Reducing Your Energy Bills On-Farm: A Practical Guide

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The energy crisis, rising inflation and soaring utility bills are all putting pressure on farm finances and food production. Reducing energy use and improving efficiencies on farm can save you money, decrease your environmental impact, increase sustainability, and make the farm business more energy secure.

Often relatively simple changes can lead to savings of between 10 and 20 percent. To identify where these changes are to be made, you will need to review multiple areas of your business, including:

- Buildings
- Equipment
- Processes
- Energy sources

Changing energy markets, smart networks, new technologies and grid infrastructure changes all provide opportunities to increase efficiency and decarbonise energy. As a starting point you should always look at options for reducing on-site demand for power and review the power intensive activities. To identify which opportunities are best for you and your business we would recommend you do an energy audit.

This practical guide is divided into three sections:

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For particularly high-use farms such as dairies and potato farms. We would advise you also download and review our high-use farms supplement, which is designed to be used alongside this guide.

Getting Started With Benchmarking And Baselines

To understand where improvements can be made, you need to understand your energy use and demand profile. This will give you a baseline that will help you see how you compare to other similar enterprises and how your energy demand changes over time.

Depending on how efficient your business is, your energy demands can be substantially different. For example:

- Electricity consumption in dairying ranges from 200 to 400 kWh/cow/year
- Average fuel consumption for ploughing to 200mm is around 15 l/ha
- A typical farrowing house will use 8 kWh per pig produced while the most efficient installations use only 4kWh.

Top Tips For Benchmarking

Benchmark your business to industry standards
Comparing your business to industry standard figures will give you context for how you've improved and where you still have opportunities to save.

Keep your records and monitor them year-on-year for changes
Digitise and store your data using spreadsheets. This allows them to be displayed and analysed using graphs, charts and formulas to easily interpret data and inform your next actions.

Take meter readings
Quantifying energy usage is much easier with accurate records. Utility bills can be used, but might be difficult to interpret and may be estimated values, Therefore, direct measurements from meters is recommended. Take note of your meter regularly (daily, weekly, or monthly depending on requirements).

Note: Smart meters are increasingly used for real time monitoring which can be used to identify usage within specific operations.

Don't just monitor mains power
Recording fuel use in tractors, combines, ATVs and other machinery will show usage by vehicles and other processes. This can reveal what practices, tasks, machines, or drivers have the best and least efficient performance, allowing best practice to be understood and replicated.

How To Use Your Benchmark Data

In addition to recording, it is important to analyse your data to identify savings and actions you can take. This might include:

- Considering changes in working practices as well as improving equipment efficiency.
- Involve all staff to prioritise energy saving options and be realistic in the goals you set yourself for continuous improvement.
- Implement zero and low-cost options first and then plan for anything that needs capital investment. Understand payback periods to ensure impacts on your cash flow are within control and your business benefits from such changes.

Revisit your benchmarks regularly
To be effective you must continue to monitor and review progress regularly, as well as consider emerging technologies and future options that might benefit you. Encouraging energy-saving habits and promoting a culture of energy efficiency on the farm will lead to sustained efforts and long term savings.

Key Steps When Building An Energy Baseline

- Measure current energy consumption – keep records of fuel and electricity use.
- Identify energy intensive processes – install additional meters for individual buildings or equipment if required.
- Maintain regular record keeping so that trends or changes can be determined.
- Implement solutions and improvements you identify.

For more information on energy audits and useful templates that could assist your monitoring and record keeping visit: https://www.farmingforabetterclimate.org/resource/monitoring-energy-use/ and https://www.farmingforabetterclimate.org/resource/introduction-to-energy-auditing/

Energy Saving Opportunities On Farm

The following advice and considerations apply to a range of farms and include simple, easy to implement solutions.

If you are operating a system that has higher energy usage, such as a dairy or potato farm, we would advise supplementing this information with our energy efficiency guide for high-use farms.

