Energy Efficiency Saves

Turf growers doing well

Growing turf requires energy. In our project, An Environmental Assessment of the Australian Turf Industry, we found the median turf farm usage is 4.5 megajoule per square meter of turf produced. Most of this energy is imported to the farm in diesel fuel to run farm equipment, including pumps at some turf farms. A survey of 30 turf growing sites across Australia indicated a large variation in energy use as illustrated in Chart 1.

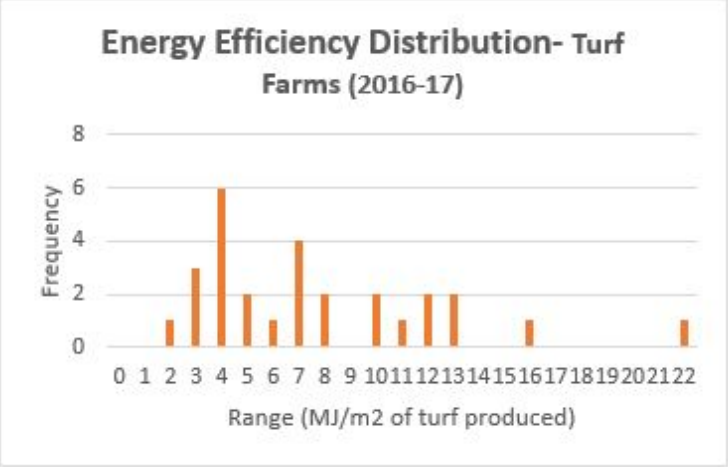

Chart 1. Distribution of energy efficiency by turf farmers

Key findings:

- **Diesel is big**
- **Keep tractors efficient**
- **Size the equipment to the job**
- **Use low pressure irrigation**
- **Measure performance**

The factors considered in energy efficiency are structural, environmental and process efficiency. The spread of energy efficiency reflects these factors. A hilly site will require more energy to move equipment, product and irrigation water. The use of bore water takes more energy than river or dam water. A hotter environment can require more irrigation. A bigger farm can utilise larger pipe works, cultivation equipment and harvesting equipment, etc.

This all adds up to varying energy demand across the industry. However, process efficiency outweighs these factors in achieving a lower energy bill. A 10% product wastage (about the industry average) loses 10% of the energy used on the farm in generating that waste.

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Diesel is the key to energy efficiency

For the typical turf farmer diesel use out ranks electricity 40:1 in terms of energy consumed. As electricity consumption is predominantly used to run irrigation pumps, those that use diesel pumps have a much higher proportion of energy use as diesel. In cost terms the diesel, on average, is 16 times the cost of electricity on the farm[1]. Therefore, efforts at reducing diesel use should be the focus of energy efficiency efforts.

Diesel pumps

A well set up diesel pump

Good practice includes housing the pump motor under cover, regular cleaning and using a direct drive to the pump. The motor should be skid mounted for easy removal and servicing and the skid acts as a bund in case of fuel or oil leaks. In most cases, greater efficiency and less environmental impact would be achieved with an electric pump performing this task.

Pump suction head is minimised by placing the pump on the dam wall and maximising the diameter of the suction pipe. Connection to low pressure irrigation equipment such as pivots and travelling laterals will also reduce pumping pressures and save diesel.

Diesel motor checklist

Motor under cover (protected from weather)	√
No build-up of grease and oil	√
Motor not allowed to idle (on or off)	√
Motor serviced on schedule	√
Direct drive connections (no belt drives)	√
Fuel records kept L/h of operation	√

[1] The cost comparison only compares the costs for energy ($1.10/L diesel and $0.25/kWh for electricity) In fact diesel costs are significantly higher when servicing and oil consumption are included.

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Tractors and Harvesters

Tractors are often the biggest diesel users on turf farms. Many farms have dedicated tractors for the particular tasks such as cultivation, spreading, rolling, mowing and harvesting. This enables the farm management to purchase equipment suited to the task. Running a log book on each tractor will enable management to track its performance. Fuel efficiency per hour of operation can be easily calculated by recording of hours at each fill.

In general, the tractor power should not be too much for the job as large tractors use more fuel. Operation of the tractor is critical to its performance. The general rule of thumb is to reduce the throttle and run it at the highest gear to achieve the best fuel economy. This is illustrated in the following table.

