

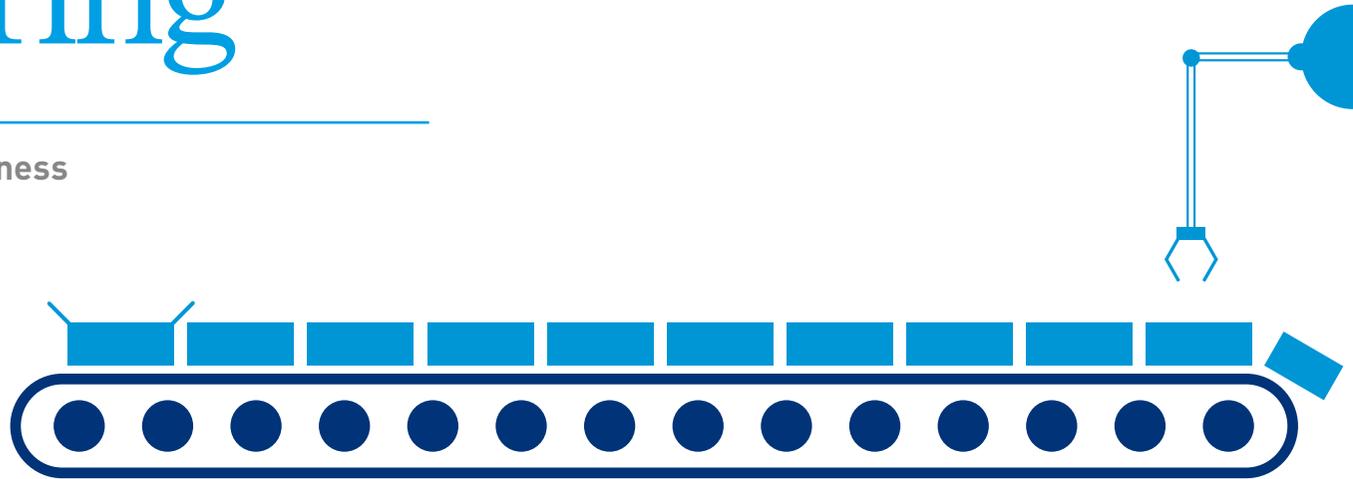


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# Manufacturing

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Introducing energy saving opportunities for business



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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 organisations take action to reduce carbon emissions, and the easiest way to do this is to use energy more efficiently.

This technology overview introduces the main energy saving opportunities for manufacturing. By taking simple actions you can save energy, cut costs and may increase profit margins.

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# Contents

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Preface	<u>3</u>
Energy Consumption	<u>4</u>
Industrial buildings	<u>6</u>
Compressed air	<u>12</u>
Motors and drives	<u>14</u>
Process heating	<u>15</u>
Process cooling	<u>17</u>
Energy management	<u>18</u>
Action checklist	<u>20</u>
Your next steps	<u>24</u>
Go online for more information	<u>25</u>

# Energy Consumption

In 2016, UK industry consumed 276TWh of energy and emitted 82 million tonnes of carbon dioxide into the atmosphere. This figure represented around 17% of the UK’s total energy use. Most of these emissions came from manufacturing.

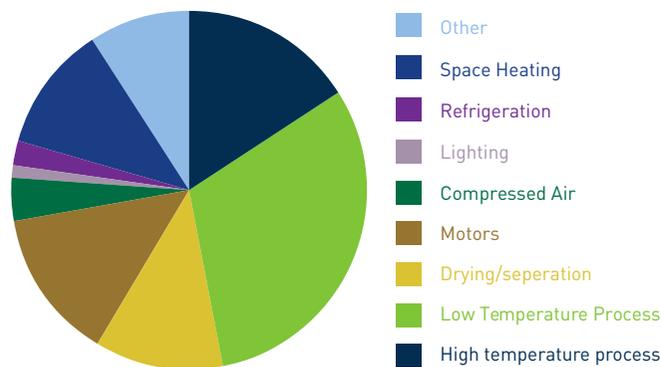
Manufacturing is any activity that transforms materials into new products. In the UK, it is a diverse sector, including food production, textiles, furniture, paper, chemicals, rubber and plastic products, glass, metals and metal products, transport equipment and electrical goods.

The chart (Figure 1, right) shows a breakdown of industrial energy consumption. It is useful as an overall guide, although the pattern will vary between industry sectors.

Although the manufacturing sector is diverse, there are some common areas where energy is wasted.

These are:

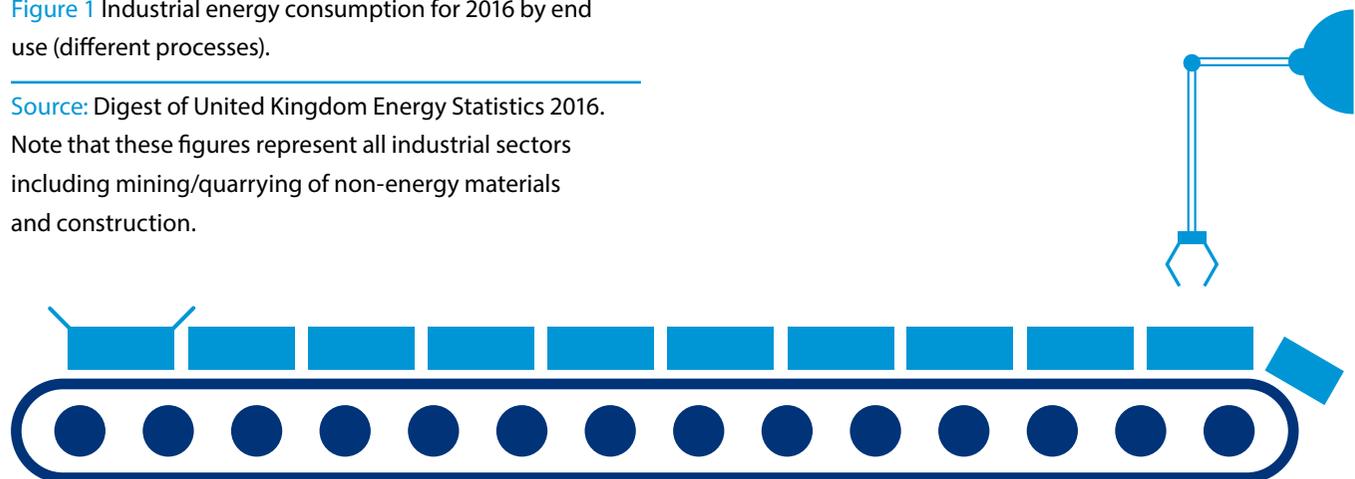
- Industrial buildings (including space heating and lighting).
- Compressed air.
- Motors and drives.
- Industrial process heating (including drying) and cooling .



