Renewable Energy & Load Management - for Agribusiness

What is renewable energy & load management (REALM)?

On-site renewable energy, especially rooftop solar, is now significantly cheaper than grid electricity. But as solar PV is a daytime-only electricity source, there are still many types of loads and business operations which cannot take advantage of the cheaper power.

Load management, identifying and shifting electrical loads, increases the value of solar PV. Loads can be shifted to make greater use of solar PV generation, flatten demand peaks to avoid network charges and take advantage of lower off peak rates. *All in a way that does not affect your business's operating schedule.*

New storage and demand control technologies make it easier and cheaper for energy to be stored and used at different times without adversely affecting operations - opening up opportunities for businesses to save money or earn energy market revenue.

Traditionally, the energy system has treated consumer demand as 'fixed' and used centralised supply options to manage variable demand. Now better data systems, onsite storage and generation technologies and automated demand control software allow businesses to pro-actively manage their demand and respond to energy market prices.

How can REALM work in your business?

Many standard agribusiness loads such as:

- pumps and mechanical drives,
- boilers,
- feedstock processing and storage
- cooling and refrigeration systems

hold potential for load management combined with rooftop or ground mounted solar in agri-business.

By installing or upgrading demand control software, your business can use stored power at high-demand times for reducing network tariffs based on monthly demand peaks or consumption during peak price periods.

Businesses can get more value from existing solar PV systems and install more panels without exporting surplus power to the grid for low rates.

Flexible REALM systems could also earn revenue, delivering low-cost energy market services by:

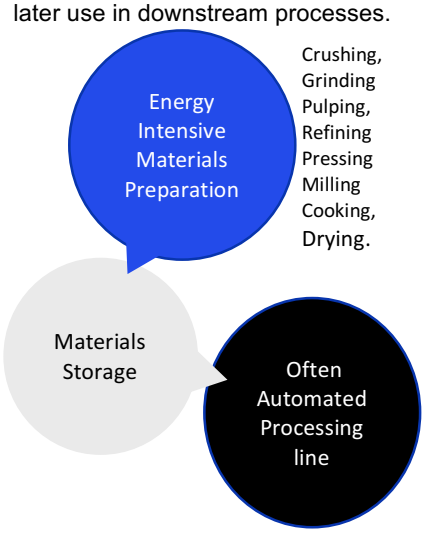
- Exporting or reducing load during high-price wholesale times;
- Reducing investment in expensive generation and poles and wires to meet demand peaks;
- Providing network support or system reserves to maintain supply.

Combining renewable energy with agribusiness operations

1. **Pumping and other mechanical drives:** this works by pumping to a header tank or taking advantage of Variable Speed Drives (VSD's) to ramp pumping up and down in concert with solar generation

   Mechanical drives including pumps and chillers often have significant opportunities to reduce peak demand through power factor correction (PFC). Traditionally, this has been addressed by capacitor banks, but modern Solar PV inverters now have PFC capacity, replacing the need to invest in separate PFC equipment.

2. **Material storage**: Where the business has an automated processing step such as milling, steaming, or grinding which is followed by storage, the processing step can be scheduled and the outputs stored for later use in downstream processes.



3. **Load shape matching.** When installing new solar, there is an opportunity to consider how the load profile of the facility is best matched by solar plant design. Operations extending into the early morning or evening may be best served by extending the solar generation profile through east-west trackers. Late afternoon peaks may be best addressed through west-facing solar.

4. **Gas for electricity - 'Virtual' energy export facility:** in some parts of Australia, it is not possible to export power to the electricity grid. However, if other fuel sources are being used on-site, gas for example, then fuel costs could be reduced by supplementing electric power in that process. For example, an electric pre-heat in a gas boiler operating at times of excess generation

Other Load Flexibility Options

- **Discretionary loads**: there are some loads which can be varied in time such as staff amenities and hot water.
- **Forklifts and Electric vehicles** can have significant batteries which offer an additional source of energy storage depending on operating needs.
- **Hot water systems**: generally small but may offer a storage opportunity.
- **Energy Efficiency Opportunities**

Low-cost energy efficiency can also target demand peaks in addition to total consumption:

- **Variable Speed Drives** (and operational procedures like soft starts or rescheduling start-up of major equipment) can target sources of demand spikes. A mechanical process start-up might not require much energy but if it adds 100kVA for a small period, the annual network charges can increase by over $10,000.
- **For climate-controlled operations, improving building thermal efficiency** to reduce electricity consumption on hot days - painting roofs with heat reflective coating, shading, glazing and green walls.
- Improving operation of the **Building Management System** - benchmarking performance to identify inefficiencies, using predictive weather forecasts to optimise storage and equipment.
- **Upgrading equipment that produces heat** within air-conditioned spaces (e.g. LED lighting). Cheaper, more flexible sensors are becoming available.

