CASE STUDY
Constant electricity load profile of hydroponics makes Glenorie an ideal candidate for 'whole of system' solar-powered irrigation

Many farmers would like to integrate solar power into the running of their irrigation systems; however, variable seasonal loads often make solar PV non-viable.

The good news is that NSW Farmers' Energy Innovation program has identified a solution that offsets grid power peak tariffs with on-site solar. In trialling this solution, Joe D'Anastasi of Glenorie Hydroponics has proven an ideal candidate, improving his farm's bottom line at a time when he's looking to expand.

Pilot site: 'Glenorie' – Sydney Basin, NSW 2157
Date of visit: 13 May 2014
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Land on the coast near the city is expensive and desirable. For this reason most farming operations, which typically require large amounts of land, are located far outside metropolitan centres where land is cheap and readily available. Joe D'Anastasi has managed to set up his horticultural operation less than an hour's drive from the Sydney Opera House by using hydroponics, thereby vastly increasing the productivity of his land.

Hydroponics

In a hydroponic system, plants are grown in water instead of soil. The water is treated with a mix of essential nutrients, which fertilise the plants, and is aerated to provide sufficient oxygen. Plants can be stacked and planted vertically to take advantage of limited space.

Energy on the farm

Glenorie Hydroponics grows lettuces that are sold at supermarkets throughout NSW. In order for the hydroponic system to work, it has to be run 24 hours a day. This maintains optimal nutrition and oxygen levels for the plants. Every day, the crop is harvested and re-planted, with a portion coming in to cool storage and going out on a truck for delivery. To maintain this level of production and throughput, the coolroom is kept at an optimal temperature for the product. This means that the water pumps and coolroom are running constantly, which results in a very consistent electricity load.

Such a load profile makes Glenorie Hydroponics a great candidate for a solar PV system, as the system can be sized to offset a highly predictable load every day, making solar a good financial investment.

Glenorie energy profile

Table 1: Glenorie Energy Breakdown

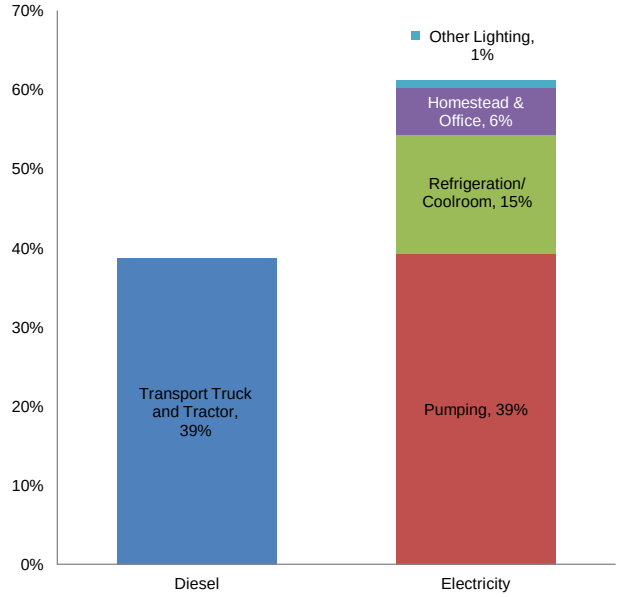
Fuel Type	Annual Energy Consumption	Units	Conversion to GJ factor	GJ	Cost	Cost per Unit	Cost per GJ
Diesel	12,000	litres	0.0386	463	$18,000	$1.50	$38.86
Electricity	203,288	kWh	0.0036	732	$37,800	$0.19	$51.65
Totals/Averages				**Total: 1,195**	**Total: $55,800**	**Average $0.84**	**Average: $45.26**

The farm's largest energy expenses are on transport and pumping.

Table 2: Glenorie Energy Breakdown by End-Use Purpose

Fuel type	Purpose	Energy used (GJ)
Diesel	Transport - truck and tractor	463
Electricity	Pumping	470
Electricity	Refrigeration/coolroom	179
Electricity	Homestead and office	72
Electricity	Other lighting	11
Total		**1,195**

Figure 1: Glenorie Energy Use by Type and Purpose



Cost reduction opportunities

The NSW Farmers Energy Team looked at the potential of both solar PV to offset operating costs, and pumping efficiency to achieve savings. They also considered the potential savings that could be delivered with an upgrade of the refrigeration equipment in Glenorie's coolroom.

Solar to offset electricity costs, and more efficient pumps

The team from NSW Farmers and Energetics worked with Joe to better understand his operation and the way energy is used on his property. This consultation resulted in the identification of opportunities that, if implemented, would reduce costs and enable more efficient hydroponic operations.

