Powering the Global Food Bowl

How captive energy solutions are growing Australia's rural investments

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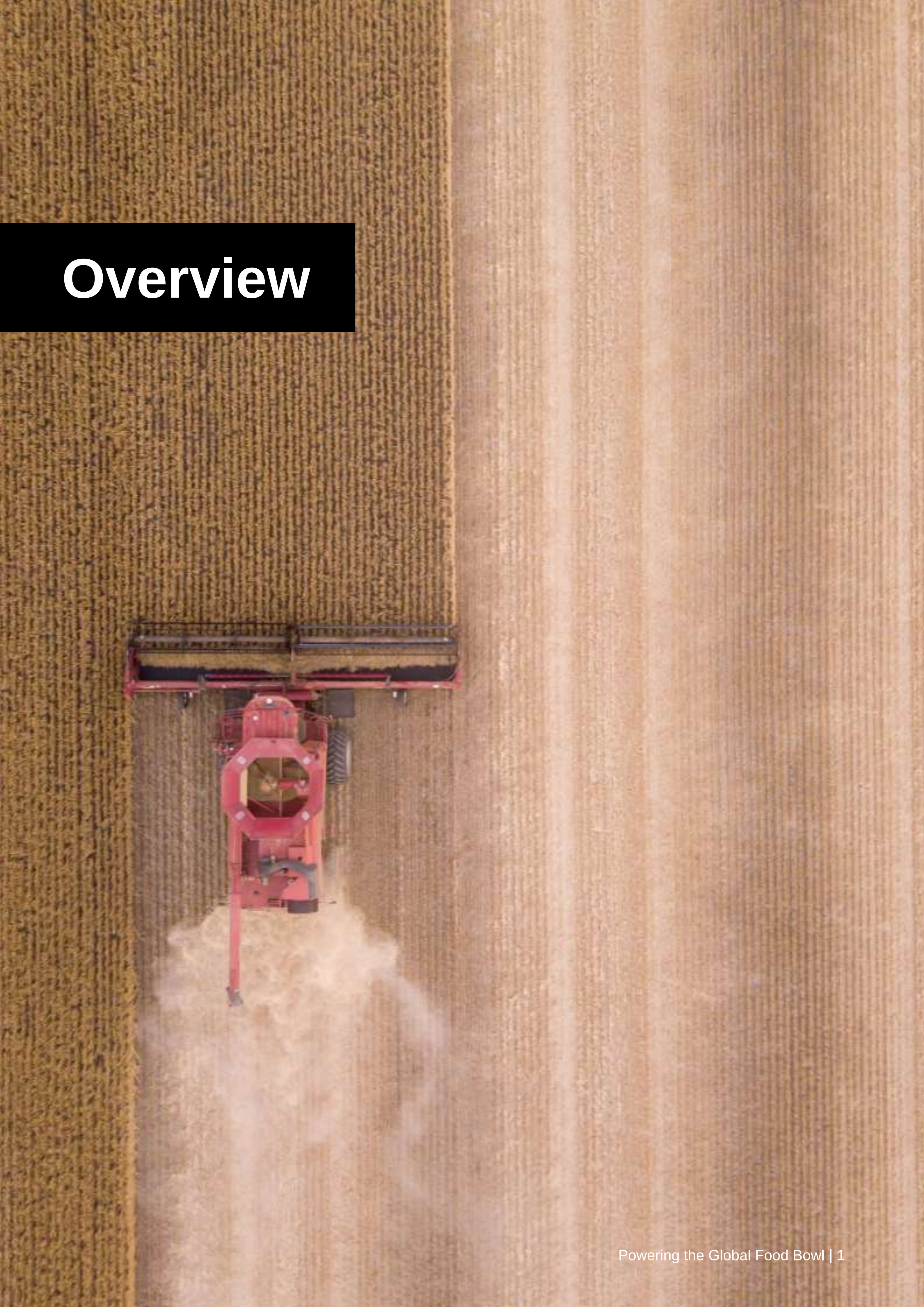


Overview

This paper considers the impact of increasing energy opportunities in the agricultural sector, by investing in captive solutions. By considering a range of energy resources for generation that can operate separate from the grid, developers can leverage innovate agricultural ventures that once were tied to grid proximity. Historically, off grid energy solutions were limited to gas and diesel, and other costly fuels. Today, the market enjoys a number of competitive energy generation sources offering more economic benefits.

Considering the fundamental role the agricultural industry has played in the Australian economy, there's significant interest from investors, farmers and a broad range of players in exploring how new technologies can influence the industry. The agriculture industry employs over 485,000 Australians[1], and contributes $58 billion through value of production to the Australian economy[2], or approximately 3% of GDP. With Australian farmers producing almost 93% of Australia's daily domestic food supply[3], the costs experienced by our agricultural industry are felt by all Australians, as well as globally in our far reaching export markets.

The technological intensity of modern day agriculture, coupled with a volatile energy market means securing access to the lowest cost and most reliable energy inputs has become a significant focus of all players in the agriculture industry. Agriculture relies on energy for every stage of its' production process: it uses energy directly as fuel or electricity to operate machinery, plant and equipment, to heat or cool facilities, to process products, enable lighting, and indirectly in the fertilisers and chemicals produced off the farm.