**Note:** Low temperature heating process includes drying and separation, process heating and distillation in the chemicals sector; baking and separation processes in the food and drink industry; pressing and drying processes in paper manufacture; and washing, scouring, dyeing and drying in the textiles industry. High temperature processes include operation of kilns and furnaces in the ceramics, glass, metals and minerals sector.

Figure 1 Industrial energy consumption for 2016 by end use (different processes).

Source: Digest of United Kingdom Energy Statistics 2016. Note that these figures represent all industrial sectors including mining/quarrying of non-energy materials and construction.



The [Table 1](#) shows end uses of energy that dominate in particular sub-sectors. This will help you identify areas with the most energy saving opportunities for your organisation.

**Table 1** Summary of the largest end uses of energy for the industrial sectors

Industry sector	Most energy saving potential
Cement, ceramics, foundries, glass	High temperature processes (furnaces/kilns)
Chemicals	Process heating; motor-driven processes, refrigeration
Engineering	Industrial buildings, including heating, boilers, steam systems and lighting
Food and drink	Boilers; process control; refrigeration
Paper making	Drying and separation
Publishing, printing	Compressed air

### Who is this publication for?

This overview outlines energy cost saving ideas relevant to all manufacturing companies across all industry sectors. It is aimed at production and engineering managers and business leaders in manufacturing. It lists straightforward, low-cost measures as well as investment opportunities, which might require specialist advice and assistance.

### Why save energy?

Some manufacturing companies treat energy bills as a fixed cost. However, by taking a positive and proactive approach to energy efficiency, manufacturing companies can control and reduce their energy spend. All manufacturers are under pressure to cut costs and increase profits, and saving energy is one good way to meet this goal.

Furthermore, by participating in Climate Change Agreements (CCAs), most of the manufacturing sector is committed to achieving targets for energy saving.

Saving energy also improves environmental performance. It can help achieve the environmental standards ISO 14001 and ISO 50001 and, by cutting carbon emissions and helping to combat climate change, it demonstrates a degree of corporate social responsibility to stakeholders.

The Carbon Trust has the following specific sector overview publications which may be more relevant to certain sub-sectors:

- [Food and drink processing](#)
- [Chemicals](#)
- [Plastics and rubber](#)
- [Ceramics, Glass and Cement](#)
- [Metal and metal products](#)



# Opportunities for energy saving

## Industrial buildings

The energy used to heat, light and ventilate manufacturing premises may seem like a fixed overhead, but through proper control, businesses could save up to 20% of the energy used for each service.

### Heating

Keeping the workplace at a comfortable temperature is essential for a happy workforce. It is not, however, usually core to production: a typical attitude is that as long as the heating system works, it can be ignored.

Manufacturing processes often require premises to have high ceilings and good ventilation. Furthermore, delivery doors are often left open for convenience. All of these can lead to heat loss and inefficiency, wasting energy and money.

Heating alone can contribute greatly to manufacturers' energy bills. Many companies could save 20% of their heating costs, or as much as 4% of their total energy bill, by being more efficient in the way they manage and operate their heating systems.

**Take control of your heating system.** Settings on heating control systems are often altered in response to a change in weather conditions or shift patterns. Up to 10% of heating costs can be saved through these simple measures:

- Check the thermostat regularly and set to the recommended temperature. The table below has guidelines on appropriate temperatures.
- If windows are regularly being opened during colder months, consider reducing the thermostat temperature.
- Check time schedules regularly – make sure that the heating is off when the building is unoccupied.

Table 2 Recommended internal temperatures

Offices	19-21 °C
Workshops	16-21 °C
Heavy work	11-14 °C
Stores	15 °C

Source: Adapted from Environmental design CIBSE Guide A 2015

### Consider radiant heating

Because of the high ceilings and large spaces, manufacturing premises tend to lose warmed air easily and, therefore, cost more to heat.

If convective 'blown air' heaters are used, then consider changing to radiant heating. In this system, surfaces and workstations are heated directly, rather than the whole circulating air space being warmed. Therefore, radiant heating reduces losses and can improve comfort as there is more control over when the heat is on and where it is directed – the whole space need not be heated. Correct positioning of the heater is important and should be placed directly in line with the person/object requiring the heat.

Further savings on heating can be made through boilers. See the next section on steam boilers for general hints, and also refer to other Carbon Trust publications.

### Did you know?

**11% of all energy consumed by manufacturing industry is used for space heating. In some manufacturing sub- sectors this rises to over 45% and is one of the largest consumers of energy.**

### Steam boilers and systems

Many manufacturing companies use boilers to produce steam for processes; however, some of the actions suggested in this section are also applicable to low temperature hot water boilers. Further information on heating technologies can be found on the Carbon Trust website [here](#).

