

# Hydropower Development in India

A Sector Assessment





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K. Ramanathan

P. Abeygunawardena

Asian Development Bank

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# Acronyms and Abbreviations

CAMPA	Compensatory Afforestation Fund Management and Planning Authority
CAT	catchment area treatment
CCEA	Cabinet Committee on Economic Affairs
CEA	Central Electricity Authority
CERC	Central Electricity Regulatory Commission
CPIB	Committee of Public Investment Board
CPSU	central power sector unit
CNG	compressed natural gas
CWC	Central Water Commission
DPR	detailed project report
EA	Electricity Act 2003
EIA	environmental impact assessment
EMP	environmental management plan
EPS	Electric Power Survey
FI	financial institution
GDP	gross domestic product
HP	Himachal Pradesh
HPERC	Himachal Pradesh Electricity Regulatory Commission
HPSEB	Himachal Pradesh State Electricity Board
IPP	independent power producer
JPVL	Jaiprakash Power Venture Limited
LADA	local area development authority
LNG	liquefied natural gas
MNES	Ministry of Non-Conventional Energy Resources
MOEF	Ministry of Environment and Forests
MOF	Ministry of Finance
MOP	Ministry of Power
MORD	Ministry of Rural Development
MOU	memorandum of understanding
NEA	Nepal Electricity Authority
NEEPCO	North-Eastern Electric Power Corporation
NHDC	Narmada Hydro Development Corporation
NHPC	National Hydroelectric Power Corporation
NTPC	National Thermal Power Corporation
NPV	net present value
NPRR 2003	National Policy on Resettlement and Rehabilitation, 2003
NEP	National Electricity Plan 2005
NER	North-Eastern Region
PAF	Project-affected family
PFC	Power Finance Corporation

PIB	Public Investment Board
PFR	prefeasibility report
PGCIL	Power Grid Corporation of India Limited
RFP	request for proposal
R&R	resettlement and rehabilitation
SEB	state electricity board
SHP	small hydro project
SEIAA	state/union territory environmental impact assessment authority
SEAC	state/union territory level expert appraisal committee
SERC	state electricity regulatory commission
SJVNL	Satluj Jal Vidyut Nigam Limited
SPCB	state pollution control board
SPDCL	Sikkim Power Development Corporation Limited
THDC	Tehri Hydro Development Corporation
TEC	techno-economic clearance
THPA	Tala Hydro-electric Project Authority
TOR	terms of reference
UERC	Uttaranchal Electricity Regulatory Commission
UPCL	Uttaranchal Power Corporation Ltd.
UTPCC	Union Territory Pollution Control Board

#### WEIGHTS and MEASURES

BU (billion unit)	Unit of energy, equal to $1 \times 10^9$
kWh (kilowatt-hour)	Unit of energy, equal to 1 unit
MW (megawatt)	Unit of power, equal to $1 \times 10^6$
GW (gigawatt)	Unit of power, equal to 1 billion ( $10^9$ ) watts
MT (metric ton)	Unit of weight, equal to 1,000 kg or 2,204.6 pounds

#### CONVERSION

Rs1 million	Equal to $\text{Rs}1 \times 10^6$
Rs1 billion	Equal to $\text{Rs}1 \times 10^9$
Rs1 lakh	Equal to $\text{Rs}1 \times 10^5$
Rs1 crore	Equal to $\text{Rs}1 \times 10^7$



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# Preface

This report is intended to be a reference document for various parties involved in hydropower development in India. It provides an assessment of the hydropower development potential in India. Although the report is somewhat technical in nature, it should be of interest to the Government, nongovernment organizations, and civil society in general. The report would serve its purpose if it helps to reinforce public awareness and concern to make the Indian energy sector more diverse and sustainable.

Energy security is a major concern in many of our developing member countries. India is no different to this. In order to maintain the required power demand-supply balance and to meet its goal of Power For All by 2012, India needs to install an additional 100,000MW power generating capacity. This is a major challenge and we hope India's vast hydropower potential can contribute to this in an environmentally sustainable and socially responsible manner. In this report, an assessment has been made to understand the hydropower potential. A significant contribution from hydropower resources to meet the emerging needs of the power sector seems technically feasible and cost-effective.

The Energy Division of South Asia Regional Department prepared this report in collaboration with the Energy and Resources Institute, New Delhi, India. I wish to convey my sincere appreciation to the authors for bringing out this report at this juncture.



Kunio Senga  
Director General  
South Asia Regional Department  
Asian Development Bank



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# Executive Summary

A fast growing power sector is crucial to sustain India's economic growth. India has an assessed hydropower potential to the tune of 84,000 MW at 60% load factor; out of this only about 20% has been developed so far. In the past various factors such as the dearth of adequately investigated projects, environmental concerns, resettlement and rehabilitation issues, land acquisition problems, regulatory issues, long clearance and approval procedures, power evacuation problems, the dearth of good contractors, and in some cases, inter-state issues and law and order problems have contributed to the slow pace of hydropower development. There have been large time and cost overruns in case of some projects due to geological surprises, resettlement and rehabilitation issues, etc. However, considering the large potential and the intrinsic characteristics of hydropower in promoting the country's energy security and flexibility in system operation, the Government is keen to accelerate hydropower development.

Most of the above concerns are being addressed through a number of legislative and policy initiatives at the central and state levels. As discussed in detail in the report, these include preparation of a shelf of well-investigated projects and streamlining of statutory clearances and approvals, establishment of independent regulatory commissions, provision for long-term financing for projects, increased flexibility in sale of power, etc. In May 2003, the Prime Minister of India launched a 50,000 megawatt (MW) hydro initiative. Under this scheme, detailed project reports (DPRs) are being prepared for 73 schemes, which have an indicative first year tariff below Rs2.50. This would provide a shelf of fairly well investigated low tariff projects to prospective developers. Risk perceptions in taking up the projects and the possibilities of time and cost overruns are also expected to get minimized. Of these schemes (total about 32,000 MW), 70 are located in the Brahmaputra, Indus and Ganga basins in the north and north-eastern part of the country.

The Government has formulated a number of measures to address the issues related to watershed management of upstream and downstream. For example, in case of multi-purpose schemes, Electricity Act 2003 requires that the state government and the generating company coordinate their activities with those other persons responsible for such scheme insofar as they are inter-related. Similarly, the techno-economic clearance and the Central Electric Authority would look into the optimal development of the river or its tributaries consistent with other requirements. The Ministry of Environment and Forestry clearance would look into the environmental impacts and social/community development aspects associated with the projects and the developers would be required to deposit adequate funds for compensatory afforestation, catchment area treatment plan, wildlife management plans, biodiversity conservation plans, etc.

Private sector participation has been low in the hydropower sector although the sector was opened up in 1991 since the investors looked at it as a higher risk proposition compared to thermal projects. The Government has initiated a number of policy measures to address such concerns. They include availability of fairly well investigated DPRs, formulation of transparent bidding procedures,

provision of open access and trading, notification of tariff determination processes, joint venture initiatives, etc. The small hydro segment also offers considerable scope for development both for grid and off-grid applications. About 80% of the estimated potential remains untapped. The Ministry of Non-conventional Energy Sources is presently providing support to the states for assessment of potential, preparation of DPRs and project implementation.

India needs to mobilize large finances for implementation of its power program. While the Government has substantially stepped up its budgetary allocations to the hydro sector, support from international agencies and the private sector is also needed. In case of such projects, the developers however seem to have a perception that the appraisal processes are often long and this in turn could cause delays in taking up the project for implementation and consequential time and cost overruns. Hence they hold the view that in case of projects that are in a fairly mature state for taking up for implementation, it may be prudent to borrow from the market (especially when such funding can be accessed). Nevertheless, the developers consider that working with international donor agencies would provide some rich experience and also improve their credit rating with other financiers.

India has been cooperating with Bhutan and Nepal in hydropower development for over a decade. There are prospects of further enhancement for the benefit of all the countries and in the larger interest of energy security in the region. Some prospects of hydropower cooperation with other neighboring countries are also indicated.

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# Introduction

**S** spurred by sustained economic growth, rise in income levels, and increased availability of goods and services, India's incremental energy demand for the next decade is projected to be among the highest in the world. This increasing energy demand also translates into higher demand for electricity. It has been estimated that in order to support a growth rate of the gross domestic product (GDP) of around 7% per annum, the rate of growth of power supply needs to be over 10% annually. This calls for rapid development of the country's power sector, taking into account, inter alia, considerations of long-term sustainability, environmental aspects and social concerns.

India is endowed with rich hydropower potential; it ranks fifth in the world in terms of usable potential. However, less than 25% has been developed or taken up for development. Thus hydropower is one of the potential sources for meeting the growing energy needs of the country. A judicious mix of hydropower in the energy portfolio can also contribute to energy security, reduction of greenhouse gas emissions, meeting the peak demand and also increased flexibility in grid operation. Besides, projects may also be conceived as multi-purpose ones contributing not only to power but also to irrigation, flood control, navigation, etc. The Government of India is, therefore, giving special emphasis to accelerated hydropower development in its power development plans.

Mobilization of adequate financial resources is an important requirement in this context. The Government has, therefore, been seeking support from international donor agencies and the private sector to supplement its own resources. This report has been prepared to facilitate such funding. It is not intended to be a critique of the development initiatives and policies of the Government. The objective is to provide a comprehensive assessment of what is happening in the hydropower sector in India that would be useful while appraising future funding options by donor agencies. This has been prepared based on detailed literature survey and personal discussions with senior officers of the Ministry of Power (MOP), Central Electricity Authority (CEA), Ministry of Environment and Forests (MOEF), and a number of public and private sector developers and consultancy organizations. The report also annexes an overview of hydropower development prospects in the states of Uttarakhand (formerly Uttaranchal), Himachal Pradesh, Sikkim and in the North-Eastern Region (NER), where large untapped potential exists.



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# Overview of Indian Power Sector

**T**he installed generating capacity in India (in utilities) as of 31 March 2006 was nearly 125,000 megawatts (MW). This included thermal (coal, gas and liquid fuel), hydro, nuclear, and renewable based generation. Hydropower constituted about 32,325 MW. A detailed energy breakdown of the installed capacity in utilities in the five power regions of the country on a sector-wise and mode-wise basis is given in Appendix 1. As may be seen there the hydro-thermal mix is low with hydropower constituting about 26% of the total capacity.<sup>1</sup> Nearly 90% of the installed capacity is in the public sector. In the case of hydropower, the public sector has a predominant share of over 97%. Nearly 78% is in the state sector. The annual gross electricity generation was about 617 billion units (BU) during 2005--2006; the share of hydropower in this was around 16%.

The energy resources of the country are unevenly distributed with bulk of the hydro resources in the northern and north-eastern part, and fossil fuel resources in the central and western parts. In order to ensure optimal utilization of these resources, the power systems of the country were demarcated into five power regions and a regional concept for power planning was introduced in the 1960s. This led to development of regional power grids and inter-regional interconnections. In the 1980s the concept of a national grid was adopted and this led to further strengthening of the intra-regional and inter-regional transmission systems. As a result an extensive network of transmission and distribution lines (over 6 million circuit kilometers) is presently in operation and a National Power Grid is in the process of evolution. The Indian power system is also interconnected with the power systems of Bhutan and Nepal, facilitating transnational power exchanges as per bilateral agreements.

The demand for power has been growing at the rate of 5.74% in recent years.<sup>2</sup> During 2005-2006 the demand was 632 BU in terms of energy and 93.21 gigawatts (GW) in terms of peak power requirements. The availability of power had been continually falling short of the demand and, as a result, the country is experiencing power shortages of varying degrees in different parts of the country<sup>3</sup>. The shortages during 2005-2006 were 8.4% in energy and 12.3% in peaking power. Per-capita consumption of electricity is relatively low, of the order of 600 kilowatt-hours (kWh). Presently, over 84% of the villages are electrified; but only 43.5% of the rural households have access to electricity.

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<sup>1</sup> A hydro-thermal mix of 60:40 is often considered ideal; but it is not sacrosanct. Nevertheless, a higher component of hydropower is preferred from the system operation point of view.

<sup>2</sup> *TERI Energy Data Directory and Yearbook, 2004-05*

<sup>3</sup> This may be attributed to a host of factors like shortfalls in targeted capacity addition (only 47.5% of the planned additions could be achieved during the Ninth Five-Year Plan 1997-2002), inefficiencies in production and usage of power, pricing distortions, etc..

The technical and commercial performance of the power utilities is a matter of grave concern. While some improvements have been noticed in recent years, there is considerable scope for improvement. The thermal plant efficiencies are of the order of 31.5% and the system losses are around 32.5%.<sup>4</sup> The Government is conscious of the situation and has in recent years taken a number of policy initiatives and reform measures aimed at improving the health of the sector. As part of the reform program, the sector was opened up for private sector participation in generation in 1991. During the mid-1990s a more broadbased reform leading to changes in the structure, ownership patterns and regulatory set up was initiated. The Electricity Act, EA 2003 provides an appropriate legal and regulatory framework for this. The reform measures especially focus on creating an investment-friendly environment for private sector participation, promotion of competition and protection of consumer interests. Some of the key features of the EA are in Box 1. Independent regulatory commissions have been established in most of the States. In case of Mizoram and Manipur, a Joint Electricity Commission (JERC) has been notified. An Appellate Tribunal has also been constituted which would hear appeals against orders of regulatory commissions. Under the provisions of EA 2003, a National Electricity Policy and Tariff Policy have been notified. A draft National Electricity Plan (NEP) was notified in 2005; this is now being finalized based on the revised information on generating capacity addition targets. Similarly, almost all the regulatory commissions have given tariff orders and a number of them have notified open access regulations. There is also an added focus on renewable energy.

There is considerable scope for improvement of efficiencies in the end use sector. Realizing this, the Government had legislated an Energy Conservation Act, which came into effect in March 2002. This Act laid down a number of measures to ensure efficient use of energy and its conservation like establishment of a Bureau of Energy Efficiency (BEE), powers to the Central and state governments to facilitate and enforce efficient use of energy and its conservation, provision for standards and labeling of energy-intensive equipment and appliances, mandatory energy audits, etc.

#### Box 1. Key Features of Electricity Act 2003

- The Central Government to prepare a National Electricity Policy in consultation with state governments.
- Central Electricity Authority to prepare a National Electricity Plan.
- Thrust to complete rural electrification; provision for license free generation and distribution in rural areas.
- De-licensing of generation (except hydropower projects beyond a certain capital cost and nuclear) and freeing of captive generation.
- Provisions for promoting renewable energy based generation.
- Provisions for private licensees in transmission and entry in distribution through an independent network
- Open access in transmission from the outset; to be introduced in phases in distribution.
- Establishment of state electricity regulatory commissions made mandatory.
- Provisions for payment of subsidy through budget.
- Trading recognized as a distinct activity licensed by the appropriate regulatory commission.
- Provisions for reorganization of state electricity boards.
- Metering of all electricity supplied made mandatory.
- An Appellate Tribunal to hear appeals against decisions of the state electricity regulatory commissions.
- Provisions relating to theft of electricity made more stringent.
- Provisions for safeguarding consumer interest. Ombudsman scheme for redressal consumer grievance.

<sup>4</sup> 32.5% system losses translate into 174 BU; approximately 24 GW at 60% load factor.



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# Plans for Future Power Development

India is pursuing a centralized system for power planning. EA 2003 requires CEA to prepare a NEP in accordance with the National Electricity Policy notified by the Government and update it once every 5 years. The plan is to be finalized taking into account suggestions and objections from licensees, generating companies and the public. The plan is to be notified only after getting the approval of the Government. CEA has also to formulate a perspective transmission plan for inter-state and intra-state transmission systems. These plans would be continuously updated to take care of the revisions in load projections and generation scenarios. Further detailed planning by the Central and state transmission utilities has to conform to this plan.

A draft NEP was notified in 2005 which was based on an all-India generation capacity addition of around 40,000 MW during 2002–2007 and the demand projections shown in Table 1.

Table 1: Long-Term Forecasts of Electricity: All India (Public Utilities)

Region	Energy Requirement		(MW) Peak Load (MW)	
	2011-2012	2016-2017	2011-2012	2016-2017
Northern Region	308,528	429,480	49,674	69,178
Western Region	299,075	395,859	46,825	61,966
Southern Region	262,718	354,599	42,061	56,883
Eastern Region	90,396	117,248	15,664	20,416
North-Eastern Region	14,061	20,756	2,789	4,134
A&N Islands	374	591	77	122
Lakshadweep	44	111	17	26
All India	975,222	1,318,644	157,107	212,725

Source: 16th Electric Power Survey, report released January 2001.

The plan covered two scenarios of GDP growth rate; namely, 6.5% and 7.4% for working out generation capacity additions. Besides the likely impact of various factors such as limited indigenous coal availability—367 metric tons (MT) as compared to 419 MT in the base case—energy conservation (about 6.9%), peak reduction (5%), inter-regional diversity in demand (3.5%), accelerated rural electrification, and household modernization, spinning reserve requirement (5%), etc. and low hydro scenario (benefits of 5,000 MW of hydropower slipping from the 11<sup>th</sup> Plan to the 12<sup>th</sup> Plan) have also been studied. A summary of the results is shown in Table 2.

Table 2: Generation Capacity Requirement in 11<sup>th</sup> Plan

Scenario	Peak Demand	Installed Capacity	Capacity Addition 11 <sup>th</sup> Plan
<b>Scenario I</b>			
Base case	157,107	204,234	60,896
Limited coal (Indigenous)	157,107	203,668	60,330
Energy conservation	146,243	190,343	47,005
Demand management	149,252	194,455	51,117
Diversity	150,721	196,575	53,237
Rural electrification	167,507	216,598	73,260
Low hydro development	157,107	204,386	61,048
Household modernization	163,723	212,523	69,185
Spinning reserve (5%)	157,107	212,056	68,718
Desirable plan*	155,520	202,453	59,115
<b>Scenario II</b>			
High GDP growth	181,941	235,168	91,830
Desirable plan (High GDP growth)	174,100	223,648	80,310

\* Considers effect of increased demand on account of accelerated rural electrification program and household modernization along with demand reductions due to inter-regional diversity and energy conservation/efficiency improvement.

Source: Draft National Electricity Plan, 2005.

The base case studies indicated that reliability indices in terms of Loss of Load Probability (LOLP) would be 1.07% by end of the 11th Plan and 0.94% by end of the 12th Plan. The Energy Not Served index worked out to 0.0342% and 0.0294%, respectively, during this period. The hydropower capacity addition targets as per this plan are 22,420 MW during the 11th Plan and 34,500 MW during the 12th Plan. The draft NEP is being revised taking into account the latest projections of capacity additions during 2002-2007.<sup>5</sup> Discussions with CEA also indicate that, based on current status, the feasible addition in hydropower capacity may be only 17,000 MW in the 11th Plan and 20,000 MW in the 12th Plan.

As regards the fuel mix, coal is likely to be the mainstay in the near future with focus on clean coal technologies. However, India's coal reserves are limited. Further, investments in the coal sector have to rely on government budgeting. In the past the Government has not made adequate budgetary allocations for development of coal mines, and as a result demand has outstripped supply.<sup>6</sup> There are also problems of high ash content, processing and washing of coal, regulatory issues regarding transportation of coal and environmental issues, etc. As regards the option of natural gas, the supplies are very limited and there is a concern of price volatility. In case of liquefied natural gas (LNG), it has to be totally imported and the price being linked to the global price of crude oil, there will be a huge price risk in importing LNG. There is a renewed focus on nuclear power; however, very large capacity additions are not likely in the near future.<sup>7</sup> Also there are concerns of availability of uranium and costs related to its mining. In recent years the Government has been giving special emphasis to promotion of renewable sources of energy, but the contribution from these would be limited considering the large power requirements of the country.

<sup>5</sup> The revised version of the document is still not in the public domain.

