Navigating a dynamic energy landscape

A briefing for farms

energy efficiency COUNCIL

National Farmers Federation

SECTOR SPOTLIGHT

AUGUST 2021

Critical insights

Australia's agriculture sector is accustomed to managing uncertainty; unpredictable commodity prices, trade disputes and extreme weather events are just some of the issues that farms regularly navigate.

Over the last decade farms have added energy to their risk registers, especially as fuel, electricity and gas prices have become increasingly volatile. And while prices have come down from the peaks of 2017, the underlying fundamentals of oil, electricity and gas markets suggest prices will stay above their historic lows for the foreseeable future.

At the same time, some farms are becoming more reliant on energy, turning to intensive farming systems and digital technologies to raise production levels.[1] Others are facing drought conditions that have made them more dependent on energy intensive irrigation. Indeed, between energy price volatility and the shift to farming practices that require more energy, Australian farms have seen their expenditure on energy more than double in the last decade.[2] These higher energy bills are sparking renewed interest in smart energy management measures that can help manage costs.

1 Productivity Commission 2005, *Productivity Commission Research Paper: Trends in Australian Agriculture: Productivity Commission*, p.42.

2 Australian Bureau of Agricultural and Resource Economics 2020, *Agricultural commodity statistics 2020*, Table 3.4.

> For intensive sectors like **dairy**, **irrigation** or **horticulture**, with pumping or refrigeration requirements, energy costs can be as high as 17 per cent.
>
> **Tony Mahar**
> Chief Executive Officer
> National Farmers' Federation

Smart management is far from new territory for leading Australian farms; enhancing productivity is a major strategic driver for improving profitability and resilience. Farmers carefully manage inputs like water and feed; they also fine-tune processes to improve precision and increase speed, which in turn drives down labour costs and reduces wear and tear on equipment.

Historically, the fact that these measures also tend to drive down energy costs has been a bonus – smart energy management has been a by-product of smart farm management. However, as energy looms as a more significant input, many farms are on the front foot, looking for dedicated measures aimed at cutting their energy costs, while leveraging the associated benefits of water efficiency and waste reduction.

Check out **Section 1.2** of the ***briefing for Australian businesses*** to learn more about the differences between the gas and electricity markets on the west vs. the east coast.

And for farms looking to bring down their emissions, measures that cut their energy related emissions can be a quick and cost-effective place to start, especially in energy intensive sub-sectors.

Whether driven by cost, productivity or emissions, most farms are paying closer attention to their energy use. Some businesses are just getting started, identifying quick wins and banking the savings. However, farms that are leading in energy strategy and management have gone further, working with energy experts to identify upgrade opportunities or modify business practices. They are acting on this advice, making targeted investments in energy efficiency, demand management and onsite generation. And after getting on top of their energy position, they are integrating a focus on energy management into their day-to-day processes to drive continuous improvement.

> With bills like this there is a serious incentive for farmers to look at managing their energy cost.
>
> **James Jackson**
> President
> NSW Farmers

This *briefing for farms* is designed to guide businesses at the start of their energy management journey through the process of identifying and implementing energy management upgrades. It showcases businesses that are doing just that, and highlights sector-specific resources as well as innovative financing and funding mechanisms that can support businesses to invest in energy upgrades.

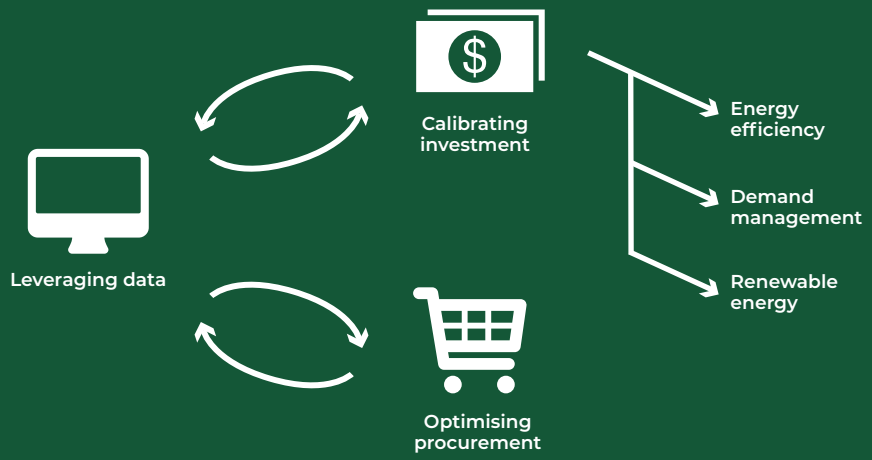


Figure 1: Leaders in energy strategy are leveraging information about their energy consumption to drive investments behind-the-meter, and to optimise their energy procurement. They are proactively monitoring the performance of these initiatives, which yields fresh data, informs future actions, and enables continuous improvement.

Sector spotlight: August 2021

This briefing accompanies ***Navigating a dynamic energy landscape: a briefing for Australian businesses***. It considers the specific issues faced by Australian farms and guides them in improving their energy management strategy.

To download the latest edition and other resources, sign up for updates or provide feedback, visit **energybriefing.org.au**

Navigating this briefing

This briefing for farms is a companion to the annual ***briefing for Australian businesses***. It is designed to provide additional information that is relevant for farms that are acting to better manage their energy.

The energy management journey

We talked with farms that are leading the field in energy strategy and management, and they told us there were four key milestones in the journey towards improving their energy performance:

1. Reaching out

Page 10

Contacting farmers groups, industry associations and governments for ideas, resources and support provides farms with the confidence to start their energy management journey.

2. Walking the farm

Page 10

Scanning the farm for visible issues and opportunities, reviewing habits and routines and diving into existing data leverages the knowledge of the team on the ground to identify quick wins.

3. Working with an external expert

Page 13

Finding the right auditor for your farm, specifying the audit you need and preparing a post-audit action plan gives you a detailed understanding of energy performance and upgrade opportunities, and builds the case for more significant investments.

4. Integrating energy management into farm management

Page 17

Establishing processes for continuous improvement in energy performance internalises smart energy management as a part of farm management, and is a way to make farms more productive, especially in peak season.

Energy landscape for farms

There are more than 89,000 farms across Australia. Despite a trend towards consolidation in the farm sector, most Australian farms are small and medium enterprises (SMEs) and family businesses.[3]

Collectively, farms only use 2.3 per cent of Australia's energy,[4] and taking the agriculture sector as a whole, energy accounts for less than 10 per cent of total outgoings, with fuel costs making up seven per cent of total costs and electricity accounting for only one per cent.[5] However, there are sub-sectors that are much more energy intensive. Indeed, energy use in horticultural farms can be as much as 1500 times higher per hectare than farms growing cereal crops on open fields.[6]

Generally, sub-sectors that rely on energy for heating, ventilation and air conditioning (HVAC), refrigeration and/or pumping are the most energy intensive, though as automation to raise production levels becomes more common, reliance on energy is going up across the sector.

For energy intensive farms, energy management presents a cost-effective opportunity to cut costs, improve productivity and reduce emissions. And with some energy management measures at low or zero cost, they can be ideal for small farms with lower operating margins as they have a direct positive impact on their bottom lines.

Energy efficiency upgrades, for example, can often save as much as 30 per cent.[7]

1.1 Managing energy costs: energy intensive farming processes

Energy used directly on farms can be divided into four broad categories with specific energy uses:

1. **Field operations:** tractors, other vehicles and machinery;

2. **Housing and sheds:** HVAC, refrigeration and lighting;

3. **On-farm processing:** conveying, processing and waste removal; and

4. **Irrigation and watering livestock:** pumps and motors.

To effectively map farms' energy management opportunities, it is useful to know where energy is commonly used. Farms often start by asking "where is my farm using the most energy?". Getting an overview of their energy intensive processes can help focus their energy strategy.

3 Commonwealth Department of Agriculture, Water and the Environment 2021, *Snapshot of Australian Agriculture 2021*, accessed 14 July 2021.