Lighting

Lighting may not be one of your most energy-intensive activities but it could be an easy way to improve efficiency.

Upgrade to LED lighting
If you are still using traditional bulbs, upgrading to efficient LED lights would lead to savings. These will need to be checked and maintained usually on an annual basis by replacing any burst bulbs and cleaning light casings. Cleaning maximises the light emitted, prevents fire risk and maintains a healthy environment for livestock.

Although using LED lighting will reduce running costs, replacing all bulbs at one time could be costly for large buildings. Therefore, consider transitioning over time as existing bulbs need replaced. Compact fluorescent bulbs use 80% less energy than conventional bulbs, but LED lighting is even more efficient and can have a very long lifespan. High intensity discharge lamps will use much less energy than incandescent lamps for lighting large areas, but LED lighting is again the most efficient solution and there are a range of design options available.

Install and check your light sensors
Fixing sensor lights at yard, shed and workshop entrances ensures they operate effectively but also increases security, acting as a deterrent for farm thefts. Check your sensors regularly to ensure they are working correctly, especially on security lights. Can you minimise excessive lighting? This can have additional benefits such as reducing light pollution and potential nuisance risks for neighbours. Ensure lights are turned off in unoccupied areas and consider motion sensors if practical to automatically switch them off.

Take advantage of natural light
Where possible optimise the use of natural light. If you need to do work on shed roofs or are replacing structures, consider if translucent sheets could replace standard roofing sheets to increase the amount of natural light inside the building. Ideally 10-15% of a shed roof should use translucent sheeting. Lighting should be uniform throughout the shed, avoiding dark or shaded areas when possible. Natural daylight is the cheapest form of lighting when available, but skylight sheets will require cleaning at least annually to maintain performance.

Heating, cooling, and ventilation

It is important to maintain and upgrade heating and cooling systems to improve energy efficiency. Choose energy-efficient systems, set appropriate temperature levels, and ensure that buildings are suitably insulated to maximise savings.

Identify and seal drafts
Where buildings are heated or cooled it is important to seal any cracks or gaps to prevent air leaks, enhancing energy efficiency. Heating and refrigeration systems should be regularly serviced to maintain efficiency and prevent over-heating or over-cooling.

Use thermostats and timers
Consider installing programmable thermostats to regulate temperature settings and set timers to reduce usage during non-operational hours. Insulate buildings to reduce heat loss during colder months and consider double glazed glass to aid heat retention. Insulating water heaters and pipework will also help reduce heat wastage and costs.

Review your ventilation
Adequate ventilation is essential for livestock health and productivity. Maintain adequate ventilation by ensuring that ducts, inlets, and fans are kept clean. Where natural ventilation is not used, computer controlled automatic ventilation can maintain optimum conditions within sheds. Recirculation of air within a building should be considered to redistribute heat to where it is needed.

Note: Motors, especially those driving fans and pumps, often don't need to run at full speed all the time and fitting variable speed drives can result in substantial savings for motors that run for long hours.

Equipment, vehicles, and machinery

Energy-efficient equipment and machinery will reduce energy consumption across the farm. When replacing machinery, choose energy-efficient models for various farm operations. You should also regularly maintain and service all equipment to ensure optimal performance and energy efficiency.

Simple management changes can also make big differences and multiple benefits, e.g., diverting clean rainwater from entering slurry systems reduces the volume required for handling and spreading, thus saving energy and freeing up storage. Train employees on efficient driving techniques and how to use equipment appropriately to raise awareness and ensure everyone contributes to energy-saving efforts.

Think about when you're using energy
That doesn't just mean turning off machinery and engines when they're not being used. Also consider scheduling equipment use to take advantage of cheaper electricity or onsite generation.

Consider lower emission tools.
Electric and hydrogen farm vehicles or low fuel consumption models will significantly reduce fuel use and emissions. For arable farms, changes to cultivation practices such as using precision farming techniques, GPS and adopting minimum or no-till will lead to energy savings in addition to lower greenhouse gas emissions.

