The farms
Three individual farms, each with different energy demand profiles and irrigation application methods were chosen to consider the economic and environmental impact of installing microgrids to offset energy use across three key sites, all grid connected, with energy consumption on different scales;

1. Small-scale furrow irrigation – 61 MW p.a. (Ayr)
2. Highly variable, large-scale seasonal energy use from a centre-pivot - 94 MW p.a. (Mackay)
3. Constant and intermittent energy use from a groundwater source and big-gun irrigator – 84 MW p.a (Bundaberg)

Method
The site’s electricity demand and pricing agreements were assessed and entered into HOMER optimisation software to design and analyse a range of hypothetical microgrid installations and rank least-cost alternatives.

“I need something that can lower my Ergon bills and let me irrigate more often”

Q: What is a Microgrid?
A: Clusters of generators which are operated as single controllable entities.

Policy considerations
A major factor in the feasibility results is the connectivity between Federal Government incentives, tariffs, electricity retailers rules regarding Feed-in-tariffs (FiT), export limits and network connection costs. For sites that don’t have uniform use over the 12 months, a FiT generates valuable revenue during periods of no consumption.

Ergon will currently only pay a FiT on a site using under 100MW pa, with a maximum inverter of 30kW. The small scale of Site 1 pumps in this study fit those conditions and achieved the highest economic returns and environmental gains. In all scenarios the best economic returns occurred when the microgrid included photovoltaic (PV) and remained eligible for a FiT.
The solutions
Solar remains the most cost effective renewable energy component. Within the analysis, wind and batteries were not cost effective due to pricing, the seasonal load profile and assumed no FiT.

Site 1: 15 & 18 kW well pumps – seasonal use
Components: 39 kW solar PV
Capital cost: $63,600
Reduction in energy costs: 26%
Payback period: Year 5 of 25

The solar delivers 50% of the load requirement

This site has the largest reduction in energy costs because the microgrid covers the site’s energy requirement while staying eligible for a FIT. Irrigating was shifted from 100% nights to 100% days to utilise the solar. Also a change in Tariff from a time-of-use to a flat tariff reduced the grid energy cost during cloudy periods when the solar didn’t meet the site energy requirements. Modelled emissions abated over 25 years were 1303t CO2e.

“[This microgrid means I could stop irrigating nights and keep my irrigations mostly in day light hours... much more user friendly!]”

Site 2: 75, 55 & 45 kW centre-pivot pumps and transfer pump used in various combinations
Components: 39 kW solar PV
Capital cost: $63,600
Reduction in energy costs: 12%
Payback period: Year 10 of 25

The PV array is designed to meet feed-in-tariff eligibility to generate acceptable returns

This microgrid is much smaller than the site energy requirements of 173 kW peak load. This results in only 9% of the annual site load being met with solar power, however the inclusion of a FiT ensures that while the pumps are not being used, the solar is generating income, resulting in an estimated payback of under 10 years. Should the export limit with FiT increase, a larger 100 kW system would be more economically and environmentally optimal.
Site 3: 55 kW bore pump supplying water in shifts to a big-gun irrigator

Components: 39 kW PV, 30 kW inverter
Capital cost: $63,600
Reduction in energy costs: 20%
Payback period: Year 9 of 25

The annual usage will remain below 100 MW p.a and future demand tariff thresholds

Due to the seasonal load profile, remaining eligible for a FiT was critical to make the investment work. 39 kW of solar PV (on a 30 kW inverter) is the maximum connection for Ergon’s FiT eligibility. This solution reduced the average cost of electricity by 20%. A larger microgrid sized to cover the site load, exceeded the export limit of 30 kW and showed paltry economic returns without the FiT.

Key Messages

- The economic feasibility of renewables depends on how much they are being used either by an electric load or export back into the grid.
- Loads that are only being used seasonally or sporadically will not be economically feasible without a FiT.
- The annualised cost of solar PV is now 4-7c/kWh for grid-connected systems, so moving loads into daylight hours can avoid retail rates of 30-40c/kWh.
- Where irrigation is moved to daylight hours, a change in tariff may improve the project economics.
- The study found, even small quantities of export (circa 10 kW) and a 10c / kWh FiT can transition PV installs from high-cost systems to more acceptable economic solutions.
- A diesel genset may be useful to avoid peak tariffs, however as fuel prices increase, the feasibility is reduced.
- Ergon’s evolving tariff structures, FiT and export policies are critical to a microgrid investment.
- Renewable energy is currently incentivised through participation in the Renewable Energy Target, contributing to a microgrids ability to reduce on-farm energy costs.

For further information:
- Contact the Economists at www.agecon.com.au for further details

GEM Energy’s technical review and assistance in selecting practical on farm solutions is gratefully acknowledged.