4 Commonwealth Department of Industry, Science, Energy and Resources 2020, *Australian Energy Update 2020*, p. 17.

5 Australian Bureau of Agricultural and Resource Economics 2020, *Agricultural commodity statistics 2020*, Table 3.4.

6 AgriFutures Australia 2015, *Benchmarking Energy Use on Farm*, p. xvi.

7 International Energy Agency (IEA) 2015, *Accelerating Energy Efficiency in Small and Medium-sized Enterprises*, p. 8.

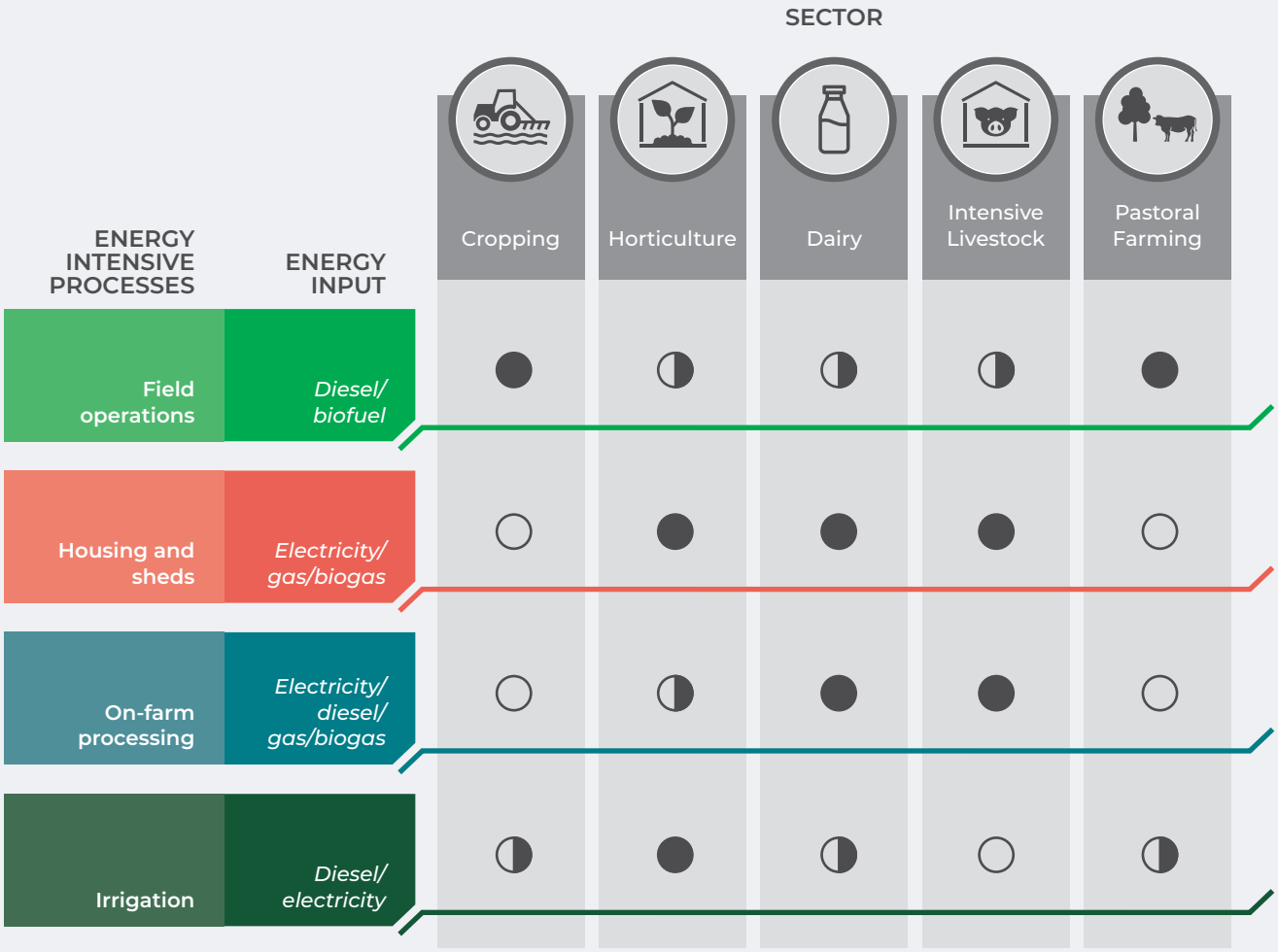


Figure 2: Energy intensive processes by sector.

Common energy management opportunities across these agricultural sectors are identified in **Section 3**.

Key:

- High energy use
- Medium or variable energy use
- Low energy use

1.2 Improving productivity: process, resource and energy efficiency

Good farm management enables productivity, which is critical to farm resilience. Optimisation is the name of the game, and in many cases process, resource and energy efficiency go hand in hand. Looking at these opportunities in an integrated way can unlock multiple benefits, including:

- Increased throughput;
- Higher resource efficiency;
- Improved animal health;
- Lower energy and labour costs;
- Bolstered energy security and reliability; and
- Reduced wear and tear on equipment.

There are many examples of smart solutions that tick multiple boxes. For example, in housing and sheds, improved thermal efficiency and smart lighting can improve the health and comfort of livestock and growth of crops.

Similarly, upgrading irrigation equipment and carefully calibrating irrigation based on soil analysis can ensure crops receive the water they need exactly when they need it, delivering increased yields. Co-benefits include reduced water use and labour as the irrigation is more precise, and the equipment has less wear and tear as it doesn't need to be moved around as much.

In both examples, lower energy costs are the icing on the cake. When making cost-benefit decisions, farms that are leading in energy strategy are considering the full value of productivity benefits in an integrated way.

On-farm manufacturing, eateries and cellar doors

Some farms – especially dairies and vineyards – incorporate on-farm manufacturing, eateries and cellar doors into their business offerings.

Whilst the principles of smart energy management don't change between sectors, the way in which energy management is implemented can. The approach to identifying energy management opportunities, and indeed the potential upgrades, do vary from sector to sector.

Many manufacturers, for example, are highly energy intensive, and energy management systems (EnMS) – see **Section 2.4.1** – are key drivers of productivity and profitability. For eateries and cellar doors, energy management can often be a lot simpler, with refrigeration and lighting upgrades often offering the biggest opportunity for energy savings - see **Sections 3.1.7** and **3.1.2**.

To learn more about smart energy management for manufacturers, read the ***briefing for manufacturers***.

1.3 Managing emissions: the role of energy management in emissions reduction

Agriculture accounts for 15 per cent of Australia's energy emissions, without accounting for farms' fuel, electricity and gas use. It is the fourth largest source of emissions after the electricity, stationary energy and transport sectors – where usage of gas and diesel commonly fall.[8] As the agricultural sector only utilises 2.3 per cent of Australia's overall energy consumption [9] – in fuel, electricity and gas – the bulk of agricultural emissions are attributable to methane and nitrous oxide from soil management, animal production and fertiliser use.[10]

Generally, energy creates a small portion of an individual farm's emissions, although the emissions profile varies by sub-sector. Dairy farms, for example, are relatively energy intensive, but carbon dioxide emissions from energy are still small at eight per cent, compared with methane at ~70 per cent.[11]

While energy is not the biggest emissions source on most farms, it can be a good place to start for farms looking to reduce their emissions. Energy management also often improves farms' energy security, or reliability of supply, by reducing demand for energy, which in turn minimises the use of back-up generators that increase energy and emissions further. For farms operating in energy intensive sectors such as horticulture, dairy and intensive livestock, the emissions reductions can be significant.

8 Commonwealth of Australia 2021, *Quarterly Update of Australia's National Greenhouse Gas Inventory: December 2020*, p.9.

9 Commonwealth Department of Industry, Science, Energy and Resources 2020, *Australian Energy Update 2020*, p. 17.

10 Commonwealth of Australia 2021, *Quarterly Update of Australia's National Greenhouse Gas Inventory: December 2020*, p.18.

11 Dairy Australia 2020, *Climate Change Strategy 2020-2025*, p.6.

Supporting farmers in achieving net zero

For farms looking to work towards achieving net zero emissions, there are opportunities to participate in government programs such as the Emissions Reduction Fund (ERF) to address non-energy related emissions.

> **Understanding net zero**
>
> Net zero emissions means achieving an overall balance between emissions produced and emissions removed from the atmosphere across the entire economy.
>
> To learn more, see **Section 3** of the ***briefing for Australian businesses***.

The ERF incentivises Australian businesses to cut the net amount of emissions they create by undertaking activities that store carbon or facilitate methane destruction. Activities could include revegetation, regenerative farming or implementation of solutions to reduce the methane emissions from livestock, such as the generation of bioenergy from effluent – see **Section 3.3.4**.

Under the scheme, farms earn Australian carbon credit units (ACCUs) that can be sold to government or voluntary buyers who wish to offset their emissions.

To learn more, go to **cleanenergyregulator.gov.au/ERF**

Identifying energy management opportunities

Farms looking to take control of their energy position start by identifying energy management opportunities. It's possible – and sensible – to start simple and get some quick wins, by reaching out to your trusted networks and walking the farm to identify opportunities. Over time, leading farms go further; they invest in an energy audit, act on cost effective upgrades, and integrate energy management into farm management to drive continuous improvement.

Figure 3: Leaders in energy strategy and management typically follow this four-step approach to identifying energy management opportunities, starting with easier opportunities and progressing to more complex ones.

2.1 Reaching out

Farmers looking to improve their energy management start by reaching out to trusted networks like farmers groups, cooperatives and associations, and government support programs.

2.1.1 Farmers groups, cooperatives and associations

Farmers groups and cooperatives support the productivity, profitability and sustainability of their members, acting as a clearing house for information on new production practices, technologies and locally relevant research and development.

As new energy technologies have hit the market, farmers groups have become key to sharing information on what works and what doesn't, and who farms can trust to provide advice, equipment and maintenance.