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The team identified solar PV as a key way to reduce and offset the major electricity costs associated with Joe's hydroponic pumps, given the regular and predictable nature of his operations. Joe is already assessing various quotes, relating to the pumping operations as well as a second solar PV system, to offset energy use associated with the shed, coolroom and homestead.

In addition to reducing energy costs via solar PV, options identified to reduce energy consumption at Glenorie include the use of higher-efficiency pumps, and making energy-efficient design choices when the time comes to upgrade the coolroom refrigeration skid.

To summarise, the NSW Farmers Energy Team found the following energy-efficiency and cost-saving opportunities:

Table 3: Full list of opportunities for Glenorie with priority opportunities highlighted

Opportunity Name	Description	Savings	Est. Capex	Payback
Cool rom design considerations - VSD on compressor	Main coolroom serviced by old refrigeration unit. Consideration of opportunity when spec'ing new system.	$600	$600	1
Coolroom design considerations - high efficiency compressor	Main coolroom serviced by old refrigeration unit. Consideration of opportunity when spec'ing new system.	$1,300	$2,600	2
Change pump configuration to reduce suction pressure	Recirculation pumps currently lift water out of receiving tank by approximately 60cm. Opportunity involves lowering the pump via construction of a pump pit, in order to reduce energy required to lift water.	$2,800	$14,000	5
Lighting upgrade in office	Office area uses older style T8 fluorescents which could be upgraded to more energy efficient T5 or LED styles. Minimal savings and only included to provide comparison of major cost savings areas	$15	$75	5
Network Tariff Review	Joe is over the 160MWh threshold used by NSPs to switch between network tariffs. Potential that he might qualify for an alternate tariff to deliver a cost saving.	$1,000	0	<1 yr
Higher-efficiency pumps	Joe purchases pumps on an average of 1-2 a year, and needs to understand if there are more efficient pump and motor sets out on the market. Joe currently does not have any spares on site.	$2,960	Under investigation	
Solar PV	Pumping conducted on dedicated account which has a flat load making farm a good candidate for offsetting through use of solar PV. Coolroom and household on other main account. Estimated potential of 10kW for each account. To be confirmed based on interval data.	$6,570	$29,565	4.5
Total		**$12,285**	**$46,840**	**3.8 yrs**

During a two-hour discussion with the Energy Team in his office, Joe decided that his priorities were solar PV for the pumping operation; investigating options for higher-efficiency pumps; and the potential savings he could make from a network tariff review that might be triggered once the other options have been implemented.

Solar PV

With water pumps operating on a flat 24/7 load year-round, and a large, unobstructed shed roof, Joe's farm is a great candidate for installing solar PV. The constant pump load makes for highly predictable energy use, which provides Joe with greater confidence and certainty in the financial return. In this instance, the NSW Farmers and Energetics' team was lucky, in that Joe already had a smart electricity meter installed, which meant they were able to request 30-minute energy-use interval data from the energy retailer. This data enabled the team to conduct a more detailed and site-specific sizing of a possible solar PV system. (Note: While all energy users can request this information, the type of meter installed and the total energy spend of the farm may mean that only monthly or quarterly usage totals are available.)

Having reviewed the data with Joe, the team found that while the load is flat, there is some slight variation in pumping load through the year, in line with greater production in response to increased consumer demand for lettuce in warmer months. Initial estimates suggested a solar PV system of about 20kW, but subsequent quotes from installers have recommended up to 25kW. This oversizing takes into account some system losses and power exports, but provides a greater amount of generation through the morning and afternoon. Such a system has the potential to save Joe up to $7,000 per year with an expected five- to six-year payback period. To sweeten the deal, some installers are offering various financing options so Joe can make savings from the outset while paying off the installation bill.

Higher-efficiency pumps

The vast bulk of electricity usage on Glenorie farm is by the pumps responsible for circulating water through the hydroponics system on a 24/7 basis. Improvements to this system therefore carry potential for greater savings than do most other energy-saving opportunities (such as upgrading the lighting to LEDs).

The hydroponics system at Glenorie is made up of a number of parallel circuits, set up the same way and driven by a couple of common household pool pumps ranging in size from 1 to 2hp. Where possible, all corners and bends in the two-inch piping are at 45 degrees rather than at right angles to reduce pressure losses.

Often, a variable speed drive (VSD) will provide savings on pumping systems, and while there are a number of VSD pool pumps available on the market (see our factsheet 'VSDs on pumps'), these pumps deliver greater savings in situations in which pumping typically occurs for shorter periods of the day and can be slowed to save power while pumping for longer periods. Joe, however, generally has his pumps working 24/7

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with no variation in flow, making these options unsuitable for his operation.

