
Agriculture and horticulture

Introducing energy saving opportunities for farmers and growers



Preface

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 sector overview for farmers and growers introduces the main energy saving opportunities for businesses within the agricultural and horticultural sector and demonstrates how simple actions save energy, cut costs and increase profit margins.

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Introduction

In farming and horticultural businesses, energy costs may only represent a small percentage of turnover, but reducing them can directly increase profits and competitiveness. In fact, a 20% cut in energy costs can represent the same bottom line benefit as a 5% increase in sales.

In addition to economic benefits, there are of course, social and environmental advantages to reducing energy consumption, such as preserving fossil fuel supply and minimising global warming. With many produce buyers now demanding that farmers and growers demonstrate their green credentials, being energy efficient can only serve to enhance your business.

Fact:

Some farmers have already reduced their energy costs by as much as 20% by implementing simple actions that produce quick returns.

Who is this publication for?

Growers, livestock farmers and anyone in the agricultural and horticultural sectors can benefit from the advice in this publication. Focusing on low and no-cost measures and actions which will have the quickest payback, this overview demonstrates the best energy saving opportunities for the sector and will help in:

- Assessing the potential for energy savings and indicating key areas for improvement.
- Raising awareness of energy conservation amongst staff and motivating them to reduce waste.
- Appraising the overall performance of a horticultural or agricultural business.

How can you benefit from energy efficiency?

Introducing an energy efficiency scheme can have many positive results such as:

- Reduced costs and increased profitability.
- Improved internal environment in a production facility.
- Improved crop quality.
- Compliance with crop assurance schemes.
- Happier and more productive staff.
- Increased sales from customers encouraged to purchase more 'green' produce.
- Enhanced business credentials through helping the environment.

Controlling energy usage also has a beneficial effect on crops, livestock and produce.

Energy consumption in agriculture and horticulture

The agricultural and horticultural sectors encompass a wide range of activities such as pig and poultry farming, dairy farming, crop growing and storage, yet there are a number of common areas where energy is wasted.

Lighting, heating, ventilation, air circulation and refrigeration equipment are the biggest energy consumers and are therefore areas that offer the most significant savings.

Proportions of energy use always vary according to the type of business and activity or process being carried out. The table below identifies major consumption areas for specific agricultural sub-sectors.

In each of the work areas identified above, there are three main opportunities to save energy:

Switching off – All energy consuming equipment should be switched off when not required. This can be done by staff, by time switches or by adjusting building control systems and need not cost any money.

Maintenance – A number of energy efficiency measures can be carried out as part of routine maintenance procedures for no extra cost.

Controls – Simple adjustments to the location and setting of controls can reduce costs without affecting the comfort of staff and livestock or the growing and storage of produce.

Farming in the UK is a complex and diverse business with a variety of facilities being used for each stage of production. The following pages introduce some generic energy saving tips and also provide some specific advice for the main sub-sectors of agriculture and horticulture. There are a wide range of opportunities to look out for and each of these measures can be incorporated into an energy saving action plan. Remember: the more measures that are implemented, the more savings can be achieved.

Table 1 Energy consumption by activity

Activity	Major energy consumption area
Horticulture	Heating typically accounts for 90% of the energy used in a greenhouse
Pig farming	Energy plays an important part in animal welfare/feeding systems, building services and environmental protection and, most notably, in waste management and emissions control
Poultry farming	Energy use is mainly associated with the maintenance of good environmental conditions for housing the stock
Dairy	Energy use is generally split into cooling, water heating and general power for lighting and pumping
Crop stores	Energy use is closely related to insulation thickness and the difference between storage temperatures and the external air temperature
Combinable crops	Storage and drying are often a large area of energy waste

Opportunities for energy saving

Heating

Heating can have the greatest impact on energy costs in agriculture and horticulture businesses, which means that there are big opportunities to make savings. Some businesses have reduced their heating costs by 30% through the implementation of some simple energy saving measures.

Avoid opening doors and windows when heating is in operation

Many businesses in the agricultural and horticultural sector revolve around the frequent delivery and collection of produce. Staff members and delivery personnel require easy access to buildings but open doors allow warmed air to escape and cold air to enter. The thermostat then senses a temperature decrease and automatically switches on heating which may be unnecessary.

Try to keep external doors open only when absolutely necessary and ensure doors to heated barns and other outhouses are closed after use.

Ensure temperature controls match requirements

Check that system operating hours match the times when heating and ventilation are required, as needs vary throughout the day and also according to different processes and activities being carried out.

- Use simple time switches to help to automate this process so that nobody forgets.
- Ensure time settings are reviewed every month or so to check that they are correct. Many systems function inefficiently because someone made a short term adjustment and then forgot about it.

Recommended temperatures include:

- Stores: 10-12°C.
- Heavy work: 11-14°C.
- Workshops and light work: 16-19°C.
- Sedentary work: 19-21°C.

These temperatures are for buildings that are primarily used as employee workspaces. Where buildings are used for animal production, specialist advice should be taken on the required temperature levels and profiles.

Controlling systems

Many agricultural and horticultural businesses find that controlling temperature is difficult. Some signs of poor control include:

- Heating being on when it is not required, because timers are not set correctly.
- Heating being on too high or not high enough, because the thermostat is located where sunlight, drafts, radiators or electrical equipment affect its reading.

Often, simple adjustments to the location and setting of controls can reduce costs without affecting staff comfort and conditions for livestock and crops. For more information, see the [Heating control guide \(CTG065\)](#), available from the Carbon Trust.

Maintain boilers and pipe work

Check pipe work for leaks and have boilers serviced regularly by a reputable firm. Gas-fired boilers should be serviced once a year; oil boilers twice a year. A regularly serviced boiler can save as much as 10% on annual heating costs.

