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# Warehousing and logistics

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Energy efficiency opportunities for warehousing and logistics companies



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# Preface

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

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

This overview for warehousing and logistics businesses introduces the main energy saving opportunities and demonstrates how well established cost effective technology and management improvements save energy, cut costs and minimise overheads.

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# Introduction

Non-refrigerated warehouses operating with legacy lighting solutions can typically reduce electricity costs by 70% by moving to LED, with further savings through heating measures.

Minimising overheads is key to maintaining profitability in the competitive warehousing and logistics sector. Ensuring that energy costs are as low as they can possibly be will help the bottom line and in addition to the economic benefits there are social and environmental advantages through reducing energy consumption.

In addition, as large client organisations look to further reduce their carbon footprints, they are focusing on opportunities to cut emissions in their upstream and downstream operations. Conditions of contract and performance reviews are commonly asking for assurance of good energy and environmental performance and management from their partners in the warehousing and logistics sector.

Links to other Carbon Trust guides are highlighted throughout this publication as suggested sources for further information and reading.

## Top tips

- **For warehousing and logistics firms energy use is concentrated across a few key systems**
- **Significant savings can be achieved by optimising lighting, heating and where applicable refrigeration systems**
- **Due to the scale of the buildings involved, roof mounted Solar PV arrays are often an effective longer term investment to offset energy use and costs**
- **Low and no cost savings can easily be achieved by improving controls, improving night time and weekend shut down routines and through better energy management.**

## Who is this publication for?

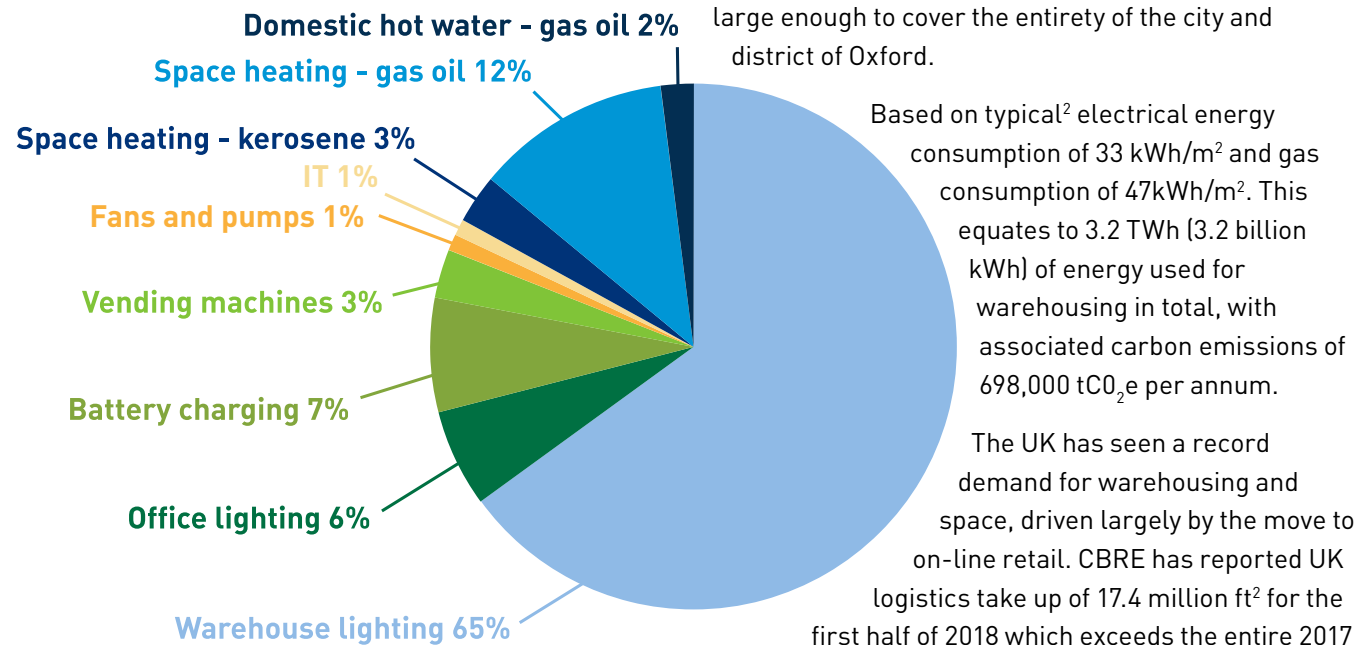
This guide is aimed at owners, operators and managers of warehousing and logistics firms, from single site operations to those with multiple premises. The guide focuses on capital measures to improve heating, lighting, and other warehouse energy use for ambient warehouses. For refrigeration measures please see our [Refrigeration systems](#) guide. In addition, low and no-cost measures and actions with short payback periods are highlighted. The guide will help companies:

