *Insulate pipes and valves*
- *Reduce pipe lengths runs wherever possible*
- *Turn to electric heating supply during the summer*

Making it Happen

- Identify heating controls
- Adjust to set points to minimum acceptable (this is dependent upon the sites Legionella strategy).

Barriers

Some sites have an irregular number of employees; temporary contractors can double the work force for a number of months each year and water load is sized to accommodate this period rather than the rest of the year.

Employees are concerned by Legionella risk and as such would rather their water is heated >60°C 24/7.

Opportunities related to cold stores

Do you have?

- Frozen or chilled storage on site?

The Opportunity

Two of the sites surveyed were of a specialist nature that had chilled and frozen storage facilities. The energy savings at these sites are so specific it is not feasible to discuss potential energy savings however the following list of opportunities may be suitable for your site

- Install and use dedicated blast freezing chambers, do not use storage chambers to accelerate the speed of product freeze
- Only cool storage chambers to the contract temperature minus 1˚C. Every °C in excess of this temperature cost money and wastes CO_2.
- Ensure suction temperature is in line with chamber temperature
- Set condensing temperature setpoint 10°C above wet bulb temperature
- Replace chamber strip curtains with rapid action roll doors.
- Ensure chamber doors fit snugly and are not bent or distorted.
- Reduce daily number of defrost to minimum acceptable. If more than one defrost a day is required investigate reason for excessive moisture penetration into chambers.
- Install metering equipment per refrigeration plant to accurately charge clients

Appendices

Appendix 1 - Making the business case for an energy efficiency project

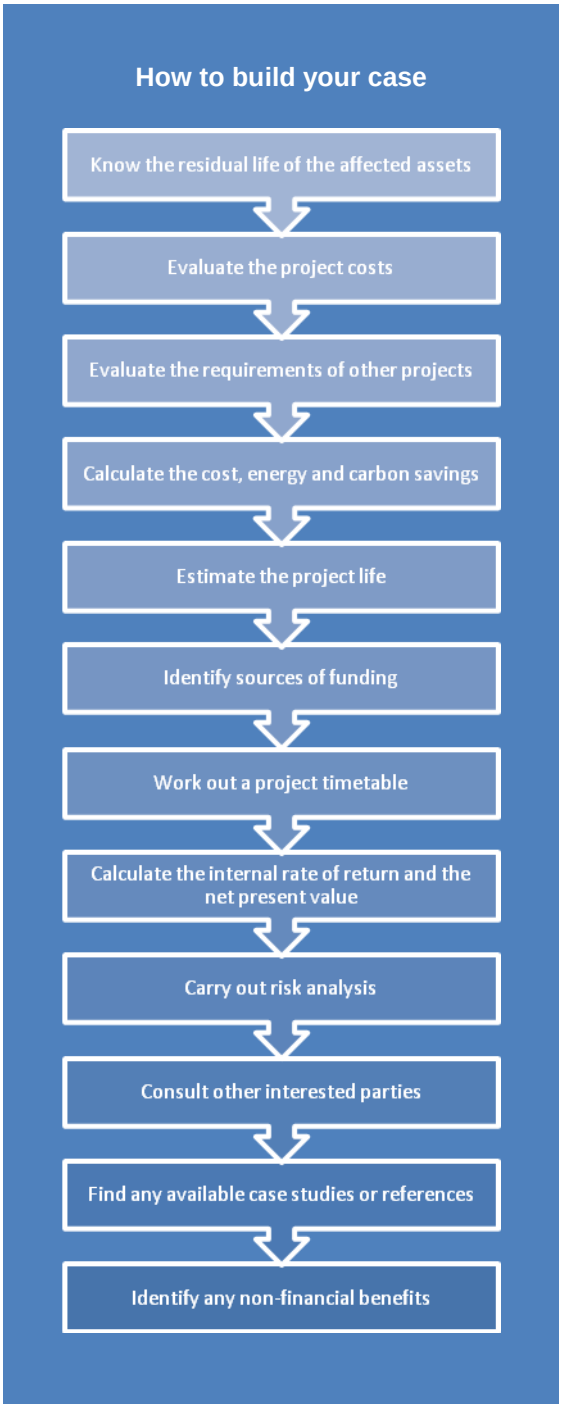
This section of the guide summarises the recommended steps to help ensure that your projects for cutting energy costs get the best chance of implementation. Financial appraisal methods are also summarised

1. What are the decision makers looking for?

- You need to offer a compelling financial return and if possible other benefits
- Concise clear proposal concluding with a single recommendation or request
- Supported by an analysis of the costs, benefits, risks and timetable
- Engage the decision makers and influencers early on, sound them out, get allies on your side.

