Reviewing orchard efficiency to reduce energy use, costs & emissions

Campania orchardist Ian Newnham is reducing his energy usage through upgrading irrigation pumps for the benefit of his bottom line and to combat greenhouse gas (GHG) emissions.

Campania, Coal River Valley, Tasmania

At a glance

Owner & location	Ian Newnham Lowinda, Campania
Property size	42 ha
Enterprises	Orchard (cherries and apricots) and cropping (vegetable seed production)
Average annual rainfall	500 ml
Irrigation water use	60 ML in an average season (ranging from 20 ML in wet years to 100 ML in dry years)

Goal to improve systems

Ian runs an 18 hectare (ha) cherry and apricot orchard at Campania in the Coal River Valley. Whilst orcharding is his main business he also has 17 ha of cropping land used for vegetable seed production, 3 ha of pasture and 4 ha forestry/ windbreaks. His farm is irrigated using on average 60 ML of water per year and ranges from 20-100 ML depending on the season.

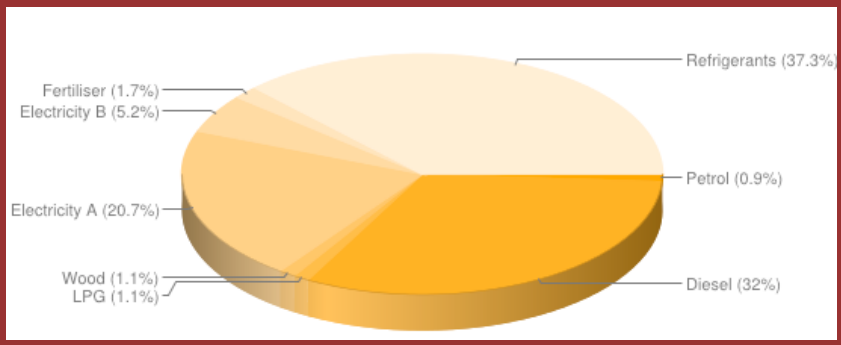
Ian has seen returns for his fresh market fruit diminish over the years and is keen to improve his systems to be as efficient as he can be in running his business and keeping it viable.

"We try to run things as efficiently as possible, as margins for our product are getting less each year" Ian Newnham

Ian has been participating in the Tas Farming Futures (TFF) project and has worked with project extension staff to calculate the greenhouse gas (GHG) emissions derived from the orchard operations on his Lowinda property.

Energy consumption at Lowinda accounts for 25.9% of the greenhouse gas (GHG) emissions. As this relates strongly to farm costs it is an area which farmers are often keen to reduce. Farm GHG emissions are 51 t CO_2e/year[1] or 1.2 tonnes CO_2e/year/hectare or 0.51 tonnes of CO_2e / tonne of fruit produced.

Greenhouse gas emissions



***Above**: Estimated GHG emissions at Lowinda are 51 t CO_2e/year, with 25.9% from energy use*

[1]CO_2e (Carbon dioxide equivalence) - Greenhouse gases can be measured in carbon dioxide equivalents. This is estimated by multiplying the amount of gas by the global warming potential of the gas.

Farm energy usage and efficiency savings tips

Irrigation

Recently Ian has reviewed his on- farm energy use, which is made up of 80% irrigation and 20% for his packing shed operation. He has discovered that savings can be made in relation to his irrigation energy use through upgrading the efficiencies of the pumps used. This will not only provide him with cost savings but will also impact on reducing the GHG emissions from his property.

Tip 1 – Undertake a pump efficiency review

In conjunction with his irrigation advisor, Ian recently undertook a pump efficiency review of the pumps used to deliver irrigation water to his orchard and seed crops. This was last reviewed about 15 years ago and at the time they were upgraded to be as efficient as they could be. Ian was surprised to find that this was not the case now and things had slipped badly, costing him more in energy use and therefore dollars spent on pumping water and in green house gas emissions.

