

Understanding energy use in its many forms has been essential to human development and flourishing. Farming and horticulture are no exception to this and efficient energy use presents many challenges and opportunities. While each farm is unique in its combination of geography, soil, climate and ecosystems, some characteristics are worth discussing as specific topics.

This factsheet provides a brief introduction to the relevant science, outlines processes and practices that can lead to lower levels of greenhouse gas emissions in areas relevant to most enterprises and some sector-specific pointers.

What emissions come from energy and fuel use?

Within farming greenhouse gas (GHG) emissions consist predominantly of nitrous oxide (N₂O), methane (CH₄) and carbon dioxide (CO₂). The last of these is produced from direct fuel use on site, but also from the process of electricity generation at power plants and is the main focus in this factsheet. For ease of comparison, GHG emissions are often discussed in terms of their 'carbon dioxide equivalent' (CO₂e) for a standard number the years that the gases remain in the atmosphere, often 100 years, but they are sometimes just referred to as 'carbon', without clarification. These factsheets will use the term 'carbon dioxide equivalent' or CO₂e.

Greenhouse gases can be emitted by a range of processes ('sources') and taken up by other processes ('sinks'). Elements within ecosystems, such as soil and woodland, can act as long-term stores of carbon that might otherwise be released into the atmosphere as carbon dioxide. It is the changing balance between sources, sinks and stores that indicates whether agricultural practices are moving towards being lower-carbon or not. Practices such as soil and manure/slurry management can affect this significantly and are discussed in other factsheets.

Why is energy efficiency important?

While the focus of these factsheets is moving towards low carbon farming, the good news is that reducing energy use through greater energy efficiency can often be achieved at low or no cost. Less energy use generally means lower GHG emissions and less spend on fuel, so this is a win-win situation. Savings of 10 – 20% are typical for many farms.

Reasons to make your farm more energy efficient -

- Saving money on your fuel bills (diesel, LPG, electricity etc.)
- Limiting future rises in energy costs
- Shrinking your 'carbon footprint'
- Demonstrating your commitment to sustainability and the environment to customers, staff and your supply chain
- Complying with regulations



How do I go about improving energy efficiency?

The place to start is the same for any business -

- Find out how much energy you use now for each type of fuel – use actual readings not estimates - and do this monthly for greater accuracy
- Consider installing sub-metres for energy-intensive processes. These are typically areas such as heating, lighting, ventilation / air handling, refrigeration; the sections below on specific types of agriculture provide more detail.
- Look at how energy is used over time – 24 hours, week days vs weekends – does usage match when processes are occurring? How does it correlate with units of production? If not, is machinery or plant might be running unnecessarily?
- Having established your 'baseline' for energy use and how much is used where and when, set targets for reduction.
- Share this information with everyone in the business and get their input on how to reduce energy use, so it doesn't remain the responsibility of a few people.
- Consider the best ways to motivate or incentivise people to save energy.

With the steps above in place it is usually possible to achieve year-on-year reductions in energy use.

What about renewable energy?

With 40% of Europe's wind energy, as much sun (in the south) of the UK as Germany and an extensive coastline, the UK has excellent renewable energy resources to exploit. Renewable energy technologies generally have far lower GHG emissions across their lifetime, compared to fossil fuels, such as coal or gas. Appropriate projects to generate electricity from renewable sources can be subsidised through the the Renewable Obligation and Feed-In Tariff schemes. The proposed Renewable Heat Incentive proposes to do the same for renewable heat generation.

Well designed and implemented renewable energy schemes can provide good financial returns in their own right. However from a low-carbon perspective, it is always better to focus on energy efficiency as the first priority. This approach enables the maximum reduction in energy use and GHG emissions to be achieved and can often mean that the size of a renewable energy system can be reduced.