	Small Tractor	Large Tractor	Large Tractor
Throttle Setting	Full	Full	Reduced
Percent Load	100%	50%	50%
Drawbar HP	55.79	56.67	56.72
Fuel Consumption (gal/hr)	4.49	5.23	4.20
Fuel Efficiency (hp•hr/gal)	12.54	10.91	13.55

Taken from http://www.farmmanagement.pro/nine-tips-for-tractor-operators/

Soil compaction is another issue that should to be considered on turf farms. A larger tyre width will reduce the pressure exerted on the soil, but may increase the rolling resistance and the wheel weight. In general, Radial ply tyres reduce rolling resistance over cross ply tyres and last longer. Tyre treads that have less grip than the standard herringbone tread (such as a diamond tread) could be useful and reduce rolling resistance, where traction is not an issue on the flat. Traction may well change from Summer to Winter months affecting the optimum choice of tyres.

Tyre pressure is generally specified by the manufacturer and is critical for efficient running. Increased tyre pressure can reduce tyre wall flexing and save fuel on hard surfaces.

Diesel fuel density is nominally 0.832 kg/L, but it changes with temperature and may vary by as much as 2-3% over the running range. Cool fuel is more efficient, so running equipment during the morning and evening will save fuel.

Regular servicing will keep the tractor running at optima efficiency. A smoky exhaust indicates it's time for a service.

Tractor checklist

Tractor suited to the application	√
Housed under cover - clean and lubricated	√
Tyre pressures correct	√
Servicing up to date	√
Operator trained on optimising performance	√
Log book up to date - L (diesel)/hour	√

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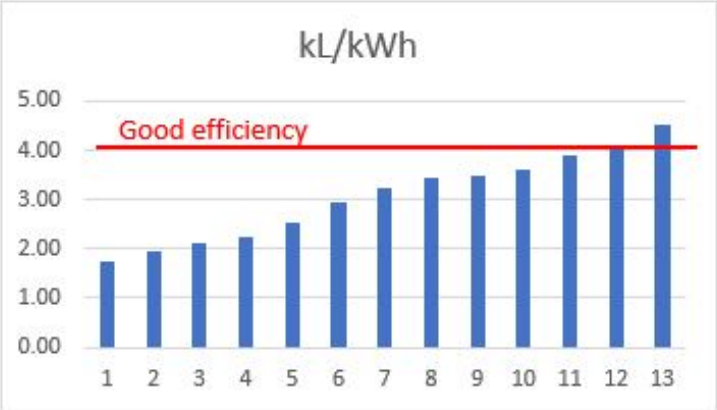
For those with electric pumps

Energy efficiency was measured for a set of 13 turf growers who use electric pumps. Their pumping energy efficiency averaged 3.2 kL/kWh or 313 kWh/ML, with the best at around 4 kL/kWh (250 kWh/ML). For comparison a diesel pump should achieve about 100 L/ML. We measured the efficiency of two diesel pumps. One with a travelling pump next to a lateral pumping from a channel provided an efficiency of about 60 L/ML and another pumping from a deep bore used closer to 300 L/ML.



Pumping energy efficiency of 13 growers

It is important to know your pumping energy efficiency and monitor it regularly, as a poorly performing pump can cost a lot of money in wasted energy. The turf growers at the lower end of efficiency are paying approximately twice the amount to pump each megalitre of water.

The actual pump efficiency depends on the system curve as some may have a larger head to pump and further to pump the water.

Pumping issues that can be addressed

Cavitating pumps can be inefficient and cause damage to the pump – make sure the pump is primed	This can occur when pumps sit above the water source and the main irrigation line giving the opportunity for water to drain from the lines
Oversized pumps run inefficiently	The use of a valve to build the pressure at the pump is less efficient than using a variable speed drive to reduce the flow rate, or setting up the pump system to meet the pressure required.
Undersized irrigation mains may save installation costs but raise the running cost	It may pay to have a 150mm main for an irrigation system. This will reduce the pressure required by a factor of 7.6 over a 100mm main
Minimise the number of elbows or "T's"in the pumping line as these lose pressure	Try to ensure straight lines to the irrigators from the pump
Transferring water to a dam should be done at the slowest practical flow rate	The pressure required in any pumping system varies as the square of the flow rate. So, halving the flow rate requires only ¼ of the pressure

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Partially closed gate valve raising the pressure at the pump

Choking the flow with a gate valve and 100mm irrigation main reduce the energy efficiency of the irrigation system.

Pump outlet undersized

Outlet restriction causes higher pressure and lower energy efficiency.

Efforts to reduce energy consumption save money but also decrease the Greenhouse emissions and improve the carbon footprint of the turf.

For further information contact Dr John Cumming, Infotech Research, on 0418 125 688 or john@infotechresearch.org

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