<sup>6</sup> Currently, the Government is planning to import about 40 million tons of coal.

<sup>7</sup> As per Government targets the nuclear capacity is likely to be 20,000 MW by 2020.

Under these circumstances power planners are giving special attention to accelerated development of hydropower as an important energy resource for ensuring the country's energy security. As is well known, hydropower has several advantages over other forms of energy sources.

- It is totally renewable and non-polluting and can also provide a more stable price regime over a long period of time.
- It has inherent capability for quick starting, stopping, load variations, etc. and is thus ideally suited for meeting the peaking demand.
- Generation cost is not only inflation free but it also reduces with time.
- Development of hydropower projects is also in many cases associated with irrigation, drinking water, flood control, navigation and tourism benefits.
- Pumped storage plants can effectively regulate the energy availability during the day by pumping up water into the reservoir during off-peak hours when there is surplus energy in the grid and generating power from this stored water when needed during peak hours. They can also quickly reverse their mode of operation from pumping to generating and vice versa. Thus pumped storage plants can play an important role in meeting the peak demand and also in improving the grid stability and load factor of thermal power stations.
- Small hydro plants have least environmental impacts and would be ideally suited for rural electrification particularly in remote areas. This assumes special importance in the context of achieving the target of 100% village electrification by 2007 and power for all by 2012.

Recently the Energy Coordination Committee (ECC), headed by the Prime Minister of India, approved establishment of five ultra-mega projects each of 4,000 MW capacity.<sup>8</sup> The ECC has also decided to set up a panel under the cabinet secretary to look into issues concerning hydropower plants for expediting approvals.

Special emphasis is also being given to plan and implement a transmission system matching with the additions to the generation capacity. In case of hydropower projects this assumes added importance in view of the fact that these are generally located far away from the load centers and the terrain often presents serious right-of-way problems. This calls for pooling of power from different projects, development of high capacity transmission corridors, staged development of the transmission system, use of new technologies, etc. The CEA is looking into these aspects while developing perspective transmission plans.<sup>9</sup> This has special relevance in case of hydropower development in Himachal Pradesh (HP), Sikkim, Uttaranchal and NER, where the local demands are low compared to the available power potential. The ground rules for connection of the generators to the transmission system and for planning and operation of the interconnected power systems

<sup>8</sup> These would be coal-based independent power producers, located at pit heads and on the coast. Tentative allocation of power from four of these projects has already been done. MOP has also in the meantime firmed up the payment security mechanism for the projects (which, it is proposed, will consist of an irrevocable letter of credit and irrevocable arrangement of escrow account having claims on receivables). In the event of a default, the developers will have the right to sell power to any other distribution companies or high-tension consumers.

<sup>9</sup> A draft perspective transmission plan was notified in July 2005.

# Hydropower Development in India

## Resource Potential

India is endowed with rich hydropower potential; it ranks fifth in the world in terms of usable potential. This is distributed across six major river systems (49 basins), namely, the Indus, Brahmaputra, Ganga, the central Indian river systems, and the east and west flowing river systems of south India. The Indus, Brahmaputra and Ganga together account for nearly 80% of the total potential. In the case of Indus the utilization is, however, governed by the Indus Water Treaty with Pakistan. The economically exploitable potential from these river systems through medium and major schemes has been assessed at 84,044 MW at 60% load factor<sup>10</sup> corresponding to an installed capacity of around 150,000 MW. As mentioned earlier, so far only 32,325 MW has been established. Tables 3 and 4 show the status of development of hydropower on a region-wise and basin-wise basis. In addition, pumped storage sites with an aggregate capacity to the tune of 94,000 MW have also been identified, but only about 5,000 MW have so far been developed. The assessment of small hydro (up to 25 MW) potential has indicated nearly 10,000 MW distributed over 4,000 sites. It is estimated there is still an unidentified small hydro potential of almost 5,000 MW.

**Table 3: Region-Wise Potential and its Status of Development at 60% Load Factor as on 1 January 2005**

Region	Potential Assessed (MW)	Potential Developed (MW)	Potential under Development (MW)	Balance Potential (MW)	Balance Potential (%)
Northern	30,155	5,150	2,905	22,100	73.28
Western	5,679	2,270	1,164	22,450	39.53
Southern	10,763	5,924	153	4,686	43.54
Eastern	5,590	1,364	201	4,025	72.00
North-Eastern	31,857	517	914	30,424	95.5
<b>Total</b>	<b>84,044</b>	<b>15,225</b>	<b>5,339</b>	<b>69,480</b>	<b>75.53</b>

Source: Indian National HydroPower Association. 2005.

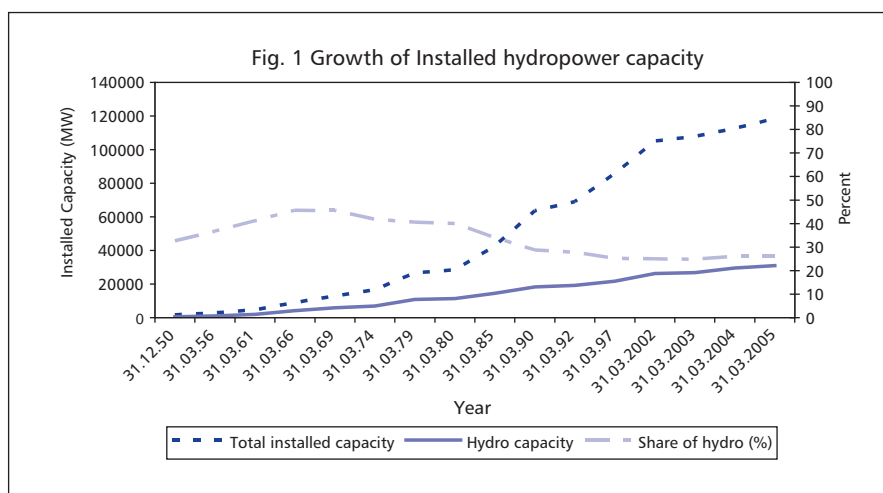
<sup>10</sup> This is based on the reassessment (the first assessment was carried out during 1953–1959) of hydropower resources carried out by CEA in 1980s taking into account new information available on topographical features and hydrology of the river systems, technological advances and experience gained in civil works of hydropower projects, and the latest trends in relative economics of power generation from different sources. The assessment of energy is based on availability of water corresponding to a 90% dependable year and the siting of power stations based on topographical studies.

**Table 4: Basin-Wise Potential and its Status of Development at 60% Load Factor as of 1 January 2005**

Basin	Potential (MW)	Potential Developed (MW)	Potential under Development (MW)	Balance Potential (MW)	Balance Potential (%)
Indus Basin	19,988	3,731	1,156	14,701	73.55
Ganga Basin	10,715	1,901	1,367	7,447	69.5
Central Indian Rivers	2,740	1,060	1,147	533	19.45
West Flowing Rivers	6,149	3,704	41	2,404	39.09
East Flowing Rivers	9,532	4,168	144	5,220	54.76
Brahmaputra Basin	34,920	661	1,085	33,175	95
<b>Total</b>	<b>84,044</b>	<b>15,225</b>	<b>5,339</b>	<b>63,480</b>	<b>75.53</b>

Source: Indian National HydroPower Association.

Hydropower development commenced over a century ago in India with the installation of a 130 kW power station in the Darjeeling district of West Bengal, almost in pace with the world's first hydro-electric station in the United States. However, to date only about 20% of the country's vast hydro potential has been harnessed. The share of hydropower in the total installed capacity has also decreased over the years; from over 50% in 1960-61 to nearly 26% now (Fig 1).



## Barriers in Development

The main barriers/concerns that have come in the way of development of hydropower projects are briefly discussed below.

**Longer gestation period and capital intensive nature of the projects:** Preparation of detailed projects reports (DPRs) for hydropower projects takes relatively longer period than for thermal projects because reliable hydrological, geological, seismological and environmental studies have to be carried out for a longer period. Thus hydropower projects generally entail a long gestation period. In addition to this, these projects are comparatively capital intensive. In the context of resource shortages and continuing power shortages, thermal projects (coal, liquid fuel and gas), which need a relatively short gestation period, have been getting priority in fund allotments.

**Dearth of good contractors:** A matter of concern in the execution of large projects is the dearth of competent and resourceful contractors, as it often results in time and cost overruns of hydro projects.

**Inter-state aspects:** A large number of hydropower projects having common river systems between adjoining states are held up on account of inter-state aspects. Some of these projects have received the techno-economic clearance (TEC) of CEA but the investment sanction could not be accorded due to inter-state aspects. A number of projects have also not been accorded CEA clearance on account of inter-state issues.

**Environmental impact and rehabilitation issues:** Important environmental concerns in hydro-electric projects are: (a) rehabilitation of project-affected people; (b) deforestation; (c) likely submergence of archaeological, religious and historical monuments; (d) protection of flora, fauna, forests, and wildlife; (e) degradation of catchment area; and (f) disaster potential in the event of earthquakes, reservoir induced seismicity, surplusage of reservoirs, etc. Rehabilitation of project-affected people is also a major issue in implementation, especially in case of storage-based hydro development. It is essentially a human problem and has to be dealt with understanding and sensitivity. In fact, many times it is one of the main reasons for the delay in the execution<sup>11</sup> of projects. Sardar Sarovar, Indira Sagar, Bansagar Tons and Tehri are some of the hydro projects where the progress had been severely hampered in the past from sustained opposition to project construction by environment activists and project-affected people.

**Valuation of forestland based on net present value:** The manner of valuation of forest land diverted for non-forestry purposes based on the net present value (NPV) of diverted land has been a matter of concern for developers of hydropower projects. As per the recommendations of a Centrally Empowered Committee (CEC), the NPV of forestland diverted for non-forest use has been charged at Rs5.80–9.20 lakhs per hectare, depending upon the density of forest involved. Under NPV, the state government has to pay to the CEC the NPV of forestland lost to mining and other projects, including resettlement. State governments, in turn, have asked for exemption in case of projects such as government hospitals, schools, and rainwater harvesting meant for public welfare. In some cases, it is argued that loading of NPV on the project may result in increase in tariff of hydro-electricity.<sup>11</sup> There is thus an urgent need to rationalize NPV calculations of forestland in case of hydroelectric projects. The matter had also come up before the Supreme Court of India, which has directed the formation of a committee to look into various issues pertaining to assessment of NPV. The Energy and Resources Institute is also undertaking a study to analyze various aspects of NPV calculation for hydroelectric projects in India.

**Law and order problems:** Disturbed law and order is one of the factors causing delay in project execution and even suspension of work. Some of the hydropower projects affected due to these problems are Dulhasti, Upper Sindh, Doyang and Dhansiri.

**Land acquisition problems:** The problems arising in acquisition of land for hydropower project are causing suspension and delay in the construction activities. Thein Dam, Doyang, Ghatgar pumped storage plants are some of the projects affected in the past due to this problem.

**Geological surprises:** The features of the hydropower projects being site specific, depend on the geology, topography and hydrology at the site. The construction time of a hydro project is greatly influenced by the geology of the area and its accessibility. Even when extensive investigation using new techniques of investigations are undertaken, an element of uncertainty remains in the sub-surface geology and the geological surprises during actual construction cannot be ruled out. This in turn adds to the construction risks.

<sup>11</sup> Appendix 3 elaborates issues related to clearances in this regard.

<sup>12</sup> As per some reports, payment of NPV as per prevailing norms is likely to result in 20% increase in project cost (by nearly Rs1,000 crores) as in the case of the proposed Tapaimukh project in NER.

**Power evacuation:** A number of the hydropower projects are located in remote sites and the home states do not have adequate demand. Timely provision of power evacuation system presents many complexities in such cases, since (a) the beneficiaries are to be identified well in advance, and (b) where there are serious right-of-way constraints, excess capacity would have to be built in one go considering likely future development of projects in the evacuation corridor. This could result in high transmission tariffs initially and also adversely affect sustainability of the project in case of slippages in projects. These issues are especially relevant in case of projects in NER.

**Lack of private sector interest:** The private sector has also not been evincing much interest in taking up hydro projects in view of non-availability of adequately investigated projects, construction risks, etc.

**Tariff and regulatory issues:** The existing tariff formulation norms for hydro projects (based on a cost plus approach) with no premium for peaking services and the provision for 12% free power<sup>13</sup> to distressed states from the initial years are also proving to be deterrents.

**Small hydro segment:** Development of small hydro often suffered due to inaccessibility of the sites, lack of power evacuation infrastructure, investigation and construction difficulties, land acquisition and financing difficulties, inadequacies in institutional support and in some cases law and order problems.

## The Way Forward

The power planners in India are concerned about this slow development of hydropower, especially in view of its several advantages over other forms of energy sources including its role in promoting the country's energy security, as discussed in Section III.

## Hydropower Technologies

India has achieved a fairly high degree of self-reliance in hydropower technology. Nevertheless, there is a continuing thrust toward adoption of new technologies. The focus on the civil engineering side is on using techniques and tools that could improve quality of planning and investigation and reduce construction delays, and to adopt measures that will help contain silting problems. On the electrical and mechanical side, the focus has been to improve the life and performance of turbines (through metallurgical improvements, design and coatings of blades, etc.) and to minimize problems in transportation of equipment to project site and in installation due to space constraints within the powerhouse (through use of split transformers, gas insulated substations, etc.). The country is also trying to use new technologies like powerformers, adjustable speed turbines, etc. Another technological advance in recent years has been the widespread use of information technology in new projects for construction monitoring activities as well as for operation and control after project commissioning.

<sup>13</sup> As per the decision taken by the Central Government in 1990, 12% of power from the energy generated by the power station would be supplied free of cost to those states of the region (including the state where the project is located) where distress is caused by setting up the project at the specific site, like submergence, dislocation of populations, etc. The Government of HP is seeking 12% of the deliverable energy of the project for the period starting from the date of synchronization of the first generating unit and extending up to 12 years from the date of commercial operation of the project, at 18% of deliverable energy of the project for a period of the next 18 years and thereafter at 30% of the deliverable energy for the balance of the agreement period beyond 30 years.

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# Strategies for Accelerated Hydropower Development

The Government has taken a number of initiatives in recent years to improve the functioning of the power sector and attract investments. There has also been a special emphasis on accelerated hydropower development. These are briefly discussed below.

## Policy Liberalization

As mentioned earlier the power sector was opened up for private sector participation in generation in 1991 with a view to bring in additional resources for capacity addition including in hydropower. Private sector entrepreneurs were allowed to set up enterprises, either as licensees, or as generating companies. The generated power was to be sold to state electricity boards (SEBs) on the basis of a power purchase agreement. Further, a debt equity ratio of up to 4:1 was made permissible for all prospective private enterprise entrants (i.e., for both licensees and generating companies). In order to ensure that the investor brings in additionality of resources to the sector, it was also stipulated that not less than 60% of the total outlay for the project has to come from sources other than Indian public financial institutions (FIs).

Subsequently, in March 1992 a tariff notification was issued incorporating several incentives to private developers which broadly covered incentives for better availability of machines, for generation of extra energy above the design energy, compensation for hydrological risks, etc. Later, up to 100% foreign equity participation was also permitted.

## Policy on Hydropower Development (1998)

The above liberalization measures did not provide expected impetus to hydropower development; it also did not generate much interest in private sector participation in hydropower development. Based on a review of the situation, the Government brought out a policy on hydropower development in 1998, which, inter alia, laid down several policy instruments like full budgetary support to ongoing projects, establishment of a power development fund, a mechanism to resolve inter-state issues, favorable tariff formulation, etc. The policy also outlined that the selection process of private developers would be such that for projects up to 100 MW in capacity, the memorandum of understanding (MOU) route would be adopted, whereas for projects above 100 MW capacity, a competitive bidding process would be adopted. Although all these policy measures could not be effectively implemented, the Government has been pushing ahead with strategic initiatives from time to time.



## Ranking of Potential Hydro Sites

A need was also felt in the meantime to evolve a comprehensive approach for the phased development of the large untapped potential. With this in view, CEA prepared a vision document in 2001 giving a road map for expediting hydropower development in the country. This document indicated that in order to harness the entire remaining assessed hydropower potential of the country by 2025–2026, about Rs5,000 billion would be required for project implementation based on present day costs and another Rs50 billion would be required for survey and investigations, which would need to be completed by 2016–2017.<sup>14</sup>

As a follow-up of the recommendations contained in the vision document, CEA carried out preliminary ranking studies of about 400 schemes in the six river basins of the country. Schemes totaling to about 107,000 MW have been ranked into five categories as A, B, C, D and E from the point of view of attractiveness (in decreasing order) for implementation. The aspects considered are resettlement and rehabilitation (R&R) issues, inter-state/international aspects, potential of the scheme, type and height of dam, length of tunnel/channel, accessibility of site, present status of the project and the status of upstream or downstream developments. The preliminary ranking study report released in February 2002 was expected to provide information to developers on the relative risks and attractiveness of different potential sites and also to take up more detailed investigations including preparation of feasibility reports.

## Prime Minister's 50,000 MW Hydroelectric Initiative

In order to give further fillip for development of hydro sector, the Prime Minister of India announced a 50,000 MW hydro initiative in May 2003. Under this program prefeasibility reports (PFRs) of 162 new projects with an aggregate capacity of 47,930 MW distributed across 16 states have been prepared. Out of these 162 schemes, 73 schemes having first year indicative tariff below Rs2.50 have been selected for preparation of detailed project reports (DPRs) and subsequent implementation.<sup>15</sup> The installed capacity of these schemes is about 33,000 MW. Of these schemes (32,000 MW), 70 are located in Brahmaputra, Indus and Ganga basins in the north and north-eastern part of the country. A list of these schemes is given in Appendix 2.

Studies done so far indicate prospects of many projects delivering power at a cost of Rs1.50–2.50 per unit. It is expected that the availability of a shelf of well-investigated DPRs would help to minimize the gestation period, firm up the costs and also enliven the interest of the private sector in taking up hydro projects.

## Streamlining of Clearance Procedures

Recognizing the fact that sanctioning of projects is itself a process that requires streamlining, the MOP, Ministry of Finance (MOF), MOEF and the Planning Commission are working to minimize the time cycle for sanctions by reengineering processes. Special emphasis is being given to expediting environmental clearances, as detailed in Attachment A to Appendix 3. Further, the National Policy on Resettlement and Rehabilitation for Project-Affected Families, 2003 (NPRR, 2003) notified by the Ministry of Rural Development (MORD) is expected to provide a better appreciation of the issues as well as the obligations and risks on the part of developers.

A TEC from CEA is now required only in cases where inter-state water issues are involved or the capital cost of the project exceeds Rs25 billion as mentioned in Appendix 3. CEA has also evolved

<sup>14</sup> CEA. 2001. Preliminary Ranking Study of Hydro-electric Schemes.

<sup>15</sup> The cost of preparation of DPRs is proposed to be recovered later from the developers.

modalities for simplified transfer of TECs from one agency to another. During the period 1999–2004 TECs were transferred in favor of new executive agencies in eight hydropower projects<sup>16</sup>.

As mentioned earlier, the ECC, headed by the Prime Minister of India, has also decided to set up a panel under the cabinet secretary to look into issues concerning hydropower plants for expediting approvals.

In case of projects to be executed by the central power sector units (CPSUs), the Government has approved a three-stage clearance procedure in consultation with MOF and MOEF. The salient features of this procedure are given in Box 2. The first and second stage clearance system has helped to cut down construction time by at least 2 years and consequently, the project cycle time for a typical project has been reduced from over 7 years to around 5 years<sup>17</sup>.