2. Building the case

- The financial case rests on the balance between projected costs and savings
- Collect the most reliable data and evidence you can to support the case
- **Direct financial benefits**. Focus on the financial case first.
- **Verify your numbers.** Check estimated figures and assumptions given by suppliers. Get references from other customers, check against third party sources e.g. is a product on the Energy Technology List (www.eca.gov.uk/etl). Check against industry publications or guidance. Commission an independent assessment for important projects.
  - Do not exaggerate the savings
  - The business case must identify and review the barriers and risks, so that the decision makers know that they have been considered and can be dealt with
  - Consider an initial pilot, with phased roll-out.
- **Obtain forward estimates of energy prices**



- From subscription energy market intelligence services or energy journals and business press
- Review with any senior allies

- **Additional benefits**
  - Identify further financial benefits, such as
    - Reduced maintenance costs
    - Increased life of plant
  - Identify other benefits
    - Improved staff comfort
    - Enhanced reputation
- **Implementation costs**
  - Check suppliers estimates, obtain other quotations
  - Talk with other customers, what factors increased their costs? Ask the supplier.
  - Investigate further the unknown factors e.g. cabling costs, through similar projects on your site.
- **Carry out a preliminary evaluation**
  - Repeat the financial analysis with different assumptions, to provide a sensitivity analysis
  - If necessary obtain firm quotations to confirm evaluation

- **Financing**
  - Find out how the project would be financed, timetables etc
  - Identify if capital or revenue expenditure could be used (e.g. for rapid recovery projects)
  - Subject to criteria the Carbon Trust can provide interest free loans, more details are provided later in this guide
- **Risk**
  - Business case must identify and discuss possible risks, technical, cost, operational, energy price risks, circumstantial risks – closure, outsourcing etc.
  - Also discuss the risks of not taking the project forward

3. Drafting the proposal

- This needs to convey to people at a glance what you want and why – full story on the first page
- Also needs detail to satisfy the diligent in the body
- Clear and logical, brevity, clarity, certainty
- Obtain past examples of good proposals
- Aim for one clear recommendation for endorsement
- If the case is financially weak, focus on how it supports a concrete corporate objective.
- Put the detail in the appendices

4. Financial Appraisal Methods

Simple Payback

- The most familiar way of evaluating and expressing the cost effectiveness of projects is the 'simple payback period' (SPP). Dividing the project's cost by the annual savings tells us how long it will take to recoup the initial outlay. It does not tell the whole story.
- SPP gives us a rough-and-ready way to compare alternative projects, but most importantly, it is not the method used for evaluating investment choices in financially-savvy organisations.
-

Table below provides two hypothetical (and simplistic) scenarios which illustrate the subtle difficulties of choosing between projects. Project X will save £5,000
a year for three years, while Project Y saves only £4,500 but will last five years. Both projects cost £10,000 to implement.
The most familiar way of evaluating and expressing the cost effectiveness of projects is the 'simple payback period' (SPP). Dividing the project's cost by the annual savings tells us how long it will take to recoup the initial outlay. We can see here, for example, that Project X has an SPP of 10,000/5,000 = 2.0 years, while Project Y achieves an SPP of 10,000/4,500 = 2.2 years. On those grounds, Project X seems preferable. Yet the net return from Project Y is £12,500 over its lifetime compared with only £5,000 for Project X, making Project Y preferable. Clearly, simple payback is not telling us the whole story.

Project X	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Total
Cost of project	(£10,000)						(£10,000)
Savings		£5,000	£5,000	£5,000			£15,000
Cash flow	(£10,000)	£5,000	£5,000	£5,000	£0	£0	£5,000
Project Y	**Year 0**	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**	**Total**
Cost of project	(£10,000)						(£10,000)
Savings		£4,500	£4,500	£4,500	£4,500	£4,500	£22,500
Cash flow	(£10,000)	£4,500	£4,500	£4,500	£4,500	£4,500	£12,500

Another of the drawbacks of simple payback is that it tells us nothing about the absolute value of the proposal: replacing a filament lamp with a compact fluorescent would give a stunningly short SPP, but will only have a negligible impact on your organisation's carbon footprint. A further, more subtle, objection is that quoting the payback period is a slightly weak proposition. To say "this project will pay back its costs in two years" is not quite as powerful as saying "this project will repay its cost every two years". The latter wording stresses the continuity of future savings and sounds like a positive choice. The former wording is slightly defensive and unconsciously suggests that the benefit is short-lived ("don't worry, you will get your money back, but only after two years"). SPP gives us a rough-and-ready way to compare alternative projects, but most importantly, it is not the method used for evaluating investment choices in financially-savvy organisations.

Discounted cash flow

To capture the value of continued savings in the future and to show how the proposed project compares with other possible investments, most accountants would use an assessment method based on discounted cash flow (DCF). In DCF calculations, all the project's current and future costs and savings are aggregated into a single lifetime figure, but with due allowance made for the fact that cash flows in the far future have less weight than those in the near future.

This example illustrates how we weigh up the relative values of cash received in the future. Let us assume that you can earn 4% interest on money in the bank. Now suppose that you are offered a choice of three cash gifts on condition that you don't spend the money until five years from now. You can have:

£822 today; or
£889 in a year's time; or
£1,000 in five years' time.

