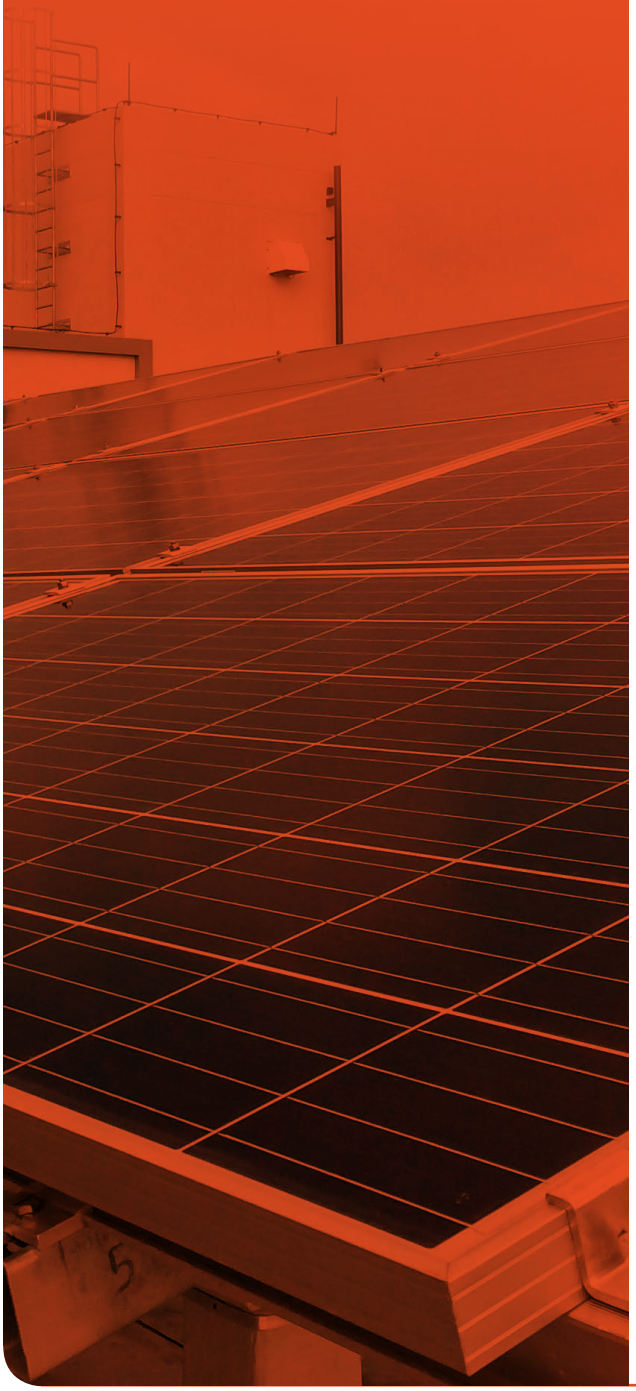
REPORT

Industrial Energy Strategic Opportunity



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Energy is an Increasingly Important Issue To Australian Commercial and Industrial Operations.

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With power prices on the rise, proactive industry leaders are presented with a substantial opportunity – to improve their business to be more competitive. For the first time ever, industry players can become self-sufficient and position their business with a cost base that is static or decreasing while the rest of the market suffers the burden of cost blow.

50-200%

The expected increase in wholesale power price over the next 3 years across mainland Australia *(Jacobs)*

19.2%

The amount of global consumption provided by renewable energy *(KPMG)*

30%

The amount solar power is cheaper than modern, high performance coal fired power stations *(Climate Council Australia)*

30GW

The amount of additional solar power to be installed in Australia in the next decade *(Climate Council Australia)*

Solar power has reached the point that its cheaper than grid in most places in Australia and can be cash flow positive from day one.

Global Energy Insights

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Global trends in renewable energy are encouraging to say the least. In the last few years there have been dramatic achievements in the field, and innovative solutions are being rushed to market. The rate of annual growth in the sector is increasing and cost per watt is falling to unprecedented lows.

The world will soon be able to move to a distributed model for energy generation. Those who stay solely reliant on the grid will be forced to fund the upkeep of the network and incur increasingly high costs. With this in mind, businesses and governments globally are now looking for energy solutions to empower their economic models and ensure a secure and sustainable network in the future.