Based on the 2018 Australian Energy Update, over the course of 2017, the agriculture industry in Australia consumed 116 petajoules of energy, a 5.9% increase over the year and 2.3% increase over the last 10 years. It's also the only industry with a continuous rise in energy intensity since 2008[4], amounting to an annual industry electricity cost of approximately AU$5.85bn per annum.[5]

Although energy inputs have traditionally formed a relatively small proportion of overall production and post-farm processing costs, the increasing cost (particularly of electricity) and intermittent reliability are becoming increasingly important issues for farmers. Access to affordable and reliable energy is imperative for continued sustainability and enhanced growth in the agricultural sector.

As investors into the Australian rural and agricultural sector increasingly question the traditional energy approaches, alternative options through captive energy solutions are showing promise.

The purpose of this paper is to both provide a broad overview of the role of energy in supporting Australia's global food production capacity, and to explore the potential for off grid energy investment to boost agricultural growth.

Set out on the following page is an infographic summarising the key energy related issues facing farmers. It is based on a survey that was carried out by Agriculture Victoria in partnership with the Victorian Farmers Federation to better understand on-farm energy consumption, cost structures and barriers to investing in energy efficient technologies.

What are the main energy-related concerns for farmers?

Cost of energy was the number one concern for 75% of gas users, 66% of diesel users, and 59% of electricity users

Reliability was also a concern for 35% of electricity users and 21% of diesel users

What are the biggest barriers to decreasing on-farm energy costs?

- High up-front cost of investment
- Low return on investment
- Unsure of how to choose appropriate technologies
- Technology changes to quickly
- Unsure of how to implement appropriate technologies
- Need to see others in my industry succeed first
- Lack of interest

What actions have farmers taken in the past two years to keep energy costs down?

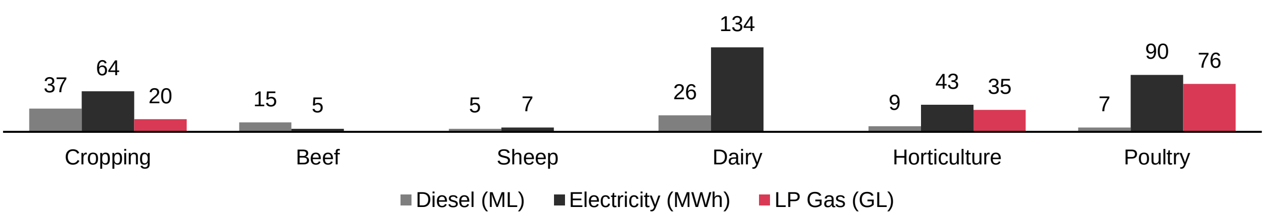
- **21.2%** Changing power usage to manage demand
- **20.5%** Switching to Energy efficient lighting
- **19.3%** Negotiating directly with provider for cheaper energy
- **13.8%** Using solar panels
- **13.0%** Seeking advice from electricians
- **11.3%** Improving insulation and seals

Who is using back-up energy supplies?

55% of farmers have **back up energy supply** in place

40%+ of farmers generate some renewable energy on-farm

What was the average energy use in 2016-17, by farm type and energy type?



Utility issues affecting Australian agricultural farmers

Utility issues affecting Australian agricultural farmers

Affordability

One of the key challenges for electricity supply and distribution in the agriculture sector is overcoming geographical limitations. Although only 2 per cent of Australia's population live in off-grid areas, over 6 per cent of the country's total electricity is consumed in off-grid areas, owing to the energy intensity of agriculture in rural or remote areas. Around 74 per cent of that electricity is generated from natural gas and the remainder is mostly from diesel fuel, making it Australia's most expensive electricity due to the underlying high gas and diesel prices in such remote areas.[6]

Figure 2: Fringe of grid and off-grid areas

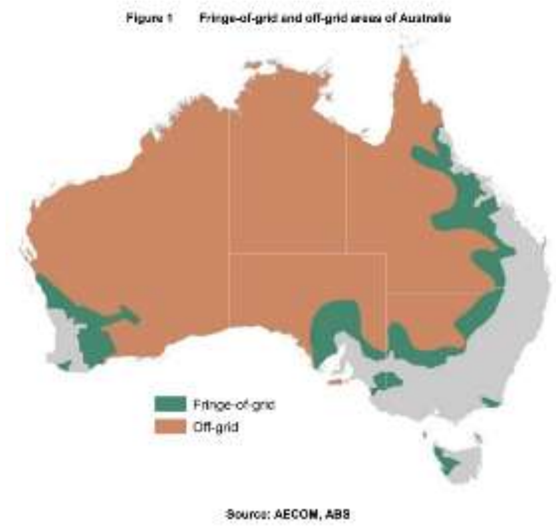
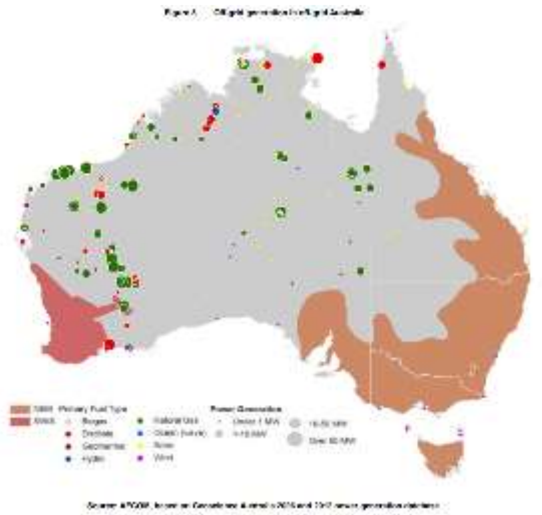