For a list relevant farmers groups go to
energybriefing.org.au/industry-associations/farms

Finding the right support

Farms may find that there are plenty of suppliers that offer products and services to address their energy management needs. It's important to ask suppliers about their on-farm experience and sense check the information and advice with trusted networks.

2.1.2 Government support programs

In many states, dedicated programs exist to provide resources, case studies and support to help farms on their energy management journey. Some states have research farms that demonstrate emerging technologies and techniques.

For a list of relevant government relevant government support programs for farms go to **energybriefing.org.au/farms-support**

2.2 Walking the farm

After reaching out to trusted networks, farms looking to improve their energy management identify quick wins, scanning their operations for obvious issues that can be easy to fix, such as:

- Changing habits and routines that result in energy waste;
- Scanning the farm for issues that could be causing energy waste; and
- Diving into existing data to identify straightforward energy management opportunities.

Acting on these issues can result in immediate savings, often at no or very low cost. And experience and information gained from these actions can open up further opportunities.

Check out **Section 3** for a review of common energy management opportunities for farms.

2.2.1 Changing habits and routines

Energy waste often occurs because saving energy hasn't been high on the list of operational priorities. Common examples on farms include leaving lights or compressed air processes on at all times, or setting and forgetting the temperature of cool rooms. Having signs or procedures can help change behaviour; opportunities include:

- Establishing start-up and shutdown procedures;
- Putting instructions and energy savings targets on notice boards;
- Having signs on equipment and by doors reminding staff to turn things off during breaks and at the end of operating hours; and
- Discussing potential energy inefficiencies regularly at team meetings.

2.2.2 Scanning the farm for issues

Simple energy savings opportunities – often related to maintenance issues – build up over time. However, they can often be picked up by:

- Using eyes to spot leaks or differences between equivalent equipment;
- Using ears to listen out for anything that sounds unusual – for example, if a piece of equipment is louder than usual; and
- Using touch – when safe to do so – to determine if heating or cooling is being wasted from a lack of thermal efficiency, leading to over- or under-heating and cooling. Fluctuations in temperature – both ambient and operational – are often a key indicator of wasted energy.

This sort of scan is often most effective when undertaken by someone familiar with the equipment along with someone that does not typically operate it; this gives you the benefit of both familiarity and a fresh pair of eyes, ears and hands.

Walking the property with someone from another farm in the area can provide a fresh perspective on energy management opportunities.

2.2.3 Diving into existing data

All farms have existing data that can help them identify straightforward energy management opportunities. The most common sources for insights are:

- Energy bills;
- Interval meter data; and
- Asset registers and maintenance history.

2.2.3.1 Energy bills

Energy bills prove useful because they include:

- Energy consumption data;
- A breakdown of peak, shoulder, and off-peak energy usage; and
- A graph that compares current energy use with the same time in the previous year.

Comparing recent energy bills with historic bills and production data enables businesses to benchmark and track their energy use per unit of production. Leading businesses identify and track key performance indicators, such as how energy usage relates to output or revenue. Comparing energy bills with production out data is an effective way to get more insights even if the farm has one only one meter with monthly bills.

Further, reviewing the breakdown of peak, shoulder and off-peak usage and prices on electricity bills can help farms identify demand management opportunities. These could include running equipment when energy is cheaper, which is known as load shifting, and can result in significant savings for energy intensive processes like irrigation. In some cases, load shifting can even be a source of revenue through demand response programs – see **Section 3.2**.

Farms that are familiar with their energy bill are well positioned to pursue innovative procurement options when their energy contract is due for renewal – see **Section 3.3** of the ***briefing for Australian businesses***.

Simple measurements

Simple measurements of temperatures, pressures and indeed electricity are available, and more are emerging for businesses with digital meters. For example, dairies can benefit from putting simple thermometers on the outside of vats to identify heating or cooling problems for milk and water. Fluctuations in temperature are often a key indicator of wasted energy.

2.2.3.2 Interval meter data

Farms with interval meters can review their energy consumption in 15- to 30-minute intervals. Generally, interval data is available online on the electricity retailer's website, or following a request to the retailer, which must provide the data within ten business days.

A simple analysis of this data can provide insights into energy management opportunities. For example, high overnight electricity consumption may indicate that equipment is being left on when it is not in use. Additionally, the data may demonstrate spikes in electricity consumption that align with certain processes or equipment usage, which can be investigated further.

Analysis of interval data provides a deeper dive than standard electricity bills, and can help a business analyse energy usage patterns and identify demand management opportunities – see **Section 3.2**.

2.2.3.3 Asset registers and maintenance history

Keeping asset registers current, including operating hours, installation dates and power ratings, helps ensure that the farm has the information needed to manage energy investments. Correlating data from the asset register with data from energy bills enables businesses to build out an understanding of their energy use.

As a rule of thumb, if the maintenance history of a piece of equipment shows it is breaking down often or requires a lot of maintenance, there is a good chance that it is operating inefficiently and consuming too much energy.

Keeping an eye on asset registers and maintenance history also supports planned maintenance and replacement of equipment, and helps to avoid rushed and reactionary decision making. And by keeping efficiency in mind when shopping for equipment, businesses can minimise total cost of ownership and improve productivity. It can be useful to compare purchase costs with the likely lifetime operating costs of options.

2.3 Working with an external expert

After walking the farm to uncover and act upon straightforward energy management opportunities, it can be worthwhile getting the support of an external expert to undertake an energy audit to assist with quantifying and prioritising energy upgrade activities.

There are three key elements to a successful audit process:

- Finding the right auditor;
- Specifying the right type of audit; and
- Preparing a post-audit action plan.

2.3.1 Finding right auditor

Finding the right auditor for your farm is important. When procuring an auditor, it is worth asking:

1. Do they have a working knowledge of the Australian Standard?

All energy audits should be consistent with Australian/New Zealand Standard 3598:2014. Your energy auditor needs to be familiar with the Standard, preferably by having previously completed actual energy audits that are compliant with the Standard. Ask the auditor for references to past work.

2. Do they have experience with the major energy uses on your farm?

There is a lot of variability in the way energy is used on farms, however for many sites, most energy will be consumed by one or two processes. Make sure the auditor has experience in those areas as well as a broader awareness of agricultural operations.

For larger and more complex sites, it is often beneficial for the auditor to have a team that includes members with a range of technical expertise, and the ability to consider the interactions between processes and how they can be adjusted or redesigned to deliver an optimal outcome in terms of process, resource and energy efficiency.

3. What other technical and general skills will they bring to an audit?

An energy audit is not just about identifying savings measures; it is about evaluating the potential benefits and capital costs of those savings measures. That means an auditor must have a diverse range of technical and general skills.

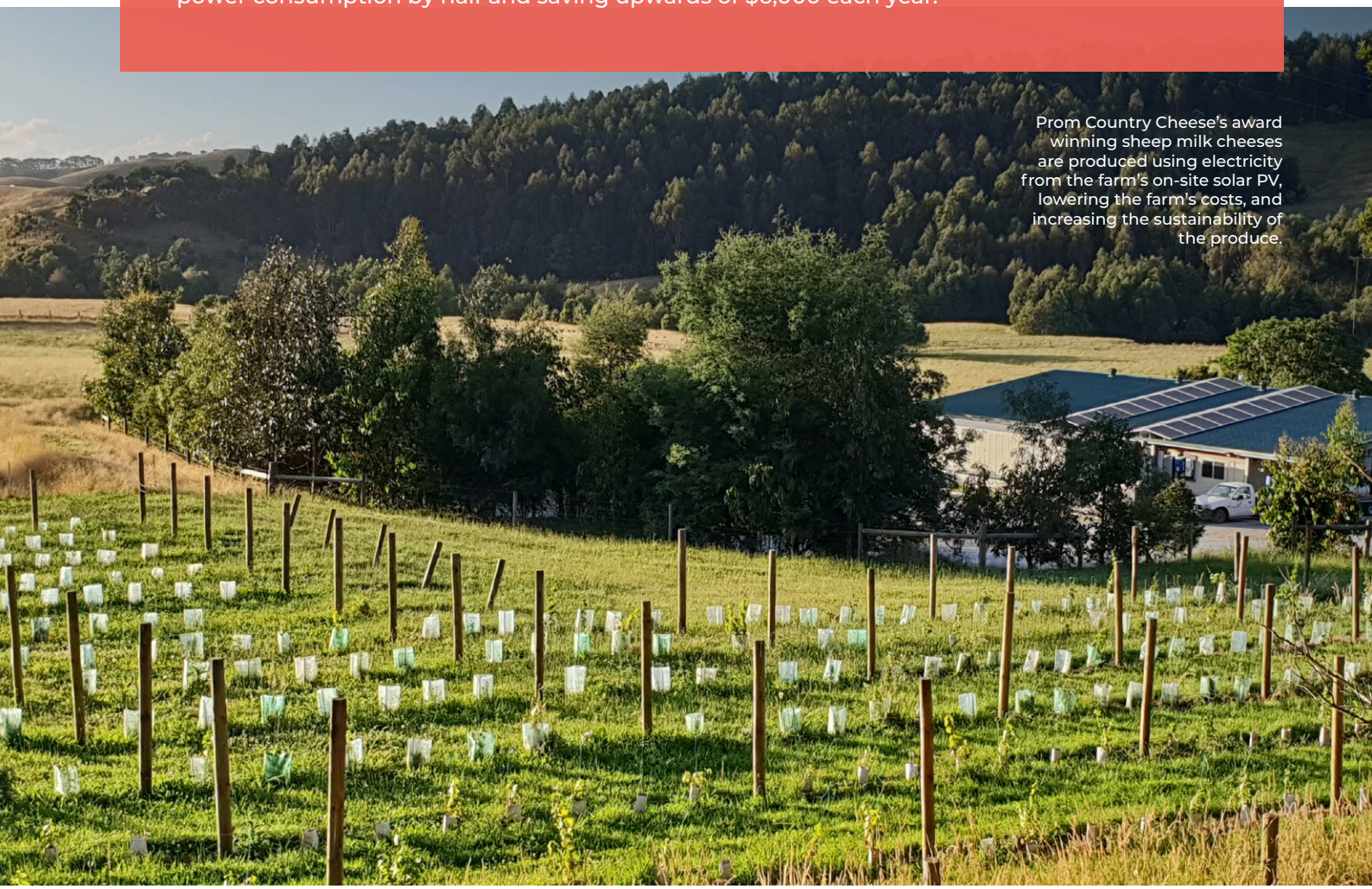
Prom Country Cheese churns out sustainable produce