The next avenue Joe and the energy team explored in their bid to progress pumping efficiency at Glenorie was to review different makes and models of pumps to find is the most efficient one. Finding a pump that offers a 10% improvement in efficiency has the potential to generate an additional $3,000 per year in savings. Making life a bit difficult, however, is the fact that any new pump would need to be of a similar size and shape to Joe's existing ones.

Network tariff review

Due to the large pumping load at Glenorie, Joe is classed as a contestable electricity consumer and is able to organise a contract directly with an energy retailer, rather than simply being on standard small business electricity rates (typically, your spend would have to be > $50,000 per year on a single account to qualify). In addition to being able to take advantage of more competitive market rates (often 30% or better than standard), Joe has the potential to switch his network charge rates if his usage changes significantly. If Joe goes ahead and installs solar PV and more efficient pumps, he should see a dramatic reduction in Glenorie's electricity use – some 25% or more – and there may be options to shift his network tariff to a cheaper option and save additional money.

Freight efficiency opportunities

Like many other small producers, Joe tries to control Glenorie's costs by not outsourcing the job of transporting its product to buyers. Joe has a large refrigerated freight truck that is driven by his son. The truck uses diesel at a cost of about $20,000 a year. In Joe's case, it is believed that this truck is driven and maintained well. However, adjusting driver behaviour and undertaking various low-cost maintenance tasks on a routine basis might offer other growers opportunities to make fuel savings. Some of these opportunities are similar to the tractor-efficiency opportunities (see our Factsheet: Adaptive Driving), with savings of up to 30% observed, depending on current driving and maintenance practices.

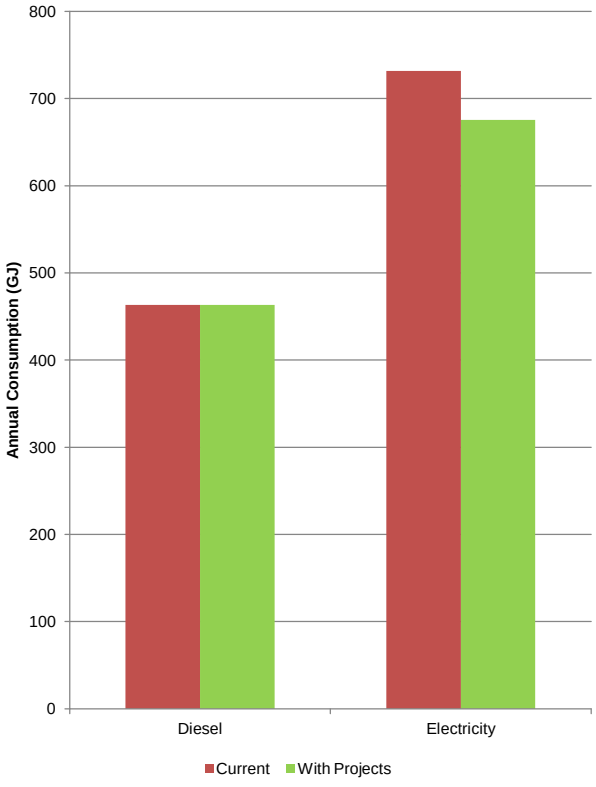
Figure 2: Pumping systems like this one make up the bulk of the energy use on site. Finding a more efficient pump could save about $3,000 a year.

Figure 3: Farmer Joe D'Anastasi and Leigh Rostron from Energetics examine electrical equipment outside one of the pump sheds on site.

Outcomes

Installing a suitable solar PV system and upgrading to more efficient pumps could save Glenorie Hydroponics more than $10,000 p.a. or 5% of the operation's energy costs.

Figure 4: Expected energy savings from continuing implementation of projects



Savings per year (GJ)	57
Savings per year (%)	5%
Savings per year ($)	$10,000

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Planning for prosperity

Joe, with the assistance of NSW Farmers' Energy Innovation Program, will continue to explore energy-efficiency options that secure the future of his family-run business.

In the **short term**, installing solar PV, especially with advantageous financing options, offers an immediate cost saving for Joe.

In the **medium term**, he will investigate options for more energy-efficient pumps that are compatible with the existing piping at Glenorie.

Over the **longer term**, Joe will need to consider upgrades to his coolroom and the associated refrigeration skid with a view to implementing a more energy-efficient design, factoring long-term operating savings into the purchasing decision.

For help in identifying ways to reduce your energy costs, contact the Energy Team at NSW Farmers:

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