A diverse range of boiler equipment is used to provide heat, hot water and steam to agriculture and horticulture businesses. For more specific information related to these technologies, contact the Carbon Trust.

Ask for flue gas composition before and after a service – there should be more carbon dioxide and a lower temperature afterwards.

Consider radiant heating

Heat can be easily lost in outhouses which may have high ceilings, high air change rates (through the regular opening of delivery doors) and high ventilation rates especially where fumes need to be removed.

In these circumstances, radiant heaters can provide more energy efficient heating through radiant heat transfer. This type of heating is generally mounted overhead with a clear line of sight to the object requiring the heat at floor level. Humans and animals directly absorb energy from the heater, so the desired level of comfort can be achieved without excessively warming the surrounding air.

Insulate to save on heating costs

Boilers, hot water tanks and the associated valves and flanges (pipe joints) should be insulated to prevent heat escaping. While savings may vary depending on pipe diameters, pipe temperatures and boiler operating hours, payback can usually be expected within a few months of installation, with additional savings in subsequent years.

Easily removable covers can be used to insulate valves so if maintenance work is carried out, there is a greater chance that the covers will be replaced. Always consult a professional contractor.

Fact:

Inaccurate temperature controls lead to higher heating costs. A 1°C error in the control temperature can increase heating costs by 8%.

Upgrade controls

Heating system control can be problematic with old, inefficient time controls. Upgrades are well worth implementing as they can pay for themselves very quickly through energy and cost savings.

Heating systems are able to adjust themselves in line with the changeable UK climate. A **compensator** is a form of control for heating systems that automatically regulates the heating temperature based on the weather. An

optimum start controller learns how quickly the building reaches the desired temperature and brings the heating on at the optimum time prior to building occupancy, again depending on the weather. Both systems can achieve higher levels of comfort for staff and livestock and, in a horticultural setting, can assist in maintaining more stable temperatures for a building.

These types of controls can save thousands of pounds and will pay back their investment in just a couple of years. Consult a qualified heating technician to discuss the range of options available. More information can be found in the Carbon Trust [Heating control guide \(CTG065\)](#), available from the Carbon Trust.

MYTH – Boilers have to be on all year round.

FALSE! – If you have several boilers, it is likely there is a smaller one designed to supply your hot water needs only. If you do not require year round heating then switching off the other boilers, particularly during summer months, can save 5% of your water heating costs.

Sub-sector hints

Pig farming

Install creep heating

About 25% of the energy used on pig breeding units is for farrowing (creep) heating. Energy use is influenced by the control system, the type of heating chosen and whether creeps are boxed or open.

For example, fitting insulated creep boxes with thermostatically controlled heating to a 20 place farrowing room can yield savings of over £1150 per year, provide a more favourable environment for the piglets and significantly extend the life of heat lamps.

Install under-floor heating pads

They are generally more efficient than infrared bulbs.

Dairy

Consider radiant heating

Milking parlours are difficult to heat because they are draughty and un-insulated, so radiant heating is more efficient than space heating systems.

Contact the Carbon Trust to find out more.

Insulate pipes

Pipes can freeze during cold weather. Rather than wasting energy on heating milking parlours unnecessarily, insulate pipes so that the cold does not affect them as much. This can save on heating bills as the whole space does not need to be heated at all times.

Important: Animal farming sub-sectors

Excessively high temperatures can lead to increased heat stress in animals, affecting beef and dairy cattle, pigs and broilers. Increased heat stress will have implications for milk yield, herd fertility and general welfare, so always check that controls are set correctly.

Horticulture

Use thermal screens

Thermal screens are an effective method of reducing the heat loss from a greenhouse by up to 30%.

Fixed screens can be put in place above crops in their early stages of development (during the coldest months of the year) and then removed.

Movable screens are more tailored to crop requirements and can be opened or closed as necessary, enabling the best use of available light and heat. Costs for installing screens are around £5/m², with payback of less than three years.

Screens should be maintained in good condition, fit properly and have pelmets installed with them. A low-cost, temporary solution is to use polythene or bubble wrap.

Clean measuring boxes and sensors regularly

Always position measuring boxes close to the crop.

Clean glass regularly

Dirty glass in greenhouses reduces the amount of light reaching the crop and the free heating energy from the sun.

Important: Horticulture sub-sectors

There are a wide variety of horticultural businesses growing a range of crops under different stringent conditions. These conditions are often maintained by sophisticated environmental control systems. Significant savings are achievable in all areas, however, it is important to prioritise the conditions to maximise your crop yield. Ensure that any saving measures implemented do not conflict with environmental control systems. Always consult a qualified expert.

Use climate control equipment

Controls can be set so that heating is efficient while optimising the crop response.

Crop storage

Ensure controls are accurate Check sensors annually against a reference thermometer to make sure that the store is at the desired temperature.

Combinable crops

Establish a maintenance plan to ensure heaters operate at optimum efficiency Inadequate heaters or dehumidifiers can prolong drying times and increase costs.

Case study

What are other growers doing?

A nursery in London providing plants to local parks installed two condensing boilers to generate heat for its greenhouses. The additional investment has been recouped a number of times during the life of the installation and the boilers have been problem free for ten years.

Figure 1 A greenhouse facility



Tax incentives

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 on the investment value of energy efficient equipment, if it is on the Energy Technology List. The procedure for claiming an ECA is the same as for any capital allowance. For further information please visit www.eca.gov.uk or call the Carbon Trust on 0800 085 2005.

Ventilation and air circulation

Ventilation is important to many agricultural and horticultural production systems, and on average it accounts for 14% of energy bills across the sector. Following a few simple energy saving measures can save up to 20% of ventilation energy consumption.