Economic Benefits of Renewable Energy

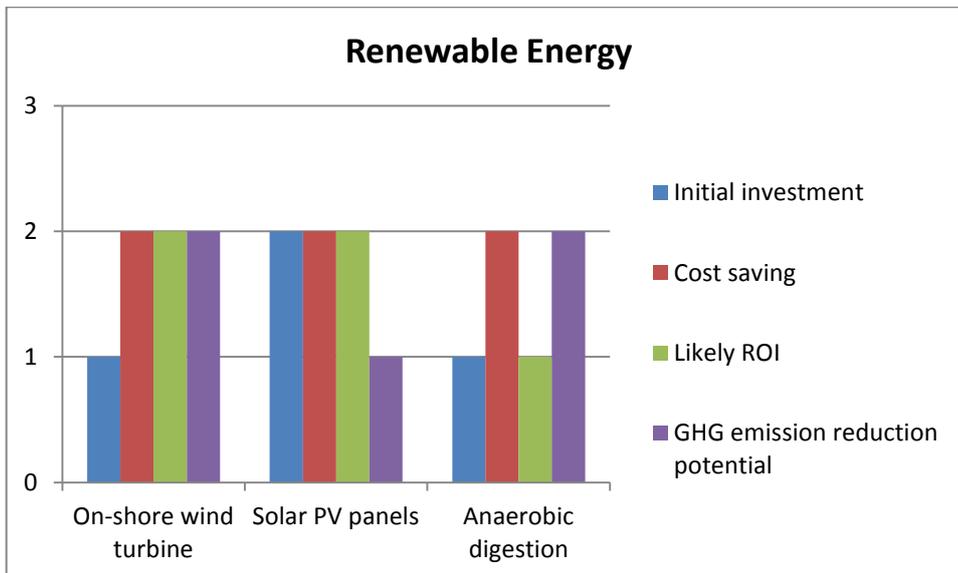
We have researched three of the most popular renewable energy options and assessed their relative benefits based on:

1. Initial investment
2. Cost saving
3. Likely ROI
4. GHG emission reduction potential

The graph below shows the results of the research.

Results: Of the three RE measures considered for farm usage, it is a fairly even playing field. Wind and AD have high investment costs; all three options have excellent cost saving potential; wind and PV have the best ROI; and wind and AD have the best GHG reduction potential.

Economic verdict: a hard one to call, but solar PV panels seem to be the best all round, low-risk option.



Reducing energy wastage

Before any renewable energy equipment is purchased, there are often opportunities to reduce energy use by identifying where energy is currently wasted. For example designing water management to trap and store water at the top of a slope or just slowing its progress through soil can reduce the cost of pumped irrigation. Utilising the heat generated by fresh animal manure to raise the temperature in a greenhouse or to pre-heat water is another example.

Buildings, vehicles and processing/packing plants

These are common areas where energy use can be reduced and processes made more energy efficient.

Buildings

Key areas to consider are the fabric or structure of the building itself, plant control systems, ventilation and lighting.

- Are all walls, floors and roof structures insulated and draught-proofed to current building regulations or better?
- Could more use be made of natural ventilation to improve air flow?
- Is low-energy lighting used, especially in flood-lit areas?
- Are light levels correctly specified and not excessive?
- Are lighting time switches, daylight sensors and occupancy sensors used?

Vehicles

- Are vehicles regularly serviced and tyre pressures checked to minimise fuel use?
- Are diesel engines left idling, and tractors driven in the highest gear and lowest throttle appropriate for the job?
- Can vehicle trips be combined, saving both time and fuel?
- Does the diesel storage tank have a fuel meter to allow fuel use to be monitored?

Packing/processing plants

- Are boilers, ventilation units and chillers fitted with appropriate temperature and time controls?

- Are they checked regularly to ensure they are still appropriately set and regularly maintained to ensure optimal performance?
- Are variable speed motors used for applications such as vacuum pumps, milk pumps, irrigation and ventilation, as these can save energy over fixed speed motors?

Sector-specific considerations

The following sections provide pointers to potential areas of energy saving for specific sectors.

Beef and sheep

Potential areas of net energy saving -

- Switching from grass silage to other forage crops that require lower energy inputs (e.g. maize)
- Using alternative methods of harvesting forage, silage creation and storage
- Improving cattle feeding efficiency through use of forage with higher energy density and genetic selection of cattle that can process feed more efficiently
- Diverting clean water away from slurry stores and using low-rate irrigation for slurry application rather than vehicles
- Counting nutrients in applied slurry and manure in the total nutrient budget to avoid over application
- Drying cereals to the optimum moisture content for rolling
- Using anaerobic digestion to produce energy from slurry and manure

Dairy

Dairy farms have the highest overall energy usage of the sectors considered, with the main items being milk cooling (35%), heating water for cleaning (30%) and vacuum pumping (15%) (ADAS report p 26).