- Understand the current energy performance of their business
- Assess the potential for savings at their business
- Raise energy awareness and the standard of energy management amongst staff
- Put together long term strategies to minimise energy use.

# Energy consumption in warehousing and logistics

Energy use for warehousing and logistics businesses is typically confined to a small number of systems, however the energy performance of these systems can vary dramatically.

Figure 1 shows where warehousing and logistics companies use most energy and hence where the biggest savings can be made; namely lighting, heating and where applicable, refrigeration.



The United Kingdom Warehousing Association (UKWA) has estimated that there are over 1,500 individual warehousing units in the UK with a total floor area of 420 million ft<sup>2</sup> of property. This is equivalent to 41 km<sup>2</sup>, large enough to cover the entirety of the city and district of Oxford.

take up. The demand for warehouse space has almost doubled over the past 10 years<sup>3</sup>.



**Figure 1:** Typical percentage breakdown by energy use, based on 15,000m<sup>2</sup> ambient warehouse<sup>1</sup>

<sup>1</sup> Energy Efficiency Warehouse operation UKWA / Carbon Trust

<sup>2</sup> The Non-Domestic National Energy Efficiency Data Framework: Energy Statistics 2006-12, DECC 2015 – Warehouses 500-1,000m<sup>2</sup>

<sup>3</sup> CBRE Logistics, The Property Perspective, H1 2018

# Key opportunities for energy savings

## Improving the energy efficiency of the main energy using systems

The following section details how warehousing and logistics energy consumption can be cost effectively reduced for each of the main energy using systems, namely:

- a. Lighting
- b. Heating and ventilation
- c. Forklifts, cranes and automation
- d. Energy management

### a. Lighting

Lighting accounts for between 65% and 95% of energy use in ambient warehousing. Good quality lighting is essential to safe operation; however, this is often achieved through energy inefficient solutions. There are many simple and inexpensive ways to reduce lighting energy consumption and costs while maintaining adequate light levels:

1. Turning off lighting in unoccupied areas and switching off lighting when sufficient natural daylight is present.
  - Many warehouses have discrete areas which are lit but not always occupied. For example, overflow bays or areas storing seasonal products. The lighting in these areas can often be turned off either through the

existing switching or with minor electrical modifications.

- Many warehouses have areas where natural daylight through roof or wall lights provides adequate light without the need for artificial lighting. By simply having a strategy in place to switch off lighting when good levels of natural daylight are present, significant savings can be made.
2. Replacing inefficient light sources such as SON / Metal Halide and fluorescent with low energy LED products.
    - Carbon Trust surveys have indicated that most warehouses are lit by discharge lighting, typically 250W or 400W SON or metal halide luminaires. Advances in lighting technology in recent years have led to the emergence of more effective alternatives such as high frequency fluorescent and LED. In addition to providing improved efficacy (the light output relative to the power input) these fittings are easier to control than the legacy discharge fittings which suffer from long restrike times. Installing LED lighting also reduces maintenance costs due to the longer life of LED lamps.

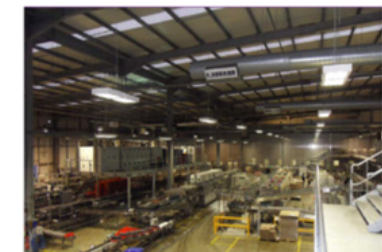
#### 400W Discharge

Running Cost - £385\* (per fitting per year)



#### 220W Fluorescent

Running Cost - £212\* (per fitting per year)



#### 150W LED

Running Cost - £131\* (per fitting per year)



\* Based on a single luminaire of the wattage stated; electricity costs of 10p per unit; ballast losses of 10% for discharge and fluorescent and continuous operation 365 days per year.