**By ensuring efficient steam generation and distribution, energy costs can be reduced by 10 to 30%.**

### Keep boilers well maintained

A poorly maintained boiler can consume 10% more energy than one that has been well maintained. Most industrial sites require weekly boiler checks to troubleshoot any problems, such as warning lights, air-vent blockages and unusual noises. Boilers need servicing at least once a year or as recommended by the manufacturer, and burners and heat exchangers must be cleaned to remove the build-up of deposits. Any worn parts should also be replaced. The servicing should include a combustion and/or flue-gas test, and an adjustment to the fuel/air mix should be made ensure that the boiler burns fuel efficiently.

## Case study

### What other manufacturers are doing

Through the Carbon Trust's Green Business Fund, one of the UK's leading providers of labelling and marking solutions was able to secure funding to replace an aged gas boiler with an energy efficient condensing boiler. Through reduced energy bills the company now save £2,200 every year as well as minimising their carbon footprint. Furthermore, they have been offered a rebate from the Carbon Trust's Green Business Fund of £2,200.

### Fact:

**Around 10% of the heat produced in steam boilers can be lost through insufficient or ineffective insulation on the distribution system.**

### Check for leaks

Look for wisps of steam leaking from faulty steam traps, pipework flanges and joints. Leaks are easily detected and even a small leak can waste a lot of steam, so it is important to find and repair them promptly.

**Fit insulation and inspect it regularly**

Make sure that all distribution networks (such as pipes, valves and flanges) are fully insulated and that the insulation is in good condition. Reducing heat loss will cut running costs.

**Isolate and control**

Boilers are at their most efficient when operating at their maximum firing rate. If the business needs different rates of heat for different processes, it might be worth considering having several small boilers rather than one large one. Installing automated controls will ensure that the boilers are used in the most efficient way. These ideas are discussed in more depth in the Carbon Trust's publications on boilers: [Steam and high temperature boilers \(CTV052\)](#) and [Low temperature, hot water boilers \(CTV051\)](#).

**Fact:**

**A single 3mm hole in your steam system could cost £1,700/year!**

**Ventilation**

Effective ventilation helps manufacturing companies to stay productive and safe. Because of this, many manufacturers are often concerned about changing

ventilation systems that appear to be functioning adequately. However, ventilation can waste a significant amount of energy and require regular reviews.

## Case study

### What other manufacturers are doing

A steam trap survey at a refinery found 314 traps (8%) to be failing to open or passing steam (see [page 14](#)). The steam trap replacement project provided an opportunity to standardise the assembly, installation and the approach to retrofitting. The reduction in energy losses through replacing the faulty steam traps saved £69,000/year and made further maintenance easier and quicker.

**Turn off unnecessary ventilation**

If there is unnecessary ventilation, not only is energy being lost through running the ventilation system itself, but there also may be additional costs incurred in treating and heating the replacement air.

Check that local extraction fans are not left running unnecessarily, either outside of production hours or during long breaks between shifts. When the fans cannot be seen or heard, detect air movement by holding thin strips of tissue paper in airflows or by using a child's bubble maker. Ask staff to ensure that ventilation is not running unnecessarily.

**Consider automating controls**

Consider automating the process of shutting down ventilation systems with controls such as timers, occupancy sensors or controls linked to machinery operation (interlocked controls). These will stop ventilation systems running when staff members are not working, or when related plant are off.

**Localise ventilation**

Position process plant that needs localised ventilation in a self-contained area where possible and introduce fresh, untreated air close to the plant and extractor. This reduces costs by preventing heated or cooled air being drawn from the surrounding areas.

**Fit and maintain shutters**

Back-draught shutters or dampers prevent air blowing through fans when they are not in use. Ensure shutters or dampers are fitted and kept clean.

See the motors and drives section on page 16 for more energy saving ideas applicable to ventilation systems.

## Case study

### What other manufacturers are doing

With help from the Carbon Trust, one manufacturer in Scotland saved £170,000/ year (equivalent to 2,200 tonnes per year of CO<sub>2</sub>) on ventilation costs. This was achieved by reducing fan speeds, installing non-return dampers and reducing chiller loading. The same actions could be taken by any manufacturer using large-scale ventilation and air conditioning, such as in the manufacture of semiconductors, pharmaceuticals or large computer suites.

#### Air conditioning

Air conditioning is sometimes essential to the manufacturing process, and it is often found in offices to improve staff comfort (though this is more accurately referred to as 'comfort cooling', see box). Air conditioned buildings use around twice as much energy as naturally ventilated buildings. It is worth reviewing where air conditioning is used to save energy. Careful selection and control of air conditioning can reduce costs, as can a linked heating, ventilation and air conditioning system.

In recent years, there has been significant progress in the application of techniques that reduce the dependency on conventional air conditioning. For example, there is now a move towards natural and passive ventilation, mixed- mode operation and low energy cooling systems.

#### Control it – temperatures and times

It is a common occurrence for settings to be altered on air conditioning units and not reset correctly, so check temperature and time controls regularly. Make sure, for example, that temperatures are not set at an excessively low cooling set point, for example below 24°C. Look at the operating patterns of the air conditioning chillers relative to outside conditions and check for excessive running.

Review switch on temperatures. Set higher 'switch on' temperatures and set a gap or 'dead band' between the heating and air conditioning control temperatures of at least 4°C. This improves staff comfort, cuts operating costs and reduces wear and tear on both systems.

**Comfort and process requirements can be met while keeping the operation of the air conditioning system to a minimum.**

#### Stop relative humidity control – if possible

Controlling relative humidity is very energy intensive. Consideration should be given to whether humidity control is really needed and, if so, keep the minimum and maximum acceptable humidity levels as far apart as possible. Whilst some processes may need relative humidity control, full air conditioning may not always be necessary.