Internal conditions have a direct impact on the yield so it is crucial to get ventilation right.

Take advantage of natural ventilation and free cooling to halve energy costs

It may be possible to use windows and doors to provide good levels of natural ventilation, allowing mechanical ventilation and fans to be switched off or turned down to save money. Always consider security implications.

Maintain system components to ensure efficiency

If regular maintenance is not carried out, the effectiveness of ventilation systems can fall by up to 60%. Dirty or faulty components directly affect system efficiency and will increase running costs and risk of breakdown. The performance of the whole system should be reviewed annually and replacement parts

ordered as necessary. Always consult a maintenance technician.

Consider fitting variable speed drives (VSDs)

In most agricultural and horticultural settings, ventilation and air circulation fans do not need to operate at full speed all of the time. Variable speed drives can help to reduce costs by enabling the output speed of the fans to match requirements at different times of the day or for different processes. This reduction in speed saves energy and there may be corresponding heating and cooling cost savings too. More information on motors is available from the Carbon Trust.

Avoid excessive ventilation by using good control

Small errors in ventilation rates have a large impact on running costs so use controls to optimise ventilation rates and reduce energy use. This is particularly important during cold weather.

Consider interlocked control for ventilation systems and equipment

Automatic control via time switches, occupancy sensors or controls linked to machinery can prevent fans operating when not required.

An interlocked control works by switching ventilation off when a specific piece of equipment is also switched off.

ASSUMPTION – Switching off an extractor fan will not have much of an effect on our cost savings.

FALSE! – A single fan may only signify a small power load yet could bring about a significant loss of heat if not adequately controlled. The heating system then has to compensate which could typically increase boiler fuel consumption by around 5%.

Improve airflow through well-designed ducts and air inlets/outlets

Ensure internal surfaces of ducts are smooth and that well-designed air inlets are used to increase ventilation efficiency by 20%. Ensure there are no obstructions to airflow. As well as costing more to run, dirty ventilation systems will be less effective and fan motor life will be shortened.

Use efficient fans and ducts

Types of fan that could be considered range from simple fans which redistribute hot air that collects in the roof space of a building, to complex systems of circulation fans, to achieve a consistent environment.

It is important to recognise that fans vary significantly in their efficiency. Take particular note of the rated air throughput of the fan at the operational pressure it requires, together with the energy rating. In most cases, the additional cost of a more efficient fan will quickly pay for itself. Always test fan performance to check it reaches the specified speed, output required and other specifications.

Figure 3 Use smooth inlet bell mouths to improve efficiency

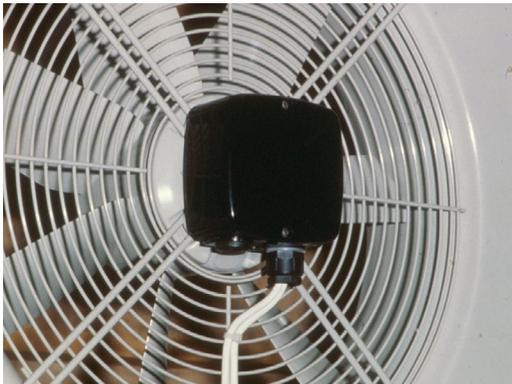


Image courtesy of FEC Services

Figure 2 A typical greenhouse facility



Image courtesy of FEC Services

Sub-sector hints

Pig and poultry farming

Specify as high performing ventilation equipment as possible

Ventilation directly affects feed and mortality rates for animals. For example, because of the sustained operation of fans in a typical finishing building, a single fan will consume its own value in energy in around 18 months. So, spending 10% more when purchasing the fan to secure a 10% energy saving will pay back in around the same time – a very good return on investment.

Winter ventilation

Ensure the minimum winter ventilation rate is controlled accurately where heating is used in the building, such as for weaning accommodation. If the level is too high then heating costs will increase dramatically. Too low a level will produce foul air conditions.

Maintain systems

Pig and poultry farmers should include all fans and ducts in their thorough 'end of batch' clean, and filters should be replaced. Dirty fans and ducts can reduce ventilation efficiency by as much as 40%, equivalent to 16p per bird per laying hen per year, or 36p per pig.

Pig farming

Design systems to suit changing need Since the metabolic heat output of growing pigs increases with weight and their temperature requirement falls, ventilation systems in finishing buildings are of a higher capacity than those required in farrowing or weaning. Ventilation is therefore the major energy user at this stage of production; the careful choice of fans, the design of ducts and the maintenance of these systems is critical for efficient operation. Any alterations should take full account of the animals' environmental requirements and welfare.

Automatically controlled natural ventilation

Fit pig kennels with automatically controlled natural ventilation (ACNV) where possible to maximise natural resources and save on costs. Note: not all building designs lend themselves to these systems. ACNV uses little energy. Contact the Carbon Trust for more information.

Horticulture

Direct warm air where it is needed

Hot air rises, and in facilities like greenhouses this can lead to layers of very warm air at high level, sometimes 2 to 3°C warmer than at the

level of the crop. Consider installing ceiling circulation fans so warm air can be redirected to where it is needed. In most cases the value of the heat savings far exceeds the cost of the electricity required to operate the fans.

Minimise heat loss

Main access points may benefit from automatic doors, making access easier/faster while ensuring that they are closed whenever possible.

Combinable crops and crop storage

Inspect ducts and repair as necessary

A leaky main air duct can lead to a 10% air loss which leads to slower drying of crops.

Store management

Stores should be loaded/unloaded so that good airflow is achieved around and through the crop to promote consistent drying.

Maintain fans

As the core of any drying and cooling system, it is essential that fans are kept in good working order. Specifically, check for corrosion and damage and clean the blades thoroughly.