"When we were growing Pyrethrum (15 years ago), CIG offered a free energy audit to their growers. We had Chris Thompson [an irrigation consultant] *undertake an efficiency audit of our pumps. We changed both the pumps, which suited our pumping needs at the time, which was based on irrigation through travelling irrigators. Things change and we no longer use travelers* [irrigators]*".*

"Pumping went from 160 psi to 100 psi in the main lines. We have changed to shifting volume without changing too much. We upgraded two thirds of the pump line at the river. Our failure to check the pump curves meant our power bill wasn't going down accordingly. Then Will Burden from Roberts Irrigation came in and used a pump efficiency calculator."

Tip 2 – Upgrade pumps to ensure that the pump size and pressure is optimised

Initially the upgrades and savings will be made at the river where Ian sources his irrigation water.

"The pump at the river [irrigation water source] *was expensive per ML of water. It has cost $10,000 to upgrade the pump but we can recover this in one year in power savings. The new pump has a bigger suction line and upgraded filter plate…. I will halve my irrigation costs."*

"By installing a new pump we will save between $8,000 and $10,000 per year where we draw water from the river. Power usage should go from $12,000 per year to $2,000 per year at the river."

"My jaw hit the ground when I was told what the new price would be".

Tip 3 – Ensure that in-orchard irrigation delivery is designed to run efficiently

Ian has also reviewed his irrigation system within the orchard and is making changes to the sub mains and blocks to enable him to operate the system more efficiently.

"In the orchard we are changing the block sizes for the irrigation to run a system of mains and sub mains. We are altering the size of the blocks to run them more efficiently. At the moment the blocks are slightly too large to run 2 blocks at a time."

"A block runs 3,000 sprinklers and all of our blocks have 2,000 sprinklers. We are going to bump them up to 3,000 per block. As we plant new blocks we are planning them with this in mind to fit in with the irrigation or we go to 1,500 for half a block. When it all comes together we can run 3,000 sprinklers on each side of the farm. It is all part of our irrigation plan."

Tip 4 – Use irrigation scheduling and moisture monitoring tools in the orchard

Ian uses a range of techniques when working out his irrigation scheduling in the orchard to ensure he delivers the right amount of water when it is needed. These include:

- The use of trans-evaporation figures to determine water needs
- Use of data loggers (Hansen logger) and g-dots to measure soil moisture levels

"I have 2 loggers each with 3 sites. One is located at the centre of the main root zone (20 cm depth) and the other is 3-6 inches below that (30cm depth)."

More tips for energy savings …

Tip 5 – Ensure irrigation type provides an optimal wetting pattern

Ian has changed from drippers to mini sprinklers to achieve the best wetting pattern for his trees.

"We use mini sprinklers. Originally we had drippers; the wetting pattern was not good and on a hot day couldn't get water on fast enough."

Tip 6 – Reduce irrigation needs through using mulches to help retain soil moisture

Orchard floor management practices will influence water retention and soil organic carbon stores. Soil carbon is an important factor influencing the water holding capacity of the soil (greater soil carbon = greater water and nutrient holing capacity).

The use of compost or other organic amendments / mulches under trees will reduce water evaporation and increase soil organic carbon thus leading to increased water holding capacity, increased nutrient availability and increased microbial activity.

Ian has trialed the use of compost in his orchard.

"We have used Renew compost. We used a mixed spreader to apply 10 cubic meters per ha. It seemed like not a lot really, it was only a trickle and we could have put on half as much again."

The use of side throwing mowers to throw grass clippings from grassed alleyways to the tree mound is a useful way of providing a ground cover / mulch under the trees.

Tip 7 – Save fuel and increase efficiency by applying fertilisers through irrigation (fertigation)

Applying fertiliser through irrigation systems (fertigation) not only saves on diesel (through tractor use) but is also good practice for increasing the effective use and uptake of applied nutrients by the crop. Fertigation will also reduce the risk of nitrogen losses through volatilization.

"Ninety percent of the fertilisers applied in the orchard goes on through the water and we use a bit of foliar application. I find that little feeds often are a better bang for your buck."

