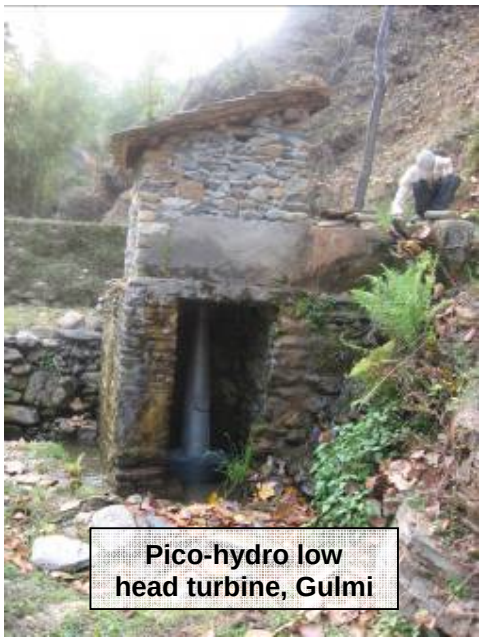
Low Head Pico-Hydro Promotion Project, Nepal

Opportunity


Pico-hydro low head turbine, Gulmi

Hydropower technology has been applied throughout Nepal to supply electricity to thousands of rural households, with all the social and economic benefits that electricity can bring. For a small community, peltic sets are available in the pico-hydro range – between 0.1 to 5 kW. As compact fluorescent light (CFL) technology has become cheaper and more affordable for villagers, a smaller amount of power generated can go a lot further in terms of lighting more households. 1kW of power can provide over 100 CFL bulbs (9W) for a community. Thus the benefits of pico-hydro technology can be very applicable to smaller villages that could previously not afford a larger hydropower project.

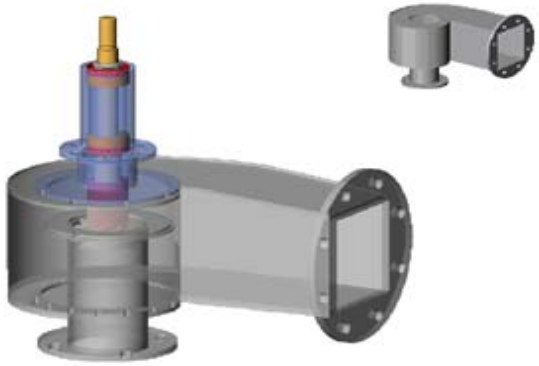
In most cases, these pico-hydro projects use a small volume of flow falling through a substantial height, usually more than 40m, to generate enough power for a small village. Unfortunately, many smaller villages **do not** have suitable sites for peltric-set type pico-hydro units. However, many villages **do** have existing irrigation canals that abstract reasonable quantities of water from nearby rivers to be supplied to their fields. Also, many hill communities use traditional water mills, known as ghattas in Nepali, to grind rice and corn. These canals and water mills often pass near homes and can provide a small head to a pico-hydro plant. For this type of situation, propeller or crossflow type turbines that run on low head but using larger water volume can be applicable. These technologies would not compete with the irrigation channels and water mill sites, as the irrigation canals and water mills could be used during the day and the pico-hydro at night.

So far the propeller type pico-hydro unit is un-common and under-utilised technology in Nepal.

There are estimated to be over 25,000 water mill sites across Nepal it is thought that at least 20% of these could be possible sites for low-head Pico-hydro units.

Pico-Hydro Hardware

Nepal Hydro Electric (P) Ltd (NHE), in collaboration with Kathmandu University and Butwal Technical Institute (BTI), have developed over a period of several years a robust propeller turbine, with generator and electronic load controller (ELC) which forms a complete pico-hydro package.



NHE has recently developed the volute cased propeller turbine – which has improved efficiencies to over 73% from the 55% to 60% efficiencies recorded for the open flume designed propeller turbines. A typical 1.2kW propeller turbine requires a flow of 85 litres/s and a height drop of 3.3 metres.

Schematic diagram of the Nepal Hydro Electric Propeller Turbine

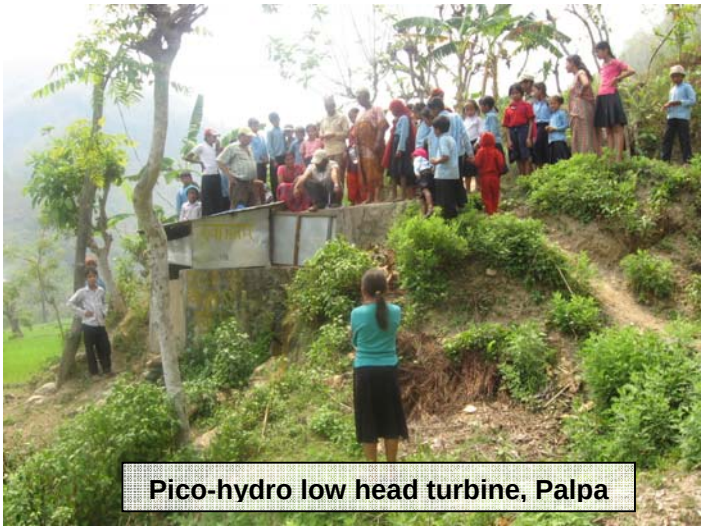
Kathmandu Metal Industry has developed a 'Crosstric' Set – a pico sized version of the crossflow turbine. This comes as an impulse turbine and induction generator set and can produce 100W to 5kW power. The crosstric sets require between 5 to 20m head and a flow range of 5 to 50 litres/s.