Prom Country Cheese's sustainable business philosophy has been helping the husband-and-wife team produce award-winning cheeses since 2014. Situated in the picturesque Moyarra Valley in South Gippsland, Victoria, Prom Country Cheese has adopted several energy efficiency and sustainability practices to cut costs and reduce their environmental impact.

> Every decision we make as a business considers sustainability and efficiency.

Recognising that they were dealing with large energy bills, Prom Country Cheese utilised a grant from Sustainability Victoria to engage an auditor to assess the farm and cheesery's energy use and identify opportunities to improve efficiency. Following the audit's recommendations, the farm introduced additional rooftop solar, an efficient boiler and electric hot water services to store excess solar power.

The business had already installed solar PV, but supplemented these north facing panels with east and west facing arrays, thereby capturing the maximum solar benefit from morning to evening. The increase in Prom Country Cheese's energy generation enables the farm to generate the majority of its daytime electricity use, further reducing peak power consumption by half and saving upwards of $6,000 each year.



Prom Country Cheese's award winning sheep milk cheeses are produced using electricity from the farm's on-site solar PV, lowering the farm's costs, and increasing the sustainability of the produce.

2.3.2 Specifying the right type of audit

In 2014, Standards Australia released a major update to the Australian/New Zealand Standard for energy audits. The update focused on ensuring it supports the delivery of consistent, high quality audits, which enable businesses to make informed decisions on energy upgrades.

Because of the different needs of different sectors, the Standard is presented in three parts:

- AS/NZS 3598.1:2014 – Commercial buildings;
- AS/NZS 3598.2:2014 – Industrial and related activities; and
- AS/NZS 3598.3:2014 – Transport and related activities.

The Standard does not specify best practices for agriculture, however farm energy assessment programs offered by state and territory governments are typically designed to be consistent with AS/NZS 3598.2:2014 Industrial and related activities with some modification to suit agricultural practices.

Check out **Section 5** for information about energy assessment programs supported by state and territory governments.

Farms should specify one of the three audit 'types' set out in the standard, depending on their needs:

- Type 1: Basic energy audit;
- Type 2: Standard energy audit; or
- Type 3: Precision subsystem energy audit.

It is also useful for the farm to inform the auditor of their future business and/or operational plans so the auditor can incorporate options that support long-term growth.

To learn more, read the *Energy audits 101* found at
energybriefing.org.au/energy-audits-101

2.3.3 Preparing a post audit action plan

A good energy audit is a briefing that drives informed action. It can help build the business case for more substantial investments that are unlikely to be pursued without some serious analysis.

Check out **Section 3** for a review of common energy management opportunities that are recommended following audits on farms.

Once an audit is handed over, the ball is in the farm's court. There are countless stories of audits gathering dust on shelves. To avoid this, proactive farms make it a priority to prepare a post-audit 'action plan' based on the auditor's recommendations. This sets out a plan for which of the recommended activities will be pursued, and when. In the case of farms, upgrades are commonly pursued in seasonal downtime.

Energy management activities can usefully be prioritised according to return on investment (RoI), where lower – or no – cost activities can generate savings to build the business case for bigger upgrades.

An audit should always be concluded with a discussion with the energy auditor for at least an hour to ensure opportunities are well understood. And don't forget, your auditor is always happy to have a chat after the fact.

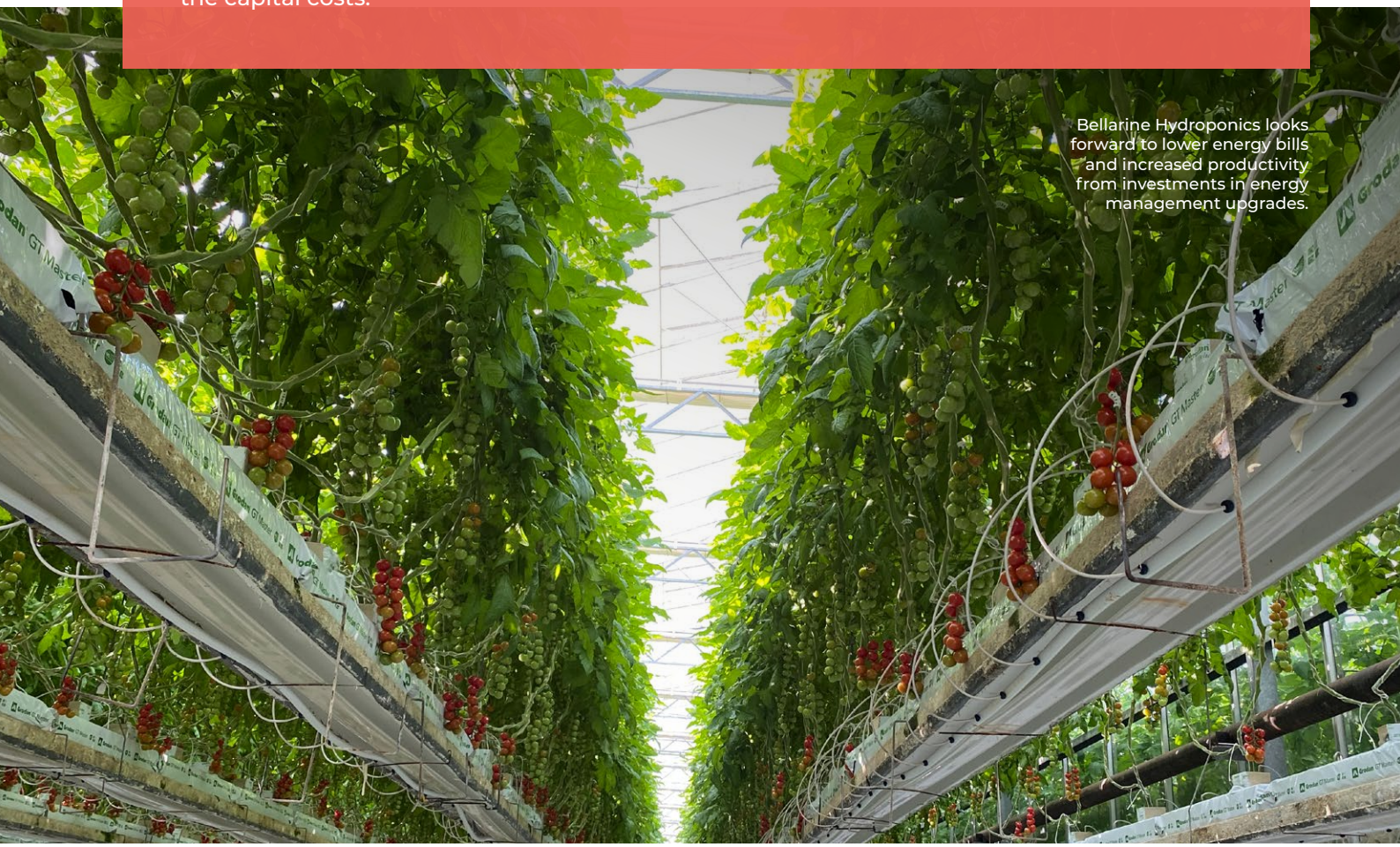
Bellarine Hydroponics plants energy efficiency to boost growth

Bellarine TechBio Pty Ltd – trading as Bellarine Hydroponics – is a leading producer of hydroponic horticultural crops located in the Bellarine region of Victoria. The business has been running commercial greenhouse operations for over 17 years, producing premium quality cherry truss tomatoes. Full control over the greenhouses' environment and irrigation enables Bellarine Hydroponics to produce every week of the year, reaching the highest possible yields for cherry truss tomato production. The temperature controlled growing conditions of greenhouses means that energy is Bellarine Hydroponics' single highest expense after staff costs.