Sustainable Energy Is Turning The Corner

The Paris agreement has been ratified by 55 countries. These countries are responsible for 55% of Greenhouse Gas emissions. This is expected to accelerate the roll-out of renewable energy projects

The G7 and G20 countries have agreed to accelerate programs in renewable energy and energy efficiency

Many countries have their own renewable energy goals, including some with immediate future 100% renewable goals. 170 countries have goals and 150 have renewable energy policies in place (Adib, Rana, et al.)

In developed countries, there has been a massive increase in the number of 'prosumers'. Prosumers are individuals who produce their own energy and export to the grid when they have an excess

According to the 2017 Employment and Energy report from the US Department of Energy. A jobs census by the Solar Foundation calculated that the industry added 73,615 jobs in 2016 -- more jobs than oil, natural gas and coal combined.

The price of power in Australia has been increasing dramatically in recent years and is likely to increase by a further 50-200% in the next few years. *(Jacobs)*

Causes of this increase in price are:

- Retirement of fossil fuel energy generation assets
- Carbon trading and tax schemes (past and potential future)
- Renewable energy goals further driving market adoption of renewable energy
- Aging infrastructure and costly grid maintenance and upgrades

According to research commissioned by the Australian Energy Market Operator these factors will likely to lead to wholesale energy costs resembling the plot below:

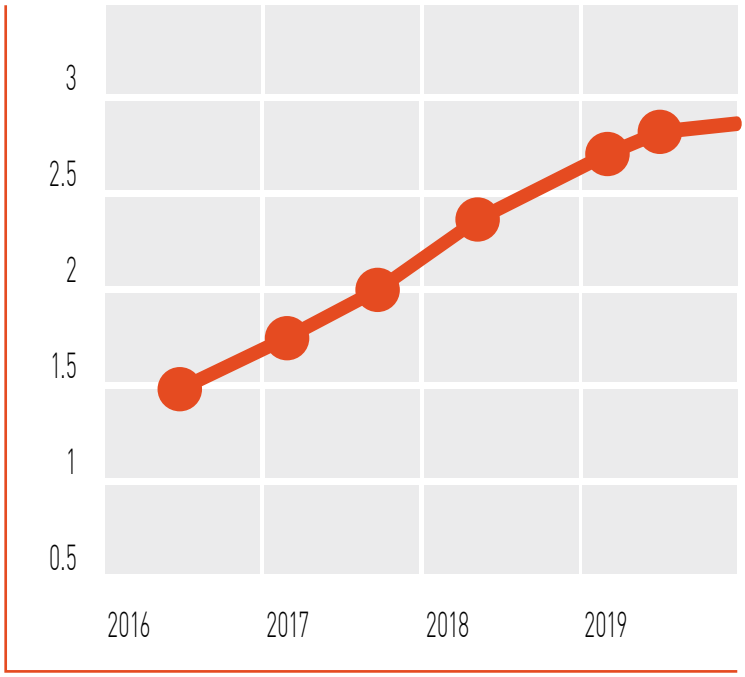

Figure 3 Predicted Wholesale Power Price *(Jacobs)*

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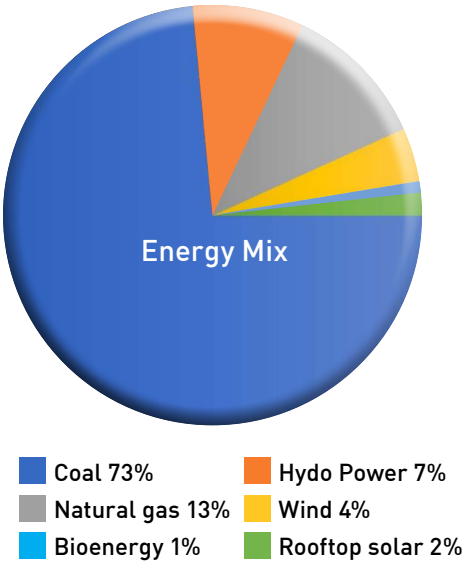
Australia's Energy Mix Has Always Been Fossil Fuel Heavy.

In recent years, coal has made up 65-70% of national generation.