Which should you choose? The answer is that give or take a few pence, it does not matter. To invest £822 for five years or £889 for four years, both yield £1,000 at 4% compound interest, meaning that the payment of £1,000 in five years' time is equivalent to £822 received today. Accountants call the £822 the *present value* of the £1,000 in question, and the 4% the *discount rate*. The higher the discount rate, the lower the present value. Table A2 shows the present value of £1,000 in five years' time, at various discount rates:

Discount rate	Present value of £1,000 five years in the future
4%	£821.93
10%	£620.92
20%	£401.88

We can also compare the present values of a certain cash sum paid at different points in the future, but at a particular discount rate. Table A3 shows the present value of £1,000 payable in the future at a 10% discount rate:

Years	Present value of £1,000
0	£1,000
1	£909.09
2	£826.45
3	£751.31
4	£683.01
5	£620.92

Applying discount factors to the Assessment

Net present value

Let us return to Projects X and Y introduced earlier and evaluate them using discounted cash flow. For the purposes of illustration, we will use a discount rate of 10%. Table A4 (overleaf) is the same as Table A1, but 'cash flow' has been relabelled 'simple cash flow' and two additional rows have been added. One is the discount factors, which are the ratios between the present and future values in each future year (you can see these same ratios in Table A3 above). The other additional row is the discounted values of the future cash flows in each year. In each case, this is the simple cash flow multiplied by the discount factor for that year.

Project X	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Totals
Cost of project	(£10,000)						(£10,000)
Savings		£5,000	£5,000	£5,000			£15,000
Simple cash flow	(£10,000)	£5,000	£5,000	£5,000	£0	£0	£5,000
Discount factor	1.000	0.909	0.826	0.751	0.683	0.621	
Discounted cash flow	**(£10,000)**	**£4,545**	**£4,132**	**£3,757**			**£2,434**
Project Y	**Year 0**	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**	**Total**
Cost of project	(£10,000)						(£10,000)
Savings		£4,500	£4,500	£4,500	£4,500	£4,500	£22,500
Simple cash flow	(£10,000)	£4,500	£4,500	£4,500	£4,500	£4,500	£12,500
Discount factor	1.000	0.909	0.826	0.751	0.683	0.621	
Discounted cash flow	**(£10,000)**	**£4,091**	**£3,719**	**£3,381**	**£3,074**	**£2,794**	**£7,059**

Looking at the right-hand columns in Table A4 you will notice that Project X, which yielded a net return of £5,000 in terms of simple cash flow, yields a net return of £2,434 in terms of discounted cash flow. This is called its net present value (NPV) because it is the sum of all the expenditure and income, discounted to present values. Project Y, meanwhile, has an NPV of £7,059. This gives us a much clearer picture of which project to choose. Doing project Y is the equivalent of a cash gift of £7,059, while Project X is only worth £2,434. In fact (if we could find the finance) both projects are worth pursuing as both have NPVs greater than zero. But this conclusion does not hold good if the discount rate is much higher.

(Further information on financial appraisal methods can be obtained from Carbon Trust publication – Management Guide CTV039 (Making the business case for a carbon reduction project) – downloadable from the Carbon Trust website)

Appendix 2 - Support for investment: The Carbon Trust 0% Business loan and the ECA scheme

In order to strengthen the business case for investing in energy saving initiatives 0% business loans of £3,000 - £500,000 are available from the Carbon Trust to help organisations finance and invest in energy saving projects.

In order to qualify for these loans your company must be able to fulfil these criteria:

1. Private sector
2. Trading for at least 12 months
3. For projects based in England, Scotland & Wales: all Small or Medium sized Enterprises (SME) OR any business that do not qualify for participation in the CRC
4. For projects sites based in Northern Ireland: any sized enterprise can qualify

For clarity the EU definition of an SME is an organisation with:

1. Less than 250 full time employees
2. Less than €50m Turnover (approx. £43m) and/or less than €43m assets (approx. £37m)
3. No controlling interest of more than 25% by a non SME

In order to qualify projects must:

- Deliver cost-effective carbon savings
- Carbon Trust can loan £1,000 for every 1.5tCO2 saved per annum from a project
- Borrow £3,000 to £500,000 at 0% interest unsecured loan, interest free, with no arrangement fees.
- Loans can be repaid over a period of up to 4 years
- Part loan are available
- Loan offers remain valid for 3 months from point of signing the Loan Agreement

ENHANCED CAPITAL ALLOWANCE (ECA)

The ECA scheme is a key part of the Government's programme to manage climate change, and is designed to encourage business to invest in energy-saving equipment (plant and machinery only).

There are three ECA schemes which provide enhanced tax relief for spending on equipment which has environmental benefits:

- Energy-saving equipment
- Water-efficient equipment
- Low carbon dioxide emission cars

The scheme provides a tax incentive to business that invests in equipment that meets published energy-saving criteria. The Energy Technology List (ETL) details the criteria for each type of technology, and lists those products in each category that meet them. It is managed by the Carbon Trust, on behalf of the Government, and has two parts:

1. The Energy Technology Criteria List (ETCL), which is reviewed annually to ensure that it reflects technological progress. It sets out the qualifying energy-saving criteria for each class of technology.

