ADAPTING TO CLIMATE CHANGE

06. SOLAR POWER GENERATION

Summary

The mushroom industry has already proven a strong adopter of solar power generation, with half the farms surveyed with systems already in place. Options include photovoltaic and concentrated solar systems. Using the energy generated at source is a key factor making solar viable, but the high energy requirements of both farms and composters mean this is readily achieved. Systems up to 100kW attract a government rebate. Larger systems may be financed through a 'behind-the-meter' contract, where the installer pays for the system and sells the power generated back to the farm. The payback time for solar systems depends on the price paid for electricity. If businesses are paying retail prices, the cost of their solar system could pay for itself in 40 months. However, if wholesale pricing means electricity prices are low, the payback period may be 7 to 10 years.

Background

The mushroom industry is already a proven adopter of solar power generation. The large roof area of mushroom farms makes them a clear candidate for solar photovoltaic (PV) energy. The costs of solar energy are falling while the efficiency of energy production has increased. Moreover, the panels shade the roof, reducing radiant heat load on the building.

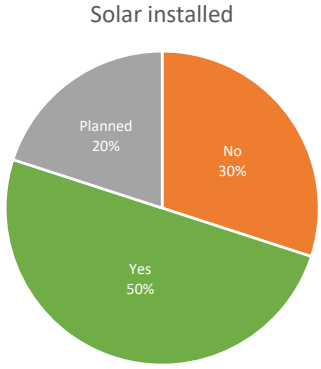

Figure 1. Percentage of Australian mushroom farms with solar already installed, solar planned or not installed.

As a result, nearly half of all Australian mushroom farms and one third of compost producers already have solar systems installed. At least half of the remainder are investigating solar options.

Battery systems to store solar generated electricity have had much lower uptake. Payback periods are longer, while the rapid rate of change in this area means many are waiting before making this further investment.

Solar power generation

The primary indicator of viability for solar energy is whether electricity can be consumed during sunlight hours, for which typical mushroom farming is well suited. AHR studied the feasibility of on-farm solar, as well as wind and gas generation, in a recent project for the vegetable industry[1] click here for the report and factsheets. The study showed that solar photovoltaics (PV) can be viable at a 10% Internal Rate of Return (IRR) with a 5 – 7 year payback period if **electricity costs are currently more than 12 – 15 c/kWh.**

[1] Rogers, G. 2014. On farm power generation options for Australian vegetable growers (VG13051) Hort Innovation final report

Hort Innovation Strategic levy investment | MUSHROOM FUND

This project has been funded by Hort Innovation using the mushroom research and development levy and funds from the Australian Government. For more information on the fund and strategic levy investment visit horticulture.com.au

ahr applied horticultural research

06. SOLAR POWER GENERATION

One drawback of solar energy has been the lack of storage facility; batteries. However, these too are becoming more price competitive. For example, the Tesla Powerpack system can provide up to 2.5MW power. This can be used to shift demand, reducing reliance on high priced energy, alleviate peaks in system load and provide emergency backup in the event of a power cut.

Concentrated solar power

Concentrated solar power (CSP), also known as concentrated solar thermal systems, generate solar power using mirrors or lenses to concentrate a large area of sunlight onto a receiver. Electricity is generated when concentrated light is converted to heat (solar thermal energy), which drives a heat engine (usually a steam turbine) connected to an electrical power generator or powers a thermochemical reaction[2]. Commercial providers can supply these systems as an alternative to solar PV.

RayGen has installed a concentrated solar power generator at an Australian mushroom composter. The plant co-generates electricity and heat by using mirrors to focus sunlight onto a photovoltaic receiver containing efficient photovoltaic Ultra modules. Electricity is generated in the receiver, while a closed-loop water cooling system captures and stores heat as a useful by-product.

Electricity is sold to the composter at a discount rate in a behind-the-meter contract, and surplus electricity is fed into the grid.

Economics of solar energy

Small-scale rooftop solar is defined as installations of 100kW or less – and which qualify for an upfront rebate (which are being wound back each year and eventually eliminated by 2030). Larger rooftop solar systems operate under a different scheme, along with utility-scale solar farms.

A key design feature of the *Small-scale Renewable Energy Scheme-(SRES)* is that regions with greater solar exposure receive a higher proportional subsidy, on account of their greater ability to generate electricity from rooftop panels.

The approach applied to large-scale projects under the Large-scale Renewable Energy Target (LRET) is that certificates are created per unit of renewable electricity actually generated.

100kW solar systems are among the most popular commercial solar system sizes in Australia, as this size is the cut-off point for up-front incentives through the federal government.

RayGen's PV Ultra Concentrated solar power generator. *Source: RayGen*

[2] Wikipedia https://en.wikipedia.org/wiki/Concentrated_solar_power

Hort Innovation Strategic levy investment | MUSHROOM FUND

This project has been funded by Hort Innovation using the mushroom research and development levy and funds from the Australian Government. For more information on the fund and strategic levy investment visit horticulture.com.au

ahr applied horticultural research

06. SOLAR POWER GENERATION

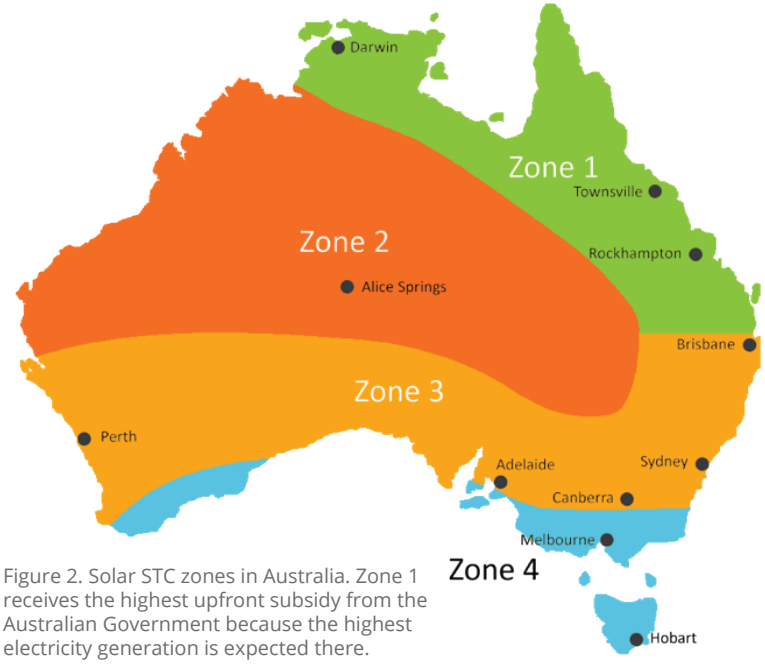

Figure 2. Solar STC zones in Australia. Zone 1 receives the highest upfront subsidy from the Australian Government because the highest electricity generation is expected there.

Source: Solargain

Figure 3. 100kW solar photovoltaic installed on a rooftop. *Source: Spinifex Energy*

COST OF SOLAR

	10kW	30kW	50kW	70kW	100kW
Adelaide, SA	$12,880	$34,580	$58,050	$79,590	$96,830
Brisbane, QLD	$11,730	$32,650	$57,400	$78,800	$97,820
Canberra, ACT	$10,760	$29,070	$53,260	$74,140	$99,560
Hobart, TAS	$15,550	$37,780	$63,350	$85,090	$93,620
Melbourne, VIC	$13,190	$32,270	$57,520	$75,650	$97,430
Sydney, NSW	$13,420	$32,760	$57,570	$75,630	$92,580
Perth, WA	$15,900	$37,410	$65,910	$83,210	$94,300

Table 1. Average commercial system prices by city & size (May 2020). STC rebate and GST included. *Source: Solar Choice*

FINANCING OPTIONS

Australia's banks offer discounted 'energy-efficiency' loans. These loans typically offer a 0.70% discount on headline rates for investments into clean-energy assets and are available from the major banks.

Power purchase agreements (PPAs) are arrangements in which an organisation benefits from lower electricity rates without having to purchase a system. Instead, a PPA provider pays for and owns the solar system, selling the energy it produces to the business directly at an agreed-upon rate that is lower than energy from the grid.

Hort Innovation Strategic levy investment | MUSHROOM FUND

This project has been funded by Hort Innovation using the mushroom research and development levy and funds from the Australian Government. For more information on the fund and strategic levy investment visit horticulture.com.au

ahr applied horticultural research

06. SOLAR POWER GENERATION

FINANCIAL CONSIDERATIONS

Price of electricity

Mushroom farms and compost yards in areas with higher prices of electricity, or which are unable to access cheap energy deals, will realise a higher return on investment from solar systems.

Wholesale electricity prices are often low during the middle of the day, when solar produces the most energy. Businesses on a retail electricity contract will benefit more than those on a wholesale electricity contract.

Feed-in tariffs

Feed-in tariffs are rebate paid for electricity exported to the electricity grid. Historically, feed-in tariffs were high in Australia, but government subsidies have been removed and replaced by STCs, which are an upfront subsidy on solar installations less than 100kW. Feed-in tariffs do remain for small solar systems, generally 5kW for single phase or 30kW for 3-phase. For maximum return on investment, a solar installation at a mushroom farm or compost yard should be designed so all electricity generated is used on-site.

SHOULD YOU INVEST IN SOLAR?

Businesses on a retail electricity contract should install solar. The economics are clear. For example, if a business is paying 20 cents per kilowatt hour ($200/MWh) during the day, a 100kW system would have a payback period of 3.3 years in NSW.

Wholesale electricity contracts are much more complex. In this case, the payback period for an investment will mostly depend on the price of electricity a business is paying during daylight hours, when wholesale prices are often quite low.

If the business has a favorable electricity deal, it may take 7 to 10 years for a solar system to provide a return.

STATE	ENERGY AUSTRALIA FEED-IN TARIFF
Victoria	12.0 cents per kWh
New South Wales	10.5 cents per kWh
Australian Capital Territory	10.5 cents per kWh
South Australia	11.5 cents per kWh
Queensland	11.5 cents per kWh

Table 2. Example of feed-in tariffs rates in Australia. *Source: Energy Australia*

	NSW	VIC	QLD	SA	AVERAGE
Wholesale price of electricity ($/MWh)	90	98	62	83	83
Electricity used on-site	100%	100%	100%	100%	100%
Purchase price (rebate included)	$92,580	$97,430	$97,820	$96,830	$96,165
Size of solar system	100kW	100kW	100kW	100kW	100kW
Payback period (years)	7.2	7.5	9.5	7.6	8.0
Internal rate of return (IRR)	14%	14%	10%	13%	13%

Table 3. Payback period of 100kW solar installations. Calculations consider the daylight hours in each area, average wholesale price of electricity. GST is included. Fixed supply charges are not considered and should not be affected by investment in solar. Calculator is available here: https://www.solarchoice.net.au/blog/solar-power-system-payback-calculator

Hort Innovation Strategic levy investment | MUSHROOM FUND

This project has been funded by Hort Innovation using the mushroom research and development levy and funds from the Australian Government. For more information on the fund and strategic levy investment visit horticulture.com.au

ahr applied horticultural research