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- **Limiting air and heat flow** from the building - thermal imaging can identify air leakage for insulation or sealing or zoning of internal areas.
- **Chiller loads** can be reduced by lowering distribution losses and enhancing operational efficiency. Monitoring the amount of defrost water produced is a useful indicator of energy waste. At times of low load, efficiency can drop off dramatically – installing a smaller flexible chiller can be cost-effective.

How can business create load flexibility?

Control strategies for integration of renewable energy and load management range from simple to more complex.

Simple

Simple automated on/off load management procedures or reprogramming of existing Building Management Systems (BMS) or control systems require low capital investment and no major change in business practices. They can be implemented through existing control systems.

Enhanced control systems will position sites to move into the next category as technology develops and better energy price signals are offered.

Medium

Medium strategies primarily utilise existing plant and equipment but involve investments in controls, PV and storage capacity (e.g. installation or extension of a storage tank).

There may be some business practice changes and additional monitoring and analysis for optimisation.

Complex

Complex strategies require significant capital investment in

- Monitoring and analysis to fully understand system operation and optimisation
- Upstream processing capacity and/or more process storage
- Battery storage
- New plant/technology change

Generally, the current price signals do not make the business case attractive for complex strategies, but energy market reform processes are opening up opportunities to access new revenue streams such as as the energy wholesale market, or network support services to the electricity networks.

How can you position your business for REALM?

Data is everything: 'that which gets measured, gets managed'

Energy consumption is understandably usually a secondary concern for businesses – but energy data systems are becoming cheaper and easier to operate.

Upgrading data systems is a foundational stone in a successful energy management strategy and can deliver very strong returns by:

- Identifying energy efficiency options with short paybacks
- assessing and establishing a business case for a REALM initiative
- Integrating and optimising loads, renewable energy and storage involves collecting, analysing and monitoring data.

The best times to consider REALM opportunities

There are particular times in the business cycle where REALM opportunities are easier to implement:

- Moving premises.
- Investing in new machinery or equipment - particularly heating or cooling equipment, or a process which involves an upstream processing step where product or materials are stored before a downstream process step.
- Investing in on-site renewable energy.
- Assessing changing energy plan or retailer.

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Be aware of load management opportunities at these times and seek a consultant's help in identifying cost effective strategies. Simply installing solar without considering load management could miss major saving opportunities.

A checklist for improving data collection.

Your data collection or building management system should be configured to:

- Collect and log data for all energy meters, and ideally, all major sub-loads and equipment e.g., chillers, boilers and lighting.
- Log temperature, cooling and heating loads and other 'outputs' of the major sub-loads and equipment.
- Keep logged data for at least 24 months.
- Log preferably at a resolution of 15 minutes or shorter. Hourly would be considered the absolute maximum.
- Allow export of logged data in csv or other easily accessible format.
- Benchmark performance. Assess Energy 'in' vs output 'out' for major sub-loads and equipment.
- Ask 'is this data actionable'? Can it be used for making informed decisions?

Building Management Systems are often proprietary software so there can be problems getting access to energy data and developing expertise in operating equipment efficiently.

Case study: Teys - Reducing peak demand

Teys operate a beef cattle feedlot at Condamine, inland from Brisbane on the fringe of the electricity grid. The facility fattens and standardises the quality of cattle before production of meat. The feedlot has the capacity to manage 30,000 head at any one time.

The major energy consuming activity is preparation of food for the cattle. Liquefied Natural Gas is trucked to the site and used to produce steam for cooking.

Over 80% of site electricity is used to operate the grain mill and food production equipment. Food preparation usually occurs each day between 6am and 3pm. Water is added to grain which is cooked in steam chests, cracked and flattened in a rolling mill before being mixed with molasses and vegetable oil to produce animal feed. The steam is supplied by burning liquefied natural gas (LNG) in a boiler.

The operational plant buys grid electricity for the grain mill plant at a fixed price per unit, with monthly peak demand charges. Time of use pricing is available, but is not utilised, given the dominance of daytime loads. Powerfactor is relatively poor at 0.75. The cost of LNG is very high, though lower than for LPG.

The PV system installed in late 2017, despite reducing energy consumption charges, is unlikely to reduce the demand charge. Additional tracking or West facing PV would better align output with demand. However, peak demand often occurs outside daylight hours. Even if peak demand did occur during the day, significant cloud on just one day or a short time of high demand would set the demand charge for the month. Improved equipment flexibility, intelligent controls, and/or energy storage could reduce peak demand charges.

PV needs to be combined with the ability to concentrate electrical loads more in the peak sunlight periods, which at TEYs could be done either through battery storage or using excess PV output to pre-heat feed water for the boiler.