2. The Energy Technology Product List (ETPL), which is updated at the start of each month on the website and lists products and technologies that are eligible for an ECA.

Key Features of the ECA scheme

- Open to all businesses that pay UK corporation or income tax, regardless of size, sector or location.
- Provides 100% first-year capital allowances on investment in energy-saving equipment against taxable profits of the period of investment.
- All the products listed on the ETPL must meet the energy-saving criteria, published in the ETCL.
- Only spending on new and unused energy-saving equipment can qualify for ECAs.
- Capital allowances are available for spending “on the provision of” plant and machinery. This can include certain costs arising as a direct result of the installation of qualifying plant and machinery such as; transport of the equipment to the site, and some direct installation costs.

Which equipment is eligible:

The Energy Technology Criteria List (ETCL) is reviewed each year, to reflect technology advances and market changes. New technology groups may be added as part of the annual review, but they must have the approval of the Department of Energy and Climate Change (DECC), Her Majesty’s Revenue and Customs (HMRC) and the Treasury.

The list of qualifying products, within each technology is updated each month. The current list of technologies is as follows:

- Air-to-air energy recovery
- Automatic monitoring and targeting (AMT)
- Boiler equipment
- Combined heat and power (CHP)
- Compact heat exchangers
- Compressed air equipment
- Heat pumps for space heating
- Heating ventilation and air conditioning equipment
- Lighting
- Motors and drives
- Pipework insulation
- Radiant and Warm Air Heaters
- Refrigeration equipment
- Solar thermal systems
- Uninterruptible Power Supplies (UPS)

Appendix 3 – Steps to Manage Cost, Energy and Emissions

Each UKWA warehouse should have begun working to reduce energy consumption and CO2 emissions. This section lays out the simple steps required to manage and monitor the progress being made. This process is a useful reminder even if the site has procedures in place.

Step 1 – Appoint a Champion

1.1 Each UKWA site should agree a champion to lead the work to manage energy and emissions. The Champion should be a senior member of staff and may choose to work on their own or as part of a group, or Green Team, if it is a larger site.

The aim of the Champion should be to manage the energy consumption from the site; depending on the site this may only require an hour or two a month.

Step 2 – Read meters and collect information

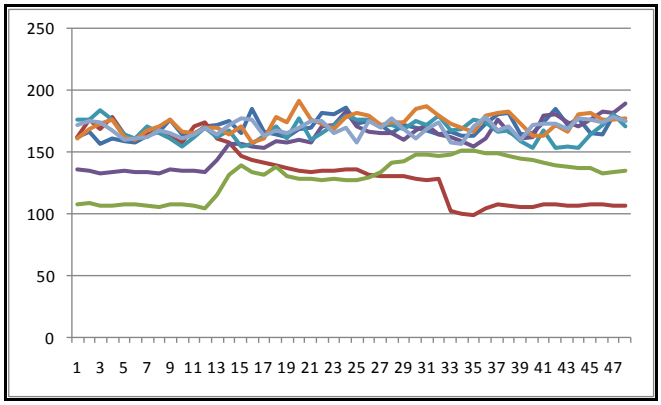
2.1 Read meters. Information recorded should cover

- Electricity (KWh)
- Gas (m^3 or kWh)
- Other gas, diesel or fossil fuel (relevant units)
- Water (m^3)
- Refrigerants purchased (kgs)

2.2 Begin a spreadsheet or a paper file and keep the information on site. Take readings monthly and were appropriate for refrigerants.

2.3 Also, try to obtain the half hourly meter (HHM) electricity data for your site. If the warehouse is relatively large with an electricity demand of over 100kW the electricity supplier will take remote readings every half hour.

2.4 It is suggested that every warehouse contact their electricity supplier to establish if they have a HHM and where relevant request HHM information. This information can be used to produce charts to show how electricity is being used through the day, see following chart.



Step 3 – Review your performance

After collecting the above information it is important to review it and look for changes in consumption.

3.1 Compare collected information to the previous month and to the same month for the previous year. Look for changes and then monitor these changes over the coming months.

3.2 If consumption is higher compared to previous months and previous years then the Champion should try to find out why. Initially this could be done by discussing the issue with shift managers and/or facilities managers to establish what has changed.

3.3 If the impact is reducing compared to previous months and previous years then the Champion should discuss the causes for this and publicise any good progress made.

Care should be taken when comparing data because there may be several reasons for the changes. From more information see the Key Publications section.

Step 4 – Regular energy walk-rounds

4.1 Undertake energy walk rounds regularly and look for changes in operation of where progress is being made or where work needs to undertaken.

As a the site develops its approach to tackling environmental impact it may wish to broaden this walk-round work to include the other area of consumption and recycling listed above.

Step 5 – Create an action plan and implement

5.1 Create an action plan to continue progressing work to reduce energy consumption.

5.2 It is suggested that this action plan is created and reviewed annually to monitor the actions taken and the successes achieved.