Realising that their energy expenses weren't set in stone, the company leveraged a free energy audit provided by the Victorian Government to identify energy savings opportunities. This audit identified opportunities that included introducing an automated climate control system, a 22kW solar PV system, thermal screens, and a heat buffer tank.

Bellarine Hydroponics started with the thermal screens upgrade as they offered the largest savings opportunity: a $24,000 per annum reduction in the gas bill. This is achieved by reducing the amount of heat that escapes the greenhouses, which minimises the need for climate control. Importantly, beyond these energy bills savings, the improved growing conditions enabled by the energy upgrades mean that Bellarine Hydroponics is expecting production gains of up to ten per cent, which will result in more than $70,000 in additional annual revenue.

The business has also leveraged the Victorian Energy Upgrades (VEU) program to help fund some of the energy upgrades, which are expected to save around 85 per cent of the capital costs.



Bellarine Hydroponics looks forward to lower energy bills and increased productivity from investments in energy management upgrades.

2.4 Integrating energy management into farm management

The energy management journey doesn't end once priority audit measures are implemented. Farms that are leading in energy management make it an ongoing part of farm management. They practice ongoing energy management as a way to improve productivity in peak and off-peak seasons, reducing equipment breakdowns and maintenance issues when they really count.

2.4.1 Energy management systems (EnMS)

Energy management systems (EnMS) are established to drive continuous improvement in an organisation's energy performance. When these are in place, companies can achieve a reduction in energy intensity of three per cent or more each year, every year.

The international standard ISO50001 specifies an energy management system framework. While ISO50001 certification may make more sense for larger organisations, its *Plan – Do – Check – Act* continual improvement framework is a useful reference for all organisations establishing an energy management system.

To learn more, read the *EnMS 101* found at **energybriefing.org.au/enms-101**

Figure 4: The Plan-Do-Check-Act cycle is central to EnMS, and management systems more broadly. It enables continuous improvement in energy management.

2.4.2 Integrated energy management on the farm

For most farms, an annual energy management 'health check' can help to ensure that they are integrating energy management into farm management, and picking up energy issues that have arisen over the previous year.

After initially reaching out to networks, walking the farm to identify quick wins and working with an external expert to implement more complex energy management opportunities, leading farms undertake an annual 'health check' by repeating the above process and asking themselves:

- **Do our networks have any new resources or examples of implementing new technologies and practices to energy management that we can learn from?**

  Australia energy industry is rapidly transforming – see **Section 2** of the ***briefing for Australian businesses*** – which offers businesses lots of opportunities to improve their energy management. Our networks are often best placed to keep us in the loop – see Section 2.1.

- **Have our energy habits, activities and data changed in the last year, resulting in savings or losses from which lessons can be learned and savings amplified?**

  Sometimes we have the best of intentions to change behaviour, but without keeping a watchful eye on our energy consumption – see **Section 2.2.3** of this briefing and **Section 3.1** of the ***briefing for Australian businesses*** – we might be wasting energy and missing energy saving opportunities – see **Section 2.2**.

- **Have we implemented new activities and/or equipment that could benefit from an energy audit?**

  Energy audits aren't commonly needed every year, but a business may want to undertake a more detailed audit, or may have introduced new activities and/or equipment – especially second-hand equipment – that could benefit from an audit to identify energy savings opportunities – see **Section 2.3**.

Like the 'pulse check' in the ***briefing for Australian businesses*** that asks directors and executives to review their energy data, energy upgrade investment and energy procurement activities and opportunities, the recommended annual 'health check' for farms supports continuous improvement in energy management, and enables the integration of energy management into farm management.

Energy management opportunities for farms

There are several energy management opportunities that commonly emerge for farms. This section outlines the key categories and technologies across energy efficiency, demand management and on-site renewable generation.

By following the steps outlined in **Section 2**, farms can determine which of the following energy management opportunities offer the best value for their businesses. As highlighted in **Section 1**, farms should also note that resource and water efficiency can also lead to energy savings, so opportunities in these areas should also be explored.

3.1 Energy efficiency

Energy efficiency opportunities are diverse and vary greatly between farming activities. However, there are a number of technologies and energy management opportunities that commonly appear on the 'hit list' for farms looking to take control of their energy costs.

3.1.1 Fuel efficiency

Most farms depend on diesel for field operations. There are several well-established and emerging opportunities for reducing use, for example:

- Monitoring and adjusting tractor and vehicle tyre pressure between road and field use enables better traction, and reduces rolling resistance and fuel consumption;
- Performing regular maintenance identifies performance issues like inefficient motors – see **Section 3.1.4**;
- Optimising vehicle use by combining operations – like watering and fertilising – and only undertaking one pass over a field or reducing the depth of tillage equipment reduces fuel use;
- Reducing tractor use with lifecycle or whole of farm practices to reduce or stop the need for tillage, saving fuel, and machinery maintenance costs;
- Upgrading tractor attachments such as seeders to wider and more precise models that allow less time and fuel spent per hectare; and
- Upgrading to fuel efficient, correctly specified, tractors and other on-farm vehicles.

Powering farm vehicles with alternative fuels

The market for farm vehicles powered by alternative fuel sources is on the horizon, but still has some way to develop.

Tractors are often cited as candidates for a switch to all electric options, as they are housed in the same place overnight making for easy charging, and are relatively low-maintenance compared with their diesel counterparts. Hydrogen fuelled tractors could emerge in the future once hydrogen supply chains have matured.

However, electric-diesel hybrid tractors – and potentially biofuel tractors where a fuel source is accessible – are emerging as viable options before all-electric and hydrogen fuelled motors.

3.1.2 Lighting

Farms use lighting in greenhouses, animal housing, sheds, cold stores and processing facilities. Lighting is a sizeable opportunity for farms as switching to light emitting diode (LED) globes from compact fluorescent lamps (CFLs) cuts energy consumption by half, and switching from incandescent to LED can save up to 80 per cent if energy-efficient lighting equipment and practices are adopted. Beyond replacing lighting, common energy management opportunities are:

- Making sure lights are switched off when the facility is unoccupied;
- Installing occupancy sensors to respond automatically to use;
- Cleaning lamps and fittings and installing reflectors, which may allow a lower wattage lamp to be used; and
- Tuning wavelength lamps to optimise growth and productivity in greenhouses and animal housing.

Considering the total cost of ownership

Evaluating the total lifetime cost of purchases of new equipment and parts can have big productivity benefits. Cheaper equipment often costs more to run due to higher energy and maintenance costs over the lifetime of the asset.

Estimating operating costs – including energy and maintenance – at the time of purchase reveals new opportunities for optimising performance and reducing cost over the lifetime of the equipment and parts.

3.1.3 Compressed air

Compressed air is widely used in agricultural activities such as ploughing and tilling, during feed processing and when delivering water to crops, livestock and pastures. Compressed air systems can often be inefficient due to leakage, irregular maintenance, and limited monitoring, wasting as much as 80-90% of the energy used. Emerging technologies such as smart electronic actuators and electric tools can allow part or all of a compressed air system to be shut down, saving up to 90 per cent of energy costs and increasing process productivity.[12]

There are proven ways to improve the efficiency of compressed air such as:

- Switching off when not in use;
- Looking for leaks while maintaining the equipment; and
- Upgrading to more efficient piping and equipment, such as variable speed compressors.

In some instances, the best option may be shifting away from compressed air entirely. There is a range of technical alternatives to compressed air. For example, electric actuators or the use of modular bioreactors that don't require aeration for wastewater treatment can reduce the need to use compressed air for odour reduction in dairies.

12 Australian Alliance for Energy Productivity 2020, *Compressed air systems, emerging efficiency improvements and alternative technologies: Review, background research and examples*, p. 1. and *www.a2ep.org.au/compressedair*

3.1.4 Electric motors and pumps

Electric motors – or power drive systems – and pumps are used across the agricultural sector, with irrigation of crops, application of pesticides, cleaning of animal housing, feed processing, and milk harvesting the biggest uses. Pumping systems are often inefficient due to inadequate sizing and materials. Energy savings can reach up to 50 per cent and can be amplified with regular optimisation and maintenance. Common opportunities include:

- Replacing old inefficient systems with newer, efficient ones, which can be powered by solar PV, rather than diesel, further reducing fuel costs;
- Minimising flow losses in pipes, valves, and fittings by accurately sizing and ensuring clear throughfare with smooth pipes and the removal of blockages;
- Replacing valves with variable speed drives instead; and
- Appropriately sizing motors.

Most electric motors are designed to run at 50 per cent to 100 per cent of rated load. Maximum efficiency is usually at 75 per cent or more of rated load. If the motor is not running at the required rate, replacing the motor may be the only course of action, though installation of a variable speed drive can also be worthwhile, especially because it increases the flexibility of the system. However, when the motor is appropriately sized and running at close to rated output, a variable speed drive may not be suitable.