Solar costs have fallen 58% In 5 Years



Solar has reached the point that it is cheaper than next generation coal plants at $110/Mwh (Megawatt hours) compared to $160/Mwh for coal. *Climate Council Australia)*

Solar costs in Australia have dropped by 58% in the last five years and are likely to drop by a further 40 to 70% over the next 23 years to 2040. *(Michael Taylor et al)*

Energy Supply	Lcoe, Levelised Cost Of Energy (AUD/MWh)
Solar	$78-$140
Wind	$61-$118
Ultra super critical coal (known as Clean Coal technology)	$134-$203
Coal with carbon capture storage	$352

Australia is a world leader in the shift towards owner generator, a massive paradigm shift in how energy is created. Distributed production is likely to be the best way to maintain networks going forward.

Australian Installations 1-10 MW	Capacity (MW)
Karratha Solar Power, WA	1
Darwin International Airport, NT	4
Morree Solar, NSW	56
Barcaldine Community Solar, Qld	25

Below can be seen the energy demand (blue) of an Australian food processing and refrigeration facility. The representation also shows the potential energy (solar) generation and the resultant draw from the grid during the course of a typical 24 hours.

Like most Australian operations, it is clear the demand cannot be serviced by solar generation alone (represented by the grey line). In the evening, the sun is down while power consumption remains high. This situation leads to inflated network charges. It is undeniable that solar installations save money but for superior energy independence, energy storage in the form of batteries or another form of local generation must be employed to provide a solution that comprehensively addresses the business's needs.

Plant Demand And Solar Production

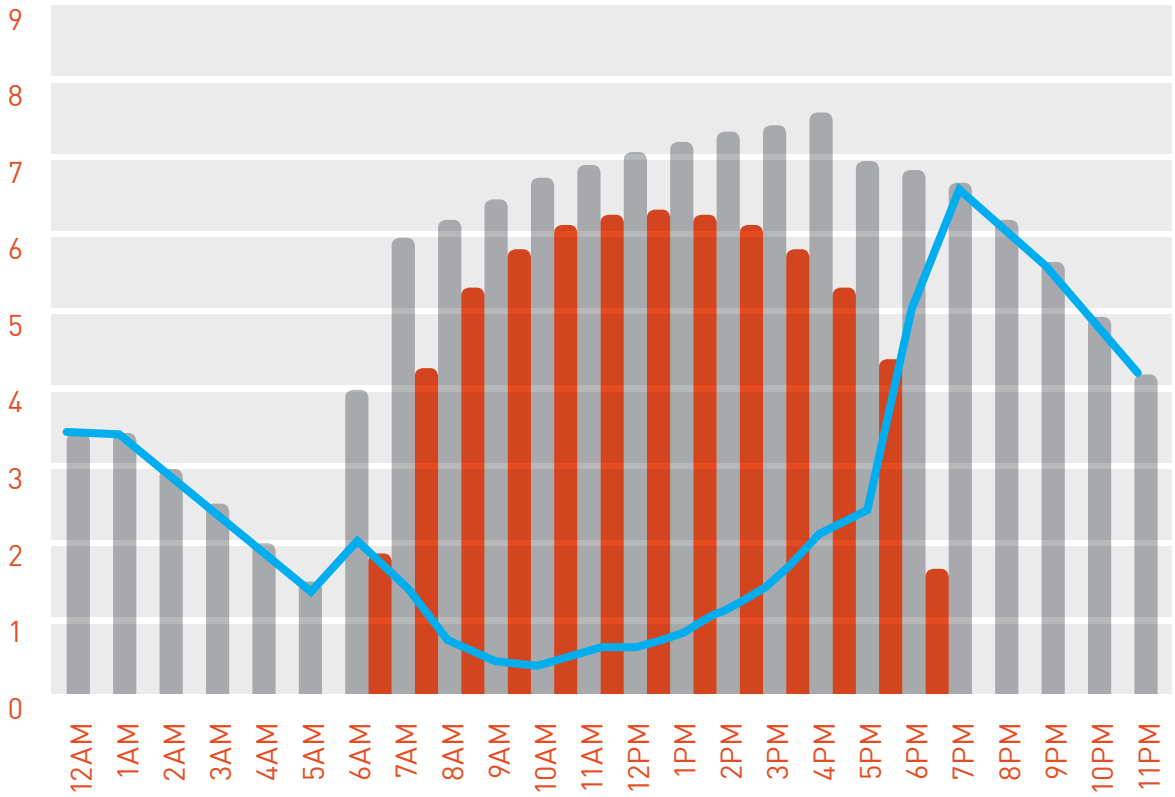


Figure 4 Power Demand, solar production and residual draw from grid

Commercial and Industrial Energy Solutions in Australia

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Australia has been slow to adopt rapidly maturing battery storage technology, with only two major solar battery industrial installations nationwide. These world leading projects are outlined in the table below.

