Hydro energy on your farm

Water – a trusted resource

Hydroelectricity has been the backbone of our electricity supply for decades, and hydro dams are a well-known feature of the New Zealand landscape. More than 50% of New Zealand's electricity comes from hydro generation, much of it through large dams such as Benmore, Manapouri, and Clyde.

Hydro technology is tried and tested, and is amongst the cheapest ways of generating electricity. There is a lot of potential for small-scale hydro schemes (typically less than 10MW) in New Zealand – these can generate electricity from streams, rivers, or irrigation systems. In some cases it may be possible to bring existing decommissioned or abandoned hydro infrastracture back into service.

Hydro-electric schemes on farms

Small-scale hydro schemes can generate electricity for use on the farm, business and home, and in some cases can also export electricity back into the local network. Farms and businesses which export may be able to sell the electricity to a power retailer, or into the wholesale market.

Small-scale hydro systems don't usually require water storage in the form of a dam or weir. Instead, a portion of a stream or river is temporarily diverted into a pipe system and to the hydro turbine and generator. The water is then returned to its source, which means these types of systems have far less impact on the environment than large-scale schemes.

Small-scale hydro schemes have less environmental impact than larger schemes. Photo courtesy Glenkit Nelson Ltd.

Hydro generation from irrigation

Hydro generation doesn't have to be on streams and rivers – it is also possible to harness the water used for irrigation. In Canterbury and Otago around 200 GWh per year of electricity is already generated every year from combined hydro and irrigation schemes – enough electricity for around 25,000 average New Zealand homes. Even on a smaller scale, generating electricity from irrigation schemes can be particularly useful during winter when water is abundant, irrigation is not needed, and demand for electricity is high.

As the use of irrigation grows and there is a drive for improved returns, many New Zealand farms may be able to access water through their local irrigation network to generate electricity before using the water for irrigation. There may be opportunities to harness the energy available in irrigation races by utilising the fall or 'head' – for example, turbines may be able to be placed where drop structures currently reduce water velocity, or by converting open races into pressurised pipe systems.

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Hydro-powered irrigation: Carew, Mid-Canterbury

Crosstech Engineering has installed many turbines in the Canterbury region, both to power irrigation pumps directly and also to generate electricity. Where there is suitable 'head' and flow for the turbine to operate, Crosstech has been able to eliminate the energy costs associated with spray irrigation pumping.

On a farm near Carew, in mid-Canterbury, Crosstech installed a turbine with a mechanical output of 52kW to drive the irrigation pump directly and an electrical output of 7kW. The electricity is used to power the nearby centre pivot irrigator. The scheme utilises a head of 4.5m which is gained by bypassing three drops on the mainrace of the irrigation scheme. The energy generated by this system offsets the power used by the irrigation, but is not sufficient for export.

Crosstech director Graeme Martin says farmers who use spray irrigation powered by electric motors, would typically spend around $150 per ha annually on power. Installing a hydro turbine system to drive the irrigation instead, can save between $20,000 and $30,000 a year in energy costs.

"We can be pretty sure that the price of electricity is only going to increase in future – so the actual savings increase year on year. Farmers who take this opportunity to power their irrigation, simply remove this overhead," he says.

Hydro-powered irrigation in operation in Canterbury. Photo courtesy Crosstech Engineering.

Using abandoned or decommissioned hydro infrastructure may be a cost-effective basis for a hydro scheme.

New power from old: Blackball Creek

In some cases it may be possible to use existing decommissioned or abandoned hydro infrastructure – saving much of the capital cost of installation.

An historic gold mining site on Blackball Creek, east of Greymouth, is the focus of an investigation into hydro-electric generation.

Engineers Keane Associates carried out a feasibility study into re-using an existing water race for generation, and concluded that a scheme at the site was viable. At a capacity of around 1.5 MW, a hydro scheme utilising the Blackball Creek water race could generate 600 MWh every year – enough electricity to meet the needs of 800 average New Zealand homes. An initial examination by Westpower has found no difficulty connecting the proposed hydro scheme to the local network.