Figure 3: Existing off grid generation



Currently, with often limited or no access to conventional grid-supplied coal and gas, rural industry has been highly dependent on diesel generation due to the relative efficiency, reliability and lifetime economic value of this fuel source. Diesel generators are commonly large, portable systems that produce energy through combustion and subsequently emitting carbon dioxide, toxic particulates and other greenhouse gases. Although there's a significant upfront cost of ~ $20,000 per generator unit, the energy provided from diesel generators is approximately 30% cheaper than electricity from the grid.[7] With grid electricity prices doubling while diesel prices have trended downward, this source of energy remains attractive to Australian farmers despite the large initial outlay, environmental footprint and general health hazards posed for them and their local areas.

Cost understandably remains a paramount concern; 81% of Australian farmers state cost as a bigger concern over reliability, furthermore, 61% state rising energy costs have a moderate or significant impact on their farm operations.[8] This further paints a picture of inconvenience and undue stress for the industry, which would benefit through improved network upgrades through the application of renewable technologies.

Waste

Waste generated through rural industrial or agricultural processes is generally organic and provides the opportunity for waste to energy investments. Although feedstock involving organic produce, waste water, animal manure, or crop waste is generally of a lower calorific value than petroleum waste, there have been several trials demonstrating economic viability in several parts of the world including the US and parts of South America. Other studies have concluded that the use of a hydrothermal liquefaction process can produce substantial bio crude oil that can be converted into other liquid fuels for aviation or vehicles[9].

Reliability

Common issues which arise regarding the reliability of electricity include blackouts, brownouts and voltage fluctuations which occur as a result of fluctuating climate conditions such as floods, severe storms and strong winds. [10] In order to manage these, Australian farmers have traditionally required individual generators on site, upgrade devices to be compatible for power outages and purchase of additional equipment for general management of outages. These requirements are in addition to the initial setup of connection to the grid, which in and of itself sees elevated prices.

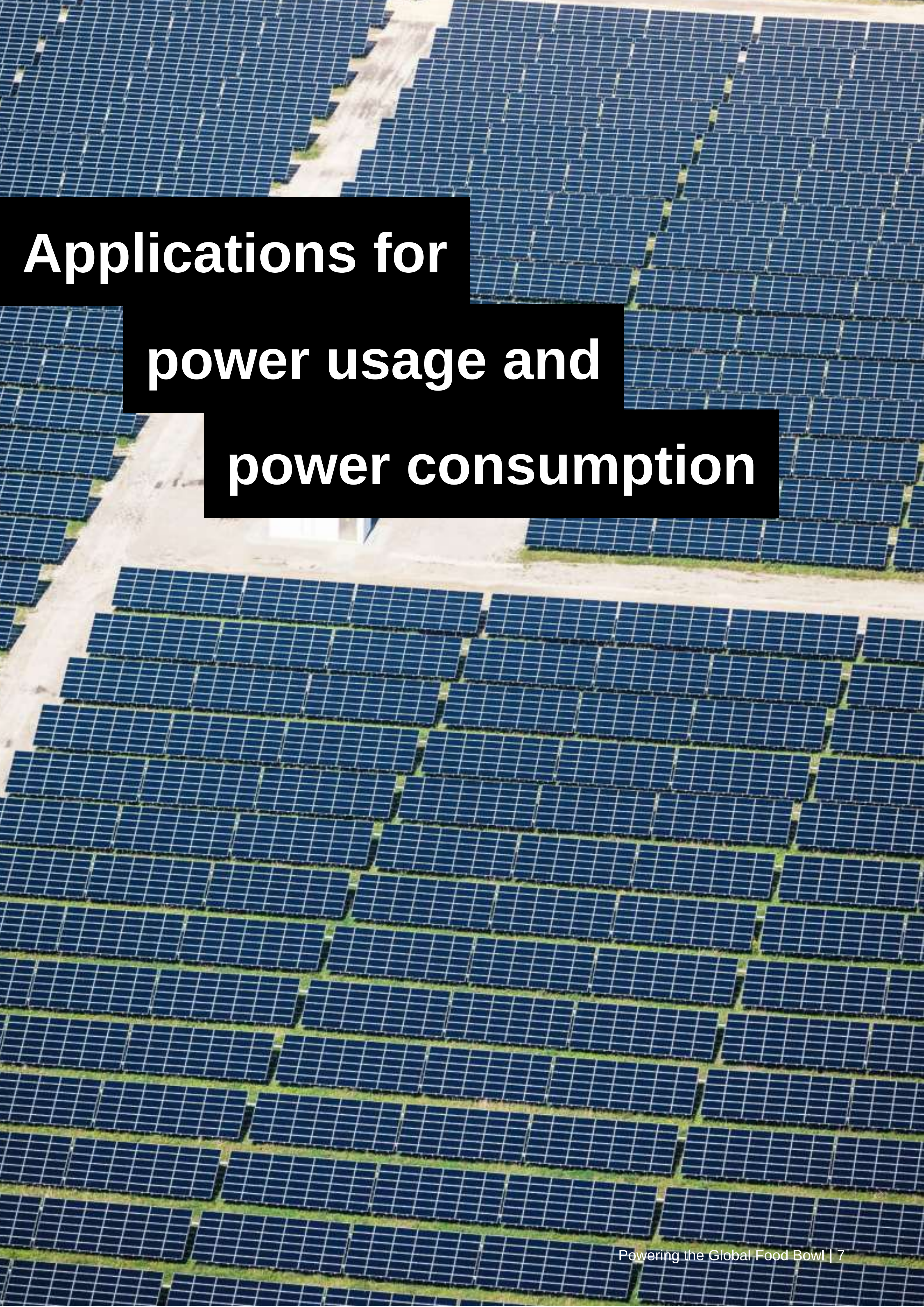
In addition to this, cost of a power failure arises also due the loss of livestock or produce, damage to equipment and cost associated with bringing the farm back to normal operation. For example, months of unexplained night-time power outages in Queensland's Isis district have left farmers unable to reliably irrigate crops in the crucial summer period. They have also affected irrigation pumps in the region's key agricultural sector, causing them to shut down without warning, causing major crop and financial losses.