#### Take advantage of free cooling

Investigate ways to reduce the internal temperature at no cost, such as by using night cooling. Free cooling or natural ventilation is the process of supplying cool fresh air to an indoor space without use of a mechanical system. This is an effective and zero-cost method to reduce excessive indoor temperatures, when it is cooler outside than inside.

More detailed information on all of these energy saving opportunities is available in the Carbon Trust's overview of [Heating, ventilation and air conditioning \[CTV046v3\]](#).

#### Did you know?

**The true definition of an 'air conditioning system' is one which has the ability to control temperature, humidity and air quality within precise limits, yet the term is often applied to systems which simply cool the space. These cool air systems are more correctly referred to as 'comfort cooling'.**

## Lighting

Most manufacturing companies spend little time considering how their premises are lit. Lighting can be a good starting point to reducing energy costs, as many of the actions cost nothing to implement, and the payback in terms of staff morale and support, not to mention cost savings, can be great. By taking the following actions, up to 20% of the energy used to light a site could be saved.

### Switch off lights

Lights switched on in the morning are often left on all day – even if they are not needed. Here are some simple ideas to ensure that lights in unoccupied areas are switched off, potentially saving 10% or more of lighting costs.

- Encourage people to turn off lights – use posters and team meetings to raise energy awareness and motivate people to turn off lights.
- Make sure everyone knows where the light switches are – label light switches so that it is easy to see which switch controls which light.
- Make sure that lights are switched off when the premises are closed – carry out a survey to find out if lights are turned off out of operating hours. Ask cleaning and security staff to turn off lights in unoccupied areas.

### Make good use of natural light

Most people prefer to work in natural light so make the most of daylight where it is available. Try the following:

- Check how often and how well windows are cleaned; have windows cleaned more often if necessary.
- Check that any skylights are clean and being used effectively.
- Make sure window blinds are open in daylight hours, except when needed to reduce glare or solar gain.
- Move any objects that are obstructing windows.
- Review the location of people and if possible move them closer to a natural light source.

### Replace inefficient lamps

Replace light fittings with more efficient equivalents. LED lighting has become the light source of choice for most industrial applications. LEDs have the highest efficacy and lamp life of all widely used lighting types, are easy to control and have no warm up period. They can save up to 80% compared to legacy lighting types.

Other benefits of upgrading to LED lighting include: Longer lamp life (lower and less frequent maintenance costs); reduced heat gain and greater luminosity; and better controllability.

### Lighting controls

No matter the efficiency of the lighting being used, if not properly controlled there will always be wastage and avoidable costs. Lighting controls are important in ensuring there is the right amount of light, in the right place at the right time. Automated controls are an effective way of doing this. There are three main form of automated lighting controls: Movement sensors (occupancy control), time clock (timed schedule), and light sensors (daylight linking). In general, properly installed and managed lighting controls can reduce lighting energy use by 30-50% in a typical office environment.

#### Fact:

For some industrial companies, over 10% of their electricity consumption can be due to lighting





Figure 2 Examples of free stickers available from the Carbon Trust

[Download](#)

### Building fabric

Many manufacturers do not set aside money to maintain their walls, doors, windows and roofs. But investing in the building fabric of the premises is often cost effective because:

- It will decrease the chances of heat loss.
- It can increase the value of the property.
- It can boost staff morale by providing a more comfortable working environment.

Simple maintenance and housekeeping actions cost little and can save energy. Some examples of this include:

- When not in use, keep factory and loading bay doors closed to prevent heat loss.
- Repair broken or cracked windows as soon as possible and apply draught strips wherever draughts can be felt.

For a small investment, there are further measures which can be taken, as detailed below.

#### Separate warm from cool space

Separate heated offices or workspaces from unheated storage areas to reduce heat losses and improve comfort.

For doors that are used frequently consider fitting one of the following:

- Airlocks / draught lobbies.
- PVC curtains.
- Warm-air curtains.
- High-speed /rapid roll doors.

Make sure the building fabric around doors is sealed.

Avoid using doors at opposite sides of the warehouse at the same time because this will create a through draught.

#### Insulate roofs, skylights and cavity walls

Improving loft and cavity wall insulation is the single most cost-effective measure that can be made to the building fabric.

Make sure there is an appropriate thickness of insulation within the roof structure, insulation with a high thermal resistance, and minimal thermal bridging. About 25% of a building's heat can escape through an un-insulated single skin roof. Methods for insulating these types of roof include lining, over-spraying and under-spraying.

- Consider installing polycarbonate secondary glazing under skylights – it can reduce heat losses by up to 50% and eliminates down draughts.
- Insulate cavity walls – it can reduce heat loss by up to 50%.

#### Redirect the heat

Heat rises, so if processes generate a lot of heat, the warmed air will be at the top of the building air space. Fitting de-stratification fans will re-circulate hot air back down to the shop floor, saving on heating costs.

More detailed information on these energy saving opportunities is available in the Carbon Trust's overview of [Building fabric available here](#).

## Case study

### What other manufacturers are doing

A Northern Ireland manufacturer reduced its energy costs by 20% after taking specialist advice from the Carbon Trust on how to reduce its energy bill of £823,000. The firm was losing money through air leakages and poor compression during production processes. They purchased new equipment that delivered energy savings, and the capital invested was set to be recouped within two years.

## Compressed air

**For many manufacturers, compressed air is an essential utility. However, it is also a major source of energy wastage.**

Compressed air is an expensive utility and many businesses spend money unnecessarily on it. Reducing wastage can save up to 30% of compressed air costs. Typical areas of waste are through leaks in the distribution system and through staff using compressed air where it is not necessary.

### Green Business Fund

**Investing in energy efficient equipment makes sound business and environmental sense. Small and medium-sized companies can benefit from direct funded support for energy assessments, training workshops, and equipment procurement thanks to the Green Business Fund brought to you by the Carbon Trust. To find out more visit <https://www.carbontrust.com/green-business-fund/>.**

### Switch it off

Quite simply, if a compressor is not being used, then make sure that it is switched off. Pay particular attention to compressors at the end of shifts or over weekends.