Remember: Horticulture sub-sectors

Ensure that any saving measures implemented do not conflict with complex environmental control systems used to maintain crop conditions. If in doubt, always consult a qualified expert.

Lighting

Lighting is important to many agricultural and horticultural businesses and, on average, it accounts for up to 4% of energy bills across the sector. Following a few simple energy saving measures can reduce lighting energy use by up to 50%. You can get more in-depth guidance by downloading [Lighting overview guide \(CTV049\)](#).

‘Switch off’ policy – involve staff and increase awareness

Involve staff in making savings by conducting regular meetings, placing stickers above light switches and posters around buildings and outhouses (available from the Carbon Trust). All staff have a role to play in saving energy so they should be made aware of wastage areas and be trained to operate equipment and controls effectively.

Label light switches

Light switches should be clearly labelled so employees can select only those lights they need for the work being carried out. Always ensure exterior lighting is switched off in the daytime and that any lights in storage areas are turned off when there is no loading activity taking place. In fact, lights in all unoccupied areas should be switched off, but remember to consider health, safety and security implications.

Maintenance

Lighting is essential for providing a productive and safe working environment so it is important to keep windows, skylights and light fittings clean. Replace old dim lamps and keep controls in good working order by ensuring timers are set to match working hours and that daylight and occupancy sensors (covered on the next page) are clean. Without regular maintenance, light levels can fall by up to 30% in 2-3 years. Establishing a basic lighting maintenance programme can reduce costs by up to 15% as well as improving light output and appearance.

Install low-energy lighting

Lighting must be selected to provide the required brightness and colour levels for given tasks. Replace any ‘conventional’ tungsten bulbs that are switched on for more than a few minutes at a time with energy saving, compact fluorescent light bulbs (CFLs). CFLs will last up to eight times longer than conventional bulbs which means less time spent replacing them. They have a similar light output to tungsten bulbs and use only 20-25% of the energy. Alternatively, you could use LEDs, which use up to 80% less energy and provide around 50,000 hours of use.

Replace blackened, flickering, dim or failed fluorescent tubes with tri-phosphor, or multi-phosphor, coated ones (this is marked on the packaging). This provides a more natural, brighter light for the whole life of the tube. If the tubes are 38mm (1.5 inch), they should be replaced with slimmer 26mm (1 inch) tubes.

Occupancy sensors

Install occupancy sensors in areas that are only used intermittently such as office areas, equipment and produce stores and toilets. These help to ensure lights only operate when there is somebody there to require them. Sensors can achieve savings of between 30 and 50% on lighting costs.

Daylight sensors

Light sensors or ‘photocells’ can be used to control artificial lighting when there is sufficient natural daylight. This option would be particularly beneficial for farmers and growers who work outside throughout the year. As daylight hours vary according to the season, additional external lighting will often be required, (for example winter working). Sensors will help to provide closer control and, thus, substantial savings.

Consider fitting sensors to external lighting – costs can often be paid back in less than a year. Both occupancy and daylight control are sometimes combined with time switches to provide even bigger savings.

Refurbishment

When replacing older, fluorescent lighting systems, specify modern high-frequency fittings. These reduce energy use and heat output, eliminate flicker and hum, extend lamp life and can allow dimming – all of which can make a building more comfortable for staff and livestock. Always consult a qualified lighting technician before upgrading lighting systems.

Case study

What are other farmers doing?

A dairy operation in the midlands has renovated its barns and outbuildings so that natural daylight is maximised through skylights and other sunlighting options instead of relying solely on electric lights. This has increased production and saved on costs and carbon emissions. It has also made a more comfortable environment for staff and livestock.

MYTH – It is better to leave fluorescent lights on as starting them up wastes more energy than if they remain permanently switched on.

FALSE! – Fluorescent tubes use only a few seconds worth of power in start up, therefore, it is always better to switch them off when you don't need them, even just for a few minutes.

Table 2 Energy efficient lighting options

Existing lamp type	Uses	Energy efficient option	Energy saving/ benefits	Application notes
 Tungsten light bulbs	General lighting, a common bulb for domestic applications	 Replace with compact fluorescent lamps (CFLs), or LEDs, in the same fitting	75-80% saving plus longer lamp life	General lighting – modern CFL and LED replacements may also be acceptable for display lighting
 38mm (T12) fluorescent tubes in switch-start fittings	General lighting, commonly used in workshops, outbuildings and office spaces	 Replace with equivalent 26mm (T8) triphosphor fluorescent tubes of lower wattage	Up to 15-20% saving plus longer lamp life	General lighting, but even better use with modern fittings (see below)
 High-wattage filament lamps or tungsten halogen lamps as used in floodlights	For lighting large spaces, such as storage areas, livestock shelters, external loading areas and yards	 Replace with metal halide, LEDs, or high wattage compact fluorescent lighting	65-75% saving plus longer lamp life	Flood lighting and some general lighting situations
 Mains voltage reflector lamps, filament spot and flood types	General lighting, often applicable to areas that need bright light and good colour rendering, such as task lighting in workshops/farm retail outlets	 Replace with LEDs or compact metal halide discharge lighting	50-80% saving for equivalent lighting performance	Where compact metal halide or LEDs are not appropriate, then low voltage tungsten halogen spotlights can reduce lighting energy use by 30%, with further savings available by using 35W infrared coated (IRC) bulbs instead of standard 50W bulbs.