5.3 The energy walk-rounds undertaken on the site should inform the creation of the Action Plan.

5.2 An action plan should be agreed by the Champion and approved by the Warehouse Manager. An action plan should;

- state clear energy saving actions, objectives and targets for the site,
- assign energy saving actions to individuals with clear deadlines for completion,
- state dates to review progress on the energy saving actions,
- describe the resources that are required,
- link into annual budgets decisions.

More information can be found in Appendix 6. Energy Saving Action Plan.

Appendix 4 –Energy Walk-Rounds

This section provides information on undertaking energy walk-rounds.

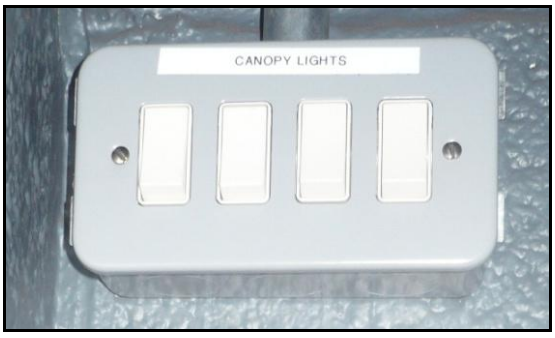
Background

Energy walk-rounds are undertaken to reduce wasteful practices and to establish which appliances, equipment or plant, will need replacing.

An energy walk-round is a simple tour or inspection of a building or site. Armed with a checklist, you simply walk around the offices and warehouse and undertake a systematic visual inspection of each area. The inspection should note:

- Efficient Operation – is plant being left switched on or controlled incorrectly?
- Inefficient Equipment – does equipment need maintenance/repair? Can it be replaced with more efficient alternative?
- Building Energy Efficiency – is being lost through the building fabric? Can natural light be increased?

The information gathered should help construct an action plan to reduce energy consumption on the site.



Exterior Canopy Lighting Clearly Labelled

How to undertake a survey

Step 1 Initially refer to the checklists and tools in this document and complete/update where appropriate.

a) **Occupancy Profile** – update this document before starting

b) Refer to **Key Carbon Reduction Check List** of simple energy saving measures

c) Refer to **Survey Check List**

d) Refer to **Low Carbon Check List**

e) Complete **Controls Sheet**

Step 2 Agree a date with a colleague to undertake the survey

Step 3 Decide on where you will start the survey, what you will inspect and where the survey will end (refer to checklist and energy consumption charts)

Step 4 Familiarise yourselves with the energy consuming plant and equipment that you will be inspecting. Make sure you understand which areas they heat, cool, light etc and how they are controlled.

Step 5 Undertake the survey using the checklists **c** and **d,** compare the outcomes of the survey to the remaining checklists **a, b** & **e** and note areas where energy could be used more efficiently.

When to undertake a survey

- When equipment is in use,
- Or when energy equipment stop being used (break times),
- When staff are not expecting a survey to take place,
- At specific times relevant to the operation of the plant and equipment to be inspected.

Appendix 5 – Cost Reduction tools

a) Occupancy Profile

How to complete the building occupancy schedule:

- First list the main areas of the site, these should be separated into areas where lighting or heating is controlled.
- Then, for each day of the week, record the times when it is occupied

Estimate if the area is **fully or partially** occupied

- List the unoccupied periods

Use the occupancy schedule to;

- Check that any timer schedules match this unoccupied period,
- Control heating, cooling and lighting,
- Compare to Half Hourly data.

Occupancy Schedule of Building Areas															Is the area fully occupied? Give a % estimate
Building area	Mon		Tue		Wed		Thu		Fri		Sat		Sun		
	Start	Finish	Start	Finish	Start	Finish	Start	Finish	Start	Finish	Start	Finish	Start	Finish	

b) Key Cost Reduction Check List:

Name of checker……..Date of Energy Check……

Key Cost Reduction Check List		Where/What to check	When to check	tick yes or no		Action	Notes (record any Action Points needed and % compliance)
1				Yes			
				No			
2				Yes			
				No			
3				Yes			
				No			
4				Yes			
				No			
5				Yes			
				No			
6				Yes			
				No			
7				Yes			
				No			
8				Yes			
				No			
9				Yes			
				No			

c) Survey Check List

Date or Survey:	**Undertaken by:**

Begin by taking meter readings. Then move through the building noting where energy saving actions are/are not being undertaken. The goal is to note areas where energy could be saved by making changes to day to day operation.

meter readings (include units, kWh, litres, m³ etc)		Gas/Oil **units**	Electricity **units**
Good housekeeping actions	Yes/No	**Offices**	**Warehouse**
Lighting			
Are windows and lights clean?			
Is lighting switched off in offices when not required?			
Are lighting time clocks set to match the occupancy of the building?			
Are time clocks for external lighting correct?			
Is lighting switched off when there is sufficient daylight?			
Heat and Hot Water			
Have the boilers or electric heaters been maintained/serviced regularly?			
Are draughts being addressed using draught curtains, blinds and draught stripping?			
Are radiators (or other heat emitters) free from obstruction?			
Are the time clock(s) on the heating controller set correctly?			
Are electric hot water heaters switched off at the end of the day?			
Is the hot water thermostat is set 60^{o}C			
Are thermostats in offices set to 19^{o}C?			
Is the heating turned off whilst not in use?			
Are radiator TRVs set correctly?			
Air Conditioning			
Are remote and wall controls on a/c set to cool to 24^{o}C			
Are air filters clean?			
Are a/c units in use when offices are unoccupied?			
Common Area actions			
Is electrical equipment switched off at the end of the day?			
Are vending machines able to be switched off?			
General actions			
Is all electrical equipment switched off at the end of the day?			
Are doors and windows closed whilst the heating or cooling is on?			