3. Using automatic lighting controls to detect occupancy and natural light levels to minimise lighting operation. Often good levels of natural light are provided by warehouse rooflights. This applies even where lighting has already been upgraded to efficient sources:

- **Occupancy sensors** - Warehouses can benefit from occupancy sensors. Modern sensors are effective, even with the use of forklifts and allow infrequently used areas to only utilise the lighting when required. Lights are automatically turned on when there is somebody there to require them and are turned off after a period of vacancy. Sensors can achieve savings of 30% or more on lighting costs and can be zoned by aisle or area depending on the individual requirements of your operation.
- **Daylight sensors** - Light sensors or 'photocells' can be used to control artificial lighting when there is sufficient natural daylight. Many warehouses already have roof-lights and cleaning or replacement of old or damaged roof-lights can also improve the ingress of light into your warehouse. As daylight hours vary throughout the year, sensors help to provide closer control and thus, substantial savings. Daylight sensors are particularly effective when coupled with dimming to provide a variable level of artificial light subject to the available natural daylight.
- **External lighting** - Where external lighting is on time-clock control this can fall out of sync with daylight hours. Review of the settings or installation of photocell controls can also provide additional savings.

## b. Heating and ventilation

### Heating

Depending on products stored and the standard of building fabric, many warehouses can operate satisfactorily year-round without the need for heating. This is ideal from an energy efficiency perspective and heating should only be provided when required.

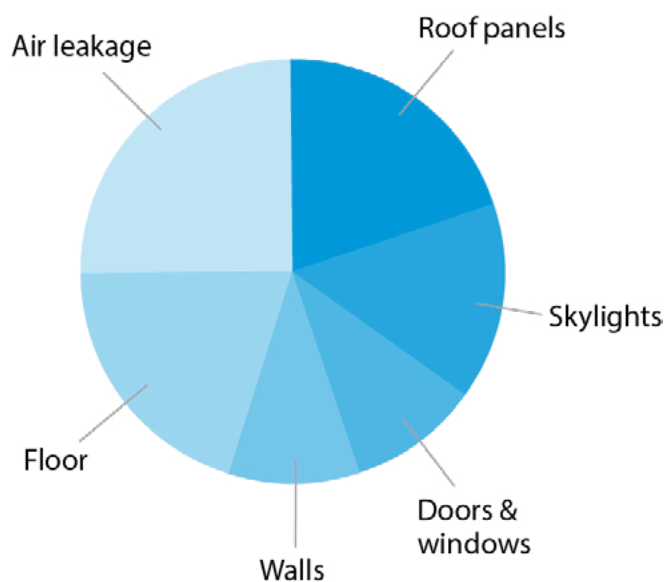
For staff wellbeing, health and safety regulations state that employers must ensure that the temperature in the workplace is 'reasonable' at all times. In accompanying codes of practice it suggests that the temperature should be a minimum of 16°C unless the work involves a lot of physical activity where this can drop to 13°C. For those working directly in a warehouse the latter requirement would be most likely to apply and would often be preferable to warmer conditions.

Permanently occupied offices, staff welfare facilities or toilets would require a permanent heating solution and for these small areas, best practice with regard to energy efficiency should be applied. In terms of heating the open warehouse space the following systems are commonly used:

Heating system	Description	Pros	Cons	Energy Performance
<b>Warm Air</b>	Usually gas fired, direct heaters with local control.	Quick effective way of heating a large space.	Significant heat loss through doors, stratification and need to heat entire space.	Good where in a well-insulated, building with good control and appropriate set points.
<b>Low Temperature Hot Water / Steam</b>	Boiler system with fan coil units and radiators.	Tends to be legacy solution with high losses.	Expensive to operate and maintain.	Poor, but option to improve performance with insulation and control.
<b>Radiant</b>	Gas or electric systems which radiate heat to local areas.	Can direct heat to the areas required, without the need to heat entire space.	Local areas heated only, temperature across space may fall below product needs.	Good where well controlled and situated in optimal positions for staff.
<b>Air rotation</b>	High volume, low velocity warm air circulation system.	Can avoid stratification, even temperature across the space.	Higher investment cost.	Very good, where well planned and designed.