### Eliminate unnecessary compressed air usage

Identify where compressed air is used on a site and then check to make sure that it is required for the task. Industrial sites can often misuse compressed air just because the air supply is readily available, not because it is the most cost effective or appropriate method.

For example, using low-pressure blowers is a more energy efficient way to dry components than using an 'air-knife' device running on compressed air. Another common misuse is cleaning machinery. If it is not

necessary to use compressed air, then brushes and vacuums could be much cheaper alternatives.

Produce a compressed air usage policy for employees specifying where and when compressed air should and should not be used. Ensure that the policy is displayed at appropriate places across the site.

### Fact:

**An idling compressor can still use up to 40% of its full load.**



## Tax incentives

Enhanced Capital Allowances (ECAs) are a straightforward way for a business to improve its cash flow through accelerated tax relief. The ECA scheme for energy - saving technologies encourages businesses to invest in energy saving plant or machinery specified on the Energy Technology List (ETL) which is managed by the Carbon Trust on behalf of Government.

The ECA scheme provides businesses with 100% first year tax relief on their qualifying capital expenditure. The ETL specifies the energy-saving technologies that are included in the ECA scheme. The scheme allows businesses to write off the whole cost of the equipment against taxable profits in the year of purchase. For further information please visit [www.carbontrust.com/energy-technology-list/](http://www.carbontrust.com/energy-technology-list/).

## Ensure maintenance is carried out regularly

Follow the manufacturer's documentation for the recommended maintenance schedule. Maintenance routines should include lubrication, oil changes and filter replacement. A well-maintained compressor can be 10% more efficient than one that is poorly maintained.

## Reduce air pressure

Many systems produce compressed air at a higher pressure than required. Ask equipment and tool manufacturers to specify the minimum air pressure necessary to drive the machinery and then ensure that the system meets, and does not exceed, these requirements.

If one specific application requires a higher pressure, then consider installing a smaller, local generator rather than increasing the pressure of the whole system.

## Check frequently for leaks

Industrial sites often have compressed air leakage rates of up to 30%, wasting considerable amounts of energy and money. A systematic and regular leak-detection programme should be put in place to check for leaks and then make sure that they are repaired as quickly as possible. It may be appropriate to schedule a leak-detection exercise every three months.

Leaks can be detected by simply listening to the system, by using a soapy solution on suspect areas to see if bubbles appear, or through ultrasonic leak detection equipment which can be hired or bought.

Once leaks are found, mark them on a plan of the system. Before attempting any repair work, make sure that the system is de-pressurised. Small leaks can be repaired on-site, but an equipment supplier should be contacted before tackling larger leaks. Consult a supplier if there is any doubt on how to proceed.

## Did you know?

Correctly siting compressors is crucial – good placement could mean the compressors have access to cooler intake air, and a way to recover the heat that is expelled from the plant.

## Are any parts of the system not needed?

Consider whether there are parts of the compressed air system that are not needed, such as unused pipework, and isolate areas that are not in use. This will increase the efficiency of the compressed air system.

If a system requires compressed air at different times in its operation, then consider using isolation valves to divide the system into zones.

## Bring in air from outside

Colder air is denser so if the intake air is cooler, the compressor does not need to work as hard because the air requires less compression. Bringing in cooler intake air from outside can therefore produce substantial savings. Consider measuring the temperature difference to see how much could be saved.

**For every 4°C drop in temperature of the intake air, efficiency improves by 1%.**

### Could waste heat be re-used?

Up to 90% of the heat generated by a compressor can be used to heat water or air. Therefore, consider whether the heat generated can be re-used to:

- Heat a space in the warehouse or workshop.
- Keep things dry – by simply placing the compressor in a warehouse, manufacturers could prevent perishable material such as cardboard boxes from becoming damp.

These and further measures are discussed in more detail in the Carbon Trust's technology overview of [Compressed air available here](#).

## Case study

### What other manufacturers are doing

By implementing the action plan from a Carbon Trust energy survey, a galvanising company is now saving £12,200/year on its compressed air costs. The actions taken included: introducing a compressed air leakage reduction programme, installing a variable speed drive compressor and reducing the pressure of the compressed air system. The payback for the project was 11 months.

### Motors and drives

**Motors consume an estimated quarter of the electrical energy used by manufacturing sites. However, they are often overlooked and, as a result, many sites have relatively inefficient motor operations.**

#### Did you know?

**A fully loaded motor typically consumes its purchase cost in electricity in 30 to 40 days of continuous running. Always consider the whole life cycle costs before buying a new motor. Make sure calculations take into account the commissioning, installation and purchase costs as well as running costs, that is, energy and maintenance costs.**

#### Switch it off

Identify all systems that use motors and encourage employees to turn them off when they are not required. Staff sometimes believe that leaving a motor on is necessary for a process, or even that it is more efficient to do so. Display information about when it is appropriate to turn off a motor, pump or fan.

Programmable controls, which switch machinery off automatically, could make energy saving even easier.

### Maintain motor systems

Carrying out regular maintenance can reduce energy consumption by as much as 7%. Maintenance programmes should consist of lubrication schedules, cleaning, belt tensioning and alignment checks. It is also worth considering using predictive maintenance techniques and software that can indicate in advance when parts will need replacing. Motor suppliers will be able to provide more details.