Existing lamp type	Uses	Energy efficient option	Energy saving/ benefits	Application notes
 <p>Fluorescent fittings with the old 2ft 40W, and 8ft 125W fluorescent lamps</p>	<p>General lighting, commonly used in workshops, outbuildings and office spaces</p>	 <p>Replace with efficient fittings using reflectors/louvres or efficient prismatic controllers with high-frequency electronic or low loss control gear</p>	<p>30-45% saving with much improved lighting quality. The use of high frequency electronic control gear eliminates flicker, hum and stroboscopic effect</p>	<p>General lighting</p>
 <p>Fluorescent fittings with opal diffusers or prismatic controllers which are permanently discoloured</p>	<p>General lighting, commonly used in workshops, outbuildings and office spaces</p>	 <p>Replace with new prismatic controllers or replace complete fittings as above</p>	<p>No reduction in energy consumption but increases the amount of light by between 30% and 60%</p>	<p>General lighting</p>

Take care when standard light bulbs are used as task lighting for machinery in workshops. Replacing them with energy saving bulbs can cause a stroboscopic effect, so standard lighting can sometimes be the safest option. An alternative is to use a compact fluorescent fitting with high frequency electronic control gear which eliminates the stroboscopic effect.

Sub-sector hints

Pig farming

Two different levels of lighting are generally required in pig farming, depending on whether workers are present in the room or not. For high level lighting, strip fluorescent lamps will be the most energy efficient and provide most even light distribution. Dimmable ballasts (circuits that control the flow of current to lamps) will allow dual use for workers and stock, enabling lights to be turned down during stock lighting periods.

Pig and poultry farming

Replace tungsten lights with energy efficient alternatives such as fluorescent or sodium lamps to save 70% of lighting costs. Tungsten bulbs in creep lighting have poor light output and are major energy consumers.

Combinable crops and crop storage

Fit shatterproof covers to all lamps in order to comply with crop assurance schemes.

Discharge lighting used for store illumination can be made safer by ensuring that debris from failing bulbs does not contaminate the produce. Covered or shatterproof lights are necessary in areas where produce might be exposed. Solutions include:

- A shield to protect the whole fixture.
- Plastic tube covers with end caps.
- Pre-coated shatterproof bulbs.

Always consult a lighting technician in order to determine the best shield for particular light fixtures.

Horticulture

Clean, maintain and replace supplementary lighting regularly.

Lighting equipment output decreases with time due to depreciation of lamps and reflectors. After 4-5 years of operation, reflectors should be re-anodised or replaced.

Refrigeration equipment

The energy consumed by refrigeration costs UK industry around £300 million p.a. and is responsible for discharging over three million tonnes of CO₂ into the atmosphere each year. In some agricultural sub-sectors, particularly dairy farming, refrigeration accounts for a significant proportion of overall site energy costs.

Farmers do not always realise how much energy is used by refrigeration or that there are big savings to be made. In fact, creameries and dairies could save over 10% of their refrigeration energy costs by implementing some low and no-cost measures.

Some key tips are outlined below and more information can be found in the [Refrigeration technology guide \(CTV046\)](#), available from the Carbon Trust.

Maintain correct temperatures and avoid overcooling

Keeping refrigerated produce at the correct temperature is better for food and for cost savings. Energy consumption can be reduced by 2-4% if the set cooling temperature can be increased by 1°C. Ensure that the

manufacturer's recommended operating temperature is set accordingly.

Operating at peak efficiency

The way equipment is operated has a big effect on the costs of running it.

- Ensure refrigerators are full but not overloaded.
- Keep refrigerators away from heat sources.
- Ensure that staff keep chiller doors shut. It may be helpful to put up energy awareness reminders.

Regular maintenance for optimum performance

Refrigerators that are not properly maintained will gradually use more energy and increase the risk of breakdown. Establish a simple maintenance schedule to save on energy and costs.

- Ensure that defrost procedures are followed.
- Check door seals on cold rooms and fridges.
- Keep condensers clean and free of dust.
- Check systems have the correct amount of refrigerant.

Clean condensers to maintain efficiency and save on costs

The condenser should be kept clean so that there is enough space for good airflow away from the unit. A blocked condenser can increase power consumption by over 20%. External condensers are usually in the form of a box containing a series of metal fins and a fan to reject heat. They can easily get clogged with leaves, so maintain regularly for optimum performance.

Insulate pipe work

Insulation on pipe work should be in good condition to prevent unnecessary heat gains. Replace insulation where it is damaged or missing.

Fit PVC curtains and improve energy efficiency

Air changes in cooled storerooms can account for up to 30% of the total heat load, as cool air escapes and warm air enters. This can be minimised by ensuring that doors remain closed as much as possible. Consider fitting self-closing doors or install a strip curtain to prevent cool air escaping from the storeroom. Ensure that the curtains are well fitted and stay in good condition. Replace damaged strips as required.

Upgrading equipment?

The decision to buy new refrigeration equipment will be based on business needs as well as price. It is always important to choose carefully because some units have much greater running costs that end up costing more over their lifetime, despite a lower purchase price.

The Carbon Trust has further information on buying the right equipment, ensuring correct installation, efficient operating practices and effective maintenance.

Case study

What are other farmers doing?

One dairy made an annual saving worth over £14,000 and achieved water savings worth a further £17,000 by monitoring its energy consumption and putting in place a number of good housekeeping measures. The initial outlay only amounted to £6,000.

Sub-sector hints

Dairy

Use plate coolers. Cooling milk and heating water probably account for two-thirds of energy used on a dairy farm. Cooling costs could be halved by pre-cooling milk using a 'water to milk' plate cooler. Reuse the water elsewhere to make even more savings.

Crop storage

Use free air cooling. Cooling using a combination of natural ventilation and refrigerated cooling systems can optimise energy efficiency. This can be used where external air temperatures allow, but take care to maintain correct conditions for crop storage.



Fact:

If you are replacing your refrigeration system, you may be eligible for financial assistance. Choose energy-efficient equipment that qualifies for an Enhanced Capital Allowance (ECA), listed on the Energy Technology List. For more information, see the box on [page 11](#).