Now use these general notes to update your Energy Check List.

d) Low Cost Replacement Check List

Date or Survey:	Undertaken by:
Whilst looking at the Good Housekeeping actions that could save energy you should consider the appliances and plant and their replacement or maintenance. Are they operating efficiently? When they were last maintained? When will they need replacing? Are they low energy appliances? Could they be replaced with lower energy consuming versions?	

Replacement/Maintenance	Estimated replacement date	Offices	Warehouse
Lighting, check - • Lighting levels, is it dull or bright, are you using daylight? • Types of fittings and lamps, are there any efficient versions available? • Is the lighting sufficiently controlled to switch off in areas that are unoccupied?			
Heating, Ventilation and A/C check - • Is the boiler reliable – has it been given a predicted lifespan? • Do the boiler controls enable you to control the heating and hot water? • Do air conditioning units need to be replaced? • How regularly do air filters need replacing? • Are heat emitters clean and unobstructed? •			
Other Electrical, when are the following due for replacement - • Computers, Printers etc • Fridges, Freezers etc • Hot water urns • TVs and entertainment devices • Vending machines **Consider energy consumption as part of purchasing decisions, see**			
General building: • Are door closing mechanisms operating freely? • Does draught proofing need replacing? • Is there insulation in appropriate roof spaces? Check thickness • Are conveyors being operated efficiently? • Are warehouse doors left open?			
Notes			

Once completed use observations on appliances and plant that need replacing and maintaining to help to create an Action Plan for energy consuming options.

e) Controls, Timers and Switches Record Sheet

The following sheets are for you to use to record the details of timers and switches and operations that will help achieve the energy savings measures outlined in the “Simple Ways to Save” section – these may change over time.

Action	Detail
Location of thermostats/time clocks and other warehouse heating controls	
Describe how to operate control – include switching off/on, and any temperature set points	
Location of warehouse light switches	
Describe how and when to switch off if sufficient daylight	
Describe how to switch off at the end of shifts	
Location of automatic lighting controls (if any)	
Describe how to adjust these controls and suggested set points	

Location of external automatic lighting controls	
Describe how to adjust these controls and suggested set points	
Location of air conditioning and air handling unit controls	
Describe which set points, a/c times, AHU times	
Location of hot water controls	
Describe how to check hot water temperature and control the time of operation	

Appendix 6: Energy Saving Action Plan

Name ……. Date of Energy Created ……

Refer to the outcomes of the most recent energy walk-round. Use the main points to complete the following action plan template.

Areas of energy waste	Action	Cost	Potential savings	Payback	Priority level	Date of action	Person responsible
Example Warehouse lighting	*Example* Upgrade warehouse lighting	*Example* £80,000	*Example* 17% from energy survey	*Example* 1.5 years	*Example* Priority for 2009	*Example* August to September	*Example* Mrs J Doe

Appendix 7 – Types of Energy Meters

Types of Energy Meters

It is important to be able to identify the different types of energy meters to ensure that accurate readings are taken.

The type of meters used will vary from premise to premise and this will also mean that the process of reading a meter will also differ. The following will explain the different types of Energy meters that maybe in use and will later explain how to read them/ The Electricity Guide.org (2008) identify three common electricity meters in use in buildings:

- **Standard meters**
- **Variable rate meters**

The differences between these meters is outlined below:

Meter Type	Rate	Example
Standard meters	Measures in terms of Kilowatt-hours All electricity units are charged at the same rate 24 hours a day	
Variable rate meters **(** Economy 7 meters)	Measures in terms of Kilowatt hours. Two readings taken, • Daytime and • Night-time Electricity is usually charged at two different rates. Night charges are usually charged at cheaper rates.	

N.B. Definition, Kilowatt-hour (kWh): The amount of energy used by a load of one kilowatt over the period of one hour

Data sourced from: energywatch.org (2008)

Gas Meter Types

Meter Type	Rate	Example
Credit meters	Gas consumption measured in units. Units can be multiplied by 31.1 to convert approximately to kilowatt hours. (breakdown will appear on a gas bill) Quarterly bills are sent to customers. Gas readings usually occur every six months, and an estimated bill will be sent when meters are failed to be read.	

Data sourced from: energywatch.org (2008)

N.B. all meters will have a **Meter Point Reference Number (MPRN)** which is individual to each meter. This is usually a ten digit number located on the meter. This number is important for taking meter readings and for locating individual meters.