In all cases the standard of building insulation and building air-tightness should be prioritised. When new warehousing space, extensions or refurbishments are planned the opportunity should be taken to review the overall standard, improve existing insulation and ensure that any new facilities meet or exceed building regulation standards.

**Figure 2:** Breakdown of heat loss for a typical industrial building with a central valley gutter

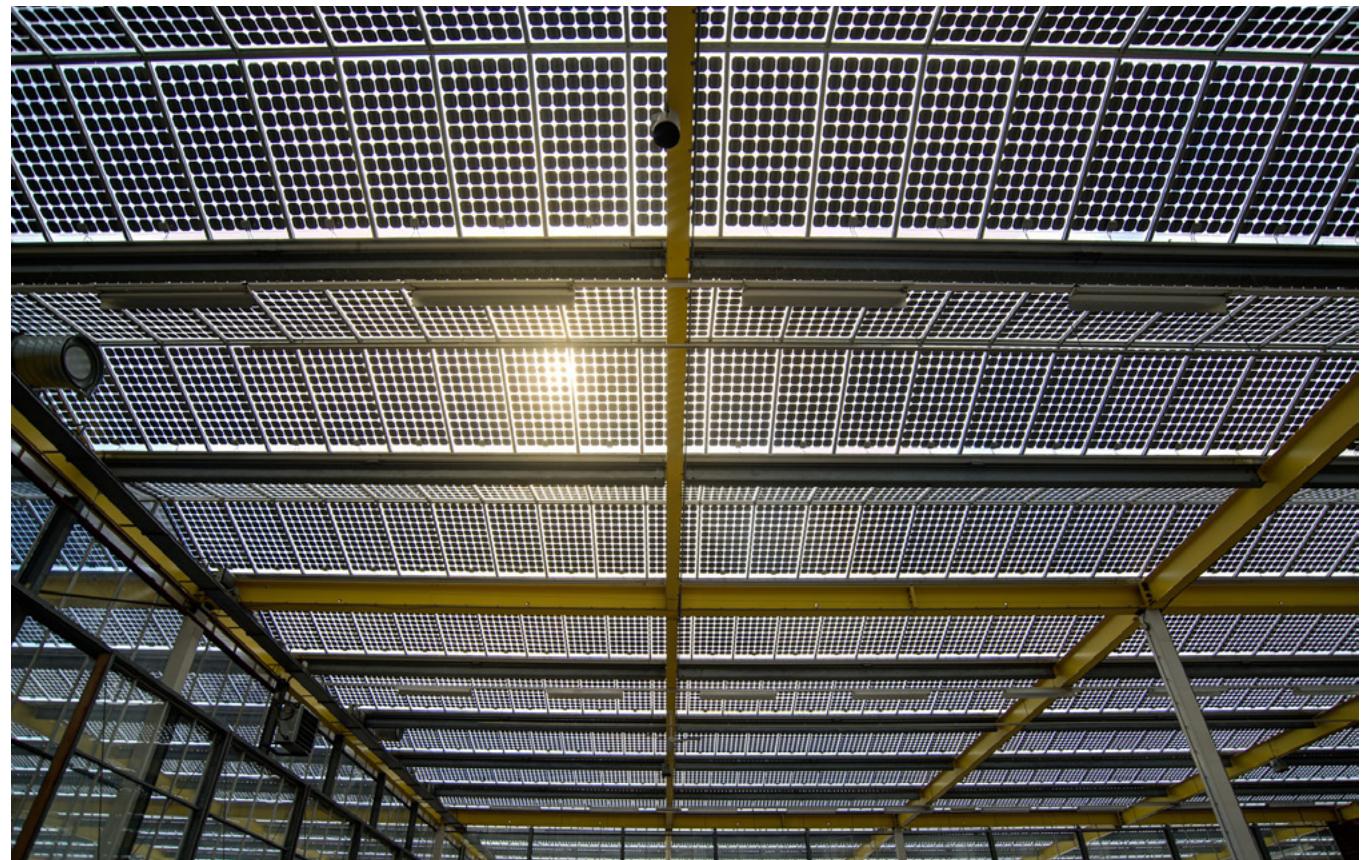


Even the most efficient heat sources require good time and temperature control. Warehouse operators should differentiate between storage temperature requirements and staff comfort. It may well be the case that the heating system can be set back to provide frost protection only, for most of the year.