Building fabric

There is a wide variety of agricultural and horticultural buildings, from new, purpose built storage facilities, to old farm buildings that may have stood for hundreds of years. The structure of these buildings, the materials that they are made from and the levels of insulation present, will all have a direct impact on the amount of energy used for heating, ventilation and cooling.

Improving your building fabric makes good sense for many reasons:

- **Better temperature control** – it can lower ventilation costs and prevent overheating.
- **Improved productivity** – staff morale and output can be enhanced by providing a more comfortable working environment through reducing draughts, overheating and noise.
- **Lower expenditure** – a more efficient, well insulated building requires less heating and ventilation.
- **Good investment** – better insulation can increase a building's value.

Undertake regular maintenance and avoid expensive problems later on

Well maintained buildings should mean that any potential problems are identified and dealt with promptly. As building regulations require buildings to be reasonably airtight, it is important to seal up gaps in the building walls, windows and doors to reduce draughts.

Weather stripping (sealing any gaps) lowers heating and ventilation costs and can usually pay back in less than two years.

Establish a housekeeping schedule and involve staff

Compile a regular checklist to address areas where energy is lost via the building structure. A comprehensive schedule should include checking window panes, frames and roof lights.

Regularly check the building for damp

Damp causes significant damage to the building structure and reduces its insulating properties. Repair split downpipes, faulty gutters and leaky roof tiles. Check for signs of damp and condensation at least once a year, preferably prior to winter months.

Remember

Pay attention to your windows, doors, walls and roof before you upgrade your heating system as you might actually need less heating. In a typical farm building, simple draught proofing combined with good housekeeping can reduce energy consumption by over 15%.

Install draught proofing

Gaps in buildings and around poorly-fitting windows and doors allow heat to escape. If you can insert a 1p coin on its side between a window or door and its frame, fit draught strips. Draught proofing helps to reduce heat losses and increase staff comfort.

Reduce heat loss via delivery doors and docking bays

There are a number of ways to prevent warm air from escaping within storage areas and anywhere where there may be delivery doors, including the application of:

- Air-locks.
- PVC curtains.
- Warm air curtains.
- High speed motorised doors with automatic opening and shutting controls.

Insulate to accumulate savings

25% of a building's heat will escape via an uninsulated roof which adds hundreds of pounds per year to heating bills. Insulation in building components should be made up of extruded polystyrene or equivalent. Buildings should be regularly checked to ensure insulation is still effective as degradation through moisture or rodent attack is common in agricultural buildings.

Consider upgrading windows, doors and insulation levels during refurbishment projects

Growers and farmers often worry about disrupting their routines, and so are not always keen to upgrade windows, doors and insulation. Scheduling these upgrades during planned refurbishment projects will ensure minimal impact to the operation of the business. Moreover, considering all these projects as one will often reduce the cost.

Remember

Insulation should measure at least 200mm deep in roof spaces and 75mm elsewhere. Insulate hot internal pipes to 25mm and external pipes to 50mm using weatherproof insulation – and don't forget valves and flanges.

Sub-sector hints

Pig farming

Use boxed creeps

Open creep areas in pig farms have substantial heat losses so it is advisable to use boxed creeps. Boxing a creep provides a controllable environment for the piglets and allows better regulation of the thermal environment.

Enclosed creeps vary in construction from fully sealed and insulated boxes with pop-holes protected by strip plastic curtains, to crude, open sided areas with uninsulated lids. The better the construction, the more heating energy can be contained and, therefore, the more effective controls will be in maintaining the correct temperature at the lowest energy input. An ideal construction will be well sealed and insulated.

Improve insulation

Improving insulation in weaning rooms and kennels will reduce heat loss, costs and temperature rises from the sun.

Horticulture

Reduce air leakage

Ensuring greenhouses are well sealed can reduce heating costs by 25%.

Check ventilators to make sure they close properly.

- Replace broken and/or slipped panes of glass.
- Seal around heating pipes and make sure that doors are kept closed.
- Use brush seals to stop air leakage around doors and ventilators.
- Fit automatic door closers to stop doors being left open or use an audible warning device to let staff know if a door is not closed.

Protect against high winds

Use windbreaks or landscaping to reduce the effect of high winds and provide a fuel saving of around 10%.

Crop storage

Check doors, louvres and air mixing boxes for sealing and leakage

Refrigeration condensate drains and other service entries can also be a source of leakage which is a significant contributor to heat gain.

Figure 4 Covered creeps with thermostatic control give the lowest running costs



Image courtesy of FEC Services

Energy management

It is important to ensure that staff members are aware of the benefits that energy efficiency can bring to your business in order to get the entire workforce involved and committed to an energy management programme.

Everyone should be reminded that good energy management helps to achieve:

- Cost savings.
- Healthier and more productive working conditions.
- An enhanced business reputation which can be promoted to customers and suppliers.

All of this means an improved competitive advantage for your business.

Whether starting an energy conservation programme from scratch or simply checking the effectiveness of an existing management system, there are a number of basics to consider.

Devise an action plan and assign responsibility

Commitment to energy efficiency should be backed up by an action plan to drive forward the energy efficiency message.

- Assign responsibility to a specific member of staff. In very small businesses, this may be the owner or manager but larger organisations should appoint a staff member to improve involvement and awareness throughout the team.
- Encourage staff members to devise individual action plans and save energy whilst carrying out their everyday activities.
- Define roles and responsibilities.
- Organise a priority list of energy saving projects.

The success of these actions will give support to the on-going energy management programme and give credence to those measures likely to involve further cost or planning.

Involve staff

All employees are important in saving energy so they must be made aware of wastage areas and be trained to operate equipment and controls correctly. Motivate staff – ask their opinions and encourage them to review their own working practices to increase energy savings.