Location	Solar Installation (MWh)	Battery Installation (MWh)
Lakeland (QLD)	10.8	5.3
Cookshire (QLD)	33.0	5.4

Table 1 Solar and Battery Installations of Australian World Leading Projects

These installations are just two of a limited global number of such projects. With substantial solar and battery installations, these projects were able to introduce reliable, renewable solar power to their remote locations. Projects like these are becoming more prevalent as battery technology becomes more accessible and costs tumble.

In addition to these Australian installations other example installations globally are:

Plant Name	Location	Solar (MWh)	Battery (MWh)
GridSolar Boothbay Pilot Project: BESS	Maine, USA	0.5	3.00
PNM Prosperity Energy Storage Project	New Mexico, USA	0.5	2.80
UC San Diago BMW Energy Storage System	California, USA	0.3	1.16
Yokohama Works	Yokohama, Japan	0.2	5.00
Reunion Island Pegase Project (Solar/Wind Hybrid)	St Andre, Reunion, France	10.0	2.00

Business Energy Opportunities

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Commercial and Industrial operators have three avenues available to mitigate the forthcoming cost increases. These are:

1. Increase energy efficiency and reduce consumption

2. Develop capacity to generate power

3. Implement both power generation and storage capacity for later use

Within each of these option there are a range of possible technologies and approaches available to leverage when seeking to avoid escalating power costs and ensure certainty of predicted power costs to apply to your strategy.

Efficiency and Consumption Reduction

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Energy Audits are where the savings start. A simple energy audit can lead to an immediate and substantial difference to power consumption and cost.

Reading an energy bill and interpreting how to address the costs as applied to your production environment into the future is a complex exercise. Maximum consumption, represented by a spike in energy drawn from the grid will make up 25% of a power bill. Even if this maximum consumption exists only for a second in the whole billing period, charges for this one second peak will be incurred.

Managing power demand spikes and mitigating this correctly can achieve a 15 – 20% reduction in power costs.

The most effective way to reduce power bills from a bulk consumption perspective is to keep your doors closed in the case of refrigerated areas, reduce unnecessary continuous lighting and use effective start up and shutdown procedures or technology. This is the means of energy saving everyone is familiar with. Unfortunately, without proper auditing or maintenance it is difficult to know how much could be saved.

Finally, and most specifically to the manufacturing industry, process optimization is an extremely effective way to reduce energy consumption. An upgrade of a 20-year-old facility can have a payback period of less than two years while making substantial returns over the operating lifetime.

Some ways in which one may implement efficiency and energy reduction are as follows:

- Optimize the use of existing equipment
- Install effective metering equipment
- Ensure effective shutdown procedure
- Optimize operating temperatures and pressure of equipment and processes
- Minimize heat gain into fridges and boilers
- Maintain your equipment

Self-generation

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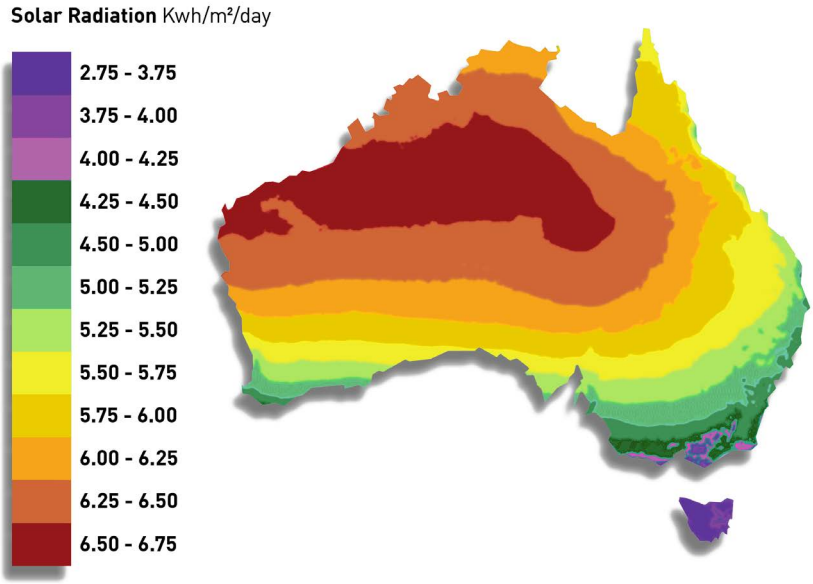
Australia has an abundance of solar radiation to capitalise on. In recent years, solar has eclipsed grid energy as the cheapest form of energy in many parts of Australia. Around the country, the post installation, cost of energy is significantly lower than that of the retail alternatives. The cost of installation also continues to tumble ensuring the number of businesses with viable opportunities for implementing their own solar facility grow dramatically.



