Technology Fact Sheet for Adaptation

I. Micro/mini hydro power [i]

Introduction

Hydropower projects below 25 MW are categorized as small hydro projects which are further classified as micro/pico (with capacities up to 100 kW), mini (capacity 101 kW- 2 MW) and small (capacity 2 MW- 25 MW).

Technology characteristics

A small hydro project (SHP) generates electricity of up to 25 MW from the energy of moving water which is used to run a turbine. The mechanical energy from the movement of the turbine is then converted to electrical energy using magnetic fields. Water flowing through a stream enters the forebay through a canal or an intake ditch where intake screens remove debris from the water. After this, the water flows through the penstock to the turbine and the generator unit, where electricity is generated. The electricity is then transmitted to the point of use via the transmission system.

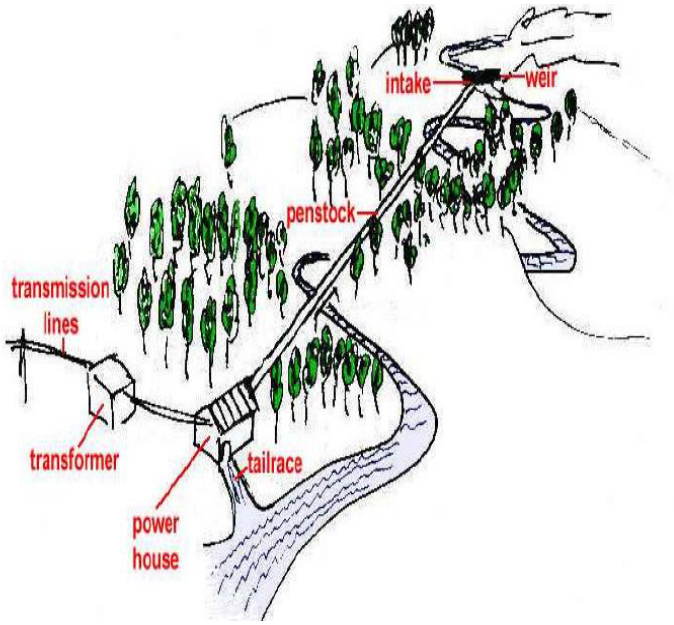

Figure 1: A typical micro hydro power system

Source: Centre for Rural Technology, Nepal (CRT/N), 2005

Country specific applicability and potential

Bhutan has great potential to meet its energy requirements by generating power through micro/mini hydro projects. Several provisions of various national policies address the development of incentivize such projects. For instance, the Electricity Act 2001 aims to promote small projects by exempting license requirement for projects with capacities less than 500 kW. Further, the development of micro-hydels (among other renewable energy) and institutional strengthening and capacity building is a priority activity under the renewable energy programme of the Tenth Five Year Plan.

Status of technology in country

Hydroelectricity contributes 98.8% of the total installed electricity capacity in Bhutan. This is only 6% of the total estimated exploitable hydro-electric potential of Bhutan. The country has 27 hydro-power projects, 12 of which are mini and 10 are micro hydro projects. Together these mini/micro hydro projects have a capacity of 8.068 MW[1].

Also, most of the projects in the country have been developed on an ad-hoc basis based on the availability of external donor funding. The various donors in the micro hydro sector and the Royal Government of Bhutan have different objectives and different approaches to micro hydro development[2], leading to differences in the way the micro-hydro power projects are constructed and later executed. For instance, the Ura 50 kW micro hydro project is managed and maintained by the Bhutan Power Corporation. On the other hand, the Chendebji 70 kW micro hydropower project is owned by the Department of Energy. The department also provides technical back-stopping, and subsidies for procurement of major spare parts and equipment. However, the operation and maintenance of the project is completely handled by the local community[3]. To summarize, the technology is known and applied in the country although at a very low scale.

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[1] South Asia Regional Initiative for Energy and USAID, 2011, available at http://www.sari-energy.org/PageFiles/Countries/Bhutan_Energy_detail.asp, accessed on 4 May 2012.

[2] Dorji KM, 2007, The Sustainable Management of Micro Hydropower Systems for Rural Electrification: The Case of Bhutan.

[3] Dorji KM, 2007, The Sustainable Management of Micro Hydropower Systems for Rural Electrification: The Case of Bhutan.

Benefits to economic/ social and environmental development

Small hydropower is one of the matured renewable energy technologies which provide inflation free energy due to absence of fuel cost. Micro/mini hydro can provide clean electricity to rural communities which otherwise might take years to be served. The possible target sites for small hydro plants are the isolated areas (usually at a higher level), which are not connected to the grid. The target beneficiaries are the rural people residing at a considerable distance away from transmission line and distribution networks.

Also, micro hydro plants are comparatively easy to manufacture and install indigenously, thus boosting local employment, economic activity and the industrial base. Small scale hydro power plants can be locally managed, operated and require much lower trained with training input to the local people.

In addition to itself being a clean source of energy, micro/mini hydro power supplied to previously unelectrified areas helps in reduction of kerosene and firewood, thereby reducing greenhouse gas emissions. Further, reduction of use of firewood improves quality of health. Power used by micro-enterprises and cottage industries increases income. Energy supplied for agricultural and supporting activities increases productivity and reduces wastage of crop.

Supply of clean and reliable energy by utilization of local water resources provides a huge impetus for overall development of the village community and empowerment of its people.

Climate change adaptation benefits

Micro/mini hydropower projects can play a critical role in allowing adaptation to climate change in Bhutan by diversifying the nation's energy sources and thereby reducing the dependence on large hydro, which is likely to be affected by various climate change events such as GLOF, reduction in the average flow of snow fed rivers, combined with an increase in peak flows and sediment yield. On the other hand, micro/mini hydro power is less vulnerable to such events since its water source is from aquifers and streams and not from glaciers.

Bhutan energy requirements are met primarily from large hydro power projects. Impacts of climate change in terms of temporal and spatial variation in flow of water (having glaciers as source of origin) is most likely to affect electricity productivity/exports in Bhutan due to disruption of average flows for optimum hydropower generation from large hydro power projects.

Thus, hydropower generation is vulnerable to impacts of climate change. This also leads to vulnerability of the entire energy sector which is primarily dependent on water resources originating from glaciers. To address this vulnerability, diversification of energy sources is an important strategy. If certain areas' demand for electricity can be met through micro/mini hydro power, it will reduce the reliance on large hydro power.

Financial Requirements and Costs

The cost of micro/mini hydro power projects can vary between USD 1500 to over USD 2000[4] per kW. Examples from India show that a 40 kW project has been built at a cost of USD 60000 with active participation from the local community. Further, a 150 kW project has also been built at the cost of USD 180,000, bringing down the per kW cost to USD 1200.

[i] **This fact sheet has been extracted from TNA Report – Technology Needs Assessment and Technology Action Plans for Climate Change Adaptation – Bhutan. You can access the complete report from the TNA project website http://tech-action.org/**

[4] Assuming USD 1 = INR 50.