Maintain your equipment regularly.
The amount of fuel used by your vehicle and tractor is determined by tyre pressure, regular maintenance, correct equipment setup and driver training. Plan your journeys and tasks to avoid unnecessary trips and make sure yourself and your staff are aware of what best practice is.

You can find more information on optimising tractor fuel here:
https://www.farmingforabetterclimate.org/resource/optimising-tractor-fuel-use/

Energy Sources & Storage

How and where you get your energy from will vary depending on the type of farm and energy demand. However, the following options should be considered to improve efficiencies:

- Where and when do you use electricity, and can you be flexible in respect to the time of day you use power?
- Can you be flexible with energy use to take full advantage of on-site generation, variable pricing, and smart local markets?
- Could you manage import/export of electricity to minimise costs and maximise income?
- Have you reviewed your energy provider? Are you getting the best deal?
- Are you making best use of your connections and systems on farm?

Energy provider

Your energy provider may not be the best option for you nor the most sustainable, therefore, switching supplier or tariff could be a beneficial option. Price comparison sites can help you compare various offers from a range of suppliers. Examples of sites would be USwitch or GoCompare.

Energy costs vary
If your tariff provides cheaper night-time electricity, use this wherever possible, especially for water heating. In addition to water heating, are there other storage options such as batteries that can make best use of cheap electricity or onsite generation?

Consider switching to a green energy tariff; where the supplier will match all or some of the energy you use with renewable energy, which it then feeds back into the National Grid to improve the overall sustainability of the network. If you don't have your own renewables of on farm, this can help to improve you carbon footprint and offset greenhouse gas emissions.

Electrical infrastructure

You can improve power efficiency of the farm by installing technologies to enable voltage management and power factor correction. Devices that allow soft start and variable speed motor controllers can reduce power consumption and costs. It is important to maximise efficiencies first before developing expensive capital projects. This will ensure you are investing in the correct type of technology, renewables, or storage option at the right scale. Considering the following points:

- Are you making full use of available grid connection?
- Are you making the best use of renewable energy generation?
- Could you add battery storage to increase on site generation and export opportunities for surplus?
- Could you offer grid balancing services to the system operator? i.e. by curtailing demand or increasing export during times of peak demand on the network.

The sections below will take you through the different options that would be available once you have considered the points above.

Onsite generation

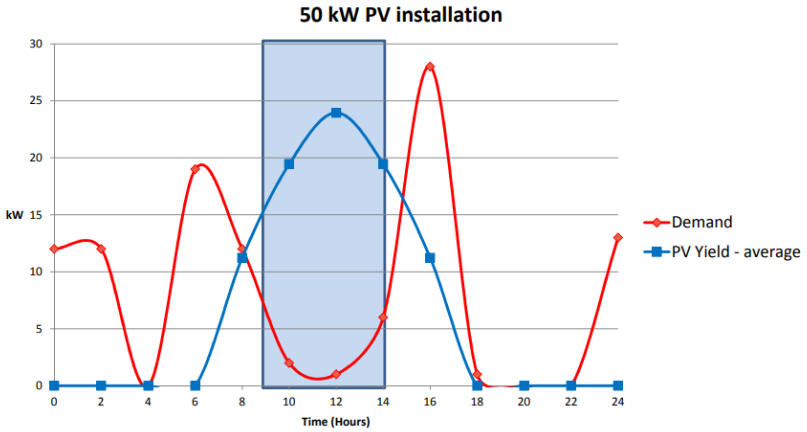
If you do not already have renewables, explore options for renewable electricity generation such as solar panels, heat pumps, wind turbines or other sources. Options may vary depending on the location of your farm, constraints to development, and the energy demand you have on farm.

