Energy Use in Cropping

About this fact sheet

This fact sheet describes the use of energy in cropping, giving a breakdown of relative consumption and areas where efforts to make reductions might have greatest effect. It focuses on direct energy uses – driving tractors and pumping irrigation.

Total energy use not only includes the direct energy content of fuels but also the energy in extraction, manufacture and delivery of that fuel, along with the embodied energy in fertiliser, agrichemicals and capital items[i].

How is energy measured?

On-farm, energy is often thought of in terms of litres of diesel or kilowatt hours (kWh) of electricity.

A common unit for energy statistics is the megajoule (MJ). Converting diesel volume into megajoule equivalents, and doing the same for electricity, natural gas or solar, allows total energy to be determined and comparisons made.

1kWh = 3.6 MJ OR 1 MJ = 0.28 kWh

Energy use is often measured on a per hectare base which does allow comparison of different production systems such as wheat versus potatoes or milk.

Converting values for typical fossil fuels to usable energy values

- New Zealand diesel contains 10.4kWh per litre, but only about 3.5 – 4.0kWh/L of useful energy are generated.
- New Zealand 91 petrol contains 9.69kWh per litre but only about 2.5 – 2.8kWh/L of useful energy is generated.

[These *usable energy* values for diesel and petrol are already adjusted for engine efficiency.]

It is also useful to measure energy use per tonne of yield, known as energy use efficiency. That allows comparisons of systems used to produce the same crop.

How much energy is used?

By national standards agriculture is a low energy consumer. In 2004 New Zealand agriculture consumed approximately 13.6 million MJ to the farm gate, or 2.6% of national consumption.

Most was used in the very large pastoral sector. Arable used only about 7% and outdoor vegetables about 4% of the total agricultural use.

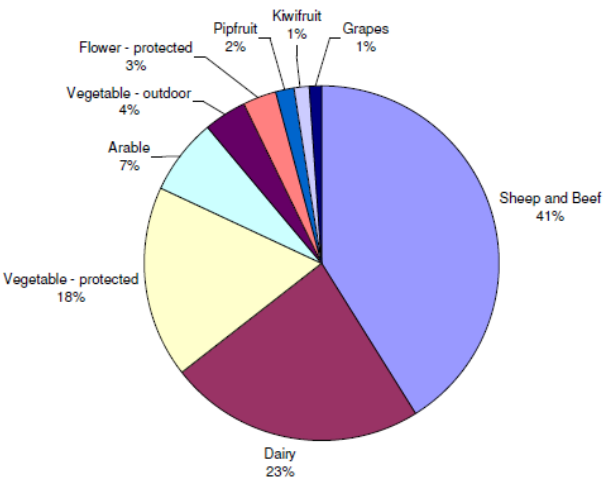

Figure 1 Relative energy use by agricultural sectors (from Barber)

What is energy used for?

Cultivation is the largest use of energy. Barber estimated cultivation fuel use for arable and vegetable crops, as in Table 1.

Table 1: Fuel use for field cropping cultivation (L/ha)

	Full cultivation (L/ha)	Minimum Tillage (L/ha)	No-Tillage (L/ha)
Arable	80	48	20
Vegetable	300	180	-

Irrigation can account for a large part of total cropping energy use. Estimates suggest 400 kWh/ha for a single 35mm irrigation application.

Energy for transporting crops depends on farm layout and locations. In Pukekohe where fields can be spread over a large area, Barber suggested 25% of vegetable growing fuel use was transporting crop from field to shed. In the South Island with mostly single large properties, transport fuel use is much less.

Post-harvest processes can use high amounts of energy for drying or cooling produce. Grain drying arable seeds uses 2,500 – 5,600 MJ per tonne of water removed, depending on drying system used.

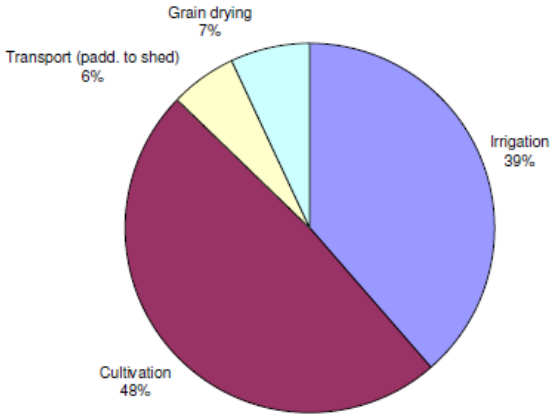

Figure 2: Energy use in arable and vegetable growing to farm gate (from Barber)

Where can savings be made?

A range of energy optimisation measures have been documented from reduced tillage and tractor driver education to irrigation efficiency and split fertiliser applications.

While direct energy use is often less than 5% of expenditure, cost savings from a 15% improvement in diesel and electricity use can boost profits significantly. Beside direct cost savings other benefits include lower labour costs, reduced repairs and less capital depreciation.

Cultivation energy can be reduced through correct tractor set up, including ballast and tire pressure. Modern tractors seek to optimise engine management automatically. The biggest savings are made by reducing cultivation operations, especially high draft activities such as deep ripping and powered cultivators. Moving to controlled-traffic or minimum or no-till systems offers major savings.

Irrigation energy use is highly variable, depending on location and season. Correct pump and pipe size, running lower pressure systems and increasing water use efficiency are the keys to reducing energy use.

Further information

Other fact sheets in this series, including irrigation energy
LandWISE Controlled Traffic Guidelines

[i] Barber, A. 2004. Seven Case Study Farms: Total Energy & Carbon Indicators for New Zealand Arable & Outdoor Vegetable Production. AgriLink NZ