3.1.5 Heating, ventilation, and air conditioning

Heating, ventilation and air conditioning (HVAC) of greenhouses and animal housing is a major source of energy use in dairies, horticulture, poultry, and piggeries. Optimising HVAC can result in significant savings, both by optimising the use of current equipment or by upgrading to more energy efficient models. The economic feasibility of energy saving methods applied will need to be weighed up against potential impact to biological efficiency. Beyond replacing the unit outright, common opportunities include:

- Installing air quality and temperature sensors to automate operation;
- Upgrading to more energy efficient fans, heaters and cooling systems;
- Improving hygiene and cleaning processes of fans, filters, and shutters to reduce airborne pollutants;
- Improving the thermal performance of sheds, animal housing and greenhouses with better draughtproofing, insulation, shading and/or heat reflective coatings to reduce reliance on heating and cooling; and
- Heat pumps and heat recovery systems to assist in water heating, drying and space climate control.

Energy savings for Bundaberg farmers no longer a pipe dream

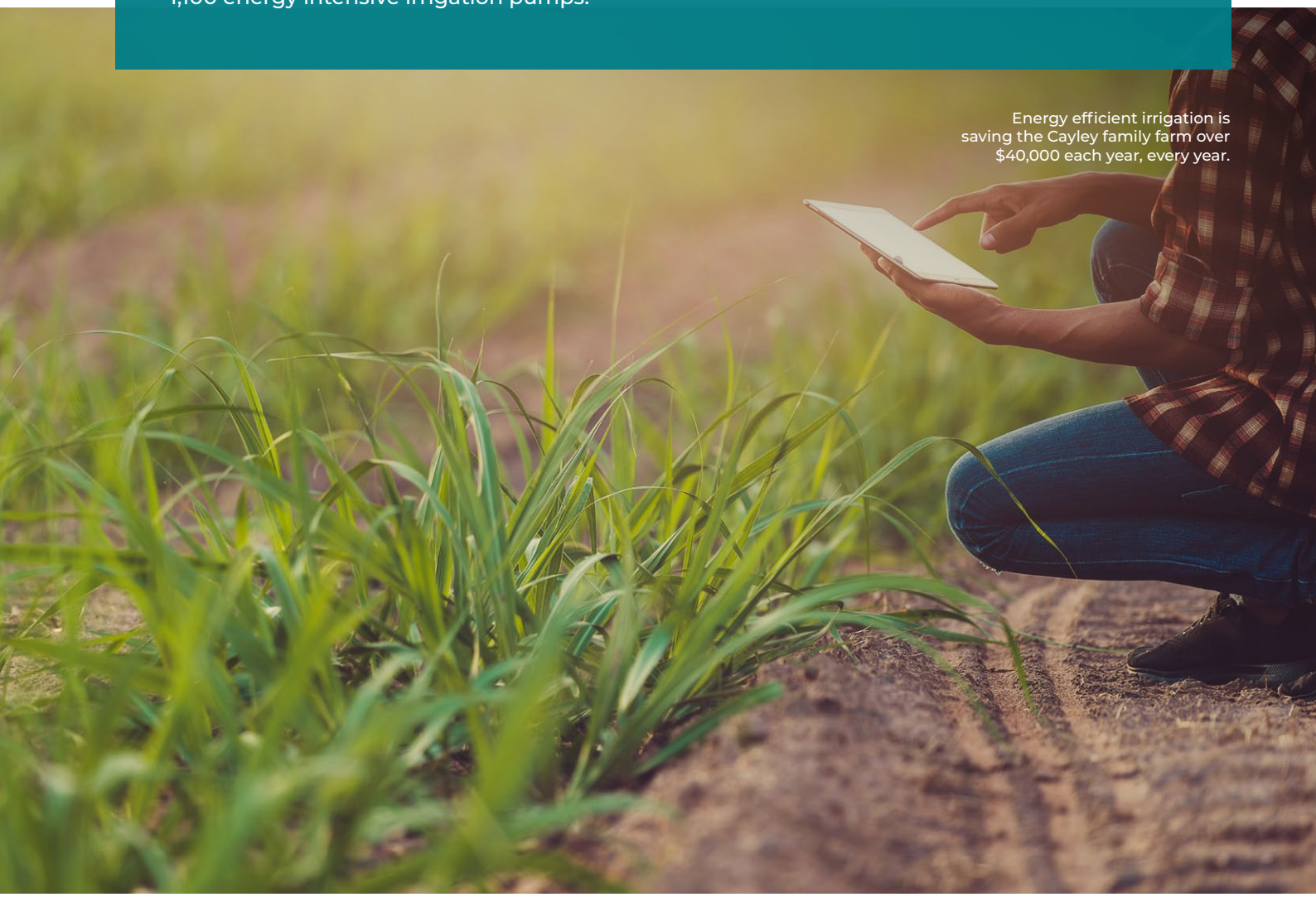
Since 1946, the Cayley family farm in Bundaberg, Queensland has grown a variety of fresh goods, including sugarcane, peanuts, asparagus, watermelon and potatoes that are used in Australia's beloved Smith's chips.

A comprehensive audit on the farm was conducted by the Bundaberg Regional Irrigators Group, in conjunction with Bundaberg Sugar Services, to understand energy use in the irrigation systems and identify opportunity for process optimisation.

The audit identified a range of opportunities for the Cayley family farm to lower energy use and enhance the farm's resilience to variable climatic conditions. Replacing over 500m of irrigation piping to reduce water distribution friction losses and undertaking extensive weather and soil analysis to determine optimal irrigation scheduling resulted in a 42 per cent reduction in energy consumption per tonne of sugarcane harvested.

These energy efficiency measures have resulted in annual savings of over $40,000 from reduced energy and labour costs and increased yields.

The Bundaberg Regional Irrigators Group has leveraged the Cayley family farm's success story by sharing the knowledge gained with their network of member farms that account for approximately 36,000ha in the local area, and operate an estimated 1,100 energy intensive irrigation pumps.



Energy efficient irrigation is saving the Cayley family farm over $40,000 each year, every year.

3.1.6 Voltage optimisation and power factor correction

Voltage optimisation is a well proven and reliable energy saving technology that is used to regulate, cleanse and condition power supply.

Voltage optimisation regulates incoming power supply from the grid to reduce the site voltage to the level needed for optimum operation – and efficiency – of on-site electrical equipment. It can deliver energy savings of up to 12 per cent and reduce risk of damage to equipment due to voltage fluctuations.

Power factor correction can help ensure that on-farm electrical equipment uses the voltage provided by the network efficiently and reduces demand or capacity charges.

These upgrades may be less suitable for operations with high peaks in electricity consumption and for farms with long and undersized electrical wiring. It is important that a farm seeks expert advice to ensure that any upgrades are right for their operations.

3.1.7 Refrigeration

Cold storage – including freezers – in horticulture and dairies typically make up a significant portion of energy use and are essential for the operations of these farms.

There are multiple opportunities associated with refrigeration, with farms often able to realise up to 50 per cent energy savings from energy efficiency improvements. Farms with larger cold storage facilities are also well suited for demand response – see **Section 3.2**.

Noting that an external expert may recommend the best course of action as being a complete system upgrade, in other circumstances, tuning and system optimisation may prove fruitful. Common energy efficiency opportunities include:

- Optimising thermostats and defrost settings so that they match climatic and cool room conditions;
- Improving thermal performance through mending damage to insulation, reducing thermal bridges, fitting flexible plastic strips to doorways, or ensuring evaporators and condensers have unrestricted airflow;
- Keeping cool rooms at or near to capacity to maintain thermal mass; and
- Planning loading to minimise the opening and closing of doors and reduce cooling requirements.

AIRAH Design Application Manuals

The Australian Institute of Refrigeration, Air Conditioning and Heating (AIRAH) has a series of **Design Application manuals** that can help with improving energy performance in refrigerated areas like cool rooms.

3.2 Demand management

Demand management – or managing when energy is used – offers a significant opportunity for the dairy, irrigated cropping and horticultural sub-sectors, but the benefits can be achieved by all energy users.

Some large energy users expose themselves to the wholesale electricity market so that they can benefit from shifting flexible loads to times when electricity is cheaper, such as when renewable energy generation is high. Reviewing the electricity bill breakdown of peak, shoulder, and off-peak usage on electricity bills can help farms identify opportunities to shift demand to times that will bring down their energy costs. As noted in **Section 2.2.3.2**, farms with interval meters can review their energy consumption in 15- to 30-minute intervals, which can help to identify what activities are contributing to usage at peak – or high-cost – times.

Businesses can also monitor their site demand to ensure that they do not exceed the monthly demand thresholds outlined in their energy contracts, which increases their network charges. To avoid this, they may choose to ramp down for an hour when electricity demand is nearing the threshold. For smaller businesses, monthly demand charges are often levied for the highest half hour of demand in a month – or in some cases, a year – so demand management can reduce these charges. Where a farm has limited electricity supply capacity, reducing peak demand can allow it to increase herd size or expand processing.