### Box 2. 3-Stage Clearance Process for Central Sector Projects

**Stage I:** Under Stage I, the central power sector units (CPSUs) will incur expenditure on survey, investigations and preparation of a prefeasibility report for hydro projects and expenditure up to Rs100 million will be sanctioned by Ministry of Power subject to the condition that the proposed hydro project is included in the 5-year plan or long-term Hydro Electric Power Development Plan. For an expenditure of more than Rs100 million, the same would be considered by a committee of the Public Investment Board (PIB). The activities under Stage 1 shall be completed within 1 year from the date of sanction.

**Stage II:** Under this stage, the CPSUs will undertake activities relating to detailed investigations and preparation of detailed project reports (DPRs). Proposals costing Rs200 million and more will require the approval of Finance Minister, while those involving a cost of over Rs500 million would require approval of the Cabinet Committee on Economic Affairs (CCEA). Projects which have been found to be commercially viable and have obtained site clearance from the Ministry of Environment and Forests (MOEF) would be considered for Stage II. Stage II development would involve preparation of a DPR, pre-construction works, development of infrastructure facilities and land acquisition, etc. Activities under Stage II shall normally be completed within 1.5 years from the date of sanction.

**Stage III:** This stage would require approval of PIB/CCEA for investment decision in respect of construction of the project. Approval of PIB /CCEA would be sought after the Environment & Forest clearance is obtained from MOEF and the techno-economic clearance from the Central Electricity Authority.

## Electricity Act, 2003

This Act is expected to provide a new momentum for the overall development of the power sector in India, including for hydropower development. The provisions pertaining to trading, open access, stand-alone systems, exemption of a power generating company to obtain a license, mandatory share for renewables and the development of the national power grid are of special relevance in this context.

<sup>16</sup> Report of the Standing Committee on Energy, August 2005.

<sup>17</sup> Interview with Mr. R. V. Shani, Powerline, January 2006.

In 2005 MOP issued guidelines for determining the tariff by the bidding process. These envisage that the purchaser of power shall procure the site, get all the requisite clearances, and then bid for developing the project at the lowest cost of developed power on the basis of tariff. The guidelines for procurement of power are given separately for base load and for peak load requirements, which should facilitate setting up of peaking power plants.

## Institutional and Budgetary Support

Considering that the public sector has played a major and almost exclusive role in developing hydropower, the world over including the developed countries and the fact that hydro in the privately owned independent power producer (IPP) mode has still to catch on, the Government proposes to pursue a judicious mix of both public and private sector options for ensuring accelerated hydro development. The efforts being made in pursuing the private sector option are covered in detail in Section VI. The aim is to generate confidence in the prospective entrepreneurs/developers and offer terms and conditions, which will be attractive and cover undue risks without jeopardizing consumer interests.

The Government has also taken a pragmatic view that in the immediate future the public sector would have to play a dominant role in developing hydropower. Accordingly, a gross budgetary support of nearly Rs175 billion has been allocated to hydropower development, out of the total allocation of Rs250 billion for the power sector for the 10<sup>th</sup> Plan (2002–2007). This also amounts to a substantial increase compared to the allocation made in the 9<sup>th</sup> Plan (1997–2002), which was to the tune of Rs92 billion.

A number of hydropower corporations have also been established in the central sector and in the joint sector (Central and State). These include the NHPC, North-Eastern Electric Power Corporation (NEEPCO), Nathpa-Jhakri Power Corporation (NJPC) now Satluj Jal Vidyut Nigam Limited (SJVN) and Tehri Hydro Development Corporation (THDC). Besides, the National Thermal Power Corporation (NTPC) has been authorized to take up hydro projects. Narmada Hydro Development Corporation (NHDC), a joint venture of the National Hydroelectric Power Corporation (NHPC) and the Government of Madhya Pradesh, has been constituted to implement Indira Sagar (1,000 MW) and Omkareshwar (560 MW) projects.

For execution of the projects as per schedule, a stronger monitoring mechanism for construction/execution of the hydro projects has been put in place by MOP/CEA to realize the target set for the 10<sup>th</sup> Plan. CEA nodal officers regularly visit project sites so as to identify problem areas and also give regular feedback on the progress made and corrective steps to be taken to streamline the execution of the projects.

Efforts are also being made to facilitate long-term financing of loans. For example, the Power Finance Corporation (PFC) is now giving loans with a maximum repayment period of 20 years with a moratorium of 6 months after commissioning of projects.<sup>18</sup> Interest during construction is also eligible for financing. There is a provision for refinancing after commissioning of the project. As per prevailing norms, 80% of the project cost can be debt financed for central sector projects and state sector projects in those states where reforms have been undertaken. For other states and IPPs up to 70% of the project cost can be financed. Key considerations of PFC for financing hydropower projects are projected tariff, quality of DPR, purchaser's financial health, power purchase agreement and payment security mechanism.

Project developers can also play a pro-active role in minimizing these barriers. A good communication strategy with the public and especially the project-affected people is also important.

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<sup>18</sup> Discussions with PFC.

A recent publication of the Indian National Hydropower Association (INHA) has chronicled some of the initiatives taken by NHPC in some of their projects.<sup>19</sup> These include ethnographic studies before formulating R&R plans, direct communication with people, provision of schools, health care centers, planting of trees, adoption of biological, engineering and bio-engineering measures to check soil erosion, etc. It also provides examples of how adverse impact or damage to any monument or structure were avoided through proper planning and design.

Recognizing the concern of the developers of the impact of the free power provision on tariffs, MOP had mooted a proposal to stagger the 12% free power keeping it low in the initial years and raising it gradually to 12% in order to keep the initial tariff viable (back-ending of tariff) during the loan repayment period. The matter is taken up with the state governments on a case-to-case basis. The Government of Jammu and Kashmir has agreed to forego its share of 12% free power, from the Baglihar Hydroelectric Project and the Government of Madhya Pradesh has also agreed to forego its free power share in the Omkareshwar Project.

The strategies being adopted in Uttaranchal, Himachal Pradesh, Sikkim and NER are given in Appendixes 6–9.

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<sup>19</sup> 'Reckoning the reality' INHA, February 2005.

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# Private Sector Participation

## Progress So Far

**A**s mentioned earlier, the hydropower sector was opened up for private sector participation in 1991. However, so far only about 910 MW has been commissioned, which constitutes less than 3% of the total installed hydropower capacity. The main developers were Malana Power Company (Malana – 86 MW), Jaiprakash Industries Limited (Baspa II – 300 MW), and S. Kumar Group (Maheshwar – 400 MW). The Malana project, India's first IPP, is often hailed as a success story. It was completed in a record time of 30 months at a cost of Rs350 crores. The project started operation with a 10-year power purchase agreement with the Rajasthan Spinning & Weaving Mills. The company was required to provide 12% free power to Himachal Pradesh and also pay wheeling charges to Himachal Pradesh, Rajasthan and to the Power Grid Corporation of India Limited (PGCIL), whose transmission systems were used for the power transfer. Presently it is supplying power to Haryana, availing of the trading facility.

## Barriers in Private Participation

Development of hydropower projects had been impeded in the past due to a variety of reasons like (a) long gestation period; (b) capital intensive nature of projects; (c) requirements of statutory clearances; (d) geological surprises often encountered; (e) land acquisition problems; (f) law and order problems in some cases; (g) R&R problems; etc., as detailed in Section IV. In overall terms, this presented a higher level of risk, which the private sector is generally averse in taking. This often meant time and cost overruns of projects. Non-availability of long-term debt financing, creditworthiness of the utilities to whom they have to sell the power,<sup>20</sup> provision of free power, and front-ended tariffs were also factors adversely impacting the foray of the private sector into hydropower development.

The reluctance of FIs to fund hydropower projects in the private sector is also a main factor responsible for the slow development of hydro projects. This can be traced to the high levels of construction risks that hydropower projects often encounter besides general problems of IPPs like payment security, etc. The FIs had therefore, been seeking additional comforts like government guarantees, escrow accounts, etc. However, encouraged by the various provisions of the Electricity Act 2003 such as open access, recognition of power trading and setting up of regulatory commissions, the FIs are no longer looking for government guarantees and have reiterated that there would be no dearth of funds for good projects with viable tariffs promoted by credible developers.<sup>21</sup>

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<sup>20</sup> The lenders also look forward long-term power purchase agreements.

<sup>21</sup> MOP. 2005. Draft Guidelines for Development of Hydro Electric Project-Sites by Private Developers.

## Review by the Standing Committee on Energy

The parliamentary committee on energy in its review of the hydropower sector had also noted with concern the poor contribution of the private sector. The committee has observed the need to generate confidence in prospective developers and offer terms and conditions which will be attractive and cover undue risks without jeopardizing consumer interests.<sup>22</sup> The committee has also recommended that the Government should frame guidelines for development of hydropower projects on the lines prevalent in the United States, where development rights are decided mostly on the basis of qualifications and credibility of the developer. The objective is to encourage only those having experience in hydropower development and an impeccable track record.

The committee has also concluded that due to long gestation period and the many uncertainties involved, hydropower projects, especially the larger ones, may not find favor with the lenders. Accordingly, it has recommended that multi-purpose projects, those involving inter-state issues and cooperation with neighboring countries, pumped storage schemes, and projects in the NER may be continued in the public sector. The following types of projects, according to the committee, may be poised for private sector participation:

- Extension projects where dam and major structures have already been constructed and the new works proposed cover mainly powerhouse buildings and installation of generating equipment;
- Projects at the toe of existing dams; and
- Run-of-river schemes involving minimum underground works.

## Government Initiatives

As mentioned earlier, the Government has taken a number of measures in recent years to accelerate hydropower development (of special relevance to private developers are the preparation of a shelf of well investigated projects, which could substantially reduce risk perceptions), streamlining of the clearance procedures, the provisions of open access and trading as per Electricity Act 2003, etc. Efforts are also being made to make long-term debt available. As mentioned in Section V, PFC is now giving loans to private sector hydropower projects for up to 70% of the project cost with a maximum repayment period of 20 years with a moratorium for construction period plus 6 months.<sup>23</sup>

In January 2004, MOP constituted an inter-institutional group (IIG) of FIs with an objective to expedite the financial closure of private sector power generation projects and to address last-minute issues impeding project development and financing. The members of IIG are the State Bank of India (SBI), Industrial Credit and Investment Corporation of India Limited (ICICI), Industrial Development Bank of India (IDBI), Life Insurance Corporation (LIC), PFC and Infrastructure Development Finance Company (IDFC). Since its formation, 11 projects with an aggregate capacity of 4,001.8 MW have achieved financial closure. Currently, six projects with an aggregate capacity of about 7,532 MW are under IIG's consideration.

As mentioned earlier, MOP has already issued guidelines for tariff based bidding. It has also recently notified draft guidelines for the development of hydropower project sites by private developers.<sup>24</sup> The salient features of these guidelines are in Appendix 5.

<sup>22</sup> Report of the Standing Committee on Energy, August 2005.

<sup>23</sup> Teesta III (1,200 MW) and Teesta VI (360 MW) promoted by Teesta Urja Limited and Lanco Energy, respectively, as joint venture projects with SPDCL in Sikkim, are under the active consideration of PFC.

<sup>24</sup> MOP. 2005. Guidelines for Development of Hydroelectric Project Sites by Private Developer.

## State-level Initiatives

The hydro-rich states like Uttarakhand, Himachal Pradesh and Sikkim have taken a number of initiatives in recent years to promote a balanced growth of public and private sector projects (Appendixes 6–9). These are briefly discussed below.

**Uttarakhand:** The key features of the government of Uttarakhand's policy are (a) potential hydro projects identified by the government of Uttarakhand are advertised for international competitive bids; (b) bids are invited over a minimum premium, payable upfront to the government of Uttarakhand, at the rate of Rs5 crores per project; (c) projects are allocated to bidders making the highest bid over and above the upfront minimum premium; (d) projects are allocated for an initial period of 45 years on a build-own-operate-and-transfer basis; (e) the developers of the project have the right to sell the power outside the state; no agency of the state will guarantee purchase of power; and (f) 12% of electricity generated is to be made available free of cost to the state during entire life of the project.

**Himachal Pradesh:** The key features of the policy of Himachal Pradesh are (a) selection of developer on MOU route for projects up to 100 MW and based on international competitive bidding route for projects above 100 MW; (b) no clearances from CEA for projects selected on competitive bidding route for projects costing up to Rs2,500 crores; (c) secondary energy rate to be at par with primary energy, (d) premium on peak power, and (e) 100% foreign equity permitted on the automatic approval route provided it does exceed Rs1,500 crores. Also for projects above 100 MW installed capacity, the government has reserved the right of equity participation up to 49% on a selective basis.

**Sikkim:** In order to expedite hydropower development through private sector participation in the State, the government of Sikkim has formed the Sikkim Power Development Corporation Ltd (SPDCL), to facilitate joint venture projects between a private power developer and the government. For SPDCL-promoted projects and as per the MOU signed between the Sikkim government and a private power developer, 12% free power would be made available to the State and the private power developer would be permitted to sell its entire balance power directly to needy states or through power trading agencies, whichever way they would like to sell. In all SPDCL-promoted joint venture projects, the government's equity participation ranges from a minimum of 10% to a maximum of 49%.

## Looking Ahead

The above analysis shows that private sector participation in hydropower development is likely to increase appreciably in the coming years. The excellent initial response from private developers in a number of states, despite the provision for free power and upfront premium and the fact that the tariffs may eventually come under the purview of the regulator, shows that there is an appreciable reduction in their risk perceptions. Early implementation of the open access provisions, increase in trading activity and premium for peaking power (as proposed in Government policies) would further enliven the interest of the private sector. A public-private partnership approach could also contribute to this.

# The Small Hydro Segment

India has an identified small hydro (up to 25 MW) potential of nearly 10,000 MW distributed over 4,000 sites. It is estimated there is still an unidentified potential of almost 5000 MW. Nearly 1,500 MW of potential has already been tapped and projects amounting to around 600 MW are under construction. Table 5 shows state-wise details of potential and existing and ongoing projects.

**Table 5: State-wise Details of Small Hydro Development**

State/Union Territory	Potential		Existing Projects		Ongoing Projects	
	No. of Sites	Capacity (MW)	No. of Sites	Capacity (MW)	No. of Sites	Capacity (MW)
Andhra Pradesh	286	254.63	52	158.26	9	23.85
Arunachal Pradesh	492	1,059.03	51	36.37	26	47.64
Assam	46	118	3	2.11	8	51.00
Bihar	92	194.02	4	44.90	10	15.00
Chattisgarh	47	57.90	3	3.50	3	15.50
Goa	3	2.6	1	0.05		
Gujrat	290	156.83	2	7.00		
Haryana	22	30.05	4	48.30		
Himachal Pradesh	323	1,624.78	44	93.54	10	67.20
Jamuna & Kashmir	201	1,207.27	27	102.24	9	13.31
Jharkhand	89	170.05	6	4.05	8	34.85
Karnataka	230	625.61	40	211.68	16	79.10
Kerala	198	466.25	10	72.02	10	73.00
Madhya Pradesh	85	336.325	7	38.96	4	26.40
Mahafashtra	234	599.47	27	207.08	4	15.75
Manipur	96	105.63	8	5.45	3	2.75
Meghalaya	98	181.5	3	30.71	9	3.28
Mizoram	88	190.32	16	14.78	3	15.50
Nagaland	86	181.39	8	20.47	6	12.40
Orissa	161	156.76	6	7.30	7	40.97
Punjab	78	65.26	21	108.40	1	2.70
Rajasthan	49	27.26	10	23.85		
Sikkim	68	202.75	12	355.60	5	15.20
Tamil Nadu	147	338.92	11	76.40	2	7.90
Tripura	8	9.85	3	16.01		
Uttaranchal	354	1,478.24	72	65.20	29	32.42
Uttar Pradesh	211	267.061	8	21.5	1	3.60
West Bengal	145	182.62	18	92.28	5	5.62
Andaman and Nicobar	6	6.40	1	5.25		
<b>Total</b>	<b>4,233</b>	<b>10,324.37</b>	<b>478</b>	<b>1,553.26</b>	<b>188</b>	<b>604.94</b>

Source: Powerline, 2005.



Small hydropower projects (SHPs) are generally developed in the potential regions by the SEBs/ state renewable energy development agencies.<sup>25</sup> Most of these SHP projects are grid-connected. However, there are some projects that are decentralized and are managed by local communities/ NGOs. The Micro and Pico hydropower projects come under the social sector which are set up under rural electrification programs and are mostly stand-alone/mini grid systems feeding power to the under-privileged population living in remote areas.

The Ministry of Non-conventional Energy Resources (MNES), which is overseeing the development of small hydropower, has set a target of tapping around 2,000 MW till 2012. Various physical and financial incentives are being extended to develop this sector. The focus of the SHP program at MNES is now toward commercialization through private sector participation. Some of the important initiatives taken by MNES are discussed below.

### Salient Features of UNDP-GEF Project

In 1995 MNES took up a project with support from the Global Environment Facility (GEF) and United Nations Development Programme (UNDP), aimed at optimal utilization of small hydro resources.<sup>26</sup> Salient features are in Box 3. This project was completed in 2004.

### Provision of Incentives

MNES is also providing financial support to states for (a) identification of new potential sites and preparation of a perspective plan, (b) detailed survey and investigation and preparation of DPRs, (c) project implementation, and (d) for implementation of off-grid micro hydro projects up to 999 kW for rural electrification development in their respective state. The level of support being provided is shown in Tables 6–9.

**Table 6: MNES Support for Assessment of Potential Preparation of Perspective Plan**

State/Union Territory	Identification of up to 50 New Sites (Rs lakhs)	Identification of More Than 50 New Sites (Rs lakhs)
North-Eastern Region, Sikkim, Jammu and Kashmir, Himachal Pradesh, and Uttarakhand (Special Category States)	22.50	30.00
Other States/Union Territories	15.00	22.50

**Table 7: MNES Support for Preparation of Detailed Project Reports**

Area	Up to 1 MW (Rs lakhs)	Above 1 MW and up to 10 MW (Rs lakhs)	Above 10 MW and up to 25 MW (Rs lakhs)
North-Eastern Region, Sikkim, Jammu and Kashmir, Himachal Pradesh, and Uttarakhand (Special Category States)	1.75	3.00	5.00
Notified hilly regions of all other states and islands	1.50	2.50	4.00
Plain and other regions of all states	1.25	2.00	3.00

<sup>25</sup> In states like Andhra Pradesh, Himachal Pradesh, Punjab, Orissa and Uttarakhand private players have also come forward.

<sup>26</sup> The project had an approved outlay of Rs450 million (\$5 million) shared through GEF inputs of \$7.5 million and Government inputs of Rs224.8 million. The project was executed by MNES and monitored by UNDP.