Reading an Energy Meter

Electricity Digital

- To read a single rate digital meter, simply write down the numbers shown from left to right.
- Make sure to write down any zeros, including any at the start of the reading. Ignore any red figures.
- To find out how many units you have used since your last reading, subtract the previous reading from the new one.

Electricity Digital (2 Rate)

You may have two rows of figures if your electricity is supplied on a Variable Rate Meter Tariff.

Always check both rows of figures when you read this meter:

- One row is for the lower priced night-rate electricity - it is marked LOW.
- The other is for the day rate - it is marked NORMAL.

Electricity Digital (Dial)

Dial Meters can vary in appearance. The dials next to each other go round in opposite directions.

- Always write down the number which the pointer has just passed – this is not necessarily the nearest number to the pointer.
- If the pointer is anywhere between, say, 4 and 5, write down 4. If the pointer is directly over the number, say 5 write that number down.

Reading your Gas Meter

Gas Digital

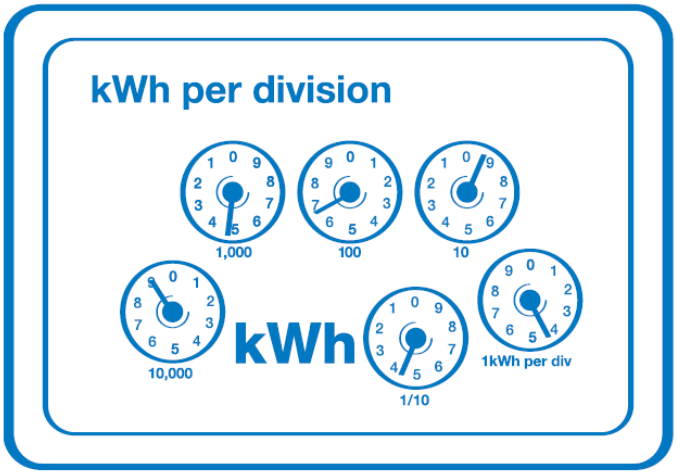
To read a digital type meter, use only the white figures. Ignore any numbers after a decimal point or any numbers in red. To get the amount of gas you have used, take away the previous reading from the new one.

Gas Dial (Clock)

Different dial meters can sometimes vary in appearance. By carefully using the tips below and practicing, reading your meter becomes very easy.

Ignore the dials marked 100 per rev, the large dial and the red dials. Read the other dials from left to right and write down the number that the hand has passed.

When reading your dial meter, always remember that dials next to each other go round in opposite directions.



Data sourced from: Scottish Power.co.uk (2008)

For further information on reading a meter please contact your local energy supplier.

Appendix 8 – Key Publications

The Carbon Trust has produced several documents that can be obtained free of charge from their website www.carbontrust.co.uk.

Telephone: 0800 085 2005
Opening hours: 8.30am-5.30pm, Monday to Friday

Key Publications

- Managing energy in warehouses (GPG319)
- Lighting Guide 006: The Lighting of Warehouses and Storage Areas (ILG006)
- Energy management case study - Scotland - Carron Phoenix (CTS052)
- Energy Management Fact Sheet (GIL136)
- Assessing the energy use in your building fact sheet (CTL003)
- Managing the Carbon Reduction Commitment (CRC) as a business opportunity (CTL081)

Appendix 9 - Glossary of Terms

Kilowatt hours
A unit of energy equal to the work done by a power of 1000 watts operating for one hour. Kilowatt hours are used by the Utility companies to measure the amount of gas or electric billed.

Carbon dioxide (CO2)
CO2 emissions result from the combustion of fuel, from land use changes (agricultural processes, deforestation etc) and from some industrial processes. CO2 emissions are limited by the Kyoto protocol.

Greenhouse gases
Greenhouse gases are those which contribute to the greenhouse effect when present in the atmosphere. Six greenhouse gases are regulated by the Kyoto Protocol, as they are emitted in significant quantities by human activities and contribute to climate change. The six regulated gases are

- carbon dioxide (CO2),
- methane (CH4),
- nitrous oxide (N2O),
- hydrofluorocarbons (HFCs),
- perfluorocarbons (PFCs)
- and sulphur hexafluoride (SF6).

Emissions of greenhouse gases are commonly converted into carbon dioxide equivalent (CO2e) based on their 100 year global warming potential. This allows a single figure for the total impact of all emissions sources to be produced in one standard unit. Conversion factors of greenhouse gas to CO2e are calculated by the IPCC and Defra publish guidance on which set of conversion factors to use.

Carbon dioxide equivalent (CO2e)
There are six main greenhouse gases which cause climate change and are limited by the Kyoto protocol. Each gas has a different global warming potential. For simplicity of reporting, the mass of each gas emitted is commonly translated into a carbon dioxide equivalent (CO2e) amount so that the total impact from all sources can be summed to one figure.

Carbon footprint
The total set of greenhouse gas emissions caused by an individual or organisation, event or product. It should be expressed in carbon dioxide equivalent (CO2e).