#### Check that motors are the correct size

Motors are often larger than they need to be. Compare the details on the motor rating plate with the actual rating required by the equipment that the motor is driving. In many cases, motors are oversized by 20% or more. For example, an application might require a motor rated at only 7.5kW, but has been supplied with a motor that is 11kW. Consider replacing lightly loaded oversized motors with smaller, higher efficiency motors where cost effective. This advice typically holds true for small motors; larger motors will typically see a much smaller drop in efficiency on reduced loading. If the motor is very lightly loaded (<40%) and cannot be changed, it may be possible to run the motor continually in a different connection mode (called star or delta mode), that could result in energy savings of between 5 and 10%.

Consult a motor supplier regarding connection modes. They will be able to assess the business's needs and advise about the most effective solution.

### Replace failed motors with higher efficiency motors

It is usually better to purchase a new motor than to rewind an old one – motors are 1% and 2% less efficient when rewound. Consider replacing failed motors with higher efficiency motors. Premium efficiency motors (IE4 and IE5) are more efficient than other motors due to their improved design and materials. Energy efficiency improvements of 5% are possible if older failed motors are replaced with high efficiency models.

**Reduce a motor's speed with a variable speed drive by 20% and energy consumption can drop by 50%.**

### Installing variable speed drives (VSDs)

A VSD is an electronic device that can vary the speed of motor-driven equipment, such as a compressor, fan or pump. The VSD converts the incoming electrical supply of fixed frequency into a variable frequency output to control the motor – a low frequency for a slow speed and a higher frequency for a faster speed.

Fans and pumps are usually the best applications for a VSD. Usually, these are used in areas with a variable demand and reduce flow by slowing the fan or pump instead of closing dampers or valves. Reducing the

motor speed by 20% reduces the power requirement by about 50% and, therefore, significant energy savings can be made.

Refer to [Motors and drives \(CTV048\)](#) and to [Variable speed drives \(CTG070\)](#) for more detail.

#### Fact:

**Installing a variable speed drive can typically save up to 30% of running costs .**

### Process heating

Process heating covers a wide range of systems. As this guide relates to manufacturing, this section focuses particularly on dryers, ovens and heated tanks. For information on other types of process heating, refer to the [previous section on steam boilers and systems \(page 7\)](#) and read the overview on [High temperature industry \(CTV056\)](#). The Carbon Trust also produces specific publications on process heating.

Changing or improving the manufacturing processes and recovering waste heat are the two main actions that should be considered by businesses with process heating systems. Other tips are more system-specific and these will generally require the help of an expert to implement.

Can the schedule or process be changed? Once a process or method of working is in place it can be

difficult to change. Sometimes, however, the most basic changes can give a good payback. For example:

- Has consideration been given to whether work schedules could be changed to operate equipment for shorter periods at higher capacity? Operating dryers, ovens and tanks when full is more efficient than running several half-loads.
- Could an alternative method be used? For example, mechanical de-watering, such as pressing or centrifuging, can reduce the need for drying heat and save energy.

### Recover waste heat

The waste heat generated by most heating systems may be able to be recovered and re-used for various applications; such as preheating feedstock or a mains water feed, or as space heating in a workshop.

### Dryers

Dryers are used in a range of manufacturing industries including food and drink, chemicals and paper. In some manufacturing sectors, dryers can contribute up to 30% of total energy use. Therefore, measures that can increase dryer efficiency or reduce the need for drying can lead to major energy savings and cost reductions.

**For example, an animal feed producer eliminated some dryers completely by re-branding the product and selling it undried.**

### *Moisture levels*

Put simply, preventing excess water getting into the feedstock during storage will reduce the amount of heat needed for drying. Conversely, increasing the allowable moisture content of the product will also reduce the need for drying.

### **Keep dryers well maintained**

Make sure that dryers are regularly maintained and are operating efficiently. Check for the following and take action as needed:

- Damaged insulation. Check for signs of damage and repair insulation, either in-house or by using contractors.
- Clogged or ripped air filters. This could reduce or increase the airflow into the dryer and could, therefore, affect the drying rate. A contractor can replace the filter or unclog it using compressed air.
- Air leaks into or out of the dryer. A maintenance engineer or contractor can rectify this.
- Product quality. Ask if the product is over-dried or still wet. Monitor product quality and have controls adjusted accordingly.
- Operation of ancillary systems (such as steam, compressed air, fans and instruments). A utility manager or plant/process engineer should be able to optimise these for the required process.

### *Improve process scheduling*

Proper scheduling should ensure that equipment is only preheated for the required period and no longer. Identify operations where dryers are heated unnecessarily and consider installing automatic controls such as a timed cut-out device.

### **Ovens**

Ovens are used in many diverse processes ranging from baking food to curing paint. There are two main types of oven: batch and continuous. The choice of oven is largely governed by the needs of the product, but the information below is applicable to both types.

### *Inspect and maintain ovens*

Ensure that ovens are regularly inspected. Check for worn or broken oven seals or damaged insulation, both of which lead to wasted heat energy. Repair these promptly.

Encourage employees to look for signs of inefficient ovens, such as hot air blowing out of the oven ends. Instances should be reported straightaway and maintenance checks made.

### *Improve process control*

Bringing ovens up to temperature uses considerable heat energy. Therefore, identify the minimum time required to heat ovens and then install automatic process control to reduce the heat-up time. This will ensure that heating only takes place for as long as is necessary for the process.

### *Keep the heat in*

In a batch oven, make sure that the doors are not left open longer than necessary. For continuous ovens, fit air curtains to tunnel openings to keep hot air in. If these are designed and balanced properly, staff should be able to stand close to the open ends without feeling any discomfort.

### **Tanks containing hot liquid**

Tanks are widely used in manufacturing for wet processes such as glazing, degreasing and metal treatment. The following actions are low-cost measures to make tanks more efficient.

### *Reduce evaporation losses*

Heat is lost from tank solutions through surface evaporation. Heat losses can be reduced by over 50% by fitting a lid to the tank, and by regulating the solution agitation and the level of extraction.