## Ventilation

Many warehouses rely on natural ventilation, through windows, doors and roof vents, however where there is a need for mechanical ventilation, careful consideration should be given to options for heat recovery and also the efficiency of the fans to be used and their control.

Stratification is caused by cold air entering a building, displacing the warm air inside towards the roof, with the incoming cold air remaining at floor level. De-stratification fans can counteract this by moving the trapped warm air downwards towards floor level. By making better use of the heat energy trapped at high level your heating system can reduce its output, and significant savings can be made.





## c. Forklifts, cranes and automation

### Forklifts

Forklifts can typically account for 7-10% of a warehousing or logistics company's non-road energy costs. A range of fuel sources and the advantages / disadvantages of each are outlined below:

- **Electric** - The best solution for air quality in the warehouse and best suited to indoor use on a good surface. Also, quiet and often more manoeuvrable than diesel or LPG. Where night time electricity tariffs are taken advantage of for recharging, costs can be lower too. The main disadvantage is the higher initial purchase price and of course the need to schedule recharging.
- **Diesel** - Better for outdoor use and on gradients or where higher power is required. Also, better from a basic fuel efficiency perspective than LPG, but noise and fumes restrict application to certain environments.
- **LPG** - Suitable for some indoor use where adequate ventilation is present and well suited to outdoor operation. Better range than electric systems with less frequent requirement to refill. Noise and exhaust fume issues still need to be considered.
- **Fuel cell** - In use by some of the global logistics companies, but essentially still in the early stages of development. Typically fuelled by hydrogen which avoids air quality issues and addresses the recharging issue of electric forklifts. Cost currently prohibitive for smaller users, but this may change over time.

### Cranage

Cranes provide warehousing and logistics companies with a practical lifting solution which frees up limited floor space and keeps traffic ways clear, reducing the risk of accidents, personnel injury and product and facility damage. It can often be the case that they improve operational efficiency and from an energy perspective if purchasing a crane the highest efficiency motor classification should be specified (IEC 60034-30-1 defines International Efficiency classes from IE1 – Standard to the highest class IE5. IE4 Super Premium Efficiency motors or above would be recommended for cranes).

### Automated warehousing

By automating a warehouse, product inventories can be stored over a smaller area than in a conventional warehouse. This improves energy performance straightaway and in addition the need to illuminate and heat much of the space can be eliminated.



## d. Energy management

It is important to ensure that all stakeholders in the business are aware of the benefits that energy efficiency can bring to a warehousing and logistics business. In addition, all staff need to be engaged, involved and committed to an energy management programme.

The key actions and techniques to achieve this include:

- Development of an effective energy policy and strategy, with appropriate targets for reduction
- Good standards of energy analysis and metering, monitoring & targeting (MM&T)
- Good investment policies which prioritise investment in energy efficiency based on whole life cost
- Regular reviews of facilities with active opportunity identification
- Staff engagement and training in parallel with communication of aims and objectives

### Further information

More information can be found on energy management techniques in the following Carbon Trust guides:

- [An introduction to energy management \(CTV045\)](#)
- [Energy surveys – a practical guide \(CTG055\)](#)
- [Monitoring and targeting \(CTG077\)](#)
- [Making the business case for a carbon reduction project \(CTV067\)](#)