The project was spearheaded by the Blackball Residents Association Trust. It is envisaged that re-using the historic goldmining site for power generation could also help promote the area's heritage, with visitors able to use adjacent walking tracks.

The trust has agreed to progress the scheme, and will develop a business case to help secure investment.

Assessing your farm for hydro energy

The technical issues – can it work?

- **The water resource.** There are two factors to consider in assessing the generating capacity of a waterway. The first is the quantity of running water (flow rate), measured in cubic metres per second. The second is the difference in vertical height (head) in metres between the intake pipe and the turbine. Usually you will need professional advice to work out whether your waterway could support a hydro scheme.
- **The electrical connection to your property and its maximum import/export capacity.** If your system is going to be connected to the electricity network, you should talk to your local lines company early on. Generally systems that meet the safety and technical requirements of the local network company are able to connect to the network to export electricity. There will likely be a charge for the connection. For larger hydro systems it will be important to work out whether any additional investment is needed to upgrade or extend the electricity lines or transformers – and how this affects the economics of the project.
- **The track record of the company that is supplying, installing and maintaining your turbine(s).** Look at what skills the staff have and their understanding of the factors that go into making a hydro system economically viable. What monitoring and maintenance will the supplier offer? You also need to assess the track record of the turbine manufacturer, including how their turbines have performed to date, and what guarantees and warranty support they offer.
- **Consents that may be required.** You will need to talk to your regional and local councils to understand the consenting requirements. Depending on where your site is, your local council may impose restrictions associated with the flow of water and the impact on aquatic life.

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Cost and benefits – do the numbers add up?

- **Assessing your power needs.** To determine what sort of system would suit you, first understand your power demand. Talk to your electricity retailer and review your power bills. As a first step, try to reduce your consumption through energy efficiency. Review what your electricity cost is now and also how this may change in the future.
- **The installed price of a turbine system and ongoing maintenance costs.** These can vary depending upon a number of factors, including what type of turbine you install, how far away the site is from the network connection and access for maintenance.
- **What price you will be paid for exported electricity and what limits there may be on the amount that can be exported.** It is important to remember that generating electricity for your own use is quite different to generating electricity for financial gain. With the former you are offsetting your own consumption so the value of the electricity is the price you pay for it. Generating electricity for profit means competing on the wholesale market where prices are significantly lower as they don't include the costs of transmission or administration. (Be aware that any electricity you generate will usually be considered taxable. You should clarify your potential tax liability and include this in your calculations. Also consider how your business treats depreciation of capital assets.)

Ideally, a suitable site for hydro generation needs:

- adequate water flow and 'head' – the vertical drop in the stream
- reasonable access to the site
- power lines close by
- no difficult resource consent issues.

I'm interested, what do I do next?

If you are interested in generating electricity from hydro on your farm check out the following links:

- The Sustainable Electricity Association of New Zealand (SEANZ) includes a list of companies that may be able to assist you investigate the potential of generating electricity on your farm – **www.seanz.org.nz**
- EECA's websites – **www.eeca.govt.nz** and **www.energywise.govt.nz** provide a wide range of advice on energy efficiency and renewable energy
- The Ministry of Agriculture and Forestry has more information on farming practices and the Sustainable Farming Fund at **www.maf.govt.nz**

EECA enables organisations to increase their domestic and international competitiveness by adopting energy efficiency and renewable energy practices.

We work with businesses to identify the opportunities for energy management that are available to them and help them develop energy management action plans to make the most of these opportunities.

Good energy management has many benefits for businesses, including lower costs, increased productivity, reduced greenhouse gas emissions and a positive effect on the brand.

We have a particular interest in:

- encouraging new or under-used technology that can make processes more efficient
- projects that reduce greenhouse gas emissions, and
- developing the wood fuel industry.

For more information contact The Energy Efficiency and Conservation Authority:

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