### *Cover and insulate*

Tanks should be covered at night with a lid to reduce heat loss. This could halve the warm-up time the next day and save up to 30% of the heat energy.

At least 50mm of insulation should be fitted to the tank sides and lid, which will result in savings of up to 90% of the heat energy.

### *Control solution temperatures and heating times*

Tanks should not be preheated for excessive periods and should not be heated when they are not being used. Regularly maintaining and calibrating temperature sensors and controls will save energy and help to ensure product quality.

## Case study

### What other manufacturers are doing

A Northern Ireland aluminium casting company has achieved impressive energy savings through implementing a number of measures at its factory including a Combined Heat and Power (CHP) unit, enabling electricity to be generated on-site and providing heat for the factory. In addition, airflow was reduced by zoning and installing automatic doors, and a Building Energy Management System (BEMS) was put in place to enable energy data to be gathered and analysed. These measures combined, resulted in annual total savings of £250,000 equating to approx. 1,150 tonnes of CO<sub>2</sub>. The project achieved payback in 3.3 years.

### Process cooling

Cooling systems are used anywhere there is a need to remove heat. The main types of cooling system are air-cooled, water-cooled and refrigerated. Process cooling is worth considering as a self-contained activity using the following steps:

#### Measure and monitor

Consider installing sub-meters so that it is easy to see how much electricity individual cooling processes or areas use. This will also help to identify areas where further energy savings can be made. The information gained will identify any deterioration in system performance, show the effects of operational changes and confirm the level of savings resulting from any actions taken.

Meter readings can be used to plot electricity consumption against production output. With good process control systems, there should be a direct relationship between the cooling system's electrical demand and the production output. If there is no direct relationship, then it is likely that the cooling system is not being controlled effectively.

See page 18 for more information on managing energy usage.

#### Implement effective control

Set target temperatures for processes. Monitor the actual temperatures achieved under normal working conditions and identify if there is any overcooling, which is a major cause of energy wastage in cooling systems. Overcooling could be reduced by changing operating procedures or by installing automatic

controls. Controls need to be effective both at the point of use, (for example, the local control of temperature on a food processing line) and at the system level (for example, the control of cooling water temperature at a central cooling tower).

#### Plan a programme of maintenance

Ensure that the cooling system operates efficiently by carrying out planned, preventive maintenance.

Focus on the four key areas below:

- Pipework and controls – check for leaks, poor insulation, scale formation, sensors drifting and control valves sticking.
- Water treatment – necessary to meet health and safety requirements, and to prevent corrosion and fouling.
- Pumps – inspect regularly, replace worn parts and clean filters. When motors fail, consider replacing them with higher efficiency motors and make sure that the motor is not oversized. Consider installing a VSD ([see page 14](#) for more information about motors).
- Cooling towers – check the thermostat controls on sump heaters, check for wear and damage to fans and water dispersion equipment, and check that schedules of fans are appropriate where banks of cooling towers exist and/or check for potential to install variable speed drives ([see page 15](#)).

## Energy Management

**Good energy management costs almost nothing – but can lead to huge savings.**

### Develop a policy and raise awareness

Commitment to energy efficiency needs to come from senior managers, who should agree and implement an energy policy. The policy should clearly identify the formal roles and responsibilities of the management team. Allocate responsibilities, time and budget for implementing energy management measures.

### Conduct a walk round

Review energy use and procedures regularly by carrying out a walk round. Use a checklist, which could be based on the action checklist on page 23, to identify sources of waste energy or new ways of saving energy. Guidance on conducting an energy survey is available [here](#).

### Monitor energy consumption

Measure energy consumption by reviewing invoices and metered data to build a picture of periodic energy performance. Larger sites will have meters recording half-hourly electricity consumption which are a rich source of data.

Check and record consumption of all energy sources for the site.

You can contact your energy supplier to request the installation of a smart energy meter. Electricity and gas