Renewable Energy

Tip 8 – Investigate options for renewable energy use on farm

The use of on-farm renewable energy sources such as wind, solar or mini hydro systems can be an option for some properties to fully or partially offset their energy use drawn from the national grid. Such systems are site specific and it is not a case of one system fits all – do your research before investing in a particular system.

Ian has looked into renewable energy options (wind and solar) but has decided not to go down that path yet due to the installation costs and currently low feed-in tariffs offered.

"I did have a romantic notion of being carbon neutral."

"I had a consultant come and quote on a wind turbine. A 20kw wind turbine was going to cost $150,000 for the unit and then $10,000 per year to maintain the fans and head."

"I then looked into solar and was getting close to doing something when they started talking about reducing the tariffs [for feeding back to the grid]. I was going to put in a 20KW system on the shed and 10KW on the house and that was close to covering our energy use. It is a pity they amended the solar rebates."

Packing sheds

Although packing sheds are only run for a short period of time they can still account for a significant component of on-farm energy use. In Ian's case he estimates that this is 20% of his total energy usage.

Ian believes that he could have saved energy through installing the most appropriate grading system when he built his packing shed.

"We bought a second hand cool-room from Shepparton. It was a quarter of the cost of a new one and only had a 3 inch panel. Knowing what I do now I should have bought a 6 inch panel and had half the energy costs. We run the shed for 6 weeks of the year for grading but it is an expensive 6 weeks."

Ian has undertaken major upgrades on his refrigeration unit, which has increased the efficiency of the system from 60% to 95%.

"We replaced the original evaporators and put in more efficient ones with variable speed drives. The old belt drive which was 60% efficient was replaced with a direct drive field unit with variable speed drives on the condenser which is 95% efficient."

Tas Farming Futures

Providing on-farm services to support producers in improving farm efficiency & reducing GHG emissions

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Working with industry and NRMs statewide

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Packing Sheds …

It is important to review your grading, lighting and refrigeration systems to ensure that energy efficient systems are being used. The following tips are sourced from the APAL - Watts in Your Business factsheet series (2014);

- **Grading Systems**

✓ Fix air compressor leaks

✓ Improve dryer tunnel efficiency

✓ Install solar hot water heaters

✓ Insulate water chiller tanks on cherry graders

- **Lighting** Switch to more efficient types of lighting

✓ Replace halogen light bulbs with LED

✓ Replace older style fluorescent bulbs (T12 and T8) with newer, more efficient types (T5) or with LED tubes

✓ Replace Metal Halide lights with LED highbay lights

- **Refrigeration systems**

✓ Optimise head pressure on refrigeration systems

✓ Install variable speed drives on evaporative fan motors

✓ Automate cold storage doors

✓ Replace old inefficient compressor motors with high efficiency ones.

Refrigerants

Ian's GHG calculation showed that 37.3% of emissions were derived from the refrigerants used in his packing shed operation. Many refrigeration systems used in orchard cool stores use Hydrochlorofluorocarbons (HCFC's) as the refrigerant gas. These have a very high Global Warming Potential (GWP) when leaked into the atmosphere. Most refrigeration systems have approximately 16% leakage or refrigerant gas per year.

Tips for reducing emissions from refrigeration systems include:

✓ Replace HCFC refrigeration with ammonia refrigeration systems. Most HCFC's are due for final phase down in 2016, so systems relying on them should be replaced (APAL 2014).

✓ Monitoring and regular servicing of refrigeration systems will identify if gas leakage levels are higher than industry accepted standards (16% annual loss), (DCCEE 2010a). Eliminating leaks will keep gas inside the system and reduce GHG emissions.

✓ Automatic refrigerant detection systems can be installed to monitor for refrigerant leaks.

Summary

Reducing farm energy use is not only good for business by saving costs but it also has a win for the environment in reducing greenhouse gas emissions.

Ian's experience has shown that assuming that your systems are efficient is not enough. Things change and this is not always the case.

Regular review of energy efficiency and implementing changes when required will set you on the right path to an energy efficient farm business.

By Sophie Folder