

On-farm clean energy technologies

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Deploying clean energy solutions on-farm may lower a farmer's energy costs and emissions and reduce their exposure to energy price increases. These solutions may increase energy security by reducing reliance on the electricity grid or fuel deliveries which may be subject to supply interruptions. Farm productivity may be improved by avoiding losses caused by energy supply interruptions and tasks such as refuelling diesel tanks.

There are a variety of clean energy technologies appropriate for on-farm use that are currently in use in Australia. There are also some technologies, such as green hydrogen and advanced biofuels, that are in development.

Clean energy technologies

Clean energy technologies currently in use on farms include:

- Solar
- Wind
- Bioenergy
- Energy storage

Solar

Energy created by the heat and light of the sun is called solar energy.

Solar photovoltaics are one of the clean energy technologies most commonly used in Australia. Solar photovoltaics, or PV, involve the collection of solar radiation from the sun. Anytime the sun is shining on a solar PV system, it is generating energy. The fuel, sunlight, is free; you don't have to rely on fuel deliveries and you're not exposed to fuel price fluctuations.

Figure 1: Solar voltaic panels on a dairy shed roof



However, PV systems generate less power on cloudy and rainy days and no power at night. PV can be paired with batteries or other energy storage technologies to deal with the intermittency of solar power generation.

Another type of solar technology is **solar thermal** which involves converting sunlight into heat. An example of a common solar thermal technology is a solar hot water system.

Wind

Wind is a form of solar energy caused by a combination of three concurrent events:

1. The sun unevenly heating the atmosphere
2. Irregularities of the earth's surface
3. The rotation of the earth.

Wind generates energy by turning the blades of a wind turbine, which turns a generator that creates power. Wind power, like solar energy, is an intermittent form of renewable energy that can be "firmed" with energy storage technologies.

Wind maps are available from the Bureau of Meteorology:

bom.gov.au/jsp/ncc/climate_averages/wind-velocity/index.jsp

Figure 2: Wind turbine



Bioenergy

Bioenergy is a form of renewable energy that is generated from the conversion of solid and liquid biomass to create electricity, heat, gas, liquid fuels and bio-based products. Biomass is organic material available on a renewable basis, such as wood, agricultural products and waste from local councils and industrial sources.

Biomass feedstock is converted to bioenergy using different types of conversion technologies such as anaerobic digestion, combustion, pyrolysis and gasification.

Figure 3: Blantyre Farms biodigester dam for collecting methane which is converted into electricity



Image courtesy of NSW Farmers

Energy storage

Energy can be stored in many forms, for example, as chemical, thermal or potential energy, for use at a later time. Energy storage can be combined with intermittent renewable generation like wind and solar to deliver continuous power.

Common types of storage include:

Batteries use chemicals to absorb and release energy on demand. Lithium-ion is the most common battery chemistry used to store electricity. The cost of batteries is relatively high, despite steep cost

reductions in recent years. The introduction of new chemistries, new manufacturing techniques and simplified pack designs will keep prices falling.

Figure 4: Battery storage



Thermal storage involves storing thermal energy for use in the future, such as storing chilled water in a tank for future cooling requirements.

Pumped hydro uses water reservoirs as a way of storing energy. Excess energy can be used during low demand periods to pump water from a lower dam to a higher one. The stored energy can be released by returning the water through a hydroelectric turbine into the lower reservoir. It is a relatively cheap form of storage but is not viable in some areas due to the topographic requirement.

Green hydrogen

Water can be split into hydrogen and oxygen molecules by passing an electrical current through the water in a process called electrolysis. To be classified as green hydrogen, the process must use electricity generated from a renewable source such as solar or wind.

Hydrogen can be fed into a fuel cell to make electricity or burnt to produce heat.

Applications for hydrogen include: power generation, transport, industrial feedstocks and heating.

Figure 5: Hydrogen fuel cell tractor



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