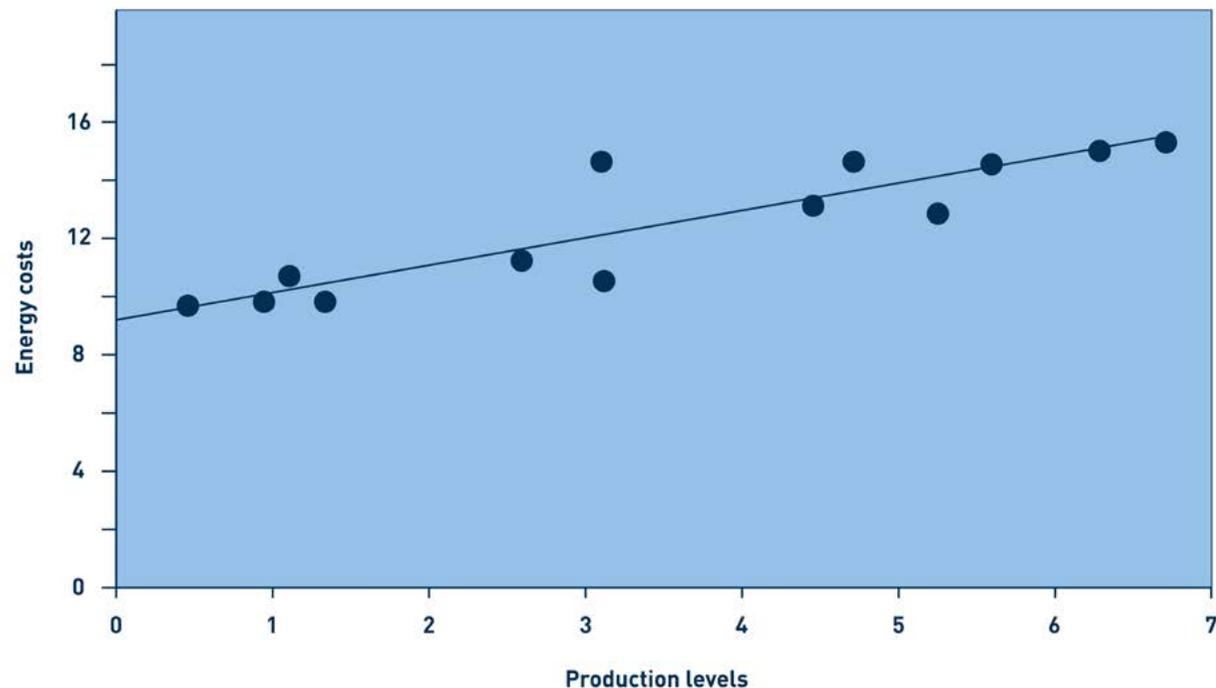


Figure 3 Example graph of energy costs plotted against production

suppliers need to demonstrate that they have done all they can to roll out smart meters to all their domestic and small business customers by the end of 2020.

### Understand energy consumption

Monitoring consumption helps to identify periods of high-energy use, such as periods of extra production. It can also demonstrate whether energy saving measures are having an impact.

As well as being a basic check on how the business is performing, energy use data can be useful when compared with production levels.

The simplest way to do this is to plot a graph comparing energy use against production levels like the one shown in Figure 3 above. The high intercept on this example shows that a high baseload of energy is being used, even when there is no production.

The scatter of points around the best-fit line gives an indication of how well controlled the process is. As energy saving measures in this overview are implemented, there should be a reduction in both the gradient and the intercept on the energy usage axis. Comparing energy use and performance data month on month, year on year can also show where energy savings measures have had an impact.

This is an internationally recognised, standardised framework that assists companies with their energy management. It aims to help develop policies and objectives, which lead to better data collection, monitoring and understanding of the results. This results in the ability to develop a continually improving energy management programme. Compliant companies will receive certification to [ISO50001](https://www.iso.org/iso-50001).

Further information can be found at: <https://www.iso.org/iso-50001-energy-management.html>

### **Set realistic targets and deadlines for improvement**

Most businesses in the UK could reduce their energy consumption by between 10 and 40%. However, it is important to be realistic: many companies start by aiming for savings of 5% per year.

Have an action plan and implement it. An action plan should be developed listing improvements to be made, when they will be made and who will be responsible. The list should be prioritised in order of energy saving potential and payback period.

**For further advice please download our Energy management guide here.**



# Action checklist



Cost	Action	Progress
Heating		
None	Check thermostat settings	
None	Check timer switches	
Medium	Consider radiant heating	
Steam boilers and systems		
Low	Prepare a maintenance schedule	
Medium	Investigate installing automatic control	
Low	Check for leaks	
Low	Fit insulation and inspect regularly	

Cost	Action	Progress
Ventilation		
None	Turn off ventilation when not needed	
Low	Consider automating control	
Low	Put process plant that needs local ventilation in a special area	
Low	Fit and maintain shutters	
Air conditioning		
None	Consider whether it is really necessary	
None	Check temperatures and times	
None	Stop relative humidity control – if possible	
None	Take advantage of free cooling	
Lighting		
None	Switch off unnecessary lighting	
None	Make better use of natural light	
Low or Medium	Replace lamps with LED	
Building fabric		
None	Keep factory and loading bay doors closed when not in use	
Medium	Consider fitting airlocks/PVC curtains/warm-air curtains/rapid roll doors	
Medium	Fit destratification fans to recirculate heat	
Low	Repair broken windows and apply draft strips	

Cost	Action	Progress
Compressed air		
None	Cut down on unnecessary compressed air usage	
None	Turn off compressors when not needed	
None	Reduce air pressure where possible	
None	Check frequently for leaks	
None	Isolate parts of the system that are not needed	
Low	Investigate supplying compressor air from outside	
Motors and drives		
None	Switch off motors when they are not required	
Medium	Check that motors are the correct size	
Medium	Replace failed motors with higher efficiency ones	
Medium	Install variable speed drives where possible	
Industrial process heating and cooling		
Low	Maintain all process equipment to optimum standard	
Variable	Automate controls where possible	
Medium-High	Check for any opportunities for waste heat recovery and use	
Process heating		
Variable	Optimise the schedule or process	
Medium	Investigate waste heat recovery	

Cost	Action	Progress
Dryers		
None	Optimise the moisture level in the raw material or product	
None-Low	Switch off process heating when not required, consider automatic controls	
Ovens		
None-Medium	Close doors or fit air curtains	
Tanks		
Low	Fit lids, control agitation and extraction	
Low	Insulate tanks	
Process cooling		
Low	Identify areas of overcooling and rectify	
Energy management		
None-Low	Develop a policy and raise awareness	
None-Low	Conduct a walk round	
Low	Monitor energy consumption	
Low	Analyse energy use	
Set targets		
None-Low	Design an action plan	

# Next steps

Start with the following easy low and no-cost options to help save money and improve the energy performance of the site:

## Step 1: Understand your energy use

Look at the site and identify the major areas of energy consumption. Check the condition and operation of equipment and monitor power consumption over one week to obtain a base figure against which energy improvements can be measured. Also monitor relevant variables that affect energy consumption.

## Step 2: Identify your opportunities

Compile an energy checklist. Walk round the site and complete the checklist at different times of day (including after hours) to identify where energy savings can be made. See [Action checklist](#).

## 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 help. 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. Take the variables and driving factors into account when you come to verify savings. This will assist future management decisions regarding your energy priorities.

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

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

# 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.

➔ [www.carbontrust.com](http://www.carbontrust.com)

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**Tools, guides and reports** – We have a library of publications detailing energy saving techniques for a range of sectors and technologies.

➔ [www.carbontrust.com/resources](http://www.carbontrust.com/resources)

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

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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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+44 (0) 20 7170 7000

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