On farm power generation

Vegetable growers

Australian vegetable growers are major consumers of electricity, with on farm irrigation, heating and cooling processes, processing and packing plants creating significant power demands. Electricity retail prices have increased on average by more than 60% in real terms over the five years to 2012–13, and are likely to continue. However, falling installation costs of some renewables, and incentive schemes, have created opportunities for growers to reduce energy costs and meet sustainability goals by adopting on farm power generation.

Research into on farm power generation has produced details of the options, and explored feasibility of adoption of such systems. Growers can use this to help them make informed decisions about the economic, technical and operational costs and benefits of the various technologies, the challenges of installation and operation, and the suitability of systems to individual ventures.

Technologies studied were well established and in use. They included:

- Devices which generate electrical power only:
  - solar photovoltaics (PV)
  - wind power
  - natural gas generation
  - Liquefied Petroleum Gas (LPG) power
  - woody biomass power generation
  - micro-hydro power generation
- Proven solar alternatives:
  - concentrating solar thermal
  - concentrating solar PV
- Storage technologies that support intermittent power generation options:
  - lead-acid batteries
  - micro-hydro as pumped energy storage
  - chilled water/ice storage

Key factors for growers looking to adopt on farm power generation include:

- The cost of electricity from the grid
- Financial performance of power generation technologies relative to network supplied electricity
- Economic incentives, such as subsidies and feed-in tariffs
- Availability, quality and affordability of energy resources or fuel
- Ease of obtaining approvals and meeting regulatory requirements for power generation
- Desire to make farming operations more sustainable, which can also have marketing benefits
- Diversification of energy sources and potentially income as a risk management measure

Some of these factors will be site specific; some specific to the operations of a particular grower. Some drivers apply across Australia: economic incentives, availability and affordability of energy resources, and ease of obtaining approvals.

Challenges facing on farm deployment were examined:

- Uncertain financial viability of renewable power generation if incentives are reduced or removed
- Uncertain regulatory environment for distributed intermittent power generation
- Unavailability of networked natural gas at the farm gate
- Implementation challenges and barriers

Individual fact sheets examine the most promising technologies—solar photovoltaics (PV), wind power, natural gas generation, and Liquefied Petroleum Gas (LPG) generation in more detail:

- Description of the technology, its level of maturity and deployment

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- Key strengths, positives
- Drawbacks and limitations
- Case studies

The detailed report provides accurate estimates of costs and returns of generating electricity on farm. Detailed case studies examine how the options could be implemented over a range of locations and crops. The feasibility of such schemes is assessed by not only examining the economics, but also the regulatory requirements, incentives and impediments, illustrating the approximate investment required and likely reductions in power costs. No reliance or actions should be made based solely on the information contained in any of these materials without site and company specific investigations.

SUMMARY OF FINDINGS FROM THE MAIN REPORT

1. Solar photovoltaics (PV)

Solar PV should be economically viable for most vegetable growers, including those in less sunny regions, provided the current Small-Scale Technology Certificate (STC) government subsidies paid under the Renewable Energy Target (RET) remain. For example, a solar PV plant with a total establishment cost of $2500 per kW of capacity can be viable at a 10% Internal Rate of Return (IRR) with a 5–7 year payback period if electricity costs more than **12–15 c/kWh**.

A key consideration in this analysis is that 90% of the electricity produced can be consumed on site.

Should the RET be repealed, this same solar PV plant then requires the current cost of electricity to be more than **19–22 c/kWh** to be viable, which could be the case for some growers. Thus, solar PV may remain financially viable for some growers even if the RET is repealed.

2. Battery storage

Battery storage is not currently viable. It costs about $800 per kWh to set up, and required a current electricity price of more than 35 c/kWh before it would be economically viable. Further, given the significant uncertainty in the full cost of battery storage systems, the researchers cannot recommend the installation of battery storage at present.

3. Simple and cogeneration using reciprocating engine generator

The study considered three types of on-site power generation using reciprocating engines:

- Simple generation (ie electricity only)
- Cogeneration of electricity and process heat
- Cogeneration of electricity and process cooling

The key issue for viability is the cost of gas. The analysis found that simple or cogeneration requires fuel prices that can compete with the amount paid for electricity. Additional heating or cooling from cogeneration can provide another potential benefit. The capital cost and payback periods are less important than the cost of fuel, which dominates the financial performance.