Potential areas of net energy saving -

- Recording energy use carefully due to the high demand in this area
- Checking that pipe and tank insulation is adequate and tank thermostats are correctly set
- Checking that refrigeration equipment is well ventilated to ensure the condenser works efficiently
- Examining opportunities to use heat recovered from milk cooling to pre-heat washing water
- Considering use of variable speed vacuum pumps as these can save energy, extend equipment lifetime and reduce noise
- Review washing practices - are areas washed more than once a day or with excessively hot water (always ensuring hygiene is maintained)?
- Considering whether renewable energy (biomass, solar thermal) could be used to heat washing water

Poultry

Energy costs are usually less than 5% of production costs, compared to 70% for feed. Housed poultry require appropriate levels of heat, light and air flow, with young birds requiring a higher temperature of up to 31°C (ADAS report).

Potential areas of net energy saving -

- Ensuring buildings are insulated to current building regulations or better and include a water vapour barrier reduce deterioration from dampness

- Checking that ventilation is appropriately designed for the number of birds and adequate for their welfare, using natural ventilation if possible
- Regularly maintain all inlets and outlets to ensure there are no constrictions or blockages
- Check ventilation levels are not too high and that ventilation and heating system controls are interlinked to avoid unnecessary heat loss
- Using sensors to control temperature and ensuring these are sited in representative places, calibrated for accuracy and maintained in a clean state
- Reducing lighting levels, consistent with animal welfare
- Installing daylight sensors to switch off lights when daylight levels are adequate.

Pigs

With indoor reared pigs, heating, ventilation, feed processes and slurry storage make up the majority of energy use. The variety of housing types used for pigs leads to a wide range in associated energy costs, with high energy demand often associated with heating. Outdoor reared pigs have minimal associated energy costs limited predominantly to transport, feeding and fencing.

Potential areas of net energy saving for indoor reared pigs -

- Considering heating creeps with lamps that modulate output or include 50% dimmer switches
- Checking creeps are well insulated and enclosed to reduce air leakage, which also improves animal comfort
- Checking that ventilation fans appropriately specified to allow efficient part-load operation and interlinked with heating controls so these don't conflict
- Reviewing the design of weaner kennels to minimise air leaks and automatically controlling natural ventilation
- Considering deep straw bedding for weaner kennels or moving to an outdoor herd using unheated arks
- Ensuring buildings are insulated to current building regulations or better and include a water vapour barrier reduce deterioration from dampness
- Considering alternative energy sources instead of electricity for heating

Arable

Field cultivation on a 200 hectare farm might cost £10K a year. Drying cereals with high temperature equipment can use 55 litre of fuel oil per hectare of crop harvested.

Potential areas of net energy saving -

- Growing energy crops or crops requiring lower inputs including energy
- Minimise cultivation and only carrying this out when necessary and not in adverse weather conditions
- Checking tractors and equipment are appropriately specified and effectively maintained
- Combining crops at optimal moisture content, and drying them in a single pass with high volumes of air
- Considering use of driers with mixed flow or cross flow with recirculation
- Measuring moisture content accurately to avoid over drying, and consequent waste of energy and reduction in saleable weight

Horticulture

Heating of glasshouses can be very energy intensive and can offer large potential for energy saving measures.

Potential areas of net energy saving -

- Considering use of lap-sealing, poly-bubble lining, windbreaks, gutter insulation, fixed temporary screens, thermal screens and secondary glazing to reduce energy use
- Considering computer-control to maintain an improved environment
- Improving insulation and reducing air leakage in ambient and refrigerated stores
- Using automatic controls in ambient stores
- Sub-dividing the refrigerated store when not full to reduce energy consumption
- Using refrigeration equipment with capacity control on the compressor to support part-load
- Using ambient pre-cooling used for cereals and fruit crops
- Using partitioned enclosures and localised heating in packing areas, and only heating these when occupied
- Ensuring regular maintenance of boilers and heaters
- Checking whether process water is recycled and waste production minimised

References

The following reports and sources have been used extensively in producing this factsheet -

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5. Centre for Alternative Land Use (CALU) factsheets – www.calu.bangor.ac.uk/technotes.php.en?menu=1&catid=5307&subid=0#climatechange
6. ADAS report 'Managing Energy and Carbon - The farmer's guide to energy audits' – www.calu.bangor.ac.uk/Technical%20leaflets/Energyauditmanual.pdf

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