What is green electricity?
Green electricity is generated by renewable energy; sun, wind, water, the heat of the earth and well managed forests. Usually “green” electricity is supplied to our homes and other buildings using the national grid by a utility company that charge for a “green” tariff.

Care should be taken when considering “green” tariffs as they will be supplied on the basis of part of the electricity being generated by renewable sources. Some tariffs may also have other environmental benefits and some “green” tariffs will supply electricity that has been generated from 100% renewable sources.

The Department for Environment, Food and Rural Affairs (DEFRA) has announced that the calculating of greenhouse gas emissions from “Green” tariffs should now use the same conversion factor as the normal grid supplied electricity. For more information see the DEFRA website.

Emissions conversion factor
When calculating emissions from energy use it is common to know what quantity of energy was used, either in kWh or by volume or mass of input material. Emissions factors enable a conversion to be made from the input measure of energy to the amount of carbon dioxide emissions that will result. UK conversion factors for energy to CO2 are published by DEFRA.

Carbon Offset
An emissions reduction, commonly resulting from a project undertaken in the developing world, which has been sold to compensate for emissions elsewhere. Offsets are commonly used to net off corporate emissions so that an organisation can claim to be **carbon neutral**. See The Carbon Trust three stage approach to developing a robust offsetting strategy.

Carbon neutral

Commonly accepted terminology for something having net zero emissions (for example, an organisation or product). As the organisation or product will typically have caused some greenhouse gas emissions, it is usually necessary to use carbon offsets to achieve neutrality. Carbon offsets are emissions reductions that have been made elsewhere and which are then sold to the entity that seeks to reduce its impact. In order to become carbon neutral it is important to have a very accurate calculation of the amount of emissions which need to be offset – requiring calculation of a carbon footprint.

Good practice

A term used in this document to indicate a building that has low annual energy consumption per square metre of floor area (kWh/m²). This benchmark (kWh/m²) is commonly used to compare buildings energy consumption performance. Good practice is defined as the top 10% of a given category of buildings that were surveyed to produce the benchmark figure.

TRVs

Thermostatic radiator valves are fitted to radiators or heat emitters to limit the flow of heat into a room. They are set manually to a desired temperature and will automatically sense when that temperature is reached and limit the flow of heat.

Lamps

Lamps are light bulbs and they are used in luminaires (light fittings) to produce light from electrical energy.

Efficacy

This is the measure of the amount of light emitted per watt (lumens per watt or lm/W) of electrical power consumed by a lamp. Together with the life expectancy of the lamp figures for efficacy can provide and indication of the efficiency of the lamp.

CFLs

Compact fluorescent Lamps are commonly used as an energy efficient replacement for traditional Tungsten lamps. CFLs are now produced with a range of efficacies, power ratings and are suitable for a range of fittings and uses.

The U-value

Thermal transmittance (i.e. the U-value) is a measure of how much heat will pass through one square metre of a structure when the air temperatures on either side differ by one degree. U-values are expressed in units of Watts per square metre per degree of temperature difference (W/m2 deg C).

Whole life cost

When considering the purchase of a new energy consuming appliance, piece of equipment or plant the purchaser should consider the other factors rather than just the initial cost. The whole life cost considers the initial cost, the cost in use (energy consumption costs) for its lifespan, maybe maintenance costs and then perhaps the disposal costs. This enables a fuller picture of cost of the appliance, piece of equipment or plant across its lifespan.

Appendix 10 – Overview of sites visited

Site size	Age and condition	Operational time	Opportunities found
200,000 ft²	80 years old, brick building with steel roof.	24/7 five periods a week	7
100,000 ft²	30 – 40 years old, steel framed, cement roof, brick and block walls. Chilled, frozen and ambient storage.	Monday to Friday 10 hours per day	7
90,000 ft²	20 years old. Brick and block construction with steel wall and steel cladding.	Monday to Friday 07:00 to 17:00	11
140,000 ft²	20 years old. Brick and block construction with steel wall and steel cladding.	Monday to Saturday 08:00 to 17:00	6
10,000 ft²	60 years old. Brick and block construction at lower levels with steel cladding. Asbestos roof that has been over clad with steel sheeting.	Mondays to Fridays 06:00 to 17:00 Saturday 06:00 to 11:00	7
60,000 ft²	Frozen and chilled storage. 30 years old of brick and block construction with steel roof and well insulated.	Monday to Sunday 08:00 to 17:00	8
210,000 ft²	5 years old, brick and block construction with steel roof.	Monday to Friday 06:30 – 18:30	8
80,000 ft²	40 years old, brick and block construction with steel roof.	24/7	8
250,000 ft²	Range from 10 to 70 years old constructed of brick and block construction with steel roof.	24/7	10
35,000 ft²	30 years old. Brick and block construction with concreted tiled roof.	Monday to Friday 06:00 – 18:00 Saturday and Sunday 06:00 – 14:00	4
250,000 ft²	5 years old, brick and block construction with steel cladding and steel roof.	Monday to Saturday 06:00 – 22:00	11
100,000 ft²	25 years old, brick construction with steel cladding and steel roof.	Monday to Friday 08:00 – 18:00	7