Finally, large energy users like dairies can be compensated for reducing their energy load during peak times, through programs like the Australian Energy Market Operator's (AEMO) and the Australian Renewable Energy Agency's (ARENA) emergency demand response program. And rules in the National Electricity Market are being changed so that many more businesses can benefit from engaging in demand response, either directly or by working with expert demand response aggregators.

To learn more, read the *Demand response 101* found at **energybriefing.org.au/demand-response-101**

Energy storage and batteries

Storing energy is about more than hooking up a lithium-ion battery to a solar PV system.

Leading farms harness the thermal energy storage of refrigeration in cool rooms and HVAC practices to minimise their energy demand at times when energy costs are high, or capacity of on-site energy infrastructure hits its limits.

In the right circumstances, water for irrigation can also be stored as a form of energy storage by pumping it up to higher altitudes – sometimes literally just up the hill – to later run through a turbine with the assistance of gravity. It is also possible to use stored, partly processed product as a form of energy storage. For example, grain can be stored, then ground when energy prices are low.

Using thermal and hydro storage alongside electric storage – i.e. batteries – that is connected to onsite renewables puts energy intensive businesses in the best position to seize demand management opportunities and lower their energy bills.

3.3 On-site renewable generation

Renewable energy is particularly well-suited for rural and remote applications, as farms have access to open land and by-products suitable for conversion into energy. Benefits include reduced energy bills from the use of on-site renewables and improving security and reliability of electricity supply. In addition, farms can secure revenue from selling electricity supply back to the grid; this can provide a financial buffer in periods of drought or low farm product prices.

Specific applications of on-site renewables include electricity generation for electrical equipment and processes like irrigation, off-grid electric fences and lighting, as well as crop drying, space, water and process heating from bioenergy applications – see **Section 3.3.4** – and using solar PV panels to shade animals and crops.

Farms considering an investment in on-site renewables should look at when they are using energy intensive processes on their farm. Some farming sub-sectors such as dairies use the bulk of their electricity in the early morning or late afternoon, which is not necessarily when the sun is shining; this can impact the RoI, influence the orientation of solar PV panels, or require consideration of storage opportunities that can be paired with the on-site renewable generation. There are a number of common opportunities, including solar, wind and hydro power, as well as bioenergy.

> Adoption of on-farm renewables cuts costs, builds long-term business resilience and cuts carbon emissions – and also creates strong regional communities.
>
> **Karin Stark**
> Founder
> National Renewables in Agriculture Conference

3.3.1 Solar power

Solar PV is a proven technology with a payback period generally between four and eight years for most manufacturers. It is an effective way to reduce reliance on electricity from the grid, lower energy bills, and potentially make some returns by exporting energy to the grid. For farms, it is often cheaper than grid-supplied electricity with an annual RoI of up to 25 per cent. To ensure that the business case stacks up over the long term, solar PV is most suitable when most of the electricity generated can be used directly on-farm or stored for later use;

Concentrating solar thermal and solar hot water can also prove cost effective for farms. There are several key factors that impact the feasibility of solar thermal technologies, including:

- Annual solar irradiation, which is higher in like Western Australian than Tasmania;
- Operating schedule, noting that 24/7 processes can't benefit from concentrating solar power overnight or in cloudy weather; and
- Land availability.

The downside to concentrating solar power is that farms need to maintain back-up process heat supply, such as boilers, for when output is low. Conversely, solar hot water, made with evacuated tube technology, can be installed directly on roofs.

3.3.2 Wind power

Farm-scale wind turbines – which are commonly sized as less than ten kW – for electricity generation have broad potential for application in rural Australia. On-site wind power generation may be a good solution if the farm is located at a place with a high wind resource, and if the cost of installing a connection point and obtaining planning approval is not prohibitive.

Farmers may also choose to host commercial wind developments on their property, in which case independent advice is essential to guide the farm through prospecting, consultation around social license, negotiations and development – see **Section 3.2.3** of the ***briefing for Australian businesses***.

3.3.3 Small-scale hydro power

Small-hydro power can be utilised by farms with access to flowing streams; small scale hydro has benefits as continuous streamflow – and the associated power generation – can be predictably forecast. In the right circumstances, water for irrigation can also be stored as a form of energy storage – pumped hydro – see **Section 3.2**.

Emerging opportunities

Innovation is driving new ways for farms to cut costs and boost on-farm productivity.

Precision agriculture uses field equipment with satellite navigation, GPS, soil sensors and yield monitors to manage variation of and output from different areas of land. This emerging group of technologies and approaches reduces the need for vehicle-based routine checks on farms, thereby reducing fuel consumption.

For example, virtual fencing uses neckbands with coordinates, wireless technologies and sensors to control the location of livestock without the need for an actual fence or use of machinery to herd the group.

Robotic or automated milking relies on the voluntary movement of cows to and from the paddocks, and harvests milk without human intervention. When implemented successfully, this solution not only reduces reliance on labour, but also improves animal health, increases energy efficiency and reduces energy demand charges as it flattens the morning and afternoon peaks in electricity use – see **Section 3.2**.

3.3.4 Bioenergy

Many farms have large amounts of effluent or biological materials that have the potential to be converted into energy in the form of fuels, heat and/or electricity. Beyond addressing the need for waste disposal, the benefits for farms are:

- Reduced energy costs;
- Emissions reduction;
- Improved air quality;
- Alternatives to commercial fertilisers; and
- Even a potential source of revenue.

Matching the available farm by-products to useful applications is critical, as is consideration of the seasonal availability of waste.

Bioenergy candidates include:

- Manure from intensive livestock operations;
- Agricultural crop waste; and
- By-products from food processing such as bagasse from the sugar cane refinery process.

Biomass can be converted to bioenergy using anaerobic digestion, incineration, or gasification; what's best for the individual farm depends on the type of raw material, scale or size of the project, and the form of energy required to be produced. Economics can be improved by sharing equipment across several farms or partnering with sewage treatment organisations or industrial sites with organic waste streams. Co-digestion – the use of a mix of different organic inputs – can increase productivity of bioenergy facilities.

The economic and technical feasibility of bioenergy is improving quickly and early adopters such as the Australian sugar and pork industries are leading the way – see Blantyre Farms' industry best practice. There are also government supported trials that focus on the development of converting sugarcane production waste into fuel to replace the use of diesel in transport and production.

To learn more, go to **arena.gov.au/renewable-energy/bioenergy**

To learn more about emerging opportunities for energy management – from pumped hydro to wind generation – on farms go to **energybriefing.org.au/farms-resources**

Blantyre Farms boosts bioenergy to realise financial and environmental savings

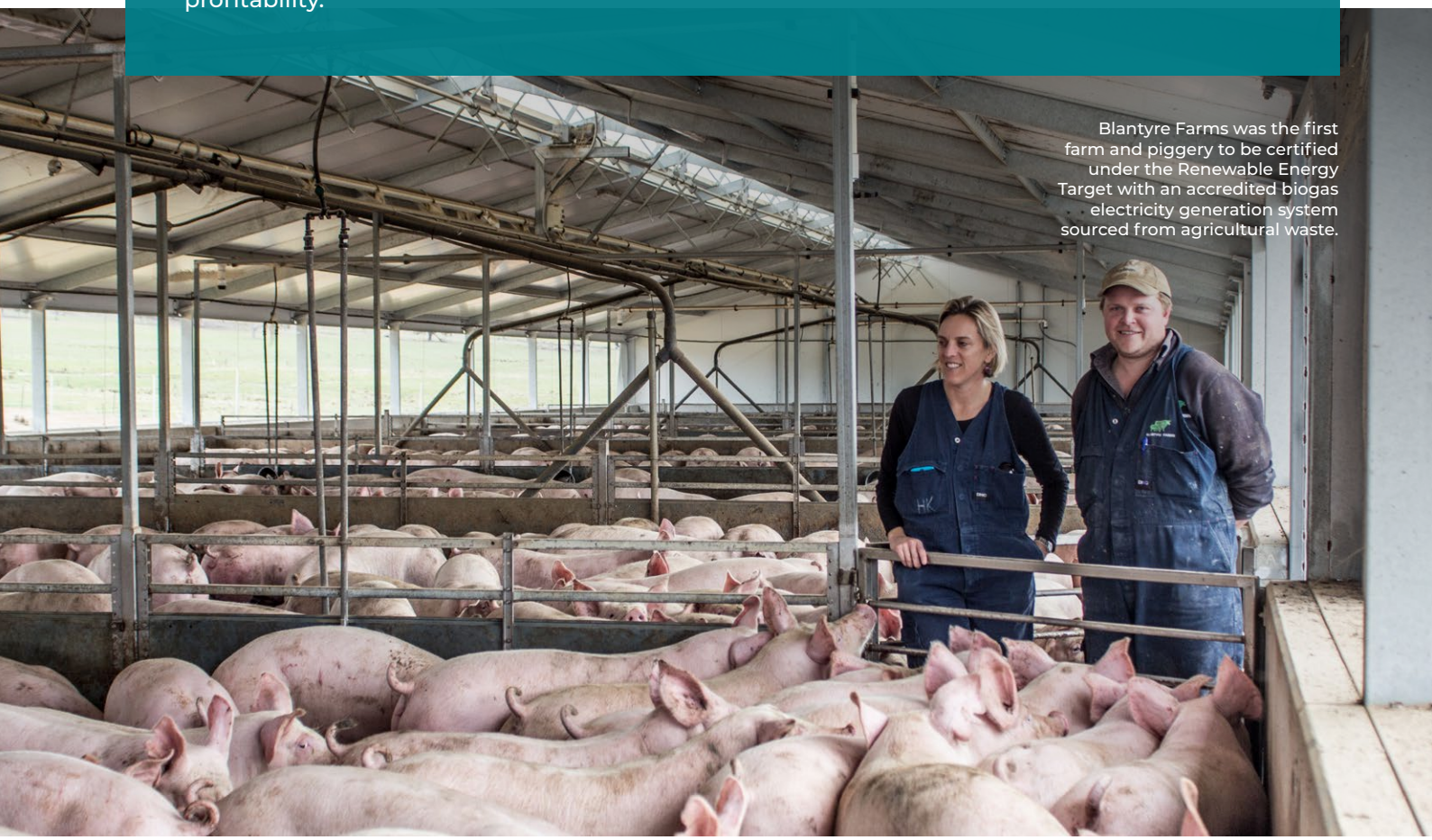
Blantyre Farms, a mixed farming and livestock business situated near Young in New South Wales, produces 40,000 pigs each year, as well as wheat, barley, canola, beef, wool and lamb. The intensive pig farming means that electricity is one of the farms largest operational expenses.