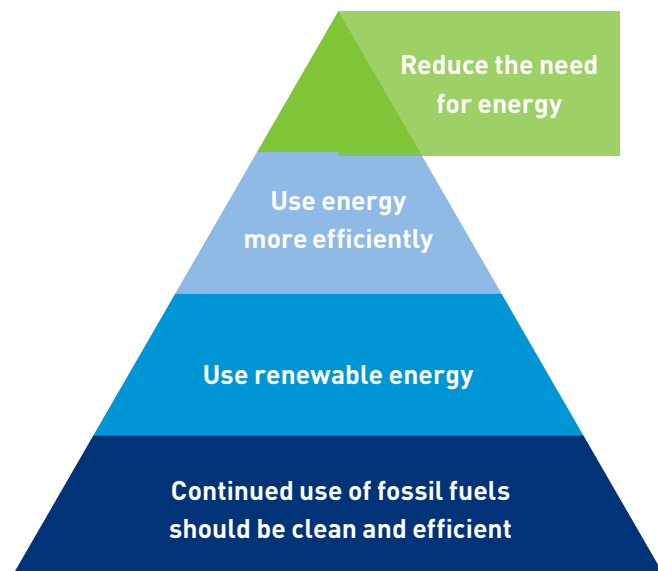


**Figure 3:** Five steps towards an energy management strategy

# Renewable energy

Using renewable energy can offer significant environmental and economic benefits

Renewable energy is part of the energy hierarchy, which defines the order in which energy saving and 'green' energy measures should be prioritised. The energy hierarchy was conceived in 1998 as part of the Local Government Position Statement on Energy and states that organisations and individuals should pursue energy issues in the following order:



As highlighted in this guide the first priority is to reduce energy consumption, through better management and through investment in more energy efficient systems. Due to the higher relative investment costs, only then should investment in renewable energy technology be considered.

## Solar Photovoltaics

Solar Photovoltaic panels (also known as PV panels) convert sunlight directly into electricity. With a reduction in prices in recent years the return on investment can be attractive. Photovoltaic materials are usually solid-state semiconductors which generate electrical current when exposed to light. Panels are available in a variety of glass and plastic based systems, including aluminium-framed panels, plain cladding, solar roof tiles and custom built glazing with integral PV cells.

With large available expanses of roof area, the warehousing and logistics sector is a good match for PV solutions. In addition, the synergy between the need for forklift and electric vehicle charging and battery storage of excess PV power can be put to good effect in well matched systems.

New-build sites in particular are ideal for PV installations because architects are able to design the roof structures to be compatible and fully integrated, for example, using PV solar roof tiles and ensuring access for maintenance.

Typical small-scale UK installations are around 15 to 25 m<sup>2</sup>. A 3 kWp system could comprise 15 panels taking up an area of 20m<sup>2</sup> and will generate roughly 2,500kWh per annum. Maintenance costs for the cells are low and generally only involve electrical checks and the cleaning of the panels.

The estimated payback time for a system ranges significantly and will depend on circumstances of each site, though it should be noted that some payback periods can be quite lengthy (7 to 10 years). The estimated life of a solar panel is around 25 years.

Solar arrays up to 5 MW are currently eligible for Feed-in-Tariff (FiT) payments with the highest amounts available for the smaller 10-50kW systems. However the feed-in-tariff scheme will end in April 2019. The example below shows the difference in payback for a typical 40kWp PV project with and without the FiT payment. Whilst the payback period is increased, there is still a case for investment.

	With FiT (4.17p higher rate)	Without FiT
Array Size	40 kWp	
Array Cost (Based on typical commercial rates)	£36,000	
Annual Energy generated (Midlands – assuming no export)	34,000 kWh	
Annual financial benefit (Assuming electricity unit rate of 12p)	£5,498	£4,080
Simple project payback	6.6 years	8.8 years

Whilst other renewable energy generation options are available for the Warehousing and logistics sector, solar PV is by far the most cost effective and practical option. For more information on solar PV and other renewable energy solutions please see the latest Carbon Trust guide [Renewable energy and CHP \(CTV010v3\)](#).

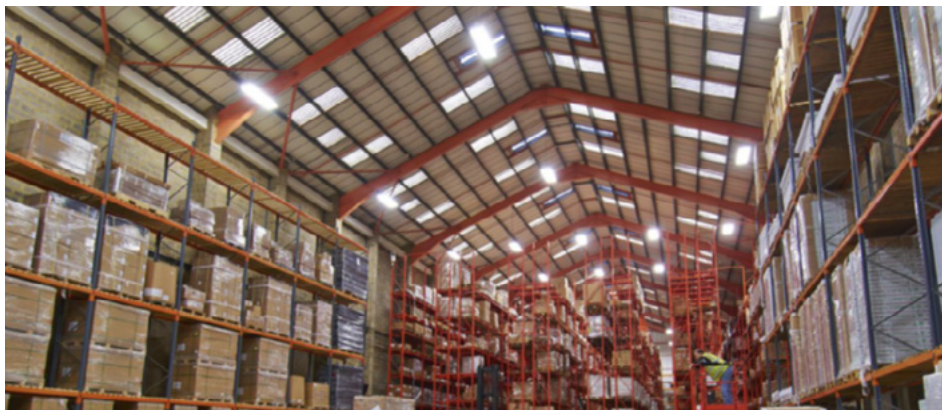


# Case Studies

## Warehouse lighting case study

A leading distributor of specialist building products replaced their lighting solution with a low energy alternative, which also increased lamp life, reducing maintenance requirements and improved light quality.