**Table 8: MNES support for Project Implementation**

	Area	Below 500 kW	500 kW up to 1 MW	Above 1 MW and up to 5 MW	Above 5 MW and up to 15 MW	Above 15 MW and up to 25 MW
Interest subsidy for commercial projects	Plain		5.00%	2.50%	2.00%	1.50%
	Hilly and North-Eastern Region		7.50%	5.00%	3.00%	2.00
Capital subsidy for government projects	North-Eastern Region and Sikkim	90% cost of the project up to Rs 75,000/-kW	90% cost of the project up to Rs 60,000/-kW	75% cost of the project up to Rs45,000/-kW	Equipment Cost + 25% of Civil cost limited to Rs22.50 crores/project	Nil
	Middle Himalayas, Ladakh, and Andaman & Nicobar Islands	Equipment Cost + 50% of Civil Cost up to Rs45,000/kW		Equipment Cost + 25% of Civil Cost up to Rs3.00 crores/MW	Equipment Cost + 25% of Civil Cost limited to Rs15 crores/project	Nil
	Other areas (only notified hilly regions)	Equipment Cost + 50% of Civil Cost up to Rs30,000/kW		Equipment Cost + 25% of Civil Cost up to Rs1.5 crores per MW	Equipment Cost + 25% of Civil Cost limited to Rs7.5 crores/project	Nil
Renovation and modernization of projects	Up to Rs2 crores/MW				Limited to Rs10 crores/project	Nil
Development/Upgradation of water mill						
Mechanical mode Mechanical/electrical mode			Rs30,000 Rs60,000			

**Table 9: MNES Support for Off-grid Micro Hydro Projects for Rural Electrification**

Region	Up to 100 kW	Above 100 kW & up to 999 kW
For North-Eastern Region, Sikkim, Jammu and Kashmir, Himachal Pradesh, and Uttaranchal	90% of the project cost limited to Rs60,000/kW	Rs60 lakhs + Rs43,250/kW
Notified hilly regions of other states and islands	90% of the project cost limited to Rs60,000/kW	Rs60 lakhs + Rs43,250/kW
Plain and other regions of all other states	90% of the project cost limited to Rs45,000/kW	Rs45 lakhs + Rs29,250/kW

## Barriers in Development of Small Hydro Segment

The barriers perceived in development of the small hydro segment are technical, procedural and cost-related in nature. The technical barriers include factors such as accessibility to the sites and risks involved in transporting heavy equipments to the sites. The procedural issues primarily relate to the number of clearances required before taking the project. Typically, a developer is required to get a project allotment from the state nodal agency, obtain clearance from MOEF where forestland is involved (in projects costing more than Rs100 crores), clearance from the Irrigation/Water Resources Department, clearance from the state government on land availability, etc. In the absence of any provision for a single window clearance, the process of obtaining these clearances/approvals may take a long time. In some areas security problems are also experienced due to insurgency. On the cost front, it is a matter of some concern that equipment prices are not going down due to the limited number of players.

## State-level Policies

As mentioned earlier the development of small hydro has been largely governed by state-level policies. The regulatory commissions are now looking into these policies. A few of the regulatory commissions have come out with their orders which cover buy-back rate, wheeling and banking conditions, which varies from state to state. For example, the buy-back rate in Uttar Pradesh is Rs3.39 /kWh compared to Rs2.69/kWh in Karnataka. Similarly the limit for banking surplus energy is 2.5% in Karnataka, whereas it is 10% in Maharashtra. Since electricity is a concurrent subject as per the Constitution of India, these variations could be expected. However, considering the renewed thrust being given for renewable energy in Electricity Act 2003, it is likely that there may be some harmonization of approaches with increased incentives aimed at expanding the share of renewable sources in the power procurement portfolio of distribution companies.

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# Energy Security Issues and Regional Cooperation in Hydropower Development

In recent years, as a result of economic and population growth, South Asia has experienced a sharp increase in energy consumption. As a consequence, the growth in commercial energy demand in these countries is very high compared to other regions of the world, and is projected to continue to grow in future. This rapidly growing energy demand coupled with inadequate supplies is a challenge for the energy security of South Asia. Despite its rich resource endowment, the region continues to face power shortages, which has constrained economic growth.

The region is well endowed with natural resources and there is tremendous scope for cooperation in the field of energy. Nepal and Bhutan, the two neighboring countries of India have rich hydropower potential far in excess of their domestic requirement. India with its large demand supply gap offers a ready market for these two countries. Cooperation between India, Nepal and Bhutan on the energy front can therefore provide a win-win situation for all. India could import hydropower to meet part of the country's energy needs. Nepal and Bhutan, on the other hand, could earn rich revenue to boost their economy. Besides, it could open up options of electrifying the border areas of these countries by extending the power grid of India. This could also lead to the evolution of the South Asian Association for Regional Cooperation (SAARC) power grid. The status of cooperation between these countries is discussed below.

## Cooperation with Nepal

India has been assisting Nepal in the development of its hydropower potential. Four hydroelectric schemes, namely, Pokhara, Trisuli, Western and Gandhak and Devighat, have been implemented in Nepal with financial and technical assistance from India. The Government of India nominated the Power Trading Corporation (PTC) as the nodal agency to deal with matters relating to power exchange with Nepal in July 2001. PTC is also the sole agency from the Indian side for finalizing all commercial and technical arrangements/systems with Nepal Electricity Authority (NEA) and coordination with associated Indian agencies. The bilateral exchange of power at the borders between the two countries is presently at a level of 50 MW. The two sides through Indo-Nepal Power Exchange Committee decide the tariff jointly at periodic intervals with the underlying principle of meeting the cost of supply of power. The power exchange between the two countries is made possible by interconnections at the voltage levels of 11 kV, 33 kV and 132 kV at 22 interconnection points.

During 2003–2004 Nepal had imported around 186 million units (MUs) of energy from India and exported 138.90 MUs. As per the water resources strategy of Nepal, by 2017 Nepal aims to develop 2,230 MW hydropower to meet the projected demand of 2,230 MW including 400 MW for export to India. Under a high growth scenario, the strategy projects that by 2027 the country would earn significant national revenue by developing a total hydropower capacity of 22,000 MW including 15,000 MW for exports.<sup>27</sup>

Three major multi-purpose projects in Nepal, viz. Karnali, Pancheshwar, and Saptakoshi are presently under discussion at various levels as mutually beneficial projects. The feasibility report for the Karnali multi-purpose project (10,800 MW) was prepared in 1989. Key parameters of this project are to be finalized after mutual discussions. A Joint Committee on Water Resources headed by the respective water resources secretaries has been constituted to act as an umbrella committee to ensure implementation of the existing agreements and also to oversee work of all technical and expert-level committees related with water resources. During the meeting of the Joint Committee, it was decided to initiate consultations for the development of the Karnali Project. Investigations have been carried out in respect of the Pancheshwar multi-purpose scheme (5,600 MW) by the two countries in their respective territories. A Joint Project Office (JPO) was established in Kathmandu in December 1999 to carry out additional investigations and for preparation of the DPR. The JPO was closed in July 2002. A draft DPR has been prepared by the Indian side, which is to be mutually agreed to. Development of this project is covered under the Integrated Mahakali Treaty signed between Nepal and India in February 1996. India has offered financial and technical assistance for investigation and preparation of the DPR of the Saptakoshi High Dam Multipurpose project and Sun Kosi Storage-cum-Diversion Scheme. A JPO was established on 4 August 2004 in Biratnagar, Nepal, for taking up field investigations and studies for preparation of the joint DPR in about 30 months. Besides the above, a number of other projects, such as Burhi Gandaki (600 MW) and Upper Karnali (300 MW), are also under discussion between India and Nepal. Joint technical expert groups have been constituted for the above projects for guidance for carrying out investigations and preparation of the DPRs.

## Cooperation with Bhutan

India has had a long association in providing technical and financial assistance to Bhutan in the development of its hydropower resources. Electricity is Bhutan's principal export commodity and the largest revenue earner. Chukha hydropower project (336 MW) has been an important project developed as a joint venture between the Government of India and the Royal Government of Bhutan, with the Government of India providing the funds for the project. The construction of the Chukha hydroelectric plant was started in 1978. It was successfully commissioned in 1988. The project was handed over to Bhutanese management in June 1991. About 84% of energy generated from Chukha plant is exported to India. The Kurichu Hydroelectric Project (60 MW) in eastern Bhutan has also been implemented with Indian financial and technical assistance. Energy traded during 2003–2004 was around 1,752 MU (1,495 MU from the Chukha and 257 MU from Kurichhu).

Another project, viz., the Tala Hydroelectric Project (1020 MW) has been taken up for implementation and is being executed by Tala Hydro-electric Project Authority (THPA) comprising the Indian and Bhutanese engineers. Design and engineering consultancy for the project in respect of the electro-mechanical and civil works is being rendered by the CEA, Central Water Commission (CWC), and Water & Power Consultancy Services (WAPCOS). The project is being funded by India through grant and loan and a major portion of the power generated will be utilized by India. The project is scheduled for completion by 2005–2006. Investigation of Sankosh multi-purpose project

<sup>27</sup> SASEC. 2004. Issues Paper on Regional Energy Cooperation, prepared by Leena Srivastava and Neha Misra.

(4,060 MW) has been completed by the CWC and DPR prepared by the CEA/CWC. Investigation of two hydroelectric projects, namely Wangchu (900 MW) and Bun akha (180 MW), have been completed and the DPR prepared. Further, the Government has agreed to provide assistance for development of two hydro projects, namely Mangdechhu (360/600 MW) and Punatsangchhu (870/1000 MW). A multi-disciplinary team visited the Punatsangchhu project site in May 2004 for identification of alternative sites and also to firm up associated survey and investigation for the preparation of DPR and at present, this survey and investigation work is in progress.<sup>28</sup>

### **Cooperation with Myanmar**

The possibility of developing the Tamanthi project (1,020 MW) in Myanmar and importing power to India has been under consideration for some time. Presently NHPC is preparing a PFR for this project.

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<sup>28</sup> TERI Energy Data Directory & Yearbook, 2004–05.

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# Conclusions

India's power sector is poised to grow at a fast pace in the coming years. This is considered crucial to sustain the country's economic growth. The reform measures being implemented and policy initiatives taken by the Central and state governments, as discussed in the report, are expected to provide an enabling environment for this.

India has an assessed hydropower potential to the tune of 84,000 MW at 60% load factor; out of this only about 20% has been developed so far. Considering the large untapped potential and the intrinsic characteristics of hydropower in promoting the country's energy security and flexibility in system operation, the Government is giving a thrust to accelerate hydropower development.

In the past various factors such as dearth of adequately investigated projects, environmental concerns, R&R issues, land acquisition problems, regulatory issues, long clearance approval procedures, power evacuation problems, dearth of good contractors, and in some cases, inter-state issues and law and order problems have contributed to the slow pace of hydropower development. There has been large time and cost overruns in case of some projects due to geological surprises, R&R issues, etc.

The above concerns are being addressed through a number of legislative and policy initiatives at the Central and state level. As discussed in detail in the report, these include preparation of a shelf of well-investigated projects and streamlining of statutory clearances and approvals, establishment of independent regulatory commissions, provision for long-term financing for projects, increased flexibility in sale of power, etc. In May 2003, the Prime Minister of India launched a 50,000 MW hydro initiative. Under this scheme, DPRs are being prepared for 73 schemes, which have an indicative first year tariff below Rs2.50. This would provide a shelf of fairly well investigated low tariff projects to prospective developers. Risk perceptions in taking up the projects and the possibilities of time and cost overruns are also expected to get minimized. Of these schemes (total capacity 32,000 MW), 70 are located in the Brahmaputra, Indus and Ganga basins in the north and north-eastern part of the country. Most of these are run-of-river schemes.

The Government has formulated a number of measures to address the issues related to water shed management upstream and downstream. For example, in the case of multi-purpose schemes, Electricity Act 2003 requires that the state government and the generating company coordinate their activities with those other persons responsible for such scheme insofar as they are inter-related. Similarly, the TEC of CEA would look into the optimal development of the river or its tributaries consistent with other requirements. The MOEF clearance would look into the environmental impacts and social/community development aspects associated with the project and the developers would be required to deposit adequate funds for compensatory afforestation, catchment area treatment plan, wildlife management plans, biodiversity conservation plans, etc. The effective utilization of

this fund would be achieved through the recently constituted Compensatory Afforestation Fund Management and Planning Authority (CAMPA).

Private sector participation has been low in hydropower sector although the sector was opened up in 1991 since the investors looked at it a higher risk proposition compared to thermal projects. The Government has taken a number of policy measures to address the concerns of prospective developers. These include availability of fairly well investigated DPRs, formulation of transparent bidding procedures, provision of open access and trading, notification of tariff determination processes, joint venture initiatives, etc. At the State level also similar initiatives are forthcoming. For example, as discussed in Section VI, Himachal Pradesh, Uttaranchal and Sikkim, which have rich untapped potential, are vigorously pursuing private sector participation. The Government's objective is to achieve a balanced growth of public, private and joint venture projects.

It is necessary to ensure that a transmission system matching with the power evacuation requirements from the individual projects are planned and implemented well in time. In order to save right-of-way and minimize the transmission charges, power from different power stations, depending upon their location, could be pooled at appropriate pooling points and these pooling points connected to the national power grid. This would call for a staged development of the national power grid with high capacity corridors. The perspective transmission plan of CEA is expected to take care of the requirements in this regard.

The small hydro segment also offers considerable scope for both grid and off-grid applications. About 80% of the estimated potential remains untapped. MNES is presently providing support to the states for assessment of potential, preparation of DPR and project implementation.

India needs to mobilize large finances for implementation of its power program. While the Government has substantially stepped up its budgetary allocations to the hydro sector, support from international donor agencies and the private sector is also needed. In case of donor-funded projects, the developers however seem to have a perception that the appraisal processes are often long and this in turn could cause delays in taking up the project for implementation and consequential time and cost overruns. Hence they hold the view that in case of projects that are in a fairly mature state for taking up for implementation, it may be prudent to borrow from the market (especially when such funding can be accessed). Nevertheless, the developers consider that working with international donor agencies would provide some rich experience and also improve their credit rating with other financiers. Accordingly, they are of the view that projects for which DPRs are under preparation and those where there are minimum R&R issues, underground works, inter-state issues and law and order problems, are best suited for seeking funding from international donor agencies.

India has been cooperating with Bhutan and Nepal in hydropower development for over a decade. There are prospects of further enhancement for the benefit of all the countries and in the larger interest of energy security of the region. Some prospects of hydropower cooperation with Myanmar are also indicated.



# Appendix A

Breakdown of Installed Generation Capacity in Utilities  
(As on 31 March 2006, in MW)

Region	Sector	Mode-wise Breakdown							Grand Total
		Hydro	Coal	Gas	Diesel	Total Thermal	Nuclear	Renewable	
Northern Region	State	6,563.68	10,752.50	901.20	14.99	11,668.69	0.00	452.68	18,685.05
	Private	390.20	0.00	0.00	0.00	0.00	0.00	241.91	632.11
	Central	4,108.00	6,840.00	2,311.99	0.00	9,151.99	1,180.00	0.00	14,439.99
	Sub- total	11,061.88	17,592.50	3,213.19	14.99	20,820.68	1,180.00	694.59	33,757.15
Western Region	State	5,220.83	14,291.50	1,390.72	17.28	15,699.50	0.00	195.05	21,115.38
	Private	460.50	2,290.00	2,398.00	0.20	4,688.20	0.00	903.78	6,052.48
	Central	1,000.00	4,360.00	1,292.00	0.00	5,652.00	1,300.00	0.00	7,952.00
	Sub- total	6,681.33	20,941.50	5,080.72	17.48	26,039.70	1,300.00	1,084.71	35,119.86
Southern Region	State	10,912.26	7,392.50	735.80	362.52	8,490.82	0.00	1,764.74	21,167.82
	Private	55.45	510.00	2,348.70	576.80	3,435.50	0.00	2,468.75	5,959.70
	Central	0.00	8,090.00	350.00	0.00	8,440.00	880.00	0.00	9,320.00
	Sub- total	10,967.71	15,992.50	3,434.50	939.32	20,366.32	880.00	4,233.49	36,447.52
Eastern Region	State	2,292.53	5,538.50	100.00	17.06	5,655.56	0.00	104.55	8,052.64
	Private	0.00	1,441.38	0.00	0.14	1,441.52	0.00	7.12	1,448.64
	Central	204.00	6,682.50	90.00	0.00	6,772.5	0.00	0.00	6,976.50
	Sub- total	2,496.53	13,662.38	190.00	17.20	13,869.58	0.00	111.67	16,477.78
North-Eastern Region	State	253.07	330.00	372.00	142.74	844.74	0.00	45.26	1,143.07
	Private	0.00	0.00	24.50	0.00	24.50	0.00	1.60	26.10
	Central	860.00	0.00	375.00	0.00	375.00	0.00	0.00	1,235.00
	Sub- total	1,113.07	330.00	771.50	142.74	1,244.24	0.00	46.86	2,404.17
Islands	State	5.25	0.00	0.00	50.02	50.02	0.00	5.25	60.52
	Private	0.00	0.00	0.00	20.00	20.00	0.00	0.17	20.17
	Central	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Sub- total	5.25	0.00	0.00	70.02	70.02	0.00	5.42	80.69
All India	State	25,247.62	38,305.00	3,499.72	604.61	42,409.33	0.00	2,567.53	70,224.48
	Private	906.15	4,241.38	4,771.20	597.14	9,606.72	0.00	3,623.33	14,139.20
	Central	6,172.00	25,972.50	4,418.99	0.00	30,391.49	3,360.00	0.00	39,923.49
	Sub-Total	32,325.77	68,518.88	12,689.91	1,201.75	82,410.54	3,360.00	6,190.86	12,4287.17

Renewable energy sources include small hydro projects, biomass gasifiers, biomass power, urban and industrial wastes, and wind energy.  
Source [http://www.cea.nic.in/power\\_sec\\_reports/executive\\_summary/2006\\_03/index.htm](http://www.cea.nic.in/power_sec_reports/executive_summary/2006_03/index.htm)

# Appendix B

List of Low Tariff Schemes under 50,000 MW Hydroelectric Initiatives

Sl. No.	Name of Scheme	State	Agency	Installed Capacity (MW )
1	Etalin*	Arunachal.Pradesh	NHPC	4000
2	Attunli*	Arunachal.Pradesh	NHPC	500
3	Naba*	Arunachal Pradesh	NHPC	1000
4	Niare*	Arunachal Pradesh	NHPC	800
5	Demwe	Arunachal Pradesh	NEEPCO	3000
6	Kameng Dam	Arunachal Pradesh	NEEPCO	600
7	Talong	Arunachal Pradesh	NEEPCO	300
8	Bhareli-II	Arunachal Pradesh	NEEPCO	600
9	Bhareli-I	Arunachal Pradesh	NEEPCO	1120
10	Kapak leyak	Arunachal Pradesh	NEEPCO	160
11	Badao	Arunachal Pradesh	NEEPCO	120
12	Dibbin	Arunachal Pradesh	NEEPCO	100
13	Oju-II	Arunachal Pradesh	NEEPCO	1000
14	Oju-I	Arunachal Pradesh	NEEPCO	700
15	Hutong	Arunachal Pradesh	NTPC	3000
16	Kalai	Arunachal Pradesh	NTPC	2600
17	Naying	Arunachal Pradesh	IPP	1000
18	Tato-II	Arunachal Pradesh	IPP	700
19	Hirong	Ar.Pradesh	IPP	500
20	Umduna	Meghalaya	CWC	57
21	Selim	Meghalaya	CWC	170
22	Mawhu	Meghalaya	NEEPCO	120
23	Nongkolait	Meghalaya	MeSEB	120
24	Nongnam	Meghalaya	MeSEB	50
25	Rangmaw	Meghalaya	MeSEB	65
26	Lachen	Sikkim	NHPC	210
27	Dikehu	Sikkim	IPP	105
28	Panan	Sikkim	IPP	200
29	Teesta-I	Sikkim	IPP	320
30	Jangi Thopan	Himachal Pradesh	IPP	480
31	Khoksar	Himachal Pradesh	IPP	90
32	Gharopa	Himachal Pradesh	IPP	114
33	Gondhala	Himachal Pradesh	IPP	144
34	Thopan Powari	Himachal Pradesh	IPP	480
35	Chamba	Himachal Pradesh	IPP	126
36	Bajoli Holi	Himachal Pradesh	HPSEB	180
37	Yangthang	Himachal Pradesh	HPSEB	261
38	Tidong-II	Himachal Pradesh	IPP	70
39	Khab-I	Himachal Pradesh	SJVNL	450
40	Luhri	Himachal Pradesh	SJVNL	465
41	Shamnot	Jammu &Kashmir	NHPC	370
42	Ratle	Jammu &Kashmir	NHPC	560
43	Kiru	Jammu & Kashmir	NHPC	430
44	Kawar	Jammu & Kashmir	NHPC	320
45	Bichlari	Jammu & Kashmir	WAPCOS	35
46	Jakhol Sankri	Uttaranchal	SJVNL	33
47	Naitwar-Mori(Devra Mori)	Uttaranchal	SJVNL	33
48	Jadh Ganga	Uttaranchal	THDC	50
49	Karmoli	Uttaranchal	THDC	140
50	Jelam Tamak	Uttaranchal	THDC	60
51	Maleri Jelam	Uttaranchal	THDC	55
52	Gohana Tal	Uttaranchal	THDC	60
53	Bokang Baling	Uttaranchal	THDC	330

Continuation...