Under current battery prices, a 50kW boiler preheat delivers superior returns (though once battery prices fall to $500/kWh a 100kW battery is slightly more cost-effective). Boiler pre-heat reduces exposure to gas prices. Both options generate returns in the order of 15%, and improve the returns on investment in solar PV.

Increasing flexibility will equip to better manage electricity costs in response to tariff changes. As technology improves, Teys may also have the ability to reduce reliance on the grid entirely. This would avoid expensive network costs and reduce exposure to future energy prices rises.

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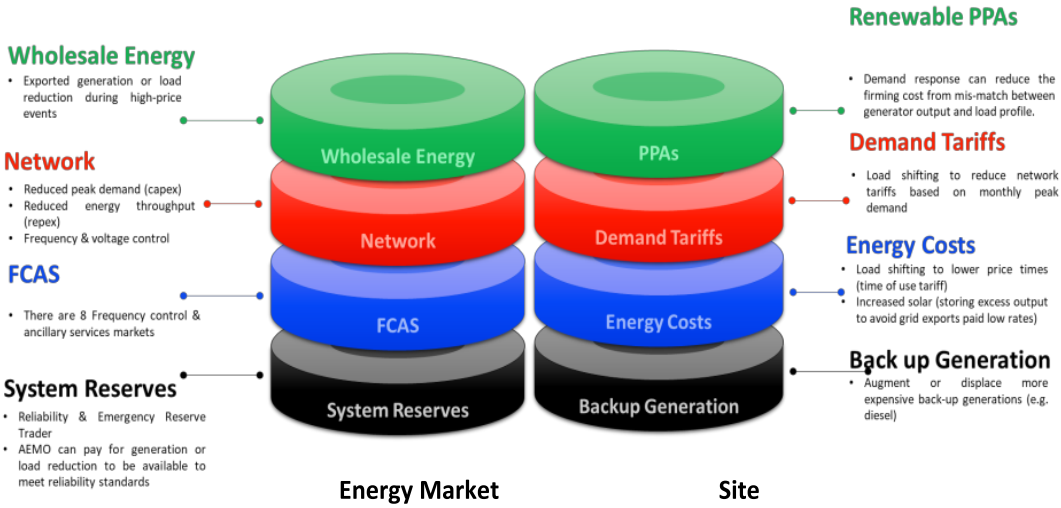
The Value Stack – REALM

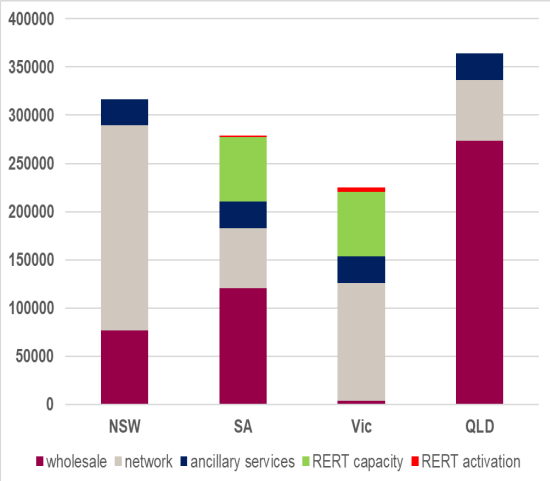


Energy Market **Site**

Currently, electricity tariffs provide little incentive for businesses to adjust demand – but with the right price signal there are low-cost alternatives to peak generation and new poles & wires.

This is now changing. Energy market regulators are considering how to enable businesses to earn revenue if they can provide demand flexibility in response to a price signal.

Demand Response Revenue, Indicative, ($/MW)



The figure illustrates the revenue that could have been available within each of the major state's markets during 2017 for providng energy market services

- **System reserves (RERT)** - 2017-18 summer payments (note: RERT capacity must be off-market and is not available for wholesale or FCAS market)
- **Wholesale markets** - value is based on bidding 1MWh into each half-hour settlement where the price was greater than $500/MWh (minus a 15% retailer margin).
- **Ancillary services** – value based on offers available from 'aggregators' who bundle small generators and providers in to a large enough total to create value on the anciliary services market.
- **Networks** - value is based on 75% of the average deferrable investment where there is a network constraint in each state (note: less than 10 per cent of zones in most distribution networks have a constraint).

  New opportunities may emerge for voltage and frequency management under the Demand Management Incentive Scheme which provides around $1 billion for cheaper alternatives to new poles and wires.

In practice, businesses can either provide off-market capacity for system reserves (if selected through tender by the Australian Energy Market Operator) or market capacity for the wholesale and FCAS markets.

Specialist aggregators such as Enernoc and Greensync provide quotes for services.

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