Renewable Energy & Load Management – for Retail Businesses

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?

- Existing on-site cooling or heating systems, cool rooms, materials storage or batteries can hold excess output from rooftop solar systems or the grid.
- 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 higher 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 services or system reserves to maintain supply.

HVAC & Refrigeration in retail operations

HVAC & refrigeration systems can be a cheap, untapped source of energy storage found in many retail settings.

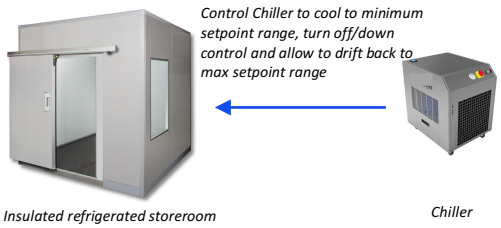
Energy can be stored by reducing temperatures to the bottom of operating settings and then the stored energy can be released during higher demand and price times.

1. **Cold water tank or ice storage** – large thermal storage capacity to support load flexibility and increase rooftop solar
2. **Chiller loads** – another storage option though lower capacity (depending on the thermal efficiency of the building)
3. **Refrigerators and freezers** – pre-cooling can create significant storage

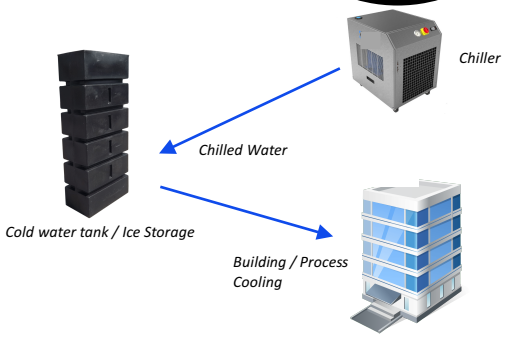
Flexible Load Systems

Cold storage and refrigeration in the retail sector offers a major opportunity to store electricity, taking advantage of the existing thermal mass of the systems. This includes freezers and refrigerated storage in major distribution centers.

Systems with a large thermal mass and wide setpoint range are most suitable. The control strategy is to to pre-cool to the minimum set-point and then switch off/down chillers until the temperature drifts towards the upper setpoint before switching the chiller back on (allowing enough time to stabilise temperatures without overshooting). Load management potential corresponds to the dwell time and surplus freezing capacity in the system.



Phase change materials (PCMs) in coolrooms can also enhance the thermal mass of systems to increase load flexiblitiy.



Centrally air-conditioned systems use chilled water (or glycol or ice storage) as cooling fluid and can be used for load management purposes. Chillers can be controlled to cool storage tanks down to their lowest temperature during low energy cost periods (or to use surplus solar generation on site) and turned off/ down during high energy cost periods so load is met from the stored cold in water or ice.

Other Load Flexibility Options

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

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. An HVAC 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.
- **Improving building thermal efficiency** to reduce electricity consumption on hot days - painting roofs with heat reflective coating, shading, glazing and green walls.

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- 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.
- **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 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

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The best times to consider REALM opportunities

- 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

Be aware of load management opportunites 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 : IKEA - Cold Storage Tank

IKEA's Tempe store in inner Sydney is a 40,000 square metre 'big box' retail facility that combines warehouse, retail, offices and a café and operates 7 days a week for extended hours. Electricity is used for air conditioning (primarily cooling), lighting, operation of a restaurant, office equipment, charging batteries of fork lifts, operating a variety of equipment such as hydraulic waste compressors.

The site hosts a 990kw solar PV system, a back-up generator, electric vehicle forklifts, a building management system, and 1.8 megalitres of cold water tank storage. The electric chiller cooling capacity is supported by the chilled water storage (maximum storage of around 22,000 kWh refrigeration) that replaces or supplements chiller operation in the day.

Optimising use of the cold storage tanks, on-site monitoring and controls, management of discretionary loads, and even occasional use of the back-up generator could deliver significant demand response benefits.

Simply upgrading the chiller controls to spread discharge over the whole day instead of finishing in the ealy afternoon delivers a high IRR in excess of 40% with a quick payback of a year. However an additional 200 to 250 kW of solar PV to charge the cold tank has a higher NPV

Using chillers controls and the cold tank is a cheaper form of storage than batteries. However, as battery prices fall, a 100kWh battery would add further value. Upgrading the batteries of the 18 forklifts as replacement is due could offer further cheap storage.

IKEA's demand tends to peak in the late afternoon – which is when rates might increase as 'cost-reflective' tariffs come in to reflect demand (as people return home and solar output drops off).

Increasing flexibility will equip them to better manage electricity costs in reponse to tariff changes – but also earn revenue as the rules are being changed to reward businesses that can change their demand profile or export during peak times or support the operation of the electricity network.

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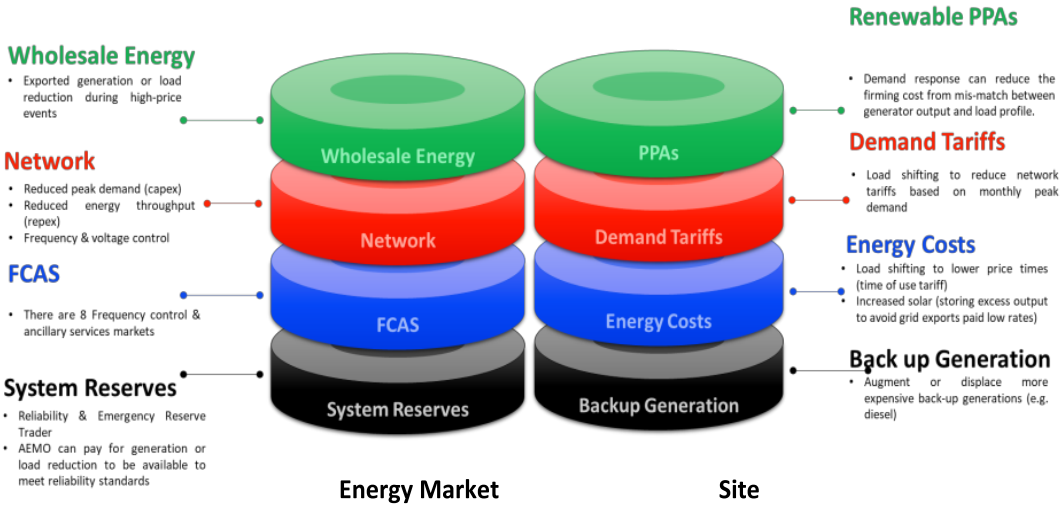
The Value Stack – REALM

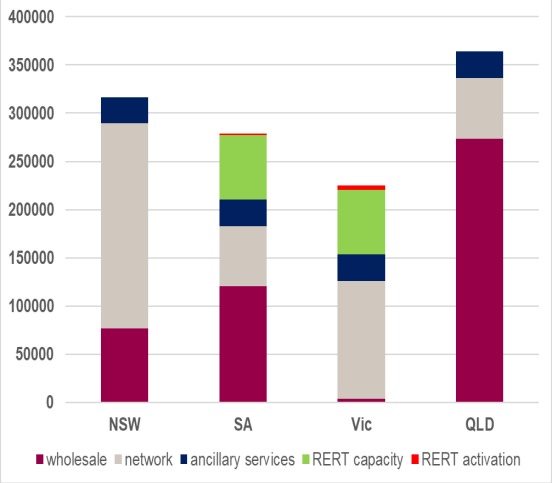


Energy Market **Site**

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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