Cheap low head pico-hydro units have been used extensively in China and Vietnam. The problem with these units are that they are not robust nor efficient. The units developed by NHE have been shown to be robust, reliable, efficient and affordable in operational testing.

Operation and maintenance of these pico-turbines and controllers is designed to be as simple as possible. For the NHE propeller turbine sets, starting the system requires only that the operator open the supply of water to the turbine and press a single switch. The ELC controller has been newly developed at Kathmandu University and maintains voltage and frequency automatically whilst fully protecting all systems from short circuit or overload. Maintenance of the mechanical components is minimal with the current design containing only maintenance free bearings.

Operational Testing

Butwal Technical Institute undertook a trial implementation and monitoring project for the NHE propeller turbines from 2001 to 2005. It found that costs per household ranges from 3,400 to 4,000 NRs per household, (US$45 to 60) assuming the available 65,000 NRs/kW AEPC subsidy. These prices included costs for all household fittings and CFL bulbs. In addition to this, a minimal monthly cost of 1.25 NR/W every month would be levied to cover maintenance and operator costs. For a typical household using 4 CFL bulbs (9W) this would cost 45 NRs per month, for unlimited use.



Pico-hydro low head turbine, Palpa

This initial cost is very similar to the costs to connect to the NEA grid system (if it is available). However, once connected to the grid, households have to pay 80 NRs per month for the minimum tariff subscription – equivalent to 110W usage for 6 hours a day.

Two Pico-hydro low head turbines in series, Bhanbhane

Hence, the costs for installing a pico-hydro system can be seen as good value and affordable for rural Nepal.

Operators only required minimal training at three sites for an operational period of one year. Lessons learned from these sites led to a number of modifications which are now incorporated into the current design.

In 2006/7 a further six sites with capacities between 200W and 1kW have been implemented in Gulmi district by a local entrepreneur, using systems purchased from NHE. These systems have also been installed in the High Himal region in Nepal – 1 in the far-western district of Humla and 3 in Tibet.

What is Needed Now

PEEDA has identified the low-head turbine pico-hydro units developed by NHE and KMI as having a significant potential for application all over the hill and Tarai region of Nepal. It has carried out a preliminary study, funded by Stiftelsen Hjelp til Selvhjelp for Nepal (of Norway), to examine the current situation. This included the level of interest amongst potential end-users and other relevant stakeholders in the value chain (i.e. manufacturers, installers and other service providers) for the promotion, marketing and installation of low-head type pico-hydro units in selected areas of Nepal. The preliminary study concluded that the technology was a viable alternative to the high head peltric-sets or to the solar home systems, and that the low head technology would work well throughout Nepal.

The technology has been developed in a thorough way and has been tested so that teething problems have been sorted out. At this point what is needed is for the technology to be distributed widely across Nepal. For this to happen, several tasks need to take place simultaneously:

- **Marketing** – Rural communities in Nepal need to be made aware of low head technology through social mobilisation, regional demonstration sites and other methods.
- **Training and Capacity Building** – Installers need to have the capacity and know-how to install the units. This includes understanding what to survey for a site, mobilising the villagers, being fully conversant with the subsidy application process and familiar with civil, mechanical and electrical systems that are part of the scheme.
- **Incentives and Commercialisation** – Manufacturers need to be incentivised to manufacture the products through having sufficient orders to be able to cost effectively manufacture the products – for example, in a batch process.
- **Sensitisation** – The Alternative Energy Promotion Centre (AEPC) through its Mini-Grid Support Programme (MGSP) needs to be sensitized into dealing with subsidy application from these pico size hydropower projects.
- **Organisational Structure and Marketing** – The right institution with the relevant experience and expertise to take forward this technology for its long-term growth, sustainability and success needs to be set-up – for example, a not-for-profit company.
- **Attractive and Integrated Packages** – In accordance with the above, suppliers need to develop customised packages which are attractive to different types of end-users/ stakeholders in the value chain.
- **Further research** – Further research is required to ensure that this pico-technology can be used well in the future. This includes synchronising multiple pico units, distribution systems, storage for load peaks and low power matching equipment such as white LED lighting or low power labour saving machines.

Currently PEEDA is scoping and designing the promotion phase of the project. At this stage we are looking for partner organisations who can work together in expanding this technology use in Nepal, including the financing of future phases.


Pico-hydro low head turbine, Palpa

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