Dr H20 on Irrigation

Small Scale Hydro – Looking at water in a slightly different way

The events of earlier this month have once again reminded many in Rural Canterbury of our exposure to power cuts and the potential hassle or hardship that occurs as a result. Sure we can all buy generators to cover our selves during periods of power disruption, but if a suitable water supply is available, hydro allows you to reduce your own energy cost and potential return and income for any additional power generation, as excess can be feed back into the national grid for which payment can be received. If conditions allow, a very high return on investment can be achieved and in many cases the scheme can have dual application as the infrastructure is used to provide water for irrigation when required as well. Currently I am working with farmers looking at developing schemes from 25kW up to about 700kW in size, so there are a wide range of opportunities out. Not all schemes are generation focused, but irrigation is the primary objective, although for many the synergy between the two applications that make them stack up financially.

How much power can I generate?

Essentially your generation potential is proportional of flow and pressure. Flow is obviously the amount of water you can take from the stream for generation purposes and this may well vary during the year as you may need to maintain low flows in the stream. Pressure is the head available which is the difference in height between the intake and the generator less friction loss in the pipe (penstock) linking the two points. Using the simple formula below a first estimate can be made. Generator efficiency varies considerably depending on generator type, flow and head, but for quick calculation at home I would suggest using 0.65 which is common for many smaller schemes.

$P_h = (q\ g\ h\ /\ 1000)*E_g$

Where:

P_h = Power (kW)
q = Flow (l/s)
g = Acceleration due to gravity (9.81 m/s^2)
h = Residual Head (m)
E_g = Generator Efficiency

So as an example if we have a residual head after pipe and other losses of 75m (take the height difference between your potential intake and generator site and multiply by .9 as a first estimate) and 80 l/s available you would have a potential generation capacity of 44 kW. Alternatively if you had only 40 l/s but doubled the available head to 150m you would still have 44kW. The only issue is the higher the head the higher pressure rating the pipes need to be which can increase the scheme cost significantly.

There are Advantages and Disadvantages that must be considered

Small-scale micro hydro power is both an efficient and reliable form of energy. However, there are certain disadvantages that should be considered before constructing a small hydro power system. It is crucial to have a grasp of the potential energy benefits as well as the limitations of hydro technology. There are some common misconceptions about micro/mini-hydro power that need to be addressed. With the right research and skills, micro hydro can be an excellent method of harnessing renewable energy from small to medium streams.

Small Scale Hydro – Advantages

Reliable electricity source - Hydro produces a continuous supply of electrical energy in comparison to other small-scale renewable technologies (ie wind and solar). Typically the peak energy season is during the winter months when large quantities of electricity are required.

No reservoir required – Small scale hydro is considered to function as a 'run-of-river' system, meaning that the water passing through the generator is directed back into the stream with relatively little impact on the surrounding environment.

Cost effective energy solution - Building a small-scale hydro-power system can be built very cost effectively. Maintenance fees are relatively small in comparison to other technologies.

Integrate with the local power grid - If your site produces a large amount of excess energy, some power companies will buy back your electricity overflow. You also have the ability to supplement your level of hydro power with intake from the power grid.

Small Scale Hydro – Disadvantages

Suitable site characteristics required - In order to take full advantage of the electrical potential of small streams, a suitable site is needed. Factors to consider are: distance from the power source to the location where energy is required, stream size (including flow rate and potential head), pipe line and a balance of system components depending if you are off grid i.e. inverter, batteries, controller, or grid tie eg transmission line and transformers.

Energy expansion not possible - The size and flow of small streams may restrict future site expansion as the power demand increases.

Reduced-power in the summer months – For most locations in the South Island the stream size will fluctuate seasonally. During the summer months there will likely be less flow and therefore less power output. Water is often required for irrigation as well and the ability to reduce power consumption on farm during the irrigation season where demand will tend to peak is reduced.

Environmental impacts - The ecological impact of small-scale hydro can be minimal as long as the amount of water taken is managed; however the low-level environmental effects must be taken into consideration before construction begins and this will have to be dealt with when obtaining the resource consent for the installation and operation of the scheme. While water is

returned to the stream some distance down from the intake, if irrigation is to be included the consenting process will obviously be more involved and the consent potentially harder to obtain.

The above is a very brief introduction to a concept that is attracting considerable attention in the South Island at present. In coming months we will revisit the topic on occasion and look more deeply at some of the considerations, Physical, Environmental and Financial around this type of development.

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