Water supply shortage in Australia

A supplementary issue for Australian farmers and growers is the shortage of water. This is due to the remote locales of various agricultural farms and the diminishing global freshwater supply, generally attributed to the impact of global warming. Currently, 70% of available water in Australia is directed to agricultural use,[11] largely owing to evaporation (which occurs via transportation of water, and transpiration from plants[12]). The World Bank forecasts further increased water consumption due to rising economic prosperity resulting in increased meat consumption – a water intensive agricultural product.[13]The outlook for agricultural production is one which faces increasing strain from resource scarcity.

Energy in particular plays an important role in the management of water supply, through the pumping of water to agricultural sites as well as a source of power for alternative water resourcing solutions. Irrigation requires the use of electrical pump sets which contributes to the energy costs for farmers, particularly when connected to the grid. Alternative water generation technologies such as desalination also produce a large carbon footprint through the energy-intensive nature of the process. For seawater desalination, energy use can represent 50-70% of total operating costs. There's significant potential for renewable technologies to provide support as cost effective, reliable and innovative solutions to these challenges.

Applications for power usage and power consumption



Applications for power consumption and power costs

Power consumption in the agriculture sector

Currently, on-farm energy and electricity are used on large-scale irrigation pumps, cold storage chains, climate controlled environments, and on-farm processing of products. Agricultural food processors (i.e. meat and dairy processors), use significant amounts of energy and electricity.[14]

Typical energy inputs required for various agricultural activities

Value chain segment	Agricultural inputs	Food processing (milling/hulling etc.)	Dairy farming	Irrigation
Typical energy inputs	The energy required to produce the inputs used in agricultural production. This segment consists of four common cross-sectoral inputs: • Stock feed; • Fertiliser; • Crop and pasture chemicals; and • Livestock materials.	The energy required for on-farm production activities.	Diesel use and costs associated with transport of the commodity across the supply chain.	The energy required for primary processing of agricultural goods.

Source: "The impacts of energy costs on the Australian agriculture sector" by the Australian Farm Institute, August 2018.

Power costs in the agriculture sector

Abattoirs

The Australian red meat industry* (RMI) is a significant user of energy, with an energy cost of approximately **$1.58 billion per annum**.

Energy is used in processing for slaughtering, boning, processing and rendering as well as for lighting and refrigeration. The most energy intensive stages of red meat production are on farm diesel use, embodied energy associated with farm inputs and thermal energy for feedlots, particularly milling.

The Australian RMI consumes large quantities of electrical energy through general operations such as livestock holding, slaughtering and processing, monitoring and testing, cleaning and packing. Refrigeration is also one of the main uses of energy in meat processing facilities, with cool rooms, air conditioning and freezing equipment all absorbing power.

The high levels of energy and water use in abattoirs are necessary to meet food safety requirements.

The RMI supply chain energy is derived from the following sources:

31.6% Grid electricity

37% Natural gas

19% Coal

The three highest costs associated with the production of red meat to retail ready products are:

On-farm diesel use (**$298 million pa**)

Red meat processor power (**$278 million pa**)

On-fam embodied energy (**$267 million pa**) Includes beef, sheep meat and goat meat

Dairy

The dairy industry uses energy both directly and indirectly. The main contributors to energy use on farm are:

80% Water heating, milk cooling and milk harvesting (80% of energy use)

20% Cleaning, irrigation and lighting (20% of energy use)

Based on a report by Dairy Australia, it was found that, on average, **48 kWh** of energy is used to produce **1000 litres** (L) of milk, totalling to a cost of energy of **$11 per 1000 L** of milk[15]. It is also estimated that the predicted energy cost per year of a cow is **$275 – $300**[16].

Grains

The total life cycle energy inputs for wheat and barley is **3,028** and **2,175 kWh/ha** or **10.9** and **7.8GJ/ha** respectively[17]

Diesel is the largest (at **85%–90%**) on energy source and cost for grain farmers. Based on a study investigating the energy-saving opportunities for various farming enterprises in Western Australia,

the on farm energy use was **0.83 GJ/ha**

consisting of **20L diesel**

1.5L petrol and **2.4kWh** of electricity

Horticulture

Australia's horticulture industry covers **140 commodities** including but not limited to fruits, vegetables, nuts, grapes, flowers, turf and nursery products. It is the third largest agriculture sector in Australia by value behind livestock and broadacre farming.

