

Energy Efficiency Information Grants

How to save energy, save money and reduce your carbon footprint



NCEA

National Centre for
Engineering in Agriculture



Australian Government
Department of Industry



Australian Government
Cotton Research and
Development Corporation

Energy Efficiency Information Grants

Improving Energy Efficiency on Irrigated Australian Cotton Farms

The Improving Energy Efficiency on Irrigated Australian Cotton Farms project aims to deliver an industry-wide awareness campaign that provides tailored energy efficiency information and tools to irrigators and their advisors. This activity received funding from the Department of Industry as part of the Energy Efficiency Information Grants Program.

For further information on the Improving Energy Efficiency on Irrigated Australian Cotton Farms project or any information in this booklet please contact the Cotton Research and Development Corporation on 02 6792 4088 or the CottonInfo Team member in your area.

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Energy Assessment & Management

EnergyCalc is a user-friendly software tool that identifies high energy consuming items, which allows efficiency a focus on the items with the highest savings.



An energy assessment establishes energy saving opportunities. Measuring (or estimating) energy use enables comparison with industry benchmarks and, in turn, identifies high energy use areas. Reducing energy use is both profitable and environmentally beneficial.

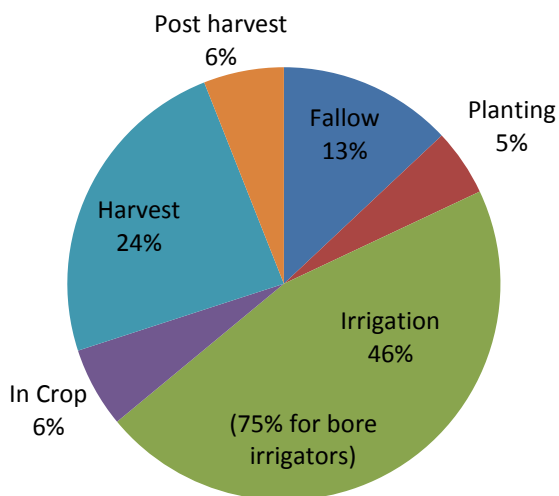
REDUCING FARM ENERGY COSTS

- Target energy improvement by auditing energy use.
- Improve the set-up of pumps and tractors.
- Reduce the number of farming operations .

Opportunities

By itemising farm energy usage, farmers can identify where the most energy is consumed and therefore explore ways to reduce energy use. Examples include:

- **Measure the performance of your pump.** Recent work has shown that diesel savings of 5% to 30% are achievable in most cases.
- **Minimum tillage farming systems** reduces energy demand by at least 10 to 20%.
- **Gear Up & Throttle Back** - in studies monitoring tractor performance, the NCEA has found that by changing gear selection up and engine speed down, you can reduce energy use by about 30% for the same power requirements.
- **Identifying ways to reduce energy consumption can pay for itself** in real dollar terms and is one of the cheapest and fastest ways to reduce greenhouse gas emissions.



Average energy consumed in different areas of cotton production.

- Irrigation is the key driver of energy use; 40 to 75% of total energy use.
- There is significant variation in energy use between cotton enterprises and this is largely due to irrigation.

- Improving your water application efficiency (or water use efficiency) has the biggest impact in reducing energy cost.

	per Ha	per bale
GJ of energy	10.9	1.18
kg CO₂e	1,091	119
cost \$	310	34

Average energy consumed, GHG emissions and cost of energy per hectare and per bale for cotton production.

Pumping Efficiency

Performing a pump test can make significant dollar savings.



Ensure that the pump and engine are matched to the application.

Pumping water is a high energy consumer with an associated high energy cost. Performing pump tests will define the cost to move water and establish any potential efficiency improvements in management or infrastructure and hence reduce running costs of the pump station.

COMMON PROBLEMS AT PUMP STATIONS

“I’m not getting enough water” is the most common problem heard and cavitation is the most common reason. Cavitation causes significant damage to the impeller and is usually caused by suction lifts that are too great.

Common setup problems include:

- the pump level being too high, causing a high suction pressure;
- suction pipe diameters being too small, restricting water flow rate;
- pulley ratios not matching pump and engine specifications;
- an insufficient number of belts to transfer power from engine to pump.

Measurement is the key

Without properly assessing energy it is difficult to accurately quantify the savings that can be made. CottonInfo team members are conducting energy audits in your area now. To arrange an on-farm audit, contact your CottonInfo team today.

PUMP CAVITATION

Pumps that cavitate even slightly suffer a permanent drop in pump efficiency by 5 to 10% - this means 5 to 10% more diesel. Over time this increases to 40% or more.



Cavitation damage to an impeller.

Did you know that **pump cavitation is the most costly and most common problem in large flood lift pumps**? This unwanted problem that occurs when pumps and associated pipelines are poorly designed and configured. **Cavitation is extremely costly** because it greatly reduces the life of the pump as well as increases the energy (and cost) required to pump water.

The process of **cavitation occurs when the suction pressure at the pump intake is so great that vapour bubbles form in the water**. These vapour bubbles move through the pump to the high pressure regions against the pump impeller.