Only network delivered natural gas is priced to reasonably compete with most current electricity prices. For example, a gas-fuelled generator with a capacity factor of 50% or more should be viable when the price being paid for electricity is more than **10c/kWh**, provided that it consumes fuel with a price of **10 $/GJ** or less.

With LPG not viable, on-site engine generation will not be viable for growers who do not have access to network delivered natural gas.

4. Wind turbines

This analysis focused on 50–500 kW capacity second hand wind turbines. Despite uncertainty about the total capital required to install a second hand wind turbine, it appears that they will be viable in many cases because they cost significantly less than new plant.

Wind is viable if the cost of electricity is more than about 10c/kWh and most of the electricity generated can be used on site. This analysis is based on:

- using second hand wind turbines with total capital expenditure of 1750 $/kW
- current subsidies (LGCs) are retained
- the turbine operates at 20% of capacity or higher
- a 10% internal rate of return is acceptable
- 100% debt financed at 6.5% pa interest over 10 years

If the Renewable Energy Target (RET) is repealed, this will have a weaker impact on the financial viability of wind than it does for solar PV. The breakeven point for viability would rise to at least 12c/kWh if LGCs (Large scale Generation Certificates) are removed. Because wind is intermittent, growers need to have an electrical load pattern that ensures most of the electricity generated can be consumed on site.

5. Woody biomass

On-site power generation using woody biomass was not analysed since it does not appear to be a significant resource for the large majority of growers, and because the performance of electricity generating plant that consumes this fuel is poor at the scale of individual growers. The most common method of generating electricity from woody biomass involves its direct combustion to drive a steam turbine. At around 100 kW and below, these steam

plants tend to have significantly lower thermal efficiencies than, for example, the reciprocating engines discussed above. Thus, unless the fuel has a very low price and is readily available—which is not the case for most growers—power generation from woody biomass is likely to be unviable.

REGULATORY INCENTIVES AND GOVERNMENT SUBSIDIES

The schemes currently in place include the Renewable Energy Target (RET) and feed-in tariffs. The RET can provide growers with financial incentives for installing eligible renewable energy power plant via creation and sales of renewable energy certificates either upfront (STCs for smaller systems) or annually (LGCs for larger systems). STCs are likely to be required for the viable installation of solar PV for many growers. Changes to the RET recommended recently by the RET Review could significantly impact the viability of on farm power generation options.

Feed-in tariffs vary by jurisdiction. With the exception of the Northern Territory and some parts of Western Australia, mandatory minimum feed-in tariffs have been significantly reduced from previously high levels, or scrapped altogether. The remaining mandated and voluntary feed-in tariffs offered by retailers are typically 5–8c/kWh for net export from small to medium scale systems. Since feed-in tariffs are often significantly below growers' electricity tariffs, consuming most of the power generated on site is much more important to a system's economic viability than generating income from feed-in tariffs.

Regulatory requirements to install and operate on farm power generation can be complex, onerous, time-consuming and costly. These requirements differ by type of generation as well as by location.

There are three key types of requirements relevant for on farm power generation installations:

1. Grid connection and technical requirements

Installation and grid connection for embedded generation plant needs to be approved by the distribution network service provider (DNSP), who will certify the technical performance of the plant. For medium and larger scale installations, the DNSP will conduct a network connection study to identify technical issues and any constraints on grid connection. Requirements for small scale generation (below 5–10kW) are typically more streamlined, particularly for rooftop solar PV installations. It is important to discuss feasibility of a proposed system as early as possible with the DNSP.

2. Planning and development approval

Growers need to contact their local government or council about planning and development requirements for technologies on their site. Planning and/or building permits may be required before construction and installation can commence, even for solar PV installations in some locations.

Typically, planning and development approvals are required for wind power and some stationary power plant. Preparing documents and supporting evidence is often time-consuming. Requirements differ between councils so there is no one set of guidelines to follow, adding significant cost and uncertainty to obtaining approvals. Environmental objections to the installation of turbines can be a major disincentive to investment in on farm wind generation.

3. Engine fuels and emissions standards

Where an engine is fuelled by natural gas, LPG, biogas, petrol or diesel:

- standards governing the fuel and the appliance,
- regulations regarding atmospheric and noise emissions, and
- OH&S standards for workplaces and hazardous areas must all be met.

The associated processes are administered by different state environmental and OH&S agencies.