For further information and resources, order the Carbon Trust's, [Creating an awareness campaign pack \(CTG056\)](#).

Monitor your energy use

Understand your energy consumption by reviewing energy invoices over the last year – you should be able to build a picture of your monthly performance. This is the basis of good energy management. Without detailed energy use data, it is impossible to get a complete and accurate picture of how energy is used in the business.

Do not rely on utility bills alone as these can often be based on irregular or estimated meter readings. Take regular meter readings and record them. Make this part of your usual routine to ensure you obtain frequent and accurate information.

If you are billed on a monthly basis then take readings at least weekly; likewise, if you are billed quarterly, then take readings at least every month. Relate the information collected to production levels and external influences like the weather. Tracking progress in this way will give an early warning of any unexpected changes in consumption which could be indicative of faulty equipment, altered controls or other problems. Correcting the problem will lead to energy savings.

Correcting for weather variations

In some buildings (for example, a greenhouse), heating can account for a large proportion of the energy bill, but consumption will vary widely with the seasons and the utilisation of the greenhouse. In other buildings (for example, a broiler house), cooling and ventilation accounts for most of the energy used. Therefore, variations in the weather from one month to the next can make it difficult to make accurate comparisons between meter readings. Allowances can be made for variations in weather conditions by using a method known as 'degree day' analysis. More information is available in [Degree Days for energy management \(GTG075\)](#).

Correcting for production levels

Another key factor that affects the amount of energy used is the current level of production. For this reason, it is best to relate energy consumption (and cost) to units of output. For example, a tomato grower would be advised to make any assessments based on kWh/kg, whereas an egg producer would do better to use kWh/dozen eggs.

Benchmarking

The data collected can be used to track the progress of the business or, if there are current benchmarks available for your sector, to see how your business compares with others. See [page 28](#) for more information.

Undertake regular housekeeping walk rounds

Carry out regular good housekeeping walk rounds. Note down and act on any maintenance measures needed in order to avoid expensive problems later on. As patterns of energy use vary throughout the day/year, it is advisable to carry out a series of walk rounds at different times to get a better idea of where and when energy is being wasted.

A sample checklist can be found on [page 32](#), and further tips and ideas can be found in the Carbon Trust fact sheet: [Assessing the energy use in your building \(CTL172\)](#).

Service and maintain tractors and field vehicles:

This will help to reduce wear, increase life, save fuel and reduce exhaust emissions.

- Allocate the most appropriate machinery for the task
- Keep a note of fuel use to establish consumption patterns
- Check tyre pressures, steering alignment and lubricant levels regularly
- Ensure employees drive safely using smooth acceleration and braking. Poor driving technique increases fuel consumption by 20%.

Sub-sector hints

Pig farming

Select equipment carefully

Equipment needs to be capable of enduring harsh conditions in the pig farming sector.

Maintain equipment

Cleaning of components should be carried out as part of the 'end of batch' cleaning programme.

Pre-soak

Reduce pressure washing times by 20% through pre-soaking. This will also save on labour and energy.

Combinable crops and crop storage

Maintain facilities

Storage and drying of combinable crops can be a large area of energy waste. Ensuring that facilities are in good working order as part of a regular maintenance programme is key to healthy crops – and reducing costs.

Prepare facilities early

Ensure that the drying and storage facilities are in good working order well in advance of the harvest. Just because they worked well last year does not mean that this year will be the same.

Make the most of the weather

Drive the dryer hard during harvest to finish as soon as possible after cutting. Dryer efficiency is highest during warm weather periods.

Use humidity-based controls

Efficient dryer operation relies on excellent humidity control. Check calibration of sensors at least annually to maintain optimum performance.

Horticulture

Review greenhouse utilisation

Heating a greenhouse that is only partly utilised is one of the biggest areas of energy wastage. Review how cropping is organised and ensure any heated areas are used effectively.

Minimise traffic in and out of the greenhouse and keep doors closed

Raise awareness about heat losses among staff. Particularly, educate the staff to minimise traffic in and out of the greenhouse and keep doors closed to reduce air leakage.

Benchmarking

Benchmarks are data which allow farmers and growers to compare the performance of their operation with other similar businesses.

They also show progress following energy saving measures (for example if a facility is modified, benchmarks can be useful to determine the effect that the change has had). Many farmers and growers track their progress on a regular basis, as part of their routine assessments.

Benchmarking not only shows how well a business is doing, it can also help to identify potential savings and areas where the business should focus its efforts initially.

Before a business can make use of energy benchmarks, it must carry out a simple assessment to establish energy use. This involves collecting information on the amount of energy used and calculating the energy intensity. For agriculture and

horticulture, this is usually calculated on the basis of total energy use for the previous year divided by total animal production or crop yield. Sometimes it is represented in kilowatt hours per metre squared.

If your fossil fuel (for example, gas or oil) benchmarks are 'typical' (the level of energy performance found in most agricultural and horticultural buildings) but your electricity use is much higher, it makes sense to investigate electricity use first. The difference between your energy cost and 'good practice' (energy performance found in a well performing agricultural or horticultural business) gives an indication of the extent of savings that are available.

Some example benchmark figures are outlined below and further information can be obtained by contacting the Carbon Trust. Benchmarking publications for pig farming and greenhouse horticulture are available from the Carbon Trust. If benchmarks are not available or relevant to your specific agricultural or horticultural business, it may be beneficial to monitor your energy use over the course of a year and benchmark your future performance against this, always seeking to improve energy efficiency. Remember that local weather conditions should also be factored in (see [page 26](#)), as these will affect your energy consumption.

