Fact sheet
Energy 01

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01

ENERGY USE ON TILLAGE FARMS

Introduction

There are considerable financial savings to be gained from being energy efficient.

Grain drying and cultivations are key to improving energy efficiency on tillage farms. From grain quality assurance standards to end user grower protocols, there is increasing pressure on tillage farmers to improve energy efficiency. While these may seem like regulatory hoops, there are considerable financial savings to be gained by being energy efficient.

Energy efficiency has always been a harder sell than renewable technology, but the returns can be just as good, with many projects paying back in two to five years. The difficulty is that energy efficiency is harder to measure and requires accurate monitoring and recording.

Keeping a record of fuel use over time allows growers to identify where most fuel is used and see how consumption can be cut just by doing things more efficiently. Electricity use on most combinable crop farms is generally fairly minimal, so the greatest scope for saving energy (disregarding embedded energy in fertiliser) lies in the fuel needed during crop drying, storage and for field cultivations. Energy used in each operation varies widely depending on the business. Some 90% of energy use might be in the field, whereas if you are drying grain, it may be closer to a 50:50 split.

Energy-saving opportunities

Reducing engine speed can save up to 25.9% in fuel costs when spreading fertiliser.

Cultivations and crop husbandry

Typical fuel costs for field cultivations on a 50ha tillage enterprise are €2,500 based on a fuel price of €0.60 per litre. Recording fuel and equipment use can provide accurate information on the relative fuel used by each operation and focus on energy used.

In terms of cultivations, the biggest step for cutting energy use is to switch to a minimum or no-tillage system to reduce the amount of soil moved. This will not suit every farm and there are some agronomic reasons for sticking with more fuel-intensive systems. With all systems, there is an opportunity to reduce energy by reducing working depth and tillage intensity where conditions allow.

Key steps to consider

Combining machine operations

Using equipment that allows multiple jobs to be done with each pass, such as ploughing and pressing or cultivation and sowing, can cut energy use by 25-40%. It may require compromises in set-up and speed, but generally saves time and fuel.

Matching tractors and implements

Using smaller engine tractors where possible can save up to 50% of fuel, depending on the job. Also consider more efficient models when buying, or use a contractor instead of buying a bigger tractor.

Match gear and engine speed

Operate tractor engines at the lowest speed for the power requirement, but do not overload the engine. The use of economy PTO speeds (540E) can help achieve this. One European Efficient Energy 20 study found that reducing engine speed from 1,800-2,200rpm to 1,000-1,600rpm gave the following fuel savings:

- spring tine cultivating – 7%;
- disc harrowing – 12.5%;
- fertiliser spreading – 25.9%;
- ploughing – 6.4%;
- rolling – 16.9%;
- drilling – 15.8%; and,
- transport – 17.6%.

Maintain machines

Key tasks include:

- field tyre pressure: reduce to minimum for load and speed being used;
- set all soil engaging tools carefully in terms of depth, level in both directions, line of draught (plough), and correct lift linkage settings;
- ensure all machines with clearance settings and cutting elements (whether mowers, balers, forage harvesters or soil-engaging parts) are set correctly, or sharpened where appropriate;
- ensure all servicing in terms of air filters, cooling systems and lubrication are attended to; and,
- sharpen blades on items like balers – 10% power losses have been found on balers with blunt blades.

Optimising tyre sizes and pressures

Reducing rolling resistance and avoiding wheel slip will save energy in the field. Rolling resistance is reduced by increasing the tyre size and reducing tyre pressure to minimise tyre sinkage.

Wheel slip is reduced by careful ballasting and fitting large enough tyres to avoid sinkage. Ploughing trials showed that a reduction in tyre pressures from 1.6 bar to 1.0 bar saved 5% in fuel.

However large, low-pressure tyres are less efficient on the road, as are tractors compared to trucks, so choose the machines you use extensively on the road carefully.

Cost of rented land

Always consider the time, fuel and machinery costs incurred on road transport when renting land and factor it into its value before deciding to farm it.

A distant block of land could add up to €150/ha on machinery costs. Arrange cropping in blocks sized to minimise road travel.

Table 1: Self-assessment questions.