Australian mean annual solar radiation levels (data and map supplied by CRES,ANU)

The feasibility of solar energy in specific locations around the country is dependent on the solar resource available (radiation). On the plot above, the colour key depicts different locations in terms of solar resource and subsequent payback periods.

It is important to note the seasonal fluctuation in solar resource. Closer to the equator there is less fluctuation in the amount of available solar energy between summer and winter making supply more reliable.

Depending on the size, location and demand profile of an operation, the cost of a solar installation will vary. Return on investment models will also range dramatically however with a rapidly maturing industry opportunity to access alternative finance offerings is common. Additionally, it is possible with outsourced ownership models e.g., BOOT schemes etcetera, to use solar energy without deploying precious capital to access the ongoing lower operating costs as soon as the solar asset is in place. This approach also reduces risk for the client as they are not required to manage the facility, nor do they take the risk of the facility's effectiveness.

Generation and Storage

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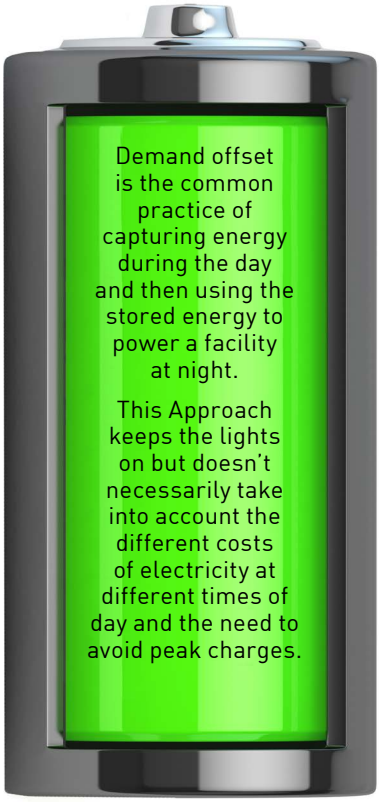
In addition to generating energy with solar panels, energy captured at peak times can be stored for later use. Storage allows an operation to compensate for the lack of available solar radiation at night and enables continued production or refrigeration using stored renewable energy into the night.

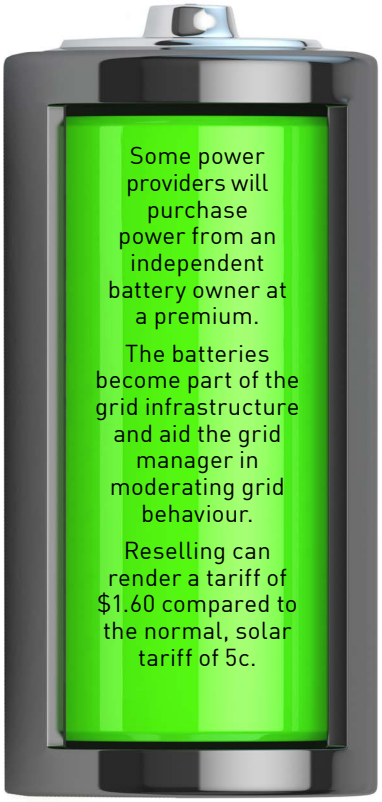
There are three main ways in which battery storage will reduce operational energy costs :

Demand offset



Peak shaving

Resell to grid in peak times



In case studies of solar generation and battery storage it was found that battery storage will generally increase the payback time of a solar project. This doesn't make battery storage an economically poor investment as the longer payback is only one financial lens. A well-designed battery installation will increase the net present value of the solar energy asset.

At this time, industrial scale battery installations between 1-10 MW are not widely installed in Australia and these installations are receiving preferential treatment from industry bodies, suppliers and government agencies. All of which adds up to potentially very sound economical solutions.