Table 3 Typical and good practice benchmarks for protected horticulture

Energy consumption kWh/m ²	Edible crops				Ornamental crops			
	Intensive		Extensive		Intensive		Extensive	
	Heat	Electricity	Heat	Electricity	Heat	Electricity	Heat	Electricity
Best practice	375	8.5	125	6	280	6*	110	5
Typical	495	10	165	8	375	10.5*	165	8

Specific guidance for an individual crop is available from Dutch data published in the *Handboek milieumaatregelen glastuinbouw* (Handbook of environmental measures in glasshouse market gardening), year 2000 edition. Appendix One gives targets for popular UK crops so that specific energy use benchmarks for each product can be determined. Appendix One also gives information on how the Dutch targets are calculated and determined. *Includes energy uses for supplementary and night-break lighting.

The table above gives average values for the broad categories mentioned. For more specific benchmarks, the individual requirements of the specific crop and/or variety must be considered. Examples of crops that fall into each category are as follows:

Edible crops

Intensive – tomato, cucumber, pepper, aubergine etc.

Extensive – lettuce etc.

Ornamental crops

Intensive – chrysanthemum (both pot and stem), begonia, poinsettia, young bedding plants, foliage plants etc.

Extensive – summer bedding plants, summer cut flowers, hardy nursery stock etc.

Table 4 Typical and good practice benchmarks for pig farming

Production stage	Energy range per pig produced		Main influence
	Typical	Good practice	
Farrowing	8kWh	4kWh	Use of box creepers with thermostatic control gives the lowest running cost. Under-floor heating pads are generally more energy efficient than infrared bulbs
Weaning	9kWh	3kWh	Major issues are the insulation of buildings (or kennels) and most importantly, the control of ventilation
Finishing (fan ventilated)	10kWh	6kWh	Efficient fan selection, good design of inlets and (fan ventilated) outlets and system cleaning are the key points to minimising energy use
Feeding system	3kWh	1kWh	Dry feeding systems use a small amount of energy for conveying. Wet feeding is generally more energy intensive because of the need to mix pump feed and pressurise pipework
Waste management (slurry systems)	6kWh	2kWh	Selection of high efficiency pumps, aerators and separators

Table 5 Typical and good practice benchmarks for creep heating

	Open creep electric / gas radiant		Boxed creep electric radiant		Underfloor	
	Typical	Good practice	Typical	Good practice	Typical	Good practice
Average annual usage (kWh/pig)	8.4	5.0	6.0	4.0	5.0	3.0

Table 6 Typical and good practice benchmarks for a weaner room

	Heating		Lighting		Ventilation	
	Typical	Good practice	Typical	Good practice	Typical	Good practice
Average annual usage (kWh/pig)	7.5	3.0	2.0	1.0	0.8	0.6

Table 7 Typical and good practice benchmarks for a kennel

	Kennel Heating	
	Typical	Good practice
Average annual usage (kWh/pig)	6.5	3.0

Action checklist

✓	Action	Savings
<input type="checkbox"/>	Switch off all non-essential lighting out of business hours. Install timers to help with this	10% of lighting costs
<input type="checkbox"/>	Replace traditional tungsten lamps with energy efficient, compact fluorescent lamps (CFLs) to reduce operating and maintenance costs (Page 15)	75% of tungsten lighting costs
<input type="checkbox"/>	Install photocell controls to switch off external lighting and some internal lighting on brighter days (Page 16)	20% of lighting costs
<input type="checkbox"/>	Ensure thermostats are set correctly – increase temperature set-point for cooling and reduce set-point for heating (Page 7)	A 1°C reduction in temperature during the heating season can cut costs by 8%
<input type="checkbox"/>	Turn off unnecessary equipment during the day and especially out of core business hours to reduce heat build-up (Page 5)	5% of energy costs
<input type="checkbox"/>	Walk around your site at different times of the day and during different seasons to see how and when heaters and fans are working. Check time and temperature settings (Page 7)	5% of energy costs
<input type="checkbox"/>	Take regular meter readings to identify excess energy consumption. Check utility bills to ensure you only pay for the fuel you have used; compare current costs with previous years; assess the seasonal pattern of consumption	5% of energy costs
<input type="checkbox"/>	Check insulation levels and increase wherever practical to reduce heating requirements (Page 23)	5% of heating costs

Next Steps

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

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 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(s) and complete the checklist at different times of day (including after hours) to identify where energy savings can be made. An example checklist is available in this guide and further examples are available from the Carbon Trust.

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 business for energy efficiency

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

Related publications

The following publications are available from the Carbon Trust:

Technology Overviews

[Refrigeration \(CTV046\)](#)

Technology Guides

[Heating control \(CTG065\)](#)

Management Guides

[Creating an awareness campaign \(CTG056\)](#)

[Energy management \(CTG054\)](#)

Further services from the Carbon Trust

The Carbon Trust advises businesses and public sector organisations on their opportunities in a sustainable, low carbon world. We offer a range of information, tools and services including:

Website – Visit us at www.carbontrust.com for our full range of advice and services.

👉 www.carbontrust.com

Publications – We have a library of publications detailing energy saving techniques for a range of sectors and technologies.

👉 www.carbontrust.co.uk/publications

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

👉 www.carbontrust.co.uk/casestudies

Carbon Trust Advisory – Delivers strategic and operational advice on sustainable business value to large organisations.

👉 www.carbontrust.co.uk/advisory

Carbon Trust Certification – Delivers certification and verification services to companies and runs the Carbon Trust Standard and Carbon Reduction Label.

👉 www.carbontrust.co.uk/certification

Carbon Trust Implementation – Delivers services to business in support of implementation of energy efficient equipment and energy efficiency financing.

👉 www.carbontrust.co.uk/implementation

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

We help to cut carbon emissions now by:

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

We reduce potential future carbon emissions by:

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

www.carbontrust.com

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