Diesel makes up a significant portion of energy use on-farm, contributing **54%** to energy use in Australian potato crops. The type of irrigation pump had a significant influence on the results of diesel use on farm.

Electricity is another major contributor to total energy use. Electricity is required for pumping for irrigation.

* Includes beef, sheep meat and goat meat

Summary

- The table below summarises the baseline energy cost for following sectors in the agriculture industry.

Sector	Baseline cost ($million)
Grains	1,592
Beef	1,336
Chicken meat	608
Dairy	591
Sheep	431
Horticulture (vegetables)	319
Cotton	270
Sugar	252
Wine & Grapes	204
Pork	171
Eggs	71
Total	**5,845**

- The table below summarises the estimated cost of energy used by the Australian agriculture sector, distinguishing them by energy source and supply chain sector.

Total estimated cost of energy for each supply chain segment (all sectors) ($millions)				
Supply chain management	**Electricity**	**Gas**	**Diesel**	**Total**
Input	155	680	-	835
Production	1,218	185	1,382	2,785
Transport	-	-	1,112	1,112
Processing	980	124	9	1,113
Total	**2,353**	**990**	**2,503**	**5,845**

* Includes all gas types

** Includes diesel, petrol and oil

Renewable energy

Captive solutions

Renewable energy captive solutions

The increasing challenges to remain profitable posed by rising energy prices and reliability issues has resulted in agricultural businesses increasingly implementing off-grid or alternative energy solutions in an attempt to gain control over energy prices. The direct benefits of implementing renewable technologies into the agricultural lifecycle includes an increased security of supply, flexibility of integration with existing energy sources and flow-on-savings from energy efficiency measures.

The following table offers an overview of the advantages, levelised cost of energy (**LCOE**), applications and limitations of various renewable energy technologies in the agriculture sector.

We note that the LCOE values provided are based on today's cost and are likely to decrease as these technologies continue to improve. It is also worth mentioning that LCOE has been used as a means of comparison of the cost competitiveness of different technologies given its simplicity and relative availability. However, LCOE is limited in the sense that it does not incorporate factors such as different energy generation profiles or construction risk, and thus does not provide a holistic comparison of the value of different renewable technologies.

Solar PV	
Advantages	• **Scalable**: Solar PV can be installed as free-standing units to power specific equipment or expanded into large scale systems for energy intensive processes such as irrigation • **Reliable**: Solar remains a reliable energy source, as the only ongoing costs post installation is for maintenance and repair, and the panels are designed for wear and tear under various weather conditions. As such, it is projected that the cost of solar could become more economical than that of diesel, where diesel costs approximately $238 per MWh[15] depending on size and load, as well as the efficiency of the diesel motor employed
LCOE	From $50/MWh, depending on a number of factors such as PV modules used, size of facility and site specific solar yield. Roof top solar ranges between $60-120/MWh, based on system size and discount rate
Applications	The most common applications of Solar PV in agriculture are: • Facility based installations to supply electricity for intensive animal and horticultural production • Diesel solar hybrid power generation provides a cost-effective and reliable supplementary power supply in remote and regional areas • Free standing small solar in areas where the cost to run power lines are high and the low maintenance of solar is highly beneficial • Large scale solar systems for irrigation
Limitations	• **Space constraints:** Solar farms are large-scale applications of active energy collection requiring large areas for installation. For example, to generate 1 megawatt, a solar farm would require up to 7 acres of land.[16] This means that available land, as well as topography and existing vegetation are relevant concerns when evaluating the amount of energy a solar PV solution can provide • **Output levels may vary:** Solar farms that are installed in regions that are cloudy or at facilities that have excess shade levels are impacted in a negative way. Without storage capabilities at the solar farm, the actual energy levels being produced at the facility can become inconsistent • **Expensive upfront costs:** For solar PV and energy storage

Wind Power	
Advantages	Farm scale (smaller and lower) wind turbines can avoid the planning disputes associated with commercial wind farms and is worth consideration by farmers in locations with predictably high wind
LCOE	Between $40-$60/MWh, averaging $50/MWh
Applications	**Irrigation**: Wind technology is commonly used as reliable pumping solution when a grid connection is too far away and when wind conditions are sufficiently steady. In off-grid areas, where there is sufficient wind (>5 m/s) and ground water supply, wind pumps often offer a cost-effective method for domestic and community water supply, small-scale irrigation and livestock water use[17]
Limitations	The scale of energy generation for a commercial scale wind farm is typically over 1MW. This is generally not practical for individual farms as the amount of power generated far exceeds the needs of the farm