Can minimal cultivation techniques be used? Consider type of seedbeds required for the crops grown, depth of cultivation, trash burial and the effectiveness of herbicides. Potential savings up to 90%.	Yes ☐	No ☐
Have you considered changing to lower-input crops? Review profitability of each crop in the light of energy and other input costs.	Yes ☐	No ☐
Is each cultivation operation really necessary? Examine the soil and avoid 'recreational cultivation'. Potential savings of up to 50%.	Yes ☐	No ☐
Do you factor in extra fuel and machinery costs when renting distant land?	Yes ☐	No ☐
Have you reviewed equipment efficiency? Optimise efficiency by reviewing all machines used, including: powered vs non-powered cultivators, tramline/fertiliser/spray width; and tractor size. Potential savings of up to 50%.	Yes ☐	No ☐
Are tractor tyres the correct size and operating pressure? Incorrect tyre choice and pressure will increase fuel consumption. Potential savings of up to 50%.	Yes ☐	No ☐

Drying and storage

Crop drying and storage is the largest single item of direct fuel usage in cereal production. A high-temperature drier will consume 55 litres of fuel oil for each hectare of crop that is harvested/dried. To bring moisture from 20% to 15% typically takes about six litres of fuel (diesel) for each tonne of grain to be dried. The improvements in management and equipment necessary to reduce the use of energy during drying and storage of crops, will lead to significant savings in cost and improved quality and value of the produce stored. Measures leading to reduction in energy may not always be cost effective because of the substantial capital investment required, but often they can be justified due to the additional benefit of improved produce quality and reduced weight loss. Simple measures such as ensuring all controls (especially humidity) are set correctly can cut energy use by a quarter:

There have been big advances in grain-drying technology over recent years.

- grain can be efficiently stored by using on-floor or bin drying systems, which use ambient air to remove the initial moisture and only then add heat to further extract moisture below 18% moisture content (MC);
- ensure equipment is well maintained, ventilation fans are the appropriate size and moisture measurements are accurate;
- adding recirculation to existing cross-flow driers can save up to 30% of energy usage;
- ensure the drier is operating at the right capacity and avoid a second pass through; and,
- increase harvesting capacity to allow grain to be harvested at lower moisture.

There have been big advances in grain-drying technology over recent years and energy efficiency is a key driver. Modern dryers include features such as precise control of grain flow and temperature, insulated walls to retain heat, air recycling and efficient burner technology. Savings noted in **Table 2** are based on cost of fuel for a 3% MC reduction.

Table 2: Drying costs questions.

Is harvesting managed to minimise additional drying? Harvest management can ensure that the crop is combined at optimum MC, though crops prone to shedding can suffer economic loss if harvesting is delayed too long. Potential savings of up to 75%.	Yes ☐	No ☐
Is grain dried in bulk with high volumes of air? This is the most energy-efficient method of grain drying. Management is critical to effectiveness and efficiency. There is no substitute for air volume (0.05m³ per second per tonne being dried). Additional heat applied to grain above 18% MC is a waste. Typical faults include undersized and restricted ducts, inlet vents, drying floors, duct air leakage and humid air recirculation. Savings of 2-10% if faults corrected.	Yes ☐	No ☐
Is steady progressive operation maintained in your high-temperature drying system? Steady progressive operation is important. Dryers must be neither too lightly, nor too heavily loaded. Efficiency is reduced if grain has to pass through the drier a second time.	Yes ☐	No ☐
Do you keep a record of your energy use? Close monitoring of fuel use identifies areas where potential savings can be made. It provides an early warning of potential/actual equipment or system failure. Potential savings of up to 50%.	Yes ☐	No ☐
Is your drier fitted with cross-flow recirculation? Savings of up to 30% compared to a basic cross-flow drier.	Yes ☐	No ☐
Do you have a mixed-flow drier? Savings of up to 50% compared to a basic cross-flow drier.	Yes ☐	No ☐
Do you use dry aeration? Savings could be 12-17%. Conversion of existing round bin system could be considered.	Yes ☐	No ☐
Are you sure moistures are measured accurately? Over drying by as little as 1% consumes an extra 3.5 litres of fuel per tonne. More important from a financial point of view is the loss of saleable weight. Potential savings of up to 35%, depending on accuracy of moisture meter.	Yes ☐	No ☐
Are controls set accurately? For air volume/recirculation/temperature. Potential savings of between 5% and 25%.	Yes ☐	No ☐
Is burner maintenance carried out? Jet condition. Air to fuel setting. Potential savings of up to 5%.	Yes ☐	No ☐
Has ventilation fan specification and design been assessed? Insufficient fan capacity slows drying. Potential savings of up to 5%.	Yes ☐	No ☐
Has humidity control been checked and improved if necessary? Potential savings of 13-44%. Energy reduction based on electric staged heaters on high heat level.	Yes ☐	No ☐
Is low rate aeration (crop cooling during storage) used? Low-volume fan units for cooling grain rather than a large drying fan. Potential savings of up to 10%.	Yes ☐	No ☐

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Further information

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