

Techno-economics of micro-hydro projects for decentralized power supply in India

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Abstract

Results of a techno-economic feasibility evaluation of few micro-hydropower (MHP) projects being planned and implemented for decentralized power supply for remote locations in India are presented. The capital cost of such projects (including cost of power evacuation and distribution system), cost per unit of rated capacity, and relative cost of different sub-systems of MHP projects in the capacity range of 10–100 kW have been analysed. Unit cost of delivered electricity for these MHP projects has been estimated. Measures of financial performance for one of the MHP projects have also been determined. Breakeven values for useful life, plant load factor, and unit cost of electricity to the user have also been estimated for the same project.

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1. Introduction

The all India installed capacity of electric power generating stations under utilities was 107,533.7 MW as on 31.1.2003 of which contributions of hydro, thermal, nuclear and wind sectors were 26,660.23, 76,525.11, 2720 and 1628.36 MW, respectively (MOP, 2003a). Though the total hydropotential in the country is estimated at 150,000 MW, only about 17.8% of it has been exploited so far which contributes about 24.8% to the total power generating installed capacity (MOP, 2003b). About 5.48% of total hydropower generating capacity is contributed by 453 small hydropower (SHP) projects installed in the country as on 31.12.2002. These projects contribute 1463 MW to the total installed electricity generating capacity of the country (MNES, 2003). In India, SHP projects have been classified as: (i) micro-hydro (up to 100 kW), (ii) mini hydro (101 kW to 1 MW) and (iii) small hydro (1–25 MW) by the

Central Electricity Authority (CEA) (AHEC, 2003). However, the term ‘SHP’ is used to describe all hydro projects up to 25 MW capacities. The Ministry of Non-Conventional Energy Sources (MNES) has created data base for 4215 SHP potential sites in 29 States and Union Territories with an aggregate capacity of 10,279 MW out of a total estimated potential of 15,000 MW (MNES, 2003). A substantial fraction of SHP capacity installed in India is contributed by micro-hydropower (MHP) projects.

The history of SHP development in the country is more than 120 years old. In the initial phase of hydropower development, most of the projects were only in SHP category. The first SHP project of 130 kW capacity was set up in the country at Sidrapong near Darjeeling in the state of West Bengal. The earliest two MHP projects implemented in the country were of 40 kW capacity and 50 kW capacity respectively at Chamba in 1902 and at Jubbal in 1911. In the absence of high voltage transmission lines, these and other SHP projects were set up primarily to meet electricity demand of nearby towns for lighting in decentralized manner. With the development of high voltage transmission lines

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the focus in hydropower development shifted from small hydro to large hydro projects with the objective of feeding electricity into the extensive transmission and distribution (T&D) networks. Interest in SHP projects also diminished with large-scale use of diesel generating (DG) sets for decentralized power generation. However, in the absence of other alternatives of power supply, installation of SHP projects on isolated basis continued on hilly streams in the Himalayan region of the country (AHEC, 2003).

The major boost to the growth of SHP projects in the country was received after 1989 when the activities relating to formulation of policies and development of SHP projects up to 3 MW capacity were placed by the Government of India under the administrative control of the then Department of Non-Conventional Energy Sources (DNES). MNES is now responsible for promoting development of entire SHP sector for projects up to 25 MW capacity. MNES is providing fiscal and financial incentives to encourage implementation of SHP projects by the private developers and state governments. These include financial support for under-

taking surveys and investigations and also for preparation of Detailed Project Reports (DPRs) for the identified sites. While capital subsidy is being given to the government funded projects, interest subsidy is being offered to private developers. The details of various incentives that were available under the Small Hydro Power Programme of the MNES during 2002–03 are summarized in Table 1 (MNES, 2003).

The growth of SHP development in the country is shown in Fig. 1. In this figure capacity addition for each calendar year and cumulative capacity for SHP projects installed in the country for the period 1994–2002 have been depicted. In the year 1999 SHP projects of about 1000 MW aggregate capacity installed in earlier years were included in the physical achievements of the MNES due to transfer of SHP projects in the capacity range of 3–25 MW to the MNES. Therefore, the cumulative capacity of SHP projects in the year 2000 stood at 1341 MW. This aspect has not been incorporated in the growth curve shown in Fig. 1.

There are about 80,000 un-electrified villages in the country and nearly 18,000 of these villages are not likely

Table 1
Details of incentives available under the small hydro programme of the Ministry of Non-Conventional Energy Sources, Government of India

Scheme	Areas	Capacity of small hydro project				
		Below 500 kW	0.5–1 MW	Above 1 MW up to 5 MW	Above 5 MW up to 15 MW	Above 15 MW up to 25 MW
Survey and investigation	Plain	Up to Rs. 75,000		Up to Rs. 0.1 million	Up to Rs. 0.15 million	
	Hilly	Up to Rs. 75,000		Up to Rs. 0.1 million	Up to Rs. 0.3 million	
Detailed project report	Plain	Up to Rs. 75,000		Up to Rs. 0.1 million	Up to Rs. 0.15 million	
	Hilly	Up to Rs. 75,000		Up to Rs. 0.1 million	Up to Rs. 0.2 million	
Interest subsidy for commercial projects	Plain	5.00%		2.50%	2.00%	1.50%
	Hilly & NE region	7.50%		5.00%	3.00%	2.00%
Capital subsidy for Govt. sector projects	NE region and Sikkim	90% cost of the project up to Rs. 75,000 per kW	90% cost of the project up to Rs. 60,000 per kW	75% cost of the project up to Rs. 45,000/- per kW	Equipment cost + 25% of civil work cost limited to Rs. 225 million per project	Nil
	Middle Himalayas, Ladakh, & Andaman & Nicobar	Equipment cost + 50% of civil work cost up to Rs. 45,000 per kW		Equipment cost + 25% of civil work cost up to Rs. 30 million per MW	Equipment cost + 25% of civil work cost limited to Rs. 150 million per project	Nil
	Notified hilly regions of other areas	Equipment cost + 50% of civil work cost up to Rs. 30,000 per kW		Equipment cost + 25% of civil work cost up to Rs. 15 million per MW	Equipment cost + 25% of civil work cost limited to Rs. 75 million per project	Nil
Renovation and modernization of old projects		Up to Rs. 20 million per MW			Limited to Rs. 100 million per project	Nil
Development/up-gradation of water mills		Mechanical mode: Rs. 30,000				
		Mechanical/electrical mode: Rs. 60,000				

1 US\$ = 45.80 Indian Rupees (Rs.) as on 16.9.2003.

NE—North Eastern.

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