Solar thermal	
Advantages	• **Dispatchable energy supply:** Solar thermal energy can generate power 24 hours a day, made possible by its energy storage medium in the form of molten salts for example. Unlike other forms of renewable energy, the energy supply from solar thermal is more uniform and reliable • **Industrial application:** Solar thermal systems were found to be the most prospective renewable energy alternatives for the provision of industrial process heat. Solar thermal technologies are most prospective for heating water or steam at temperatures below 250 degrees celcius in areas with reasonable solar resources, such as Brisbane
LCOE	Between $98-$181/MWh (for solar thermal tower with storage)[18]
Applications	As a variant of Solar PV, solar thermal technology also sees applicability in agriculture particularly through energy intensive heating/cooling processes. This technology differs from solar PV as it transforms solar energy into thermal energy that is stored in liquid or gas form This process increases the efficiency of solar energy by approximately 20%.[19] Although not as commonly adopted in Australia, farm houses, poultry sheds and horticultural greenhouses requiring temperature regulation are prime candidates for the implementation of these technology
Limitations	• **High costs:** the LCOE of solar thermal is still higher than alternative technologies, inhibiting its adoption. Further, there have been a number of high profile examples of solar thermal projects which have failed to secure financing (i.e. Solar Reserve's Port August Aurora project) • **Limited locations and size limitations:** Solar thermal energy can only be built in places which have the high amount of solar radiation and generally has to be built in large sizes which are at least 50 MW in size to be economical

Waste to energy/bioenergy	
Advantages	• Ability to store feedstock in bulk for conversion to energy when needed • The reduction or removal of waste disposal costs • Cost-effective management of smell, pests and other environmental impacts of waste • An alternative use for crops or agricultural waste
LCOE	Between $80-$65/MWh (biomass direct).[20], however there is limited visibility of the LCOE of these technologies in the Australian market
Applications	• Combustion technologies that convert solid biomass through direct burning to release energy in the form of heat which can be used to generate electricity and process steam • Biogas technologies that produce methane by anaerobic digestion of animal and crop waste • Biofuel technologies that product ethanol and biodiesel using chemical conversion process
Limitations	• Higher upfront capital expenditure costs than solar PV and wind technologies • Operating deterrents such as the costs of aggregating and transportation of the waste • Variability in volume and quality of crop and animal based waste

Energy Storage	
Advantages	• The alternative energy sources introduced above must also be managed through adequate storage equipment to maintain consistency and reliability • Battery storage offers an opportunity to maintain supply regardless of weather variability, a key limitation of renewable energies • Pumped storage offers medium to large scale options for firming solar or wind with the availability of a water source as well as a suitable structural site • Compressed air storage offers medium to large scale options
LCOE	• Variable depending on the energy storage option: – Lithium Batteries $200-$350/MWh – Pumped Storage $150-$300/MWh – Compressed Air Storage $200-$400/MWh • Noting the above, the LCOE of energy storage options is not directly comparable to the LCOE of generation sources. This is as these technologies only reshape the energy profile of an associated generation source, and do not include the cost of energy that is used to charge or pump for example.
Applications	• Enables farmers in remote off-grid regions to replace expensive diesel generators with renewable energy technologies, having comfort power will always be available despite weather variations
Limitations	• Despite a rapid decrease in cost, the expense of battery storage system installations are currently still prohibitively expensive for wide scale adoption

Although the implementation of renewables appear an attractive and cost effective prospect – and undeniably achievable as a result of recent technological developments and social awareness – there continues to be a need for the expectations of different stakeholders to be managed, especially when considering the implementation of renewable energy projects in remote and regional Australia. For example, experience suggests that proponents of the energy installations tend to overestimate the capabilities of the technology and overlook the technical limitation of on-site generation.[21] As such, both farm owners and potential agricultural players must exercise caution in evaluating opportunities.

Case study 1 Australian dairy farming

Case study 1: Australian dairy farming

Modern dairy farming involves a number of energy intensive processes – from powering the milking shed and milking machines to refrigerating milk until it can be collected, and pumping water for high pressure cleaning of the shed after milkings. As such, key issues faced in this industry include creating excessive energy demand relative to the energy supply available during morning or afternoon milkings, as well as failure of circuit boards due to voltage fluctuations.[22] Additionally, with increasing occurrences of extended power outages, grid-connected dairy farmers have experienced financial loss through the inability to milk or lost milk when they've been unable to keep collected milk at the required temperature.

Accordingly, energy is a significant expenditure item for farmers in the dairy industry, already known as an industry with slim margins. Electricity costs may constitute between $17,000 and $40,000 per year just to power a dairy farm's milking shed, with a national average of $24,200.[23] In some circumstances, this can represent up to 20% of a farmer's milking revenue.

Solar PV systems have already been evidenced to substantially assist in the management of the reliability and cost issues discussed above. For example, Dairy Australia has found the installation of solar water units in dairies costing an average of AU$16,000 has resulted in $3,000 per annum of savings from electricity costs, as well as an average of 15 tonnes CO_2 emissions.[24]

In assessing the viability of the solar PV systems, it's worth considering the relationship between the growing number of installations and the payback period. As the number of installations increase, the installation costs have notably decreased over time[25]. This has meant most systems paybacks are commonly between 7-10 years, depending on the initial installation costs and the inverter replacement costs.

This is an increase relative to a typical solar installation due to the requirement for storage within a dairy farm. Considering the timing of peak energy consumption, the ability to include this technology is a key factor in assessing viability of a potential installation. Although most dairy regions receive adequate sunlight, the energy consumption during milking peaks in early morning and late afternoon, in which sunlight is least prominent. Combining storage with shifting the time of operations, or the times of operating water heaters or stock water may be considered to distribute energy consumption to match that of sunlight availability.[26]

Case study 2

Growing of fruit in remote locations

Case study 2: Growing of fruit in remote locations

Date farming in Australia

In the context of chronic water shortages in agriculture and a changing climate, there is growing interest from both public and private institutions in improving the sustainability of Australia's agricultural base. This involves a push to re-focus the mixture of crops produced towards those which require limited additional inputs to thrive in Australia's vast arid landscapes, whilst utilising the availability of land in more remote locations.