## List of Low Tariff Schemes under 50,000 MW Hydroelectric Initiatives

Sl. No.	Name of Scheme	State	Agency	Installed Capacity (MW )
54	Chhunger-Chal	Uttaranchal	NHPC	240
55	Rupsiabagar Khasiyabara	Uttaranchal	NTPC	260
56	Lata Tapovan	Uttaranchal	NTPC	310
57	Sela Urthing	Uttaranchal	UJVNL	230
58	Bhaironghati	Uttaranchal	UJVNL	65
59	Nand Prayag	Uttaranchal	UJVNL	141
60	Tamak lata	Uttaranchal	UJVNL	280
61	Harsil	Uttaranchal	UJVNL	210
62	Sirkari Bhyol Rupsiabagar	Uttaranchal	UJVNL	210
63	Gangotri	Uttaranchal	UJVNL	55
64	Arakot Tiuni	Uttaranchal	UJVNL	72
65	Taluka Sankri	Uttaranchal	UJVNL	140
66	Bogudiyar-Sirkari Bhyal	Uttaranchal	IPP	170
67	Badrinath	Uttaranchal	IPP	140
68	Mapang – Bogidiyar	Uttaranchal	IPP	200
69	Deodi	Uttaranchal	IPP	60
70	Gundia	Karnataka	KPCL	300
71	Kalinadi Stage-III	Karnataka	KPCL	300
72	Gangavali	Karnataka	KPCL	400
73	Agnashini	Karnataka	KPCL	600
			<b>Total</b>	<b>32,936</b>

CWC = Central Water Commission, IPP = independent power producer, KPCL MeSEB MW = megawatts, NEEPCO = North-Eastern Electric Power Corporation, NHPC = National Hydroelectric Power Corporation, NTPC = National Thermal Power Corporation Ltd., SJVNL = Satluj Jal Vidut Nigam Limited, THDC = Theri Hydro Development Corporation, UJVNL WAPCO = Water and Power Consultancy Services.

Source: Central Electricity Authority.

\* Consent withdrawn by State Government.

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# Appendix C

## Requirements for Obtaining Clearances and Approvals

As per Electricity Act 2003 any generating company can establish, operate and maintain a generating station without obtaining a licence if it complies with the technical standards relating to connectivity with grid specified by the Central Electricity Authority (CEA). However, certain clearances/approvals are required for taking up hydropower projects. These are:

- (i) Consent from the respective state government for setting up the project including certificates for land and water availability;
- (ii) Techno-economic (TEC) from CEA where required as per Electricity Act 2003.
- (iii) Clearance from the Ministry of Environment and Forests (MOEF) from the point of view of environmental impact including resettlement and rehabilitation (R&R) aspects;
- (iv) Clearance from the Ministry of Social Justice & Enforcement/Tribal Affairs in case scheduled tribe population is likely to be affected; and
- (v) Clearance from the Ministry of Defence in case military land is involved.

The CEA TEC is needed only for projects involving inter-state rivers and whose estimated capital expenditure is over Rs25 billion.<sup>1</sup> This is with a view to ensure that (a) the proposed river-works will not prejudice the prospects for the best possible development of the river or its tributaries for power generation, consistent with the requirements of drinking water, irrigation, navigation, flood-control, or other public purposes; (b) adequate studies have been done on the optimum location of dams and other river-works; and (c) norms regarding dam design and safety are met.

In case of multi-purpose schemes, the state government and the generating company should coordinate their activities with those of persons responsible for such scheme insofar as they are inter-related.

As per the MOEF notification of 1994 under the provisions of the Environment Protection Act of 1986,<sup>2</sup> environmental clearance is mandatory for river valley projects including hydropower projects, including the multi-purpose ones. A project developer has to submit an application to MOEF in the specified proforma. This should include, inter alia, location and objectives of the project, number of villages likely to be displaced and a rehabilitation master plan for the same, risk assessment report and disaster management plan, an environmental impact assessment (EIA) report and details of an environmental management cell.

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<sup>1</sup> The limit of capital expenditure of the scheme is to be fixed by the Government from time to time by notification.

<sup>2</sup> MOEF. 1994. Notification on Environmental Impact Assessment of Development Projects. Available at <http://mines.nic.in/fcnot.html>

MOEF has to convey its decision regarding suitability of the proposed site within a maximum period of 30 days. This site clearance is granted for a sanctioned capacity valid for a period of 5 years for commencing the construction. Based on this clearance, the developer can go ahead with survey and investigations.

An environmental appraisal committee (EAC) set up by MOEF comprising eminent experts in the fields relevant to the EIA of river valley projects appraises the proposal. The EAC considers all the available information on the proposed project, and recommends it for clearance or rejection to MOEF. If suggested for clearance, it may also recommend conditions, which the project authorities have to comply with, such as treatment of catchment areas of the proposed reservoir, mitigatory measures for wildlife, preventive measures against waterlogging, etc. MOEF then clears or rejects the proposed project (it may over-rule the advice given by the EAC, if there are sufficient grounds for doing so); if it clears, it imposes the conditions mentioned above, seeks detailed work plans, and then institutes a system of monitoring the fulfillment of these conditions.

The process of environmental clearance has been under review for some time and MOEF has in September 2005 brought out a draft of a revised notification superseding the existing EIA notification. This aims at further streamlining of the process and does away with the need for site clearance for taking up survey and investigation of projects. It also proposes to categorize projects and delegate responsibilities for clearance of some of the projects to state governments. For example, river valley projects of capacity greater than or equal to 20 ,megawatts (MW) hydroelectric generation and 10,000 hectares (ha) of culturable command area are categorized as 'A' and these require environmental clearance from MOEF on the recommendation of an EAC. On the other hand, river valley projects of capacity less than 20 MW hydroelectric power generation and 10,000 ha of culturable command area are categorized as 'B' and these require prior environmental clearance from the state/union territory EIA authority (SEIAA). The SEIAA, in turn, will base its decision on the recommendations of a state /union territory level environmental appraisal committee (SEAC), which has to be constituted by the state government/union territory administration. The notification requires project developers to submit a pre-feasibility report along with the application. It also gives a checklist of impacts to be considered. A summary of the salient features of this notification is given in Attachment A.

Apart from the environmental clearance, projects that affect forests require a clearance for diversion of forestlands for non-forest purposes (under the Forest Conservation Act 1980). MOEF has fixed a time frame for disposal of the project proposals through Forest Conservation Rules, 2003 framed under the 1980 Act. To simplify the procedure, these rules were amended in 2004. Presently the time limit for taking a decision on forest clearance is 90 days.

A project developer is responsible for ensuring strict compliance to the provisions of the clearance issued by MOEF and for implementing various environmental measures envisaged in the EIA, including catchment area treatment (CAT) and social/community development. MOEF regional offices monitor compliance to the provisions of the Environmental Clearance. Cost of compensatory afforestation and CAT is charged to the project authorities. The money is transferred to the respective state governments to undertake the plans. Proper utilization of this money by the state/union territory governments has become a matter of concern in recent years.<sup>3</sup> In order to address this concern, the Compensatory Afforestation Fund Management and Planning Authority (CAMPA) has been constituted.<sup>4</sup> It is proposed that the developer will deposit the money with CAMPA and this will not form a part of the Consolidated Funds of India. The money will be released by CAMPA to the implementing agency in the field for execution as per schemes submitted by the

<sup>3</sup> Report of the Standing Committee on Energy, August 2005.

<sup>4</sup> Order dated 23 April 2004 published in the Official Gazette in accordance with an order dated 30 October 2002 of the Honorable Supreme Court in Writ Petition (C) No. 202 of 1995.

state/union territory governments. It has also been proposed that CAMPA will have an independent monitoring system.<sup>5</sup>

The manner of valuation of forest land diverted for non-forestry purposes based on the net present value (NPV) of diverted land has been a matter of concern for developers of hydropower projects. The matter had also come up before the Supreme Court of India.<sup>6</sup> The court has directed formation of a committee to (a) identify and define parameters (on the basis of which each of the categories of values of forestland should be estimated; (b) formulate a practical methodology applicable to different bio-geographical zones of India for estimation of the values in monetary terms in respect of each of the above categories of forest values; (c) illustratively apply this methodology to obtain actual numerical values for different forest types for each bio-geographical zone in the country; (d) determine on the basis of established principles of public finance, who should pay the costs of restoration and/or compensation with respect to each category of values of forests; and (e) identify which project deserves to be exempted from payment of the NPV. In the meantime the charges are being levied at the rate of Rs5.80–9.20 lakhs per ha depending on the density of the forest involved.

An appropriate package for R&R is yet another important consideration for hydropower projects. This is also highly sensitive from a socio-political angle. Some states and central ministries/departments already had their own policies and guidelines for R&R. With a view to bring in some uniformity in approach, the Government notified a National Policy on Resettlement and Rehabilitation (NPRR, 2003).<sup>7</sup> This policy essentially addresses the need to provide relief to the rural poor and support the rehabilitation efforts of the poorer sections of project-affected families (PAFs), small and marginal farmers, scheduled castes/scheduled tribes, and women who have been displaced. Besides, it seeks to provide a canvas for an effective dialogue between PAFs and the administration for R&R. The intention is to impart greater flexibility for integration and negotiation so that the resultant package gains all-round acceptability in the shape of a workable instrument providing satisfaction to all stakeholders. The key features of this policy are given in Attachment B.

Another area of concern in the clearance process relates to acquisition of land for hydropower development. Delay in land acquisition is one of the main reasons for delay in early execution of the projects. The process of land acquisition (both public and private) differs from state to state as per the Land Acquisition Act. Often delays take place on deciding the titleholder, classification of land and fixation of compensation.

As may be seen from the above, the process of obtaining clearances can at times be time consuming leading to not only time and cost overruns of projects but also in minimizing the interest and enthusiasm of potential developers. The Standing Committee on Energy has also taken note of this and has made the following recommendations.

- More flexibility should be given to the project authorities to acquire land by negotiations.
- Land records should be updated and computerized so that no time should be wasted in deciding the titleholder.
- The procedure for fixation of compensation for land should also be streamlined.
- The Government should amend the Land Acquisition Act and include hydropower

<sup>5</sup> CAMPA has, however, not yet become operational. In a recent ruling, the Supreme Court of India has held that the Executive Body of CAMPA has to be expanded and the involvement of NGOs should be increased. It has been directed that the Executive Body must be expanded to include two more environmentalists, one of whom may be an expert in forestry and the other in the field of forest economy development.

<sup>6</sup> Available: <http://judis.nic.in/supremecourt/qrydisp.asp?tfnm=27201>

<sup>7</sup> Ministry of Rural Development (Department of Land Resources. 2003. National Policy on Resettlement and Rehabilitation for Project-Affected Families.

projects in the priority list in order to mitigate the problems encountered while acquiring land.

- State governments should be persuaded to provide land to the project authority in the agreed time frame to facilitate shifting of project-affected persons.
- In case of projects in the hilly states, forestland should be made available by MOEF and the state government for the construction of project as well as the rehabilitation and resettlement of project-affected persons.
- Special courts should be constituted in order to expedite the outcome of land disputes, pertaining to power projects.

## Attachment A to Appendix 3

### Summary of the Environmental Impact Assessment Notification, 2006 of MOEF dated 14 September 2006

#### Background

The draft notification issued by MOEF on 15 September 2005 superseded the Environmental Impact Assessment (EIA) Notification requiring prior clearance required for river valley projects including hydel power, major irrigation and their combination including flood control. Thereafter, MOEF has incorporated the objections and suggestions received by all concerned stakeholders and have issued the EIA Notification, 2006 on September 14, 2006. This notification aims at making the EIA and prior environmental clearance processes more transparent, efficient and effective. Under the notification, all new projects or activities or the expansion or modernization of existing projects or activities can be undertaken only after the same has been accorded prior environmental clearance by the Central Government or the state-level EIA authority, as the case may be as per the requirements and procedures of the notification. River valley projects greater than or equal to 20 MW hydroelectric generation and 10,000 hectares (ha) of culturable command area fall in category 'A' of the schedule and shall require environmental clearance from MOEF on the recommendation of an expert appraisal committee (EAC), to be constituted by the Central Government. River valley projects less than 20 MW hydroelectric power generation and 10,000 ha of culturable command area fall in category 'B' of the schedule and will require prior environmental clearance from the state/union territory EIA authority (SEIAA). The SEIAA, in turn, will base its decision on the recommendations of a state/union territory level EAC (SEAC) which has to be constituted by the state government/union territory administration.

#### Application for Prior Environmental Clearance

As per the notification, an application seeking prior environmental clearance has to be made in the prescribed format after the identification of prospective site for the project and/or activities to which the application relates before commencing any construction activity, or preparation of land, at the site by the applicant. Besides, the notification gives a checklist of impacts pertaining to (i) land environment, (ii) water environment, (iii) vegetation, (iv) fauna, (v) air environment, (vi) aesthetics, (vii) socio-economic aspects, (viii) building materials, (ix) energy conservation, and (x) environment management plan, which needs to be submitted with the application. Along with the application, a copy of the pre-feasibility project report has to be submitted.

## Stages in Prior Environmental Clearance Process

The environmental clearance process will comprise a maximum of four stages:

- **Stage 1: Screening (only for category 'B' projects and activities)**  
This stage entails the scrutiny of an application seeking prior environmental clearance by the SEAC for determining whether or not the project or activity requires further environmental studies for preparation of an Environmental Impact Assessment for its appraisal prior to the grant of environmental clearance depending upon the nature and location specificity of the project.
- **Stage 2: Scoping**  
In this stage, the EAC (in case of category 'A' projects or activities), and SEAC (in case of category 'B' projects or activities), would determine detailed and comprehensive terms of reference (TOR) addressing all relevant environmental concerns for preparation the EIA report. This TOR is to be determined on the basis of the prescribed format of the notification and has to be conveyed to the applicant by the EAC or SEAC within 60 days of the receipt of the prescribed format. The TOR is also to be displayed on the website of MOEF and the SEIAA concerned. The regulatory authority concerned may also reject applications for prior environmental clearance at this stage itself on recommendation of the EAC or SEAC. In case of such rejection, the decision and the reason thereof has to be communicated to the applicant in writing within 60 days of the receipt of the application.
- **Stage 3: Public consultation**  
Public consultation refers to the process by which the concerns of local people and others concerned with respect to the potential adverse environmental impacts of the proposed project with a view to address the material concerns in the EIA and Environmental Management Plan (EMP). The public consultation is to comprise of two components:
  - (a) public hearing at site or its close proximity<sup>8</sup>
  - (b) responses by persons concerned in writing from other persons concerned having a plausible stake in the environmental aspects of the project.
- **Stage 4: Appraisal**  
Appraisal means detailed scrutiny of the application and the EIA report submitted by the applicant to the regulatory authority concerned by the EAC or SEAC concerned. The appraisal is to be made by the EAC or SEAC concerned in proceedings at which the applicant may be heard. On conclusion of the proceedings, the EAC or SEAC has to make categorical recommendations to the regulatory authority

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<sup>8</sup> To be conducted by the State Pollution Control Board (SPCB) or the Union Territory Pollution Control Committee (UTPCC) in a specified manner and forward the proceedings to the regulatory authority concerned within 45 days of receipt of request to the effect from the applicant. The proceedings of the public hearing are to be sent within 7 days thereafter directly to the applicant, the EAC or SEAC concerned, and the regulatory authority concerned.



concerned either for grant of prior environmental clearance on stipulated terms and conditions, or rejection of the application for prior environmental clearance, together with reasons for the same.

### Grant or Rejection of Prior Environmental Clearance

The regulatory authority has to consider the recommendations of the EAC or SEAC concerned and convey its decision within 45 days of receipt of the final EIA report. The regulatory authority has to normally accept the recommendations of the EAC or SEAC concerned. In cases where it disagrees with the recommendations, it has to request reconsideration by the EAC or SEAC within 45 days of the receipt of the recommendations, together with reasons for disagreement. The EAC or SEAC has to then furnish its views within a period of 60 days. The decision of regulatory authority concerned after considering these views will be final and has to be conveyed within 30 days of receipt of views of the EAC or SEAC.

### Validity of Environmental Clearance

The prior environmental clearance granted for river valley projects shall be valid for a period of 10 years. This validity may be extended by the regulatory authority concerned by a maximum of 5 years provided an application is made to it by the applicant within the validity period together with updated information in the prescribed Form.

### Post-environmental Clearance Monitoring

It will be mandatory for the project management to submit half yearly compliance reports in respect of prior environmental clearance terms and conditions to the regulatory authority concerned on 1 June and 1 December of each calendar year. All such reports will be public documents and copies of the same will also be placed on the website of the regulatory authority concerned.

## Attachment B to Appendix 3

### Key Features of National Policy on Resettlement and Rehabilitation (2003)

The objectives of NPRR 2003 are

- (i) To minimize displacement and to identify non-displacing or least-displacing alternatives;
- (ii) To plan the resettlement and rehabilitation of project-affected families (PAFs) including special needs of tribals and vulnerable sections;
- (iii) To provide a better standard of living to PAFs; and
- (iv) To facilitate harmonious relationship between the requiring body<sup>9</sup> and PAFs through mutual cooperation.

<sup>9</sup> The NPRR defines 'requiring body' as "any company, a body corporate, an institution, or any other organization for whom land is to be acquired by the appropriate Government, and includes the appropriate Government if the acquisition of land is for such Government either for its own use or for subsequent allotment of such land in public interest to a body corporate, institution, or any other organization or to any company under lease, license or through any other system of transfer of land to such company, as the case may be.

The key features are described below.

**Appointment of the commissioner and administrator for R&R.** For projects where the appropriate government is satisfied that acquisition of land for any project involves displacement of 500 families or more in plain areas and 250 families or more en masse in hilly areas, DDP blocks, areas mentioned in Schedule V and Schedule VI of the Constitution of India as a result of acquisition of land for any project, a commissioner for R&R is to be appointed. The commissioner, who will be responsible for supervising the formulation of R&R plans/schemes and proper implementation of such plans/schemes and redressal of grievances, is to be appointed by the state government. Besides, an officer not below the rank of district collector of the state government is to be appointed as the administrator for R&R in respect of that project. This administrator is responsible for taking all measures for the R&R of all PAFs in respect to that project.

**Declaration of affected zone.** The area of the villages or localities that the project will affect is to be declared as an 'affected zone of the project' by the appropriate government through a notification in the Official Gazette.

**Carrying out survey and census of PAFs.** Once the affected zone is declared, the Administrator for R&R has to undertake a survey for identification of the persons and their families likely to be affected by the project. The policy lists the village-wise information to be collected under the survey. The survey is to be completed within 90 days of declaration of project-affected zone. On the expiry of these 90 days, the administrator has to publish a draft of the details of the findings of the survey inviting objections and suggestions from all persons likely to be affected. On the expiry of 40 days from the date of publication of the draft and after considering the objections and suggestions received, the administrator has to submit the final details of the survey with his recommendations to the state government. Within 45 days from the date of receipt of these recommendations, the state government has to publish the final details of survey in the Official Gazette.

**Assessment of government land available and land to be acquired for the purpose of R&R.** The R&R administrator has to draw up a list of lands that may be available in any existing gram *panchayat* (lowest unit of local governance at the village level) for R&R of project-affected families. Accordingly, the appropriate government has to declare any area acquired or proposed to be acquired for R&R of PAFs as a resettlement zone.