The vapour bubbles, which were formed under a vacuum pressure, then collapse, or **'implode'** against the impeller. **Each bubble implosion will actually eat a small hole in the impeller**. Further bubble implosions will occur at these holes and continue to physically scour the impeller causing localised damage. These are often referred to as **'worm holes'**.

PUMP CAVITATION

Cavitation damage has a different appearance to damage caused by pumping sand or gravel, which will make the entire surface of the impeller evenly worn and shiny, as if it has been cleaned by sand paper. Cavitation does sound like sand or gravel is being pumped.

Impact of cavitation on pump efficiency

Pumps that cavitate even slightly during operation suffer an on-going drop in pump efficiency by 5 to 10% - this means 5 to 10% more diesel. Pumps that cavitate slightly for long periods of time suffer enough physical scouring damage to the impeller to permanently reduce the pump efficiency level by 40% or more. Added to this is the regular replacement cost of impellers and the decreased reliability of the pump.

Cavitation and pump station design

Over the last decade a trend has arisen in large pump station designs in the Australia cotton industry where pumps are placed high above the incoming water surface. This configuration leads to pump cavitation in most cases.

Older pump station designs sensibly placed these large mixed flow pumps at or below the incoming water surface level. These older designs have no potential to cavitate because they are placed close to the incoming water surface level.

TRACTOR SET-UP

Farming systems have the largest effect on tractor fuel use. Reduce, eliminate or combine operations, where possible, to make the biggest savings.

Farming Systems

The number of operations is crucial to reducing fuel use. Avoiding or combining operations is the fastest way to make significant fuel savings. This is particularly true for heavy tillage, such as bed forming.



Costs increase quickly as working depth increases

Optimal working depth

Every centimetre of working depth moves around 150 tonnes of soil per hectare. Every centimetre increase in working depth requires around an additional litre of diesel.

TRACTOR SET-UP

Tyres and ballasting

At the tyre/soil interface there is a trade-off with wheel-slip. We can add more ballast to reduce slip, but this increases rolling resistance (and compaction). We can reduce ballast and rolling resistance but lose out on more wheel slip. 14% wheel-slip is optimum. Always use recommended tyre inflation pressures.

Tractive efficiency

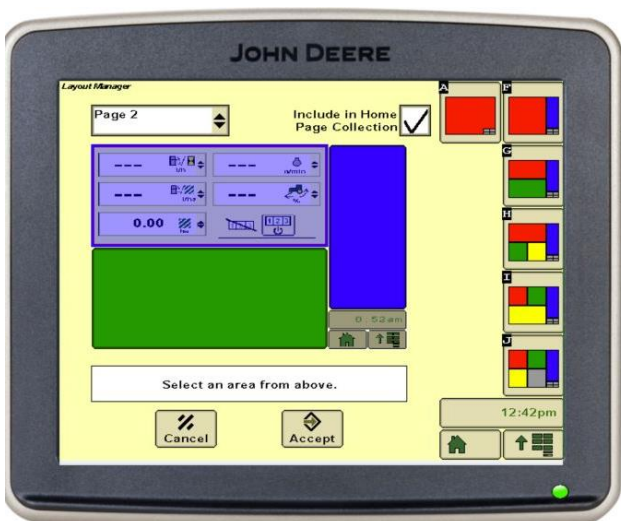
Only around 20% of the energy contained in diesel is successfully converted into tractive effort. More sophisticated tractors have engine management, traction management, variable speed transmissions and other systems. These systems assist the operator to continually optimise these complex interactions between engine and traction management.

Soil moisture

Wet soils make light work for the cultivator however, this damages the soil and does not achieve an effective cultivation. Do not cultivate in very wet soil.

MONITORING TRACTOR FUEL USE

Tractor Performance Monitors (TPMs) have the ability to show fuel use parameters which an operator or grower can use to check their fuel consumption for an operation.



Green Star Menu Option - Layout Manager

There are many makes of Tractor Performance Monitors (TPMs) available, including third-party systems.

ENERGY USE IN COTTON PICKING

Round bale module builders have a 40t operating weight compared to a 20t conventional basket picker. However there are significant advantages to the new system.

**John Deere 7760
round bale picker**



The JD7760 is much bigger, more powerful and heavier than the conventional basket pickers, and as such uses considerably more fuel per hour. However, from a production perspective, anecdotal evidence suggests that the amount of fuel used by the new machine (on a per hectare basis) is comparable to conventional picking system (picker, boll buggy, module builder and transporter). The major benefit of the new machine is the reduce workforce required (and the WH&S implications) and the ease with which it can be picking at a new location should weather interfere. Data to fully document this systems approach is being collected as part of the CRDC project.

PUMP TEST 1

Pump Picture here

Best operating point

Combined efficiency		%
Engine speed		rpm
Pump speed		rpm
Flow rate		ML/h

Maximum flow rate

Combined efficiency		%
Engine speed		rpm
Pump speed		rpm
Flow rate		ML/h

PUMP TEST 2

Pump Picture here

Best operating point

Combined efficiency	_____	%
Engine speed	_____	rpm
Pump speed	_____	rpm
Flow rate	_____	ML/h

Maximum flow rate

Combined efficiency	_____	%
Engine speed	_____	rpm
Pump speed	_____	rpm
Flow rate	_____	ML/h

NOTES

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