The date palm is an example of one such crop. Recognised as a national priority towards achieving a more environmentally sustainable Australia[27], the date palm is drought-resistant and tolerant to high levels of salinity, with certain varieties (such as the Yellow Barhi date) also attracting a premium price on global markets. With 75 per cent of Australia's annual date consumption (between 5000 – 7000 tonnes)[28] imported, and the dominance of the Northern Hemisphere in current global date production, there is also an economic argument for the development of this industry in Australia to support both domestic demand and to profit from alternating growing seasons.

However, even the most drought-resistant crops require some amount of rainfall; date palms still require between 15-25 megalitres per hectare of water annually[29], meaning irrigation is required to produce the highest yields. Although technology such as drip irrigation (targeting water directly into the roots of date plants to reduce water loss experienced through evaporation) can help to conserve water, energy is a necessary input in the pumping of water from bores or dams, and powering irrigation systems. Further, in the absence of a date processing sector in Australia, energy intensive activities such as washing, dehydrating, quality sorting, packing and refrigeration must also be performed on farm.

This places a significant energy burden on farmers, with the production of a kilogram of dates requiring over a litre of diesel fuel, which must often be transported vast distances to remote farms. However, the ideal growth conditions for dates ensure that significant solar resources are also available in the most suitable date growing locations, creating the opportunity to develop this industry sustainably and off-grid with the assistance of renewable energy.

For example, the Tamara Date Farm, located south of Alice Springs, has successfully displaced diesel fuel with an 18kW system of solar panels, utilising the 300 days per year of strong sunlight experienced in this region[30]. The success of this system paves the way for other players in the fledgling industry such as the Riverland Date Garden and Gurra Date Farm (both located in South Australia) to sustainably scale up operations in relatively remote locations.

Sundrop Farms

In contrast to desert adapted crops such as dates, growing the green, leafy vegetables and many fruits that are considered a staple in the Australian diet requires use of climate controlled greenhouses, with over 30 per cent of Australian farmers utilising some form of protected cropping[31]. These facilities inherently depend on energy to control climate and lighting and support irrigation systems, packing systems and cool rooms. This creates an unavoidable exposure to increases in energy prices, as well as power outages, which has traditionally been mitigated through the purchase of expensive diesel generators and sufficient fuel to power greenhouses for extended periods of time.

To bring back certainty over energy pricing and supply, Sundrop Farms has developed a hydroponic farm system based on concentrated solar power (CSP) technology (similar to solar thermal technology, as described earlier in this paper), to successfully grow truss tomatoes in arid Port Augusta, South Australia. This method of sustainable, closed-loop horticulture utilises energy created through solar thermal technology to pump and desalinate salt water from the nearby Spencer Gulf for irrigation, with the steam created through the process also heating and powering the system of climate-controlled greenhouses composing the 'farm'. CSP, in conjunction with a storage system with capacity for 10 days of energy supply, has allowed Sundrop to not only achieve energy security and reduce day-to-day running costs but has also displaced over two million litres of diesel annually with clean solar energy.

Sundrop Farms provides between 10-15 per cent of Australia's truss tomatoes[32] at a cost competitive price, and has plans to adapt CSP powered greenhousing to grow other fruits and vegetables such as capsicum. On a wider scale, CSP has the potential to support Australia's food production capabilities significantly by expanding the areas upon which horticulture can successfully take place. By eradicating the need for fertile soils and steady rainfall, Sundrop Farms illustrates how the desert areas of Australia can be transformed from resource poor to resource rich through the power of the sun.

Nectar Farms

Nectar Farms are another example of the utilisation of renewable energy to power glasshouse farming in remote locations. With the inability to access grid power, Nectar Farms have partnered with developer Neoen to source 100% of the energy for its Joel Joel project, located 15km east of Stawell, Victoria from the nearby Bulgana Green Power Hub.

With an anticipated 70Gwh of annual energy consumption, the Joel Joel project will take 15% or 30MW of the output of Neoen's 196MW wind farm under the agreed power purchase agreement. Given the requirement for consistent energy supply, the greenhouse will also be supported by a 20MW/34MWh Tesla battery storage facility[33], firming the power generated by the wind farm component of the energy hub.

Nectar Farms have embraced renewable energy solutions out of both necessity and favourable economics. With rising grid electricity and gas prices, Nectar Farms CEO Stephan Sasse has stated that the anticipated almost 30% of project cost that would typically be attributed to energy will now be reduced by a 'significant margin'[34] through the utilisation of renewable energy. This will enable the project to produce high quality tomatoes for both the Australian and international markets at a low cost. Nectar Farms already has a sales, marketing and distribution alliance locked in with Costa group, and is supported by a long-term funding plan driven by the National Farmer' Federation.

Upon completion, the project is set to be the largest enclosed glasshouse in the Southern Hemisphere, with first production anticipated by the end of 2020.

The examples above are just the tip of the iceberg in an evolving agricultural and horticultural industry, which is increasingly benefiting from innovations and cost reductions in renewable energy technologies. The potential for renewable technologies to unlock an expansion of energy-facilitated off-grid agriculture allows us to expand production capacity, whilst doing so in a way that presents a solution to the topical issues currently threatening Australia's farmers, such as energy and water security.

Key takeaways

Key takeaways

As the cost of a grid connected energy supply has continued to increase, the cost and source of energy is becoming a key consideration in the commercial operation of any Australian business. This is a concern at the forefront of the agriculture industry, where access to a stable and reliable electricity or fuel supply becomes essential to supporting Australia's food production capacity and global export competitiveness. Mounting energy pricing and reliability issues have increased the costs faced in the industry, with higher input costs inevitably reducing already slim margins experienced by farmers.

However, developments in renewable energy generation technologies are becoming an increasingly economically viable option to support agriculture, particularly in rural and off-grid areas, with many producers having experienced cost savings and improved reliability compared to diesel generation or an unreliable grid connection.

As discussed within this paper, there is now a range of renewable energy captive solutions available for investors, farmers and developers to explore, which can provide economic and environmental rewards, whilst reducing the risk and reliance on a costly and at times unavailable connection.

This translates to an opportunity to improve competitiveness and save up to 25% of grid connected energy costs depending on the type of captive energy generation sourced and the application. PwC is helping a range of diverse businesses control costs with captive solutions, particularly in new applications in currently off-grid locations.

With the cost of providing off-grid renewables declining, there is enormous potential to improve industrialisation of our farming and empower the global food bowl. If you are considering an off-grid generation opportunity in relation to an agriculture application, please speak to our team at PwC.

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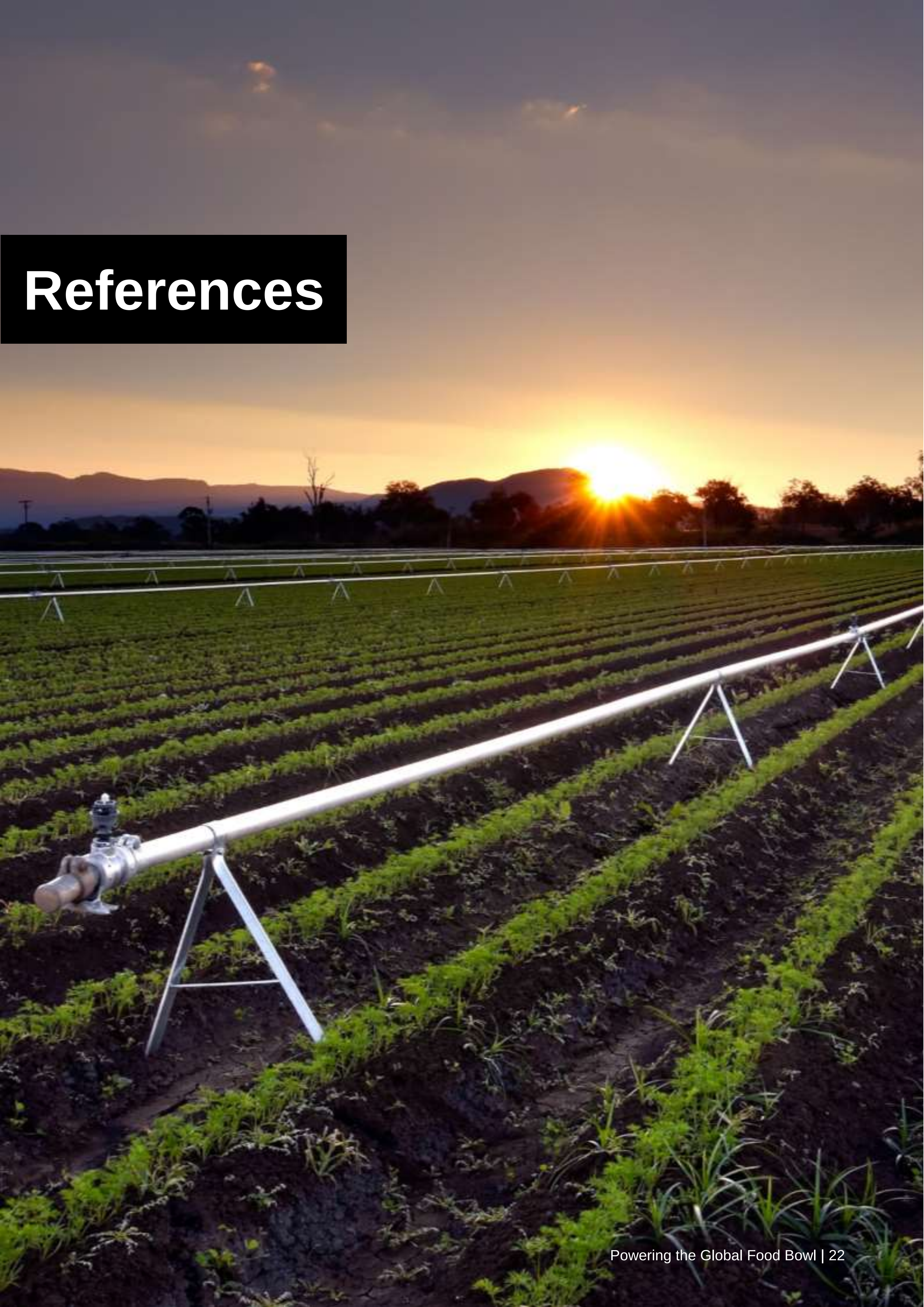

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