**Preparation of draft scheme/plan for R&R and its final publication.** After completion of baseline survey and census of PAFs and assessment of requirement of land for resettlement, the R&R administrator has to prepare a draft scheme/plan for the R&R of PAFs in consultation with their representatives including women, chairpersons of elected *panchayati raj* institutions (village-level government) within which the project area is situated. While preparing a draft scheme/plan, the administrator has to ensure that the cost of R&R scheme/plan is an integral part of the project cost for which the land is being acquired and the entire expenditure of R&R benefits and other expenditures for R&R of PAFs are borne by the requiring body for which the area is being acquired. It is the responsibility of the requiring body to provide sufficient funds to the R&R administrator for proper implementation of the R&R scheme/plan of PAFs. The administrator has to submit the R&R draft scheme/plan to the state government for its approval. The state government is responsible for obtaining the consent of requiring body before approving the same. The draft scheme/plan may be published in the Official Gazette to give wide publicity to the same in the affected zone.

### Monitoring mechanism

The Central Government, Ministry of Rural Development, Department of Land Resources has to constitute a national monitoring committee, to be chaired by the Secretary, Department of Land Resources for reviewing and monitoring the progress of implementation of R&R schemes/plans relating to all projects to which NPRR 2003 applies.

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# Appendix D

## Regulatory and Tariff-related Issues in Hydropower Generation

Electricity Act 2003 has heralded some significant changes to the regulation of power sector. Insofar as hydropower projects are concerned, the following assume special relevance:

- (i) Generation is de-licensed; a techno-economic clearance (TEC) from the Central Electricity Authority (CEA) is required only in case of projects involving inter-state issues or where estimated capital expenditure exceeds the limit as fixed by the Government from time to time.
- (ii) In case of generating stations set up on the basis of tariff-based competitive bidding in accordance with the guidelines issued by the Government, the appropriate regulatory commissions shall adopt such tariff. In other cases the tariffs are to be decided by the regulatory commissions under the guidance of the principles set out by the Central Electricity Regulatory Commission (CERC).
- (iii) Determination of tariff is to be guided by the National Tariff Policy and multi-year tariff principles.
- (iv) Right to open access in transmission is to come into force from the date of notification of Act. Open access in distribution has to come into force in phases as per regulations prescribed by the appropriate regulatory commissions.
- (v) Trading is a licensed activity. This would enable the generating companies to sell full or part of its power through a trader, if required.
- (vi) The transmission and wheeling charges are to be determined by the appropriate regulatory commission in a transparent manner.

### **Tariff-based Bidding**

As per the National Tariff Policy, all distribution companies are required to procure their future power requirements through competitive bidding from the generation companies. In case of central and state public sector companies, there is however a relaxation period of up to 5 years. The guidelines for determination of tariff by bidding process were notified by the Government in January 2005.

It is however seen that tariff based bidding has not caught up so far. In Himachal Pradesh, the memorandum of understanding route is proposed to be followed for projects up to 100 megawatts (MW). For projects above this capacity the selection would be on the basis of competitive bidding based on upfront premium that the developer is willing to pay. Uttaranchal is also presently following this approach. In view of the above, the regulators would be concerned with determination of generation tariffs for the time being.

## Terms and Conditions for Tariff Determination

CERC has notified the terms and conditions of tariff determination for generation companies in March 2004. These would remain in force for a period of 5 years. These are applicable in those cases where the tariff is determined by the regulatory commission and is based on the capital cost. The salient features are summarized below:

### Norms of Operation

- (i) Normative capacity index for recovery of full capacity charges
  - (a) During first year of commercial operation of the generating station
    - purely run-of-river power stations – 85%
    - storage type and run-of-river power stations with pondage – 80%
  - (b) After first year of commercial operation of the generating station
    - purely run-of-river power stations – 90%
    - storage type and run-of-river power stations with pondage – 85%
- (ii) Auxiliary energy consumption
  - (a) Surface hydro electric power generating stations with rotating exciters mounted on the generator shaft – 0.2% of energy generated.
  - (b) Surface hydro electric power generating stations with static excitation system – 0.5% of energy generated.
  - (c) Underground hydroelectric power generating stations with rotating exciters mounted on the generator shaft – 0.4% of energy generated.
  - (d) Underground hydroelectric power generating stations with static excitation system – 0.7% of energy generated.

**Debt-equity ratio.** In case of all generating stations, debt-equity ratio as on the date of commercial operation shall be 70:30 for determination of tariff. Where equity employed is more than 30%, the amount of equity for determination of tariff shall be limited to 30% and the balance amount shall be considered as the normative loan. In case actual equity employed is less than 30%, the actual debt and equity shall be considered for determination of tariff.

**Computation of annual charges.** There will be a two-part tariff comprising of recovery of annual capacity charges and primary energy charges. The capacity charges shall be computed as annual fixed charges minus primary energy charges. The annual fixed charges would include interest on loan capital, depreciation, return on equity, operation and maintenance expenses and interest on working capital.

**Primary and secondary energy charges.** Primary energy charge is to be worked out on the basis of paise per kilowatt-hour (kWh) rate on ex-bus energy that is scheduled to be sent out from the hydroelectric power generating station after adjusting for free power delivered to the home state. Rate of primary energy for all hydroelectric power generating stations, except for pumped storage generating stations, have to be equal to the lowest variable charges of the central sector thermal power generating station of the region concerned. The primary energy charge is computed based on the primary energy rate and saleable energy of the station. The rate for secondary energy will be the same as for primary energy.

**Incentive.** Incentive will be payable in case of all the generating stations, in the first year of operation, when the capacity index (CI) exceeds 90% for purely run-of-river power generating stations and 85% for run-of-river power stations with pondage or storage type power generating stations and incentive shall accrue up to a maximum capacity index of 100%. In addition, in case of commissioning of a hydropower generating station or part thereof ahead of schedule, as set out in the first approval of the Central/ state government or the TEC of CEA, as applicable, the generating station shall become eligible for incentive for an amount equal to pro-rata reduction in interest during construction, achieved on commissioning ahead of the schedule. The incentive shall be recovered through tariff in 12 equal monthly installments during the first year of operation of the generating station. In case of delay in commissioning as set out in the first approval of the Central/state government or the TEC of CEA, as applicable, interest during construction for the period of delay shall not be allowed to be capitalized for determination of tariff, unless the delay is on account of natural calamities or geological surprises.

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# Appendix E

## Draft Guidelines for Allocation of Hydrosites to Private Developers

The objectives of the draft guidelines set by the Ministry of Power (MOP) for allocating hydro sites to private developers are:

- To enhance hydroelectric generation capacity in the 11th Plan and beyond through private sector participation;
- To bring about uniformity in the approach of state governments toward allocation of hydro sites to private developers;
- To create an enabling and conducive environment for the accelerated development of hydropower projects including independent power producers (IPPs), by harmonizing the interests of various stakeholders such as state governments, displaced persons, power consumers, funding agencies, project developers, etc.;
- To ensure allocation of hydro sites to private developers in a fair and transparent manner, keeping in mind the optimal development of the river basin;
- To ensure safety of structures like dams, etc. and adherence to relevant construction, operation and maintenance standards in compliance with the regulations being framed by the Central Electricity authority (CEA) (under section 73, section 177 clause 2(b), and section 53 clause (a) & (b) of Electricity Act 2003 and ensure construction and operation of projects optimizing generation at the site;
- To ensure development of the required transmission network in an optimal manner meeting the integrated requirements of the projects in the river basin;
- To ensure funding of projects by financial institutions by meeting their concerns of payment security through long-term power purchase commitments;
- To ensure adequate compliance on vital issues like proper rehabilitation of project-affected families (PAFs) in compliance with the National Policy on Resettlement and Rehabilitation (NPRR 2003) and taking up environmental protection measures in

compliance with the provisions of the Environment Clearance issued by the Ministry of Environment and Forests (MOEF) and as envisaged in the environmental impact assessment/environmental management plan (EIA/EMP) including catchment area treatment and social/community development.

### **Allocation of Projects up to 100 MW**

**Identification of developer.** Utmost care needs to be taken while identifying developers through the memorandum of understanding (MOU) route in the interest of timely development of the project. In certain cases by not adopting tariff-based bidding, attempts to auction the sites have led to increase in capital costs which in turn results in higher tariffs and is counter to the overall national objective of exploiting hydro resources for the benefit of consumers to achieve the lowest possible tariff.

**Selection of developer.** The selection of the developer must be done in a transparent manner by laying down in advance the eligibility and evaluation criteria and method of selection. The evaluation of the bidder should inter alia be on his financial strength and his past track record. The project developer must be required to submit a detailed action plan within 6 months of allotment with clearly identifiable intermediate milestones. In case of inordinate delays and failure to meet the milestones, the allotment should be liable for cancellation. The state government shall be entitled to realize 12% free power from the project for local area development and mitigation of hardships to the project-affected people in line with the policy of the Government.

**Resettlement and rehabilitation.** The R&R of the project-affected people should be undertaken by the state government in line with the minimum requirements of the National Policy on Resettlement and Rehabilitation for Project-Affected Families issued in 2003 (NPRR 2003).

**Environmental protection.** The project developer should be made responsible for ensuring strict compliance with the provisions of the environment clearance issued by MOEF, and implement various environmental measures envisaged in the EIA/EMP, including catchment area treatment and social/community development. The state government must ensure that extent and level of such program/plan is decided in accordance with scientific studies carried out.

**Payment security through long-term power purchase agreements (PPAs)** in order to address the concerns of the financial institutions and requirements of transmission. In all the cases of MOU, the letter of allotment should inter alia contain a condition of the developer entering into long-term PPAs, of at least 25 years tenure, within a reasonable time frame. The tariff should follow the CERC norms which would entitle the power purchasers, who pay for the power in the initial years, to enjoy lower tariff regimes after the project is fully depreciated.

Further, long-term power purchasers through PPAs shall have to pass on the benefits of the lower tariffs to the consumer at large. Allotment conditions in this regard should be clear enough to lend itself to an appropriate dispensation by the regulator in order to ensure that the above requirements are met. It is necessary that the transmission for evacuation of power from the project is planned keeping in view the timing of project completion and optimizing the redundancies for future capacities. Agencies like the Power Grid Corporation of India Ltd. (PGCIL) (the central transmission utility) would have to be kept involved for inter-state sale of power and state transmission utilities for projects selling power within the state. CERC in its recent order has required that the transmission corridor would have to be booked for a minimum period of 25 years to qualify as "long-term user". PPAs would therefore have to also reflect this development and coincide for at least this period of 25 years.



Ensuring a time bound development. Further, in order to ensure that the projects are implemented within a reasonable time frame, a specific provision must be made in the MOU with intermediate milestones, which if not achieved on time would result in cancellation of the allocation. This sunset clause is essential in view of the experience of large number of projects already allocated by the states languishing with very little physical progress on the ground.

### **Allocation of Projects above 100 MW**

Promotion of competition in the electricity industry is one of the key objectives of the Electricity Act, 2003. Power purchase costs constitute the largest element for distribution licensees. Procurement of power at competitive rates by utilities will optimize the overall costs and facilitate development of power markets. International experience has shown that competition in wholesale electricity markets has actually led to reduction in prices of electricity bringing significant benefit for consumers.

Criteria for selection of developer. Allocation of projects (of capacity above 100 MW) should be done solely on the basis of a competitive tariff-based bidding process which would meet requirements of transparency and fair competition aimed at providing power to the consumer at competitive rates as also ensuring free power to the home state while ensuring reasonable returns to the project developer. This alone can keep the overall cost of generation of hydro projects at reasonable levels.

Minimum bidding requirements. A pre-requisite for meaningful competitive bidding is that the prospective developers have access to a reasonably reliable detailed project report (DPR). A DPR with all the relevant data is the basic requirement for a prospective bidder that will enable him/her to properly estimate the various elements of cost and make a meaningful bid on tariff. DPRs for hydroelectric projects of capacities greater than 100 MW would require very comprehensive studies from the point of view of hydrology, geology, seismology, meteorology, etc., meeting the CEA's "Guidelines for formulation of project reports for power projects" and CWC's "Guidelines for Preparation of Detailed Project Reports of Irrigation and Multi-Purpose Schemes". It would not be prudent to expect each of the developers to spend their time and money on investigations even prior to the event of putting in their bids.

For the preparation of DPRs two options are available. Either the state governments should get the DPRs prepared on their own or may approach the central agencies to get these DPRs prepared. MOP would facilitate this exercise by making appropriate provisions either in its budget or through CPSUs. In either of these two options a mandatory condition would be that the agency selected for developing this project through competitive bidding shall reimburse the cost of the DPR. The DPRs so prepared should be vetted by another agency like CEA or a reputed agency recognized by CEA. This would not only ensure that the issues relating to dam safety, river basin optimization, etc. are adequately addressed but would also address important interstate issues.

Payment security and other requirements. For securing transmission arrangements as also with a view to ensure early financial closure of the project and providing benefit of reasonable tariff to consumer at large, the requirement of a long-term PPA, of a minimum 25 years tenure, would be made mandatory. Compliance to the provisos outlined above in paragraphs on R&R, environment protection, and payment security through long-term PPAs co-terminus with long-term booking of transmission corridors and addressing the concerns of the FIs.

## **Bid Evaluation Methodology to be Adopted by the Procurer**

The bidding process must be a two-stage process featuring a separate request for qualification (RFQ) and a request for proposal (RFP).

The state government should publish the RFQ notice in at least two national newspapers, the government website and trade magazines and also accord it wide publicity. The bidding shall necessarily be by way of international competitive bidding. For the purpose of issue of RFQ the minimum conditions to be met by the bidder shall be specified in the RFQ notice along with the evaluation criteria thereof. Standard documentation to be provided by the state government in the RFQ shall include the following:

- DPR (duly vetted by the competent authority) containing the requisite hydrological, geological, meteorological and seismological data and basic dam design and project outline as per CEA's "Guidelines for Formulation of Project Reports for Power Projects" and CWC's "Guidelines for Preparation of Detailed Project Reports of Irrigation and Multi-purpose Schemes."
- Site details including land acquired, details of project-affected people and project-affected families.
- The minimum conditions, both financial and past track record, required to be fulfilled by the developer and the evaluation criteria thereof.
- The risk allocation between the state government and the project developer. The term of contract proposed (the codal life of hydro projects being 35 years the preferable term of contract would 35 years but in no case it can be less than 25 years which is the requirement for booking the long term transmission corridor).

The standard documentation to be provided by the state government in the RFP should inter alia include the following:

- Technical requirements on minimum capacity – conditions which the state government must ensure are in conformity with the requirements of CWC/CEA for optimum basin development. Issues relating to flood control, irrigation, drinking water, navigation, inter-state requirements must be addressed by the state government and the final responsibility for ensuring clearances /permission from the relevant authorities for these issues would rest with the state government as per CEA's "Guidelines for Formulation of Project Reports for Power Projects" and CWC's "Guidelines for Preparation of Detailed Project Reports of Irrigation and Multi-purpose Schemes".
- The time period within which the developer must complete critical milestones must be spelt out upfront and the developers informed that failure to adhere to the agreed time line could result in cancellation of project allocation.
- Default conditions including sluggish progress, cure thereof and penalties would also be clearly stated.

- Dam design, safety and other technical, operational and safety criteria to be met by the developer including the provisions of the Indian Electricity Grid Code/State Grid Code, relevant orders of the proper commission, and regulations framed by CEA as applicable.
- Requirements to be met by the project developer to demonstrate his ability to raise the required finances from the FIs at the time of submission of bids. This would accelerate the process of financial closure and development of the hydroelectric project within a stipulated time.
- The state government must clearly stipulate the exit option conditions for the lead developer so that the project development is not delayed/held up indefinitely in case of such a contingency.
- The RFP shall also provide the maximum period within which the selected developer must commission the project. This shall ordinarily not be less than 4 years from the date of allocation of site to the developer and would be project specific.
- The RFP shall also specify the liquidated damage that would apply in the event of delay in commissioning of the project.
- The project developer must be required to submit a detailed action plan within 6 months of allotment with clearly identifiable intermediate milestones. In the case of inordinate delays and failure to meet the milestones the allotment should be liable for cancellation and should invariably be cancelled if the project implementation is not being pursued in line with this policy.
- The cost on R&R, environmental measures, catchment area treatment, land acquisition including social and community development should be frozen before issuance of RFP and duly indicated therein. The state government should be solely responsible to provide land (both private, and government) in a phased manner in accordance with the schedule agreed with the developer.

### **Bid Evaluation Methodology to be Adopted by the State Government**

The bid must be evaluated solely on the basis of the composite levelled tariff quoted by the bidder.

The project developer must demonstrate his commitments to the tariff through duly initialed and authenticated PPAs at the indicative tariff with the distribution utilities, for at least 90% of the design energy. The remaining power up to 10% could be operated on merchant basis.

Formation of consortium by the bidders may be permitted. In such cases the consortium shall identify a lead member and all correspondence from the bid process shall be done by the lead member. The lead member shall not ordinarily have an exit option before the commissioning of the project. The state government may specify technical and financial criteria and lock in requirements for the lead member of the consortium, if required.

The state government shall ensure evaluation of the bids for all projects on inter-state rivers in line with CEA's/CWC's optimal development plan of the river basin.

The evaluation committee shall reject all bids if the composite tariffs quoted are not aligned to the prevailing market prices.

### **The Bid Process**

The bid process adopted should be as outlined in the tariff-based guidelines of the Government of India issued on January 2005.

### **Arbitration**

The state government will establish an amicable dispute resolution mechanism in accordance with the provisions of the Indian Arbitration and Conciliation Act, 1996. The Alternate Dispute Resolution mechanism shall be mandatory and time-bound to minimize disputes regarding the bid process and the documentation thereof.

### **Time Table for Bid Process**

The state government must in advance suggest a time table for conclusion of the bidding process. However, the State Government may give extended time frame based on prevailing circumstances and such alternations shall not be construed to be a deviation from these guidelines.

### **Contract Award and Conclusion**

The award of site to the selective developer consequent to the selection process in accordance with the terms and conditions as finalized shall be signed by the state government. Consequent to the signing of the award the evaluation committee shall provide a proper certification on adherence to these guidelines and to the bid process established by the state government. The state government shall also make published all contracts signed by the successful bidders. The final agreement along with certification of the evaluation committee shall be forwarded to the state regulatory commission.

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# Appendix F

## Hydropower Development in Uttarakhand

### Overview

**U**ttarakhand has installed capacity of 1474 megawatts (MW), including allocated share in central sector utilities as on 31 March 2006. Out of this installed capacity, hydropower share of state and central sector are nearly 986 MW and 144 MW, respectively. The power requirement of the State during 2005-06 was 5155 million units (MU) and 991 MW in terms of energy and peak demand, respectively. The availability of power was less than the requirement and as a result the State experienced an energy shortage and peaking shortage of 2.9% and 13.5% respectively.<sup>10</sup> In the state sector, Uttarakhand Jal Vidyut Nigam Limited (UJVNL) is operating large and medium-sized projects with an aggregate installed capacity of around 986 MW whereas central sector share contributes nearly 144 MW. In the private sector, Jaiprakash Power Venture Limited (JPVL) has implemented the 400 MW Vishnu Prayag project, in June 2006

### Status of Hydropower Development

The State has an identified hydropower potential of about 20,000 MW.<sup>11</sup> Out of this potential, only about 14 % has been developed so far. The generation capacity addition plan for the 10th Plan<sup>12</sup> (2002–2007) had envisaged an addition in hydropower capacity by 4,383 MW. Central sector utilities, viz., NHPC and the Tehri Hydro Development Corporation (THDC), have taken the lead in developing hydro projects in the State for over 80% of the planned capacity addition for the 10th Plan period followed by the private sector (9%) and the state sector (7%). However, as per present indications and based on the information so obtained from UJVNL, it is likely to be 2,984 MW against 4,383 MW for the X Plan period. The projects slipping into the 11th Plan period (2007–2012) include the 400 MW Koteswar and 1,000 MW Tehri II projects in the central sector being developed by THDC. The status of the projects for benefit during 10th Plan are as follows:

(a) Central Sector

- (i) Dhauliganga, 1,280 MW (NHPC) – Commissioned (1,135 MW)
- (ii) Tehri Stage I, 1,000 MW (THDC) – Under construction

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<sup>10</sup> [http://www.cea.nic.in/power\\_sec\\_reports/executive\\_summary/2006\\_03/index.htm](http://www.cea.nic.in/power_sec_reports/executive_summary/2006_03/index.htm)

<sup>11</sup> [http://www.uttarakhandjalvidyut.com/newsite/hydro\\_power.htm](http://www.uttarakhandjalvidyut.com/newsite/hydro_power.htm)

<sup>12</sup> CEA (List of power projects for benefits during the 10th Plan – 41,109.84 MW (Target)).