If you already have renewables on the farm, can you increase your renewable capacity? Many small-medium scale renewables were put in to make the best use of available FITs or RHI payments. As these payment contracts end and devices reach the end of their lifespan, there may be benefits in changing the size and type of technology to better suit on farm needs and make use of advancements in technology.

Consider the needs of your own business
Renewable output can be intermittent and change throughout the day, therefore demand on farm may not necessarily match with renewable output (Figure 1), and as such, backup sources of power will still be required. Where possible, match renewable technology to best fit farm demands and schedule tasks on farm to match your renewable generation.

For example, the figure below highlights how this dairy farm could be benefiting from reduced energy costs if they found a way to store and use the energy produced by their solar panels in the middle of the day.

Figure 1: yield demand profile example for dairy farm with solar PV



Take the time to understand renewable energy legislation
The potential of renewable energy generation on farms could be a good option to improve energy security by protecting against global energy market shocks, generate clean sustainable power and offset expensive grid bought power. However, there are several planning, environmental and regulatory considerations which could limit development options in addition to grid network constraints, which will need to be carefully assessed and costed.

We have produced a range of resources to support farmers and crofters across Scotland, you can find them here: https://www.fas.scot/environment/climate-change/renewable-energy/

Key points when installing renewables:

- Consider your options to meet energy demands from on-site generation or when grid power is cheapest.
- Can tasks be rescheduled or automated to match renewable energy generation?

Energy storage and hydrogen

Renewable output by its nature is variable and intermittent, and considering battery storage technologies will help to maximise renewable output and associated benefits

Storage technologies are becoming more common place on farms. Some technology options can be expensive although costs are falling. On-site storage can make more use of intermittent generation from renewables by storing excess generation not required on farm at that time, for use later.

Battery Energy Storage Systems (BESS) are playing an increasing role in meeting our energy demands. A range of technologies and scales are available include lead-acid batteries, lithium-ion batteries, flow batteries and hydrogen generation. The rise in electric vehicles also presents additional storage opportunities.

Can you use alternative fuels, such as hydrogen to offset fossil fuel use and minimise emissions on vehicles and machinery? Technologies like electrolysers might have cost implications but are an emerging area that can reduce fossil fuel use on a range of agricultural vehicles. The offsetting of bought fuel and the use of on-farm renewables to create “green hydrogen” can aid economics and act as another form of energy storage.

How to identify the best options for your business
When paired with renewables, energy storage can provide a buffer so that on-site use can be varied from the time of generation. The advantage of this is that more expensive imported energy can be offset by renewable generation and can lead to savings in overall energy costs at the site. A range of revenue streams can be accessed by storage operators including reduced energy import costs, the ability to trade electricity at more attractive price points and receipt of payments for providing grid balancing services.

To inform a decision on whether battery storage would make a good financial investment, assess the cost of energy delivered from the battery system in p/kWh. Manufacturers will often provide a warranty up to a maximum number of charge/discharge cycles and will also provide a specification for the useable storage capacity. Where a system is designed to completely charge and discharge every cycle, then a crude estimate of the total energy delivered over the expected life of the batteries can be made by multiplying the useable storage capacity by the number of warranted cycles.

Key considerations for energy storage:

- A range of BESS are available with the technologies developing rapidly.
- Investment in energy storage technology should be considered especially to maximise benefits from renewables.
- Assess costs and benefits carefully. Benefits from battery storage installations should be calculated in p/kWh over the expected life of the specific batteries proposed.
- Calculate savings based on energy returned from the storage device, not from the input energy.

Energy Improvements For High-Use Farms

If your farm is makes use of significant amounts of energy, we have produced an additional supplement that goes into further detail about ways to reduce your usage and save money.

Click here to read our high energy-use supplement

If you have further questions, you can contact the FAS Advice line for free

Email: advice@fas.scot Phone: 0300 323 0161

If you found this practical guide useful and would like to read others, we have many more on the FAS website.