Acknowledging this, Blantyre Farms worked with Australian Pork Limited to implement a process where the effluent from the piggery is flushed into covered anaerobic ponds. Once there, the emissions are captured and refined into methane that runs several generators to provide electricity and heating for the piggery, and any excess electricity is sold back into the grid.

The biogas production saves the business approximately $350,000 per annum in power and gas bills, and brings in a further $68,000 from excess power sold back into the grid. As an added bonus, the upgrade has reduced methane emissions by over 100,000 tonnes of CO_2 equivalent.

But the savings don't stop there: the farm has also implemented a strategy of using food waste from food manufacturers as pig feed. And with 70 – 80 per cent of the pigs' feed now coming from food waste, Blantyre Farms has protected itself from volatile grain prices whilst also diverting 8,000 tonnes of waste food from landfill each year.

The remaining feedstock for the pigs is being sourced from grain on the farm that is fertilised with the manure used for the biogas production, which further reduces costs by minimising the purchase of synthetic fertiliser. Taken together, these innovative energy and sustainability practices have dramatically increased the farm's productivity and profitability.



Blantyre Farms was the first farm and piggery to be certified under the Renewable Energy Target with an accredited biogas electricity generation system sourced from agricultural waste.

Taking action: cutting your energy costs

Taking action isn't just about making energy efficiency upgrades and putting solar PV on the roof or out in the paddock, it's also about changing the behaviour of your employees and your business as a whole. Some of the simplest ways to cut energy costs are turning off lights and machinery when not in use, or adjusting activity schedules. And with technology ever advancing, continuous improvement is still possible for even the best performers; but it all starts with intent and an action plan.

4.1 Action plan

So where can farms start?

Figure 5: Leading farms in energy strategy and management follow the above checklist to leverage their networks and energy data to make smart investments and continuously improve their energy management.

4.2 Financing and funding options

Farms – and especially SME farms – often operate with small financial margins, and have limited access to existing capital for investment in energy upgrades. This lack of capital can be a substantial barrier to investing in strategic energy management.

Despite this, several options exist for funding and financing energy services, including:

- Traditional financing options;
- Service agreements; and
- Government grants and incentives.

Leveraging tax provisions for energy management upgrades

In May 2021, the Federal Government announced an extension of the generous scheme available to businesses with an annual turnover of up to $5 billion to immediately deduct the business portion of the cost of an asset in the year it is first used or installed ready for use. Many leading businesses are leveraging this provision for energy management upgrades.

To learn more, read the *Leveraging tax incentives to improve energy performance guide* found at **energybriefing.org.au/tax-incentives-guide**

To learn more, read the *Energy financing and funding 101s* found at **energybriefing.org.au/financing-and-funding-101s** and for the latest grants and incentives, go to **energybriefing.org.au/current-grants**

An accountant's perspective on behind-the-meter investments

If farms set the right objectives and investment criteria, the financial outcomes of behind-the-meter investments are compelling.

A $2 million investment in new LED lighting and rooftop solar, which yields annual savings of $350,000 in energy and maintenance costs, is accounted for like this:

Operating statement impact:
The $2 million capital investment is depreciated over 15 years, resulting in an annual expense of $133,000. Additionally, there is an annual reduction in other expenses (energy and maintenance) of $350,000. The net result of this is a $217,000 annual improvement to the operating statement.

Balance sheet impact:
The net impact on the balance sheet at the time of investment is zero. The $2 million capital investment increases non-financial assets by $2 million. However, it either creates a liability (if you borrow to fund the project) or reduces financial assets (if you use cash to pay for the project) by $2 million.

Net debt impact:
This impact varies over time, following the net cashflow for the project. At the time of investment, there will be an increase in net debt of $2 million. Over six years, the net debt impact will reduce to zero. Over the remaining years, the annual savings will achieve a net reduction in debt.

Net present value (NPV):
Over a 15-year period, assuming a discount rate of four per cent (real), the NPV is $2 million. A positive NPV indicates it is worth investing in the project.

Resources for farms

The resources and information listed below complement those in Section 4 of the ***briefing for Australian businesses***.

For a full list of resources for farms go to **energybriefing.org.au/farms-resources**

5.1 Industry support

Many businesses have existing relationships with trusted experts. For those that do not, sourcing a referral from professional networks is a natural first option. Farmers groups, cooperatives and associations can be a great place to start.

Beyond that, seeking out a member of a well-established, credible industry association – like those outlined in the ***briefing for Australian businesses*** – is a good starting point.

For a full list of relevant associations go to
energybriefing.org.au/industry-associations

For a list of relevant farmers groups go to
energybriefing.org.au/industry-associations/farms

5.2 Government support

Further information about government support can be found in Section 4.2 of the ***briefing for Australian businesses***.

5.2.1 Business Energy Advice Program (BEAP)

BEAP is a free energy advisory program for small businesses across Australia that delivers face-to-face and phone consultations, helping them to discover industry specific energy saving opportunities. BEAP is funded by the Australian Government and delivered by Business Australia.

If your business has between 6-20 employees or is a drought-affected business employing 0-5 employees, you qualify for a one-on-one consultation with an independent business expert.

BEAP provides advice on energy procurement and energy efficiency opportunities to help SMEs manage their energy consumption and costs. The service also gives small businesses free access to information available online including case studies, fact sheets, and information on how businesses can access government grants.

For more information go to **businessenergyadvice.com.au**

5.2.2 Government grants and programs

To see the latest offers from the Commonwealth, state, and local governments, go to **energybriefing.org.au/business-support**

5.2.3 State based energy efficiency schemes

Farms in the ACT, NSW, South Australia, Queensland and Victoria can access their energy efficiency scheme – the **ACT Energy Efficiency Improvement Scheme (EEIS)**, the **NSW Energy Savings Scheme (ESS)**, the **SA Retailer Energy Productivity Scheme (REPS)**, the **Queensland Business Energy Savers Program**, and the **Victorian Energy Upgrades (VEU) program** – to subsidise energy efficiency upgrades.

These schemes operate by requiring energy retailers to meet targets in relation to emissions reductions via energy efficiency upgrades. These reductions are generally met by providing subsidised energy efficiency products and upgrades to energy users, and can be used for a range of upgrades for farms. In particular, project-based methodologies help farms access incentives for large and custom projects.

5.3 Other resources

Practical guides and other resources that support farms with strategic energy management can be accessed at **energybriefing.org.au/other-resources**

Glossary

ACCU	Australian carbon credit unit
AEMO	Australian Energy Market Operator
AIRAH	Australian Institute of Refrigeration, Air Conditioning and Heating
ARENA	Australian Renewable Energy Agency
BEAP	Business Energy Advice Program
CFL	Compact fluorescent lamps
EEC	Energy Efficiency Council
EEIS	Energy Efficiency Improvement Scheme (ACT)
ERF	Emissions Reduction Find
ESS	Energy Savings Scheme (NSW)
EnMS	Energy management system
HVAC	Heating, ventilation and air conditioning
IEA	International Energy Agency
ISO	International Organization for Standardization
LED	Light emitting diode
M&V	Measurement and verification
NFF	National Farmers' Federation
NPV	Net present value
PV	Photovoltaics
RoI	Return on investment
REPS	Retailer Energy Productivity Scheme (SA)
SME	Small and medium sized enterprises
VEU	Victorian Energy Upgrades program

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