## (b) State Sector

(iii) Maneri Bhali II, 304 MW (UJVNL) – Under construction

## (c) Private Sector

(iv) Vishnu Prayag, 400 MW (JPVL) – Commissioned

Sixteen schemes with a total capacity of 5,500 MW have been identified for benefits during the 11th Plan. Out of this, 10 schemes with total installed capacity of 4,402 MW in the central sector, 4 schemes with an aggregate installed capacity of 726 MW in the state sector and the balance of 2 schemes with a total capacity of 372 MW in the private sector, are envisaged. Out of 16 schemes, 13 schemes are run-of-river type, two schemes are storage type and one scheme (Tehri II) is pump storage type. Also, 9 schemes with total capacity of 3,982 MW in central sector and 1 scheme (42 MW) in the state sector fall under "A" category, i.e., realistic and with 100% confidence with regard to project completion schedule during the 11th Plan, whereas 1 scheme (420 MW) in the central sector, 3 schemes with a total capacity of 684 MW in the state sector and 1 scheme (42 MW) in the private sector fall under "B" category, i.e., optimistic and with 80% confidence. However, only 1 scheme (330 MW) in the private sector falls under "C" category with 30% confidence. The status of these projects is shown in Table 6.1.

Major projects under development include NHPC's 520 MW Kotli Bhel St I (A&B), 440 MW Kotli Bhel St II, 420 MW Lakhwar Vyasi (storage); NTPC's 600 MW Lohari nagpala, 520 MW Tapovan vishnugarth; THDC's 1000 MW Tehri II (pumped storage), 400 MW Koteswar (storage), 340 MW Vishnugadpipalkoti in the central sector; UJVNL's 480 MW Palamaneri, 132 MW Bowalanandprayag in the state sector; and Alaknanda Hydro-electric Ltd.'s 330 MW Srinagar in the private sector. Salient features of Kotli Bhel, which is reportedly being considered by the Asian Development Bank and Japan Bank for International Cooperation, for financing are given in the Box below.

#### Box . Salient Features of Kotli Bhel

Kotli Bhel 1A (240 MW), 1B (280 MW) and Kotli Bhel II (440 MW) are run-of-river schemes and have been developed as power generation schemes with flood control provision. The projects are being developed by the National Hydroelectric Power Corporation and are likely to be commissioned by the end of the 11th Plan. Kotli Bhel St I & II are independent from each other in all aspects. Kotli Bhel IA and IB are located on the Bhagirathi and Alaknanda rivers, respectively, and Kotli Bhel II is located further downstream on River Ganga.

The detailed project reports of these projects are being prepared and therefore the final project cost and tariff have not yet been worked out. However, based on the December 2004 price level, project cost and indicative tariff has been worked out for Kotli Bhel St 1A (Rs1,263.69 crores, Rs2.63/kWh), Kotli Bhel St IB (Rs1,661.58 crores, Rs3.31/kWh) and Kotli Bhel II (Rs 2,577.03 crore, Rs 2.98/kWh).

Expected beneficiary states from these projects include Jammu & Kashmir, Himachal Pradesh, Punjab, Haryana, Uttar Pradesh, Uttaranchal, Rajasthan, and the union territories of Chandigarh and Delhi.

All the projects involve extensive underground and tunnel work due to the underground location of powerhouse. Expected completion schedule is 4 years, 6 months and 4 years, 9 months from the date of government sanction for Kotli Bhel St 1A & 1B each and Kotli Bhel St II, respectively. The CEA has issued techno-economic clearance (TEC) to Kotli Bhel 1A & 1B. Other approvals of state government and Environment & Forest clearance are under process.

On the other hand, for Kotli Bhel St II, TEC/state government approval and Environment & Forest clearance are still awaited and are expected before March 2007.

Table 6.1: Hydroelectric Schemes Identified for Benefits During 11th Plan

Sl No.	Name of Scheme	Type	Agency	IC (MW)	Benefits 11th Plan	Years of comm'n'g	DPR	TEC/State Govt. Approval	Environment Clearance	Forest Clearance	PIB/CCEA/ Invt. Declaration	Award of Contract	Status	Cat.*
1	Lakhwar Vyasi	STO	NHPC	420	420	2010-11	3/06	6/06	To be transferred	To be transferred	9/06	9/06	Agreement on cost sharing to be done	B
2	Kotlibhel-St 1A	ROR	NHPC	240	240	2011-12	12/05	3/06	11/06	11/06	12/06	12/06	DPR to be prepared	A
3	Kotlibhel-St 1B	ROR	NHPC	280	280	2011-12	12/05	3/06	11/06	11/06	12/06	12/06	DPR to be prepared	A
4	Kotlibhel-St II	ROR	NHPC	440	440	2011-12	1/06	4/06	11/06	11/06	1/07	1/07	DPR to be prepared	A
5	Lohari Nagpala	ROR	NTPC	600	600	2010-11	Ready	11/08/2004	8/02/2005	Awaited	3/06	3/06	Work award to be done	A
6	Tapovan Vishnugarh	ROR	NTPC	520	520	2011-12	Ready	11/08/2004	13/02/2004	5/03/2003	3/06	3/06	Work award to be done	A
7	Lata Tapovan	ROR	NTPC	162	162	2011-12	Ready	12/05			6/06	6/06	TEC to be done/DPR received in 7/05, returned for resubmission	A
8	Vishnugadpipalkoti	ROR	THDC	340	340	2011-12	3/06	6/06			10/06	10/06	DPR to be prepared/ Capacity has been revised	A
9	Tehri II	PSS	THDC	1000	1000	2009-10	Ready	20/09/88	19/07/1990		8/06	8/06	PIB held on 19.8.05, CCEA to be held	A
10	Koteshwar	STO	THDC	400	400	2007-08	Ready	23/08/89	19/07/1990	4/06/1987	10/04/2000	31/08/2002	Under construction	A
11	Tuinipalasu	ROR	UJVNL	42	42	2011-12	8/06	12/06			3/07	3/07	Revised DPR to be prepared	A
12	Bowala Nand Prayag	ROR	UJVNL	132	132	2011-12	5/06	8/06			11/06	2/07	Revised DPR to be prepared	B
13	Palamaneri	ROR	UJVNL	480	480	2010-11	Ready	12/05			12/05	3/06	TEC to be done/DPR recd. in 7/05, returned for resubmission	B
14	Arkot Tiuni	ROR	UJVNL	72	72	2011-12	8/06	11/06			12/06	3/07	DPR to be prepared	B
15	Hanol Tiuni	ROR	PS	42	42	2011-12	3/06	6/06			19/06	12/06	DPR to be prepared	B
16	Srinagar	ROR	Alaknanda PC	330	330	2010-11	Ready	14/07/2004	27/07/1999		14/07/2004	11/05	Financial closure	C

Source: Central Electricity Authority.

Note: Category A - Realistic, 100% confidence; Category B - Optimistic, 80% confidence; Category C - Critical, 30% confidence.

## Projects Under the 50,000 MW Initiative

Under the 50,000 MW hydroelectric initiatives, preliminary feasibility reports (PFRs) of 162 MW hydro electric projects having an installed capacity of 47,930 MW have been prepared. Out of 162 schemes, 73 schemes with first year tariff below Rs2.50/kWh have been identified as low tariff hydroelectric schemes for preparation of DPRs/implementation through various agencies. Out of these 73 Schemes, 28 Schemes with an aggregate installed capacity of 4748 MW are in Uttaranchal. Two schemes, viz., 162 MW Lata Tapovan of the National Thermal Power Corporation (NTPC) in the central sector and 72 MW Arakot Tiuni of the Uttaranchal Jal Vidyut Nigam Limited (UJVNL) in the state sector have been included for benefit during 11th Plan period. Since all schemes are run-of-river type, less work with regard to resettlement and rehabilitation is anticipated. In addition, silt problem is expected to be far less in most of the proposed schemes due to their locational advantage at high altitude. The status of all these schemes is shown in Table 6.2.

## Private Sector Participation

In order to expedite the hydropower development in the State, the government of Uttaranchal has framed the hydropower policy for projects with a capacity of 25 MW and above. The key features of the policy are as follows:

- (i). Potential hydro projects identified by the government of Uttaranchal shall be advertised for international competitive bids. There shall be a pre-qualification selection of the bidders based on their past experience and financial and technical capacity.
- (ii). Bids shall be invited over a minimum premium, payable upfront to the government of Uttaranchal, at the rate of Rs5 crores per project. Projects will be allocated to bidders making the highest bid over and above the upfront minimum premium.
- (iii). Projects will be allocated for an initial period of 45 years on build, own, operate and transfer basis. After the expiry of the initial period or the extended period, as the case may be, the projects will revert back to the government of Uttaranchal.
- (iv). The developers of the project will have the right to sell the power outside the state. No agency of the state will guarantee purchase of power.
- (v). 12% of electricity generated shall be made available free of cost to the state during entire life of the projects.
- (vi). The developers may build his own evacuation system or get the same constructed through the state transmission utility/central utility (PGCIL). If the evacuation system is constructed by the undertaking of the state, the same will be developed as a commercial venture. In this case or in case of utilization of existing evacuation system, wheeling charges, as determined by the Central Electricity Regulatory Commission, will be payable by the developer to the state corporation/central utility.



Table 6.2: List of Low Tariff Schemes in Uttarakhand under 50,000 MW Hydroelectric Initiative

Sl No.	Name of Scheme	Agency	IC (MW)	TYPE	First Year Tariff (Rs/KWh)	DPR	Status
1	Jakhol Sankri	SJVNL	35	ROR	1.71	12/07	For implementation
2	Naitwar –Mori (Devra Mori )	SJVNL	33	ROR	1.85	12/07	For implementation
3	Jadh Ganga	THDC	50	ROR	2.19	12/07	For implementation
4	Karmoli	THDC	140	ROR	1.71	12/07	For implementation
5	Jelam Tamak	THDC	60	ROR	1.8	12/07	For implementation
6	Maleri Jelam	THDC	55	ROR	1.8	12/07	For implementation
7	Gohana Tal	THDC	60	ROR	1.64	12/07	For implementation
8	Bokang Baling	THDC	330	ROR	1.68	12/07	For implementation
9	Chhunger -Chal	NHPC	240	ROR	1.13	9/07	For implementation
10	Garba Tawaghat	NHPC	630	ROR	0.9	8/07	For implementation
11	Rupsiabagar Khasiyabara	NTPC	260	ROR	1.59	9/08	For implementation
12	Lata Tapovan	NTPC	162	ROR	2.21	Ready	implementation /InclFor uded in 11th plan /DPR prepared for I.C. 162 MW
13	Sela Urthing	UJVNL	230	ROR	1.4	8/07	For implementation
14	Bhaironghati	UJVNL	400	ROR	1.8	8/07	For implementation/Capacity revised to 400 MW
15	Nand Prayag	UJVNL	141	ROR	2.05	8/07	For implementation
16	Tamak lata	UJVNL	280	ROR	2.3	8/07	For implementation
17	Harsil	UJVNL	210	ROR	1.1	-	Included in DPR of Bhaironghati
18	Sirkari Bhyol Rupsiabagar	UJVNL	210	ROR	1.55	8/07	For implementation
19	Gangotri	UJVNL	55	ROR	1.62	-	Included in DPR of Bhaironghati
20	Arakot Tiuni	UJVNL	72	ROR	1.00	8/06	For implementation/ included in 11th Plan
21	Taluka Sankri	UJVNL	140	ROR	1.33	8/07	For implementation
22	Rishi Ganga -1	UJVNL	70	ROR	1.18		For implementation /MOEF problems
23	Rishi Ganga -2	UJVNL	35	ROR	2.22		For implementation /MOEF problems
24	Bogudiyar-Sirkari Bhyal	IPP	170	ROR	1.99	12/07	For implementation
25	Badrinath	IPP	140	ROR	0.81	12/07	For implementation
26	Mapang –Bogidiyar	IPP	200	ROR	1.3	12/07	For implementation
27	Urthing Sobla	IPP	280	ROR	1.49	12/07	For implementation
28	Deodi	IPP	60	ROR	1.37	12/07	For implementation

Source: CEA

- (vii). The project developer shall be liable for the rehabilitation of the displaced persons from the project area and the cost of the same shall be included in the project cost. The state government will provide necessary assistance to the developer in the implementation of the resettlement and rehabilitation plan.

So far, four projects with an aggregate capacity of 790 MW have been allocated to the private sector developers through the competitive bidding route for implementation. Out of four projects, two projects, viz., Mopang Bhogidiyar (200 MW) and Boghidiyar sarkari Bhyol (170 MW), are being developed by GVK, whereas GMR & RIL are developing Alaknanda<sup>13</sup> (140 MW) and Urthing Sobla (280 MW), respectively. As per UJVNL all projects are likely to be commissioned by 2014.

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13 Also known as Badrinath

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## Appendix G

### Hydropower Development in Himachal Pradesh

**H**imachal Pradesh has installed capacity of 1655 MW including allocated share in joint and central sector utilities as on 31 March 2006. Out of this installed capacity, hydro power share of state and private sector utilities are 323 MW and 386 MW, respectively. The power requirement of the State during 2005-06 was 4,302 million units (MU) in terms of energy and 788 MW in terms of peak demand. The availability of power was less than the requirement and as a result the State experienced an energy shortage of 1% and a peaking shortage of 4.9 % respectively.<sup>14</sup> The major projects under operation include the National Hydroelectric Power Corporation's (NHPC) 540 MW Chamera I, 300 MW Chamera II, and 198 MW Baira Siul; Bhakra Beas Management Board's (BBMB's) 1,200 MW Bhakra, 360 MW Pong Dam, and 990 MW B.S.L; Satluj Jal Vidyut Nigam Limited's (SJVN) 1,500 MW Napptha Jhakri in the central sector; Himachal Pradesh State Electricity Board's (HPSEB) 120 MW Bhaba, 60 MW Giri, and 60 MW Uhl-II (Bassi) in the state sector; Malana Power Company Limited's (MPCL) 86 MW Malana; and Jaiprakash Power Venture Limited's (JPVL) 300 MW Baspa II in private sector.

#### Status of Hydropower Development

The State has an assessed potential of 19,044.55 MW<sup>15</sup> (excluding SHP) in its five river basins: Sutlej (9,420.25MW), Beas (4,582 MW), Ravi (2,294 MW), Yamuna (591.52 MW) and Chinab (2,748.3 MW). However, only about 31% of this potential has been developed so far. The generation capacity addition plan for the 10th Plan<sup>16</sup> (2002–07) had envisaged an addition in hydropower capacity by 2,774 MW. However, as per present indications<sup>17</sup> and based on the information so obtained from HPSEB, it is likely to be 2,226 MW against 2,774 MW for the 10th Plan period. The project slipping into the 11th plan (2002-12) period include 1) Rampur, 412 MW of SJVN in the central sector, Kashang I, 66 MW of HPSEB in the state sector and Dharmavari Sunda, and 70 MW in the private sector. The status of the projects for benefit during the 10th Plan are as follows:

##### a) Central Sector

- (i) Chamera II, 300 MW (NHPC) – Commissioned
- (ii) Napptha Jhakri, 1,500 MW (SJVN) – Commissioned

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14 [http://www.cea.nic.in/power\\_sec\\_reports/executive\\_summary/2006\\_03/index.htm](http://www.cea.nic.in/power_sec_reports/executive_summary/2006_03/index.htm)

15 <http://www.hpesb.com>

16 CEA (List of power projects for benefits during 10th Plan –41109.84 MW (Target)).

17 Discussion with HPSEB.

**b) State Sector**

(iii) Largi , 126 MW – Under construction

**c) Private Sector**

(iv) Baspa, 300 MW— Commissioned

A total of 19 schemes with a combined capacity of 6,049 MW have been identified for benefits during the 11th Plan. Out of this, 6 schemes with total installed capacity of 3,063 MW in the central sector; 6 schemes with an aggregate installed capacity of 908 MW in the state sector; and 7 schemes with total installed capacity of 2,078 MW in the private sector are envisaged. Out of 19 schemes, 18 schemes are run-of-river type and 1 scheme, the National Thermal Power Corporation's (NTPC) 800 MW Koldam project, is storage type.

Major projects under development include NHPC's 800 MW Parbati II, 520 MW Parbati III, and 231 MW Chamara III; SJVNL's 412 MW Rampur and 700 MW Luhri; NTPC's 800 MW Koldam in the central sector; HPSEB's 402 MW Shongtong Karcham and 180 MW Bajoli Holi in the state sector; and JPKHCL's 1000 MW Karcham Wangtoo in private sector. The status of these projects is shown in Table 7.1.

### Projects under the 50,000 MW initiative

Under the 50,000 MW hydro electric initiatives, preliminary feasibility reports (PFRs) of 162 MW hydroelectric projects having an installed capacity of 47,930 MW have been prepared. Out of 162 schemes, 73 schemes with first year tariff below Rs2.50/kWh have been identified as low tariff hydroelectric schemes for preparation of detailed project reports (DPRs)/implementation through various agencies. Out of these 73 schemes, 11 schemes with an aggregate installed capacity of 3,095 MW are in Himachal Pradesh. However, 4 schemes, viz., Luhri, 700 MW (SJVNL) in the central sector; Bajoli Holi ,180 MW (HPSEB) in the state sector; and Thopan Powari, 480 MW and Chamba, 126 MW in the private sector, have been included for benefit during the 11th Plan period. The status of these projects is shown in Table 7.2.

### Private Sector Participation

The state government has taken several initiatives to encourage private sector participation in hydropower development. Himachal Pradesh is among the few states which has streamlined and crystallized the various procedures to minimize the bottlenecks and has come up with an investor friendly hydropower policy<sup>18</sup> in place to attract private sector investment. The key features of the policy are as follows:

- (i) Selection of developer on Memorandum of Understanding (MOU) route allowed for projects up to 100 MW;
- (ii) Selection of developer on international competitive bidding route for projects above 100 MW;
- (iii) No clearances are necessary from the Central Electricity Authority (CEA) for projects selected on competitive bidding route for projects costing up to Rs2,500 crores;
- (iv) Secondary energy rate to be at par with primary energy. Premium on peak power is proposed;

18 Official web site of HPSEB.

Table 7.1 Hydroelectric Schemes Identified for Benefits During 11th Plan

Sl No.	Name of Scheme	Type	Agency	IC (MW)	Benefits 11th Plan	Years of comm'n'g	DPR	TEC/State Govt. Approval	Environment Clearance	Forest Clearance	PIB/CCEA/ Invest. Declaration	Award of Contract	Status	Cat.*
1	Parbati II	ROR	NHPC	800	400	2008-09	Ready	10/99	06/01	08/99	09/02	09/02	Under construction	A
2	Parbati III	ROR	NHPC	520	520	2010-11	Ready	11/03	04/05	09/04	10/05	10/05	Under construction	A
3	Chamera III	ROR	NHPC	231	231	2010-11	Ready	10/03	03/05	06/04	08/06	09/05	Under construction	A
4	Rampur	ROR	SIVNL	412	412	2010-11	Ready	12/05			03/06	04/06	PIB/CCEA to be held	A
5	Koldam	STO	NTPC	800	800	2008-09	Ready	06/02	05/00	10/00	10/02	6/03	Under construction	A
6	Shongtong Karcham	ROR	HPSEB	402	402	2010-11	Ready	03/06			9/06	12/06	DPR under scrutiny by HPSEB for TEC	B
7	Sainj	ROR	HPSEB	100	100	2010-11	Ready	03/06			06/06	09/06	DPR under scrutiny by HPSEB for TEC	A
8	UHL III	ROR	HPVVNL	100	100	2008-09	Ready	09/02	11/02	12/02	02/03	09/05	Under Construction	C
9	Kashang -1	ROR	HPVVNL	66	66	2010-11	Ready	11/01	11/02	12/01	02/03	12/05	Award of work to be done	C
10	Dhamwari Sunda	ROR	PVC	70	70	2010-11	Ready	07/01	12/98	03/98	07/01	12/05	Revised DPR to be prepared / Court case	A
11	Sawara Kuddu	ROR	PVC	110	110	2010-11	Ready	Done			12/05	03/06	Work award to be done	C
12	Allain Duhangan	ROR	ADHPL	192	192	2010-11	Ready	08/02	10/02	10/02	08/02	09/05	Under Construction	C
13	Karcham Wangtoo	ROR	JKHCL	1000	1000	2010-11	Ready	03/03	Awaited	Awaited	03/03	12/05	MoEF clearance awaited. Financial closure to be done	C
14	Chamba	ROR	PS	126	126	2011-12	03/07	06/07			12/07	12/07	DPR to be prepared	C
15	Thopan Powari	ROR	PS	480	480	2011-12	03/07	06/07			09/07	09/07	DPR to be prepared	C
16	Kashang -II	ROR	HPSEB	60	60	2010-11	03/06	06/06			09/06	09/06	DPR to be prepared	C
17	Malana II	ROR	PS	100	100	2010-11	Ready	10/04			03/06	03/06	Work award to be done	C
18	Bajoli Holi	ROR	HPSEB	180	180	2011-12	03/06	06/06			09/06	12/06	DPR to be prepared	C
19	Luhri	ROR	SIVNL	700	700	2011-12	01/07	04/07			09/07	09/07	DPR to be prepared	C

Source: CEA

\* (Category A - Realistic; 100% confidence, Category B - Optimistic, 80% confidence, Category C - Critical, 30% confidence)

Table 7.2: List of Low Tariff Schemes in Hydropower Scheme Under 50,000 MW Hydroelectric Initiative

Sl No.	Name of Scheme	Agency	IC (MW)	TYPE	First Year Tariff (Rs/KWh)	DPR	Status
1	Jangi Thopan	IPP	480	ROR	2	3/08	For implementation
2	Khab-i	SJVNL	450	ROR	2.24	9/06	For implementation
3	Khoksar	IPP	90	ROR	2.46	3/08	For implementation
4	Gharopa	IPP	114	ROR	2.09	3/08	For implementation
5	Gondhala	IPP	144	ROR	1.92	3/08	For implementation
6	Thopan Powari	IPP	480	ROR	1.81	3/07	For implementation/included in XI plan
7	Chamba	IPP	126	ROR	1.48	3/07	For implementation/included in XI plan
8	Bajoli Holi	HPSEB	180	ROR	2.03	3/06	For preparation of DPR /included in XI Plan
9	Yangthang	HPSEB	261	ROR	2.39	3/08	For preparation of DPR only
10	Tidong -II	IPP	70	ROR	2.02	3/08	For implementation
11	Luhri	SJVNL	700	ROR	2.41	12/06	For implementation /capacity has been revised from 400MW / included in XI Plan

Source: Central Electricity Authority.

- (v) Process of transferring clearances to independent power products (IPPs) is simplified.
- (vi) 100% foreign equity permitted on the automatic approval route provided it does exceed Rs1,500 crores;
- (vii) 100% foreign equity permitted on the automatic approval route provided it does exceed Rs1,500 crores.
- (viii) Tariff determination by State Electricity Regulatory Commission (SERC)/Central Electricity Regulatory Commission.

Himachal Pradesh has invited proposals for 43 projects<sup>19</sup> (bids were due on 22 January 2006) totaling 5,768 MW (out of 69 schemes) from eligible bidders on a build, own, operate and transfer basis. Evaluation of the bids received in this regard is underway and projects are expected to be awarded as soon as informed by HPSEB

The projects advertised under notice inviting proposals were divided into following three parts:

- (i) Part 1: 23 projects for which PFRs are ready
- (ii) Part II: 20 projects for which feasibility has to be ascertained by IPPs
- (iii) Part III: Self-identified projects

<sup>19</sup> HPSEB invited applications in October 2005 for 15 hydel projects with a total capacity of 1,767 MW. To initiate the process of allotting the remaining identified hydel projects in the State, the Himachal Pradesh government invited bids from public and private firms for developing 28 hydel-electric power projects with a total capacity of 4,000 MW in December 2005.

Projects are further divided in to two categories:

- (i) Category 1 (Projects less than 100 MW)
- (ii) Category II (Projects of 100 MW capacity and above)

Also for projects above 100 MW installed capacity, the government of Himachal Pradesh reserves the right of equity participation up to 49% on selective basis. The operation period of the projects shall be 40 years from the commercial operation date of the project, at the end of which these shall stand transferred to the government of Himachal Pradesh free of cost.

Projects less than 100 MW (Category I) are proposed to be allocated through memorandum of understanding (MOU) route. Under MOU route, a letter of allotment will be issued to the selected bidders asking them to execute an MOU with the government of Himachal Pradesh for which a sum of Rs1 lakh per MW of installed capacity subject to a maximum amount of Rs50 lakhs only shall required to be deposited by successful bidder as a security deposit. The selected bidder shall be required to deposit upfront premium (fixed) at following rates:

- (i) For project above 5 MW to 50 MW — Rs1.00 lakh/MW
- (ii) For projects above 50 MW to 100 MW — Rs2.00 lakhs/MW

Projects of capacity 100 MW and above (Category II) are proposed to be allocated through the competitive bidding route. Under this route, the selection process will be in two stages. In the first stage interested companies shall submit pre-qualification bids as per the request for qualification (RFQ) document. In the second stage, the pre-qualified bidders will be invited to submit price bids. In the price bid, the bidders would be required to quote the upfront premium over and above a minimum amount of Rs10 lakhs per MW capacity of project.

The project developer will be required to provide royalty in the shape of free power from the project to the government of Himachal Pradesh in lieu of surrender of potential site at 12% of the deliverable energy of the project for the period starting from the date of synchronization of the first generating unit and extending up to 12 years from the date of commercial operation of the project; at 18% of deliverable energy of the project for a period of next 18 years and thereafter; and at 30% of the deliverable energy for the balance agreement period beyond 30 years.

The government will constitute a local area development authority (LADA) for project(s) being implemented in each river valley. Activities of the LADA during execution will be financed by the project itself and for this purpose the developer shall make a provision of 1.5% of total capital cost in the detailed project report other than the funds required for R&R scheme and catchment area treatment (CAT) plan. The LADA activities should be financed from the 1.5% provision proposed in the DPR and not from free power royalty. Activities under LADA are as follows:

- (i) Oversee the restoration of facilities adversely affected due to implementation of the project;
- (ii) Oversee the implementation of rehabilitation and relief plan;
- (iii) Oversee the implementation of catchment area treatment plan and compensatory afforestation; .
- (iv) Local development activities related to development of agriculture, horticulture, animal husbandry, health and forest development and other social activities; and
- (v) The developer shall ensure minimum flow of 15% water immediately downstream of the dam so as to protect the rights of the local inhabitants for irrigation and drinking water requirements.

With a view to mitigate problems that may arise during execution of the project and in the post-commissioning phase in case of hydropower projects in the Satluj Valley, a Forum of Hydro power Producers of Satluj Basin came into existence in November 2005. The main functions of this Forum relate to (a) environment, (b) operation of power stations and sharing of technical expertise and experience, (c) data sharing, and (d) disaster management and planning. It will also be concerned with sorting out common issues with the state government and the Government of India.<sup>20</sup>

The project developer will be required to make arrangements for evacuation of power from the project to the HPSEB/Power Grid Corporation of India Limited's (PGCIL) sub-station (designated as the interconnection point). For evacuation of power beyond the interconnection point, the developer shall tie up with HPSEB/PGCIL for arrangements of a suitable integrated transmission system at mutually agreed wheeling charges.

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20 Source: Government of Himachal Pradesh.



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# Appendix H

## Hydropower Development in Sikkim

### Overview

**S**ikkim has an aggregate installed capacity of 114 MW including allocated shares in central sector utilities as of 31 March 2006.<sup>21</sup> Out of this installed capacity, hydropower share of state and central sector are 32 MW and 8 MW respectively. The power requirements of the State during 2005-06 was 212 MU and 47 MW in terms of energy and peak demand respectively. The availability of power was less than the requirement and as a result the State experienced an energy shortage and peaking shortage of around 1% and 4.3% respectively. The major projects under operation include 60 MW Ranjit St III (NHPC) in the central sector and 12 MW Lower Lagyap in the state sector. Sikkim abounds in innumerable stream and rivers flowing down the glaciers, which have provided the State with abundant potential for development of hydroelectric power. Prominent rivers that run through the State include Teesta and Rangit. Sikkim has mainly small hydel stations of the run-of-river type and there is no dam or reservoir that could be used to store water and used for power generation during lean/peak periods.

### Status of Hydropower Development

The State has an accessed potential of 1,283 MW at 60% load factor.<sup>22</sup> However, only about 7% potential has been developed so far. The generation capacity addition plan for the 10th Plan (2002–2007) had envisaged an addition in hydropower capacity by 510 MW Teesta V of the National Hydroelectric Power Corporation (NHPC) in the central sector that is likely to be commissioned by the end of 10th Plan. Schemes totaling a capacity of 1,785 MW have been identified for benefits during the 11th Plan. Out of this, one scheme, viz., 495 MW Teesta IV of NHPC is in the central sector and the balance of three schemes, viz., 600 MW Teesta III, 330 MW Teesta II and 360 MW Teesta VI are in the private sector. All schemes are run-of-river type. The status of these schemes is shown in Table 8.1.

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21 [http://www.cea.nic.in/power\\_sec\\_reports/executive\\_summary/2006\\_03/24-30.pdf](http://www.cea.nic.in/power_sec_reports/executive_summary/2006_03/24-30.pdf)

22 Ministry of Power.

Table 8.1: Hydroelectric Schemes Identified for Benefits During 11th Plan in Sikkim

Name of Scheme	Type	Agency	IC (MW)	Benefits 11th Plan	Years of Commissioning	DPR	TEC/State Govt. Approval	Environment Clearance	Forest Clearance	PIB/CCEA/ Invest. Declaration	Award of Contract	Status	Cat.*
Teesta –IV	ROR	NHPC	495	495	2011-12	9/06	12/06	2/07	2/07	3/07	3/06	DPR to be prepared	A
Teesta –III	ROR	IPP (Teesta Urja Ltd)	1200	600	2011-12	Ready	12/05			6/06	6/06	TEC to be done /DPR submitted in August'05	A
Teesta II	ROR	IPP (Himurja )	330	330	2011-12	12/05	3/06			9/06	9/06	Revised DPR to be prepared	C
Teesta VI	ROR	IPP (Lanco )	360	360	2011-12	12/06	3/06			9/06	9/06	Revised DPR to be prepared	C

Source: Central Electricity Authority.

\* (Category A - Realistic, 100% confidence, Category B - Optimistic, 80%confidence, Category C - Critical, 30% confidence).

## Projects Under 50,000 MW Hydroelectric Initiative

Under the 50,000 MW hydro electric initiatives, preliminary feasibility reports (PFRs) of 162 MW hydro electric projects having an installed capacity of 47,930 MW have been identified as low tariff hydroelectric schemes for preparation of DPRs/implementation through various agencies. Out of these 73 schemes, 4 schemes with an aggregate installed capacity of 835 MW are in Sikkim. Out of the 4 schemes, 3 schemes, viz., 105 MW Dikchu, 200 MW Panan and 320 MW Teesta-I are in the private sector and 1 scheme, viz., 210 MW Lachen of NHPC, is in the central sector. All schemes are run-of- river type. The status of these schemes is shown in Table 8. 2.

In addition to the schemes mentioned in Tables 8.1 and 8.2, the government of Sikkim has also signed a memorandum of agreement (MOU) with few more independent power producers (IPPs).<sup>23</sup> These schemes are listed in Table 8.3. The government expects benefits from these schemes during the 11th Plan period.

Table 8.2: List of Low Tariff Schemes in Sikkim Under 50,000 MW Hydroelectric Initiative

Sl No.	Name of Scheme	Agency	IC (MW)	TYPE	First Year Tariff (Rs/KWh)	DPR	Status
1	Lachen	NHPC	210	ROR	2.35	3/08	For implementation
2	Dikchu	IPP	105	ROR	2.15	3/08	For implementation
3	Panan	IPP	200	ROR	2.15	3/08	For implementation
4	Teesta – I	IPP	320	ROR	1.8	3/07	For implementation

Source: Central Electricity Authority.

## Private Sector Participation

In order to expedite hydropower development through private sector participation in the State, the Sikkim government has formed the Sikkim Power Development Corporation Ltd (SPDCL) to facilitate joint venture between a private power developer and the government. For SPDCL-promoted projects and as per the MOU signed between the government and a private power developer, 12% free power would be made available to the State and the private power developer would be permitted to sell its entire balance power directly to needy states or through power trading agencies, whichever way they would like to sell. However, SPDCL has been finding it difficult to achieve financial closure of these identified schemes as the lenders insist on payment security mechanism either in the form of purchase by the Energy Department or financial guarantee from the State.

<sup>23</sup> Power Department, Government of Sikkim.

Table 8.3: List of Additional Schemes

Sl No.	Project	IC (MW)	Name of Developer	Year of Commissioning	DPR	Status of Agreement
1	Rangyong	141	BSCPL- SCL Joint Venture	2010-11	09/06	Signed
2	Rongnichu Storage	96	Chattisgarh Electricity Company Ltd.	2010-11	03/06	Signed
3	Lingza	120	Sikkim Power Development Corporation	2010-11	09/06	-
4	Rukel	33	Sikkim Power Development Corporation	2010-11	09/06	-
5	Sada Manager	71	Gati Ltd.	2008-09	03/06	Signed
6	Chujachen	99	Gati Ltd.	2008-09	03/05	Signed
7	Bhasmey	32	Gatii Ltd.	2008-09	03/06	Signed
8	Rolep	36	Amalgamated Transpower India Ltd.	2008-09	03/04	Signed
9	Chakhungchu	50	Amalgamated Transpower India Ltd.	2009-10	06/06	Signed
10	Ralong	40	Amalgamated Transpower India Ltd.	2009-10	06/06	Signed
11	Rangit II	60	Gammon India Ltd.	2009-10	06/06	Signed
12	Rangit IV	96	Jal Power Corporation	2009-10	12/05	Signed
13	Jorethang Loop HEP	96	DANS IT System Pvt. Ltd.	2008-09	11/05	Signed
14	Rorathang	25	Sikkim Power Development Corporation	2008-09	03/06	-
15	Tarumchu	25	Sikkim Power Development Corporation	2008-09	03/06	-
16	Ting Ting	70	SMEC Pvt. Ltd.	2008-09	03/06	-
	<b>Total</b>	<b>1090</b>				

Source: Power Department, Government of Sikkim.

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# Appendix I

## Hydropower Development in North-Eastern Region

### Overview of the Power Sector

**T**he installed generating capacity in the North-Eastern Region (NER)<sup>24</sup> as of 31st March, 2006 was 2404 megawatts (MW). Out of this, the hydropower share of state and central sector utilities are 253 MW and 860 MW respectively<sup>25</sup>. The power requirement of the region during 2005-06 was 7534 million units (MU) in terms of energy and 1385 MW in terms of peak demand. The availability of power was less than the requirement and as a result the region experienced an energy shortage of 8.6 % and a peaking shortage of 13.9 % respectively.

### Status of Hydropower Development

NER has an assessed potential of 167 billion units (BU) (31,857 MW at 60% load factor); but only about 5% of this potential has been developed. The generation capacity addition plan for the 10th Plan (2002–2007) had envisaged an addition in hydropower capacity other than small hydro projects (SHPs) by 349 MW. However, as per present indications,<sup>26</sup> it is likely to be 125 MW. The projects slipping into the 11th Plan (2007–2012) period include Turial 60 MW (law and order problems) in the central sector and Bairabi 80 MW (funding constraint) and Myntdu 84 MW (delay in award of contracts) in the state sector. Schemes totaling a capacity of 4,956 MW have been identified for benefits during 11th Plan. Out of this 4,580 MW are envisaged in the central sector. The status of these schemes is shown in Table 9.1.

### Projects Under the 50,000 MW Initiative

Out of the 162 schemes under this initiative, 62 schemes with a total installed capacity of 30,416 MW are in NER. Twenty-five of these schemes with an aggregate capacity of 21,482 MW have an indicative tariff of less than Rs2.50 per kilowatt-hour (kWh). Nineteen of these are in Arunachal Pradesh and six in Meghalaya. Action has been initiated for survey and investigation and preparation of detailed project reports (DPRs) for these schemes. The status is shown in Table 9.2. As may be seen therefrom:

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24 The NER grid comprises the power system of the seven states; namely, Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland and Tripura with the central system superimposed on it.

25 [http://www.cea.nic.in/power\\_sec\\_reports/executive\\_summary/2006\\_03/24-30.pdf](http://www.cea.nic.in/power_sec_reports/executive_summary/2006_03/24-30.pdf)

26 Discussions with CEA.

Table 9.1: Hydroelectric Schemes Identified for Benefits During 11th Plan

Name of Scheme	Type	State	Agency	IC (MW)	Benefits 11th Plan	Years of Commissioning	DPR	TEC/State Govt. Approval	Environment Clearance	Forest Clearance	PIB/CCEA/ Invest. Declaration	Award of Contract	Status	Cat. *
Subhansir Lower	STO	Ar. P	NHPC	2000	2000	2010-11	Ready	Jan 2003	16.7.2003	10.6.03 withdrawn	9.9.03	19.12.03	Under construction/ slow progress	C
Ranganadi II	STO	Ar. P	NEEPCO	130	130	2010-11	3/06	6/06			9/06	9/06	DPR to be prepared	A
Kameng	STO	Ar. P	NEEPCO	600	600	2009-10	Ready	30.4.1991	29.3.2001	Aug 2000	2.12.04	8.12.04	Under construction	A
Pare (Dikrong)	STO	Ar. P	NEEPCO	110	110	2010-11	12/05	4/06			10/06	10/06	DPR to be prepared	A
Siang Middle (Siyom)	STO	Ar. P	NHPC	1000	1000	2011-12	Ready	-	11.3.2005		3/06	3/06	TAC to be held DPR received in Sept 2003 being transferred to reliance	A
Dibbin	ROR	Ar. P	NEEPCO	100	100	2011-12	3/06	6/06			12/06	12/06	DPR to be prepared	B
Badao	ROR	Ar. P	NEEPCO	120	120	2011-12	3/06	6/06			12/06	12/06	DPR to be prepared	B
Kapak Layak	ROR	Ar. P	NEEPCO	160	160	2011-12	3/06	6/06			11/06	12/06	DPR to be prepared	C
Talong	STO	Ar. P	NEEPCO	300	300	2011-12	3/06	6/06			11/06