Constructing a Business Case for Sustainable Energy Assets

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Regardless of the best intentions of being green or sustainable a business cannot justify investing in energy assets without a business case that stacks up.

Whenever our businesses seek to invest precious capital in projects, someone is looking for a return.

Due to solar energy only being available during the day a generation asset alone can make sense for some businesses whereas other operations will need an energy storage asset to pair with their generation capacity to make a viable case for returns.

To make a business case for solar an operation must first seek to assess usage and undertake steps to minimise energy waste or mitigate dramatic use or fluctuation in demand. This allows the business to minimise network charges (as opposed to energy consumption charges).

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A business case for an energy asset will comprise of tangible monetary benefits and intangible elements such as sustainability and reputational value. Each business and it's stakeholders will have a different approach to the intangible aspects and putting a value on them through their own assessment. For the more financial elements someone developing a business case should look at the following;

1. Opportunity

In terms of energy, our opportunity is to reduce operating costs, deliver certainty of future operating costs, guarantee supply and insulate against projected price rises. These will each have a value to the business.

2. Current status

What do we do or how do we operate currently? What are our costs of performing like this (are they static or changing)? Can we continue like this? What are our competitors doing in this space (if relevant)? Is this approach sustainable? Will it be sustainable if the prices of retail energy increases 25%, 50%, 75% or 100%?

3. Future status

Based on the best available insights, what will happen in the future? Will the price of energy and the price of assets the business could use to generate and store energy?

4. Actions considered

Identify and model the potential future costs and options for energy including;

- generating power through solar, wind etc
- storing power from these generating assets or the grid
- doing nothing

5. Preferred / recommended actions

Outlining in detail the recommended or preferred action including the analysis undertaken, the potential benefits and the identified risks following the model above.

6. Costs

Develop a budget including the capital expenditure and the foreseeable operational expenditure as far into the future as possible. Carefully considering aspects like, the cost of finance, the rate of depreciation, tax and regulatory concessions, clean energy certificates, labour savings, maintenance savings, opportunities for new revenue (e.g. sale of waste products) are all valuable and metrics such as determining the Net Present Value (NPV) and the break-even point (date) on the capex.

7. Potential benefits / returns

A business case needs to clear articulate a number of things;

- any financial or tangible upsides that the business can bank on with certainty, increased revenue or yield, minimised loss, decreased costs, short and long-term sustainability, a shift in how competitive the business will be in the market, growth in market share, drop in costs as a percentage of revenue and the list goes on
- any non-financial or intangible upsides, improved brand sentiment, improved staff engagement and morale, decreased environmental impact, improved sustainability, reduction in risk and more

8. Risks

When reviewing a business case the business should review the risks in as greater detail as the potential benefits. Every effort should be made to document each risk and to determine either, a means of mitigation (including its cost and resource demand) and the projected response should the unfavourable circumstance come to pass.

9. Recommended actions

The business needs to make a decision on its energy generation assets and whether to act now. Thanks to the items above the business knows what is at stake, what are the options, what are the costs and where are the potential traps.

The recommended action should be to take a path forward but it should also include a narrative on how to move forward. Should the project move forward with haste? Should the project be phased with a series of break or go/no-go points? Should the business deploy its own capital or seek a financed option? Should the business rely on its own people and skills for this project or engage specialist contractors and partners?

The recommended action isn't just why and what should be done but also **how**.

10. Appendices - Known Real-Word Case studies

One means of assisting those with less nuanced knowledge of the area in gaining clarity is through cases studies. Providing real-world case studies and examples of projects, initiatives and programs of capital expenditure to the executive can allow the audience to understand how projects like this play out. Not just the successes but also the failures. Case studies included should cover projects from the business itself, its competitors, other industries with similar projects, projects from other comparable markets, and projects of similar cost and scale.

These case studies can incorporate data tables, links to real URL's, quoted statements, supporting documents, images, video, audio, or any other appropriate material. This section is for reference and teaching. It's designed to illustrate and inform and help the executive gain context and empower informed decisions.

What Next...

Energy assets make increasing sense with hardware costs dropping and energy pricing on the rise for most large users of retail power the question isn't whether to act but when and with what strategy. The business cases in these areas make more and more sense and the trick is determining the optimum business case for action.

The technological development in this sector is moving at breakneck speed. A range of start-ups and larger players all working to innovate their way to the top. There are a number of studies into Artificial Intelligence as a means of battery management being used to drive battery performance which may shake up the market and next generation solar cells which surpass all presently available cells.

Qnovo developed artificial intelligence for battery storage (Lithium Ion). This produced dramatic improvements in battery life and overall performance. The company was acquired by Sony and has been integrated into all Sony handsets. It is expected that Qnovos dramatic increase in data will lead to the intellectual property making the transition to the broader battery management system market in the near futures. Their findings have made a 20% increase in battery life and two times increase in the lifetime of the battery.

ESS Inc. use iron flow batteries to overcome the major challenge to battery technology today – lack of materials. There are dozens of battery companies using similar chemical storage methods (e.g. Lithium Ion), many of which compete for scarce natural resources. ESS Inc uses abundant iron to produce cheap and reliable batteries and it's this kind of innovative approach that could lead to a step change in the cost of energy storage.

Morgan solar use cheap plastic lenses and well-known manufacturing techniques from processing chips to make solar panels extremely cheap and efficient. These panels can be made with a fraction of the materials used in conventional solar panels leading to substantial reductions in cost.

Geli are an American battery management company. They specialize in using artificial intelligence to control batteries for residential and industrial applications. One might think that batteries are a simple matter of charge and discharge. But there is an art to managing when to discharge to maximize returns.

Summary

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As the Australian energy situation progresses we will see greater and greater power prices and more unpredictable outcomes for business. Industry executives and leaders must ensure their operations remain profitable into the future in spite of energy volatility and growing costs.

There are three effective ways the reduce the power bill:

1. Increase efficiency and reduce consumption

2. Introduce solar production

3. Introduce solar production in addition to battery storage

These options need to be considered in this order as it is redundant to install a solar facility without first addressing the demand for energy. Once the facility's demand has been addressed and the efficiency maximized, returns from installing an extremely effective solar installation will be compounded.

Using market leading storage and energy management solutions it is possible to implement cost effective battery systems. With the support of government and industry bodies, it is possible to make these solutions highly profitable and more effective than their solar only counterparts.

Looking forward

The next 12 to 18 months are expected to see industrial storage batteries become economically viable without funding assistance. When this occurs, there will be a rush of investment in distributed prosumers producing and consuming their own energy with a large degree of independence from the grid.

Solar energy on its own is already cheaper than the grid even when the cost of finance is taken into account. Assuming a consistent demand for power through a 24-hour period without energy storage options, solar can only provide 40% of a facility's energy needs regardless of its size. Under a solar only model you can only use this power when the sun is shining.

The door is open for proactive industry leaders to introduce cutting edge technology. With grants available and the price of power increasing locally, there has never been a better time to improve your competitiveness and profitability by better managing your energy.

If you are curious to know more, discuss this report in detail and gain a greater understanding of Wiley service offerings in energy, please contact Brett Wiskar or Ryan Harvey

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Survey

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Join the conversation

As part of Wiley's ongoing research into market and operational conditions in the manufacturing, food and industrial operations we have developed a survey.
The results of this market research will be published in a forthcoming report.

You can complete the survey at www.wiley.com.au/energysurvey

To receive a FREE copy of the industry data analysis and the following report please answer the final questions including your contact details.

Our Culture

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Bibliography

Adib, Rana, et al. *Renewables 2016 Global Status Report.* Paris: Renewable Energy Policy Network for the 21st Century, 2016.

Australian Government Department of Environment and Energy. *Non-residential buildings.* 2016. http://www.environment.gov.au/energy/efficiency/non-residential-buildings. 2017.

Bloomberg New Energy Finance. *New energy outlook 2016.* Beijing: Bloomberg New Energy Finance, 2015.

Climate Council Australia. *State of Solar 2016: globally and in Australia.* 2017.

JACOBS. *Retail electricity price history and projections.* Melbourne: JACOBS, 2016.

KPMG. *Global Trends in Renewable Energy.* Singapore: KPMG, 2017.

Michael Taylor et al. *The power to change: solar and wind cost reduction potential to 2025.* International Renewable Energy Agency. Bonn: IRENA, 2016.

Electricity Generation Across Australia. *Origin Energy* https://www.originenergy.com.au/blog/about-energy/energy-in-australia.html 2017