The energy efficient LED solution reduced lighting energy costs by 75% and provided the company with a return on investment in just 28 months. Re-lamping requirements were also eliminated in the short to medium term.



## Warehouse heating case study

A car parts manufacturer moved from old inefficient oil fire space heating to an efficient gas fired solution with optimised controls in their 3,250m<sup>2</sup> warehouse.

The solution incorporated destratification fans to ensure good distribution of the warm air and the more efficient system provided annual savings of £11,500. This led to a simple payback period of just 2.5 years.



# Action Checklist

Carry out this straightforward checklist to determine which actions your business should take to improve their energy performance.

Examples of energy efficiency and energy management improvements	Benefit
Put in place routine end of day and end of week walk-rounds to ensure all unnecessary lighting and equipment is switched off, where possible review energy profiles to confirm savings	Minimise energy wastage
Prioritise staff energy awareness to ensure that day to day energy issues are tackled routinely and put in place an energy policy and strategy	Minimise energy wastage
Review lighting controls and introduce presence detection and daylight dimming solutions where practical and cost effective to do so	20 – 80% saving on lighting energy
Review existing luminaire types and move to well controlled low energy LED solutions where cost effective to do so	50 – 90% saving on lighting energy
Review heating controls and improve time and temperature set points to minimise heating use	10 – 30% saving on heating energy
Review efficiency, condition and effectiveness of your existing heating solution and consider replacement with more efficient alternatives	30 – 50% saving on heating energy
Consider installing de-stratification fans to distribute warm air across the warehouse and make use of warm air trapped at high level during the winter heating season	~25% saving on heating energy
Consider installing door-interlocks to ensure that heating only operations when loading doors are closed	Minimise loss of heating energy
Ensure forklifts are charged at night to take advantage of lower tariffs	Cost saving
Review hot water requirements, tap temperatures and flow rates and optimise to reduce energy consumption. (Aim for a flow rate of 4 litres / minute and a tap temperature of ~40°C)	20 -50% saving on hot water cost
In the longer term consider options to install renewable energy solutions such as solar PV. The large roof areas of warehouses are often well suited to solar arrays	Return on investment in 7- 10 years

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# Your next steps

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

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## Step 1: Understand your energy use

Look at your site and identify the major areas of energy consumption. Check the condition and operation of equipment and monitor the power consumption over say, one week to obtain a base figure against which energy efficiency improvements can be measured.

## Step 2: Identify your opportunities

Compile an energy checklist. Walk round your building and complete the checklist at different times of day (including after hours) to identify where energy savings can be made. An [example checklist is on page 14](#).

## Step 3: Prioritise your actions

Draw up an action plan detailing a schedule of improvements that need to be made and when, along with who will be responsible for them.

## Step 4: Seek specialist help

It may be possible to implement some energy saving measures in-house but others may require specialist assistance. Discuss the more complex or expensive options with a qualified technician.

## Step 5: Make the changes and measure the savings

Implement your energy saving actions and measure against original consumption figures. This will assist future management decisions regarding your energy priorities.

## Step 6: Continue to manage your office's energy use

Enforce policies, systems and procedures to ensure that your business operates efficiently and that savings are maintained in the future.

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# Go online for more information

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

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**Website** – Visit us at [www.carbontrust.com](http://www.carbontrust.com) for our full range of advice and services.

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**Events and workshops** – We offer a variety of events, workshops and webinars ranging from a high level introductions to our services through, to technical energy efficiency training.

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➤ [www.carbontrust.com/resources/tools/sme-carbon-network](http://www.carbontrust.com/resources/tools/sme-carbon-network)



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

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