Solar Powered Pumping

Irrigation solutions

NSW FARMERS

NSW GOVERNMENT Office of Environment & Heritage

Solar power in irrigation

Solar Photovoltaics (PV) is a significant source of energy for pumping on irrigation farms of all sizes, ranging from broad acre cropping to protected horticulture.

The high cost of pumping water using mains electricity or diesel is a burden on Australian agricultural productivity.

Irrigated agriculture produces more than 20 percent of the total value of Australian agricultural production on less than one percent of agricultural land. To achieve this, approximately five million megalitres (ML) of irrigation water is applied every year in NSW alone (ABS, 2014). Diesel and grid connected electric pumps are used to lift water from rivers and ground water, and to pressurise distribution systems.

While electricity is more efficient than diesel for pumping, high network charges and connection costs in rural areas have inhibited growth in the electrification of irrigation pumping. Increasingly, irrigators across all farming systems are looking to solar power for solutions.

Technically, there is no limit to the volume of water that can be pumped using solar power as a solar array can be sized to meet any scale of power demand.

The business case for solar powered irrigation on a given farm depends on factors including the number of months pumping per year, water storage capacity, the time of day when irrigation occurs and the potential to utilise or export and sell excess energy.

The scalability of solar power and its ability to be integrated with mains electricity are among its greatest strengths. Many different configurations are possible, including full replacement of mains electricity or diesel, hybrid solutions that combine mains and solar power, and installations that provide power for only part of an irrigation system, such as a transfer pump that is used year round.

Hybrid solutions – combining mains and solar power

The ability to integrate solar power with mains electricity opens up many possibilities for irrigators. Electricity generated by a solar array not being used for irrigation off season can be allocated to other farm uses or exported to the network. Energy generated on farm can be used to replace expensive day time mains electricity, enabling access to lower tariff structures when negotiating power contracts.

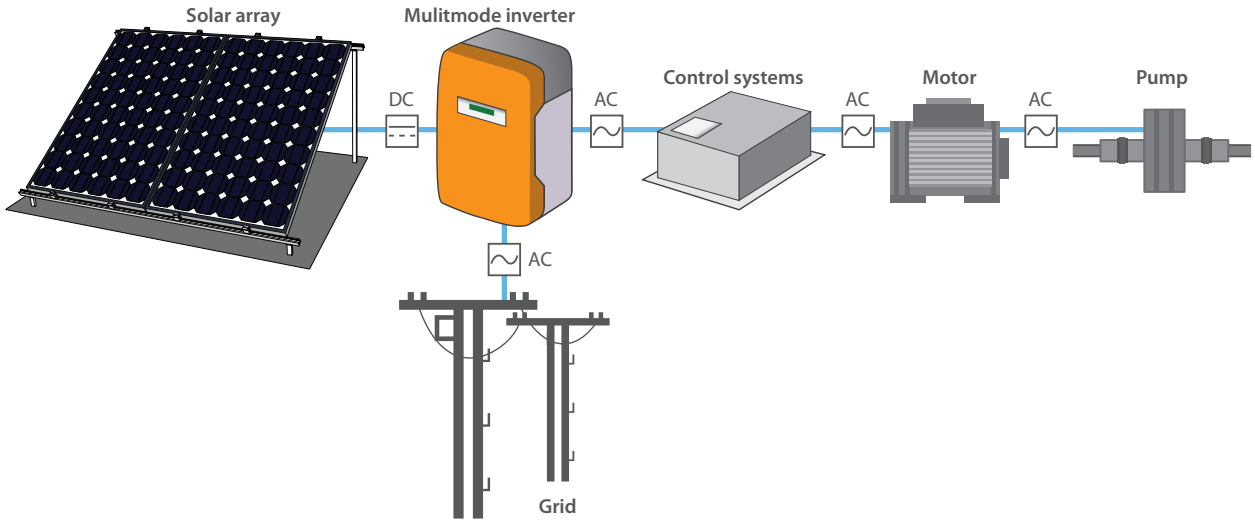
Key elements in solar pumping systems

The central component in all solar PV irrigation solutions is an array of panels that convert sunlight to DC electricity. The amount of power generated is a factor of the area of the panels and the intensity of sunlight.

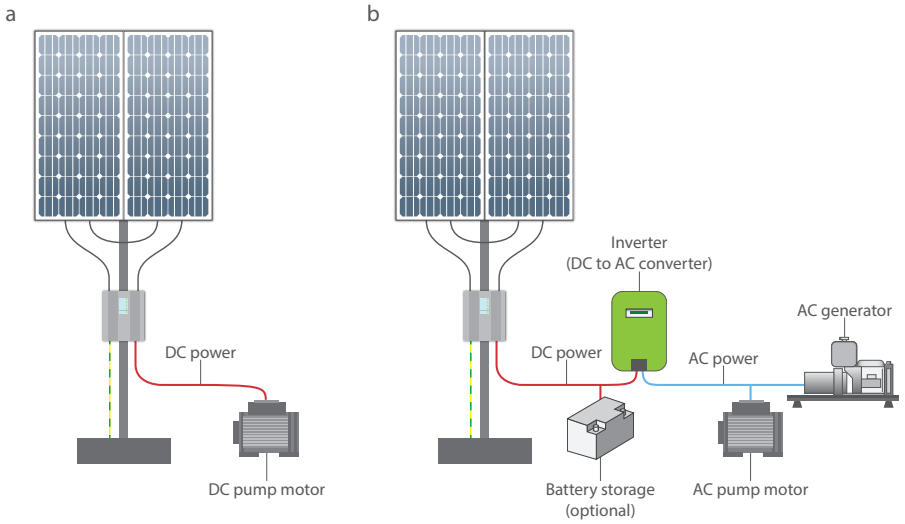
Power requirements for irrigation can be substantial requiring large solar PV installations typically 10 to 300kW, usually integrated as grid-connected solutions.

The components that comprise such systems typically include a solar array, an inverter to convert generated DC electricity into AC electricity (and enable integration with other electricity supply), power controllers, and electric pumps to lift the water from source and move it to delivery points.

Stand alone solar arrays can be connected directly to DC motors and pumps. Other standalone options may include an inverter to supply AC motors, with optional battery storage and/or back-up diesel generators.



A grid connected solar pumping configuration using a combination of solar and grid power as the energy source



a) A simple stand-alone system
b) A system using AC motors backed by battery storage and diesel generators

Feasibility, sizing and design

When assessing feasibility, size and configuration, key factors include the timing of pumping, the volume and reliability of water supply required, water storage capacity, and the potential to integrate solar with other power sources.

Farms that have relatively continuous and predictable day time irrigation needs are ideal candidates for solutions that fully replace mains power. As a result, many horticultural growers have already adopted solar. However, in most broad acre irrigation systems, pumping requirements are seasonal and vary in response to climate. These systems require more complex assessment and design.

Where pumping is irregular or not always in day light hours, return on investment and optimal system size should be calculated with reference to external factors. Factors include other electricity demand on farm, ability to export and sell unused electricity and ability to offset night time mains electricity cost with savings on day time usage.

Prior to committing to a major system we recommend that you:

- Commission a general energy assessment of your farm. This should include accurate documentation of the quantity, cost and timing of energy used by your irrigation system.
- Address energy efficiency savings first. Poor layouts, pipe diameters, incorrect pump size and maintenance are all typical energy wastage points.
- Check the capacity of your water storage infrastructure and minimise leakage and evaporation.
- Involve your irrigation engineer to clarify priorities and technical requirements (e.g. dynamic pumping head, pressure, control systems).

Having this information at hand will prepare you to discuss options with suppliers and obtain accurate quotes. It is essential that suppliers have experience with solar irrigation applications.

Discuss your needs with potential suppliers on site

It is essential that your installer fully understands your operational priorities for the system and can quantify how the system will deliver what you require in terms of water supply, not just energy.

Battery Storage

Advances in battery technology will make it cost-effective to store solar energy for night time irrigation.

Case study

Gunnedah farmer, Scott Morgan, grows cotton, wheat and other grain on his 730 ha Liverpool Plains property, 'Kensal Green'.


Scott Morgan


1


2


3

Scott has installed 160 amorphous silicon solar panels to power his bore lift pump.

"My reliance on bore water, which requires a lot of energy to lift, got me thinking about ways to save energy. I installed a travelling irrigator fed by a two-kilometre pipeline which has eliminated the need for two lift pumps and at the same time installed the solar array to power the remaining lift pump.

"The system works perfectly – solar is a fantastic technology for agriculture. The only barrier for me and other local irrigators is the seasonal nature of our electricity demand – we generally only pump high volumes three months of the year.

I want to go fully solar but viability would depend on receiving income for generation capacity off season. My current system has shaved $18,000 off my power bill. That is a substantial saving for me. The price of solar panels has come down dramatically since I installed mine. A system that was close to $60,000 now would probably cost $20,000. I think there is a bright future for solar.

Electricity demand is increasing in this region. We have plenty of land and sunshine. Instead of installing new high voltage infrastructure to meet peak load from the national energy market, the network could be exploring ways for farmers to assist. All things considered, there is an opportunity to work with irrigators to reduce load and/or supply power"

> "The system works perfectly – solar is a fantastic technology for agriculture"

Photographs

1. Scott's 40kw, 16 inch, mixed flow pump moves 30 ML per day in irrigation season.
2. Scott Morgan in front of the inverter which is used to convert DC solar power to AC.
3. Scott's arrays are located along an internal road. In the background, his travelling irrigation system.

Why go solar?

Going solar can be an important step towards increasing the resilience and sustainability of your farm business.

Solar PV has many possible applications in agriculture including powering intensive animal and horticultural facilities and water pumping. The technology is scalable, proven, well understood and widely adopted across Australia and internationally.

On most farms, solar is a cost effective option for at least some of your energy needs.

Benefits of implementing solar as a source of power for irrigation pumping include:

- Reduced bills for mains electricity and diesel
- Easy integration with mains power
- Reduced connection and infrastructure costs when new power lines and poles can be avoided
- Reduced noise, fumes and fuelling runs when replacing diesel
- Scalable technology – additional panels can be added to increase output
- Low maintenance. Aside from tracking systems, traditional solar generators have no moving parts and are generally very reliable
- Protection from rising energy costs – sunshine is free. Generating energy on farm reduces exposure to rising electricity and diesel prices.

Provided it is correctly specified and installed, a solar powered irrigation solution should provide long and trouble free service and excellent return on investment.

Replacing diesel with solar power

Diesel for pumping has become a crippling input cost for many irrigators and is motivating uptake of solar solutions wherever a sound business case can be established.

Sunshine is free

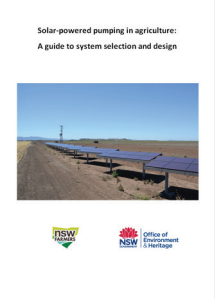
Solar panels can perform efficiently for several decades. Payback periods may be as short as five years.

Is solar right for your irrigation system?

Solar has potential to reduce your irrigation energy bill if any of the following apply:

- You pump many months of the year and mostly during the day
- Do not necessarily need to be grid connected
- You can use solar to load shift and lower network charges
- You have substantial and efficient water storage
- You can join a community solar project, sharing costs and power

Want to find out more?



NSW Farmers has produced a comprehensive guide to solar PV pumping systems in Australian agriculture.

Follow this link to order or download the guide: **aginnovators.org.au/initiatives/energy/information-papers/solar-pv-pumping-systems**

Check out the resources below and start researching suppliers

aginnovators.org.au

The web portal, **aginnovators.org.au** contains extensive information relevant to farm energy, including solar PV. See: **aginnovators.org.au/initiatives/energy**

Water and energy
http://goo.gl/mVZ2bq

Solar photovoltaic energy on farm
http://goo.gl/B5yU7c

DPI pumping factsheets

How efficient is your pump?
http://goo.gl/lQcTIF

Is your diesel pump costing you money?
http://goo.gl/nMMYPo

How much does it cost to pump?
http://goo.gl/LJVl0P

OEH Resources

Solar Energy
environment.nsw.gov.au/households/solar-energy.htm

Finance guide
environment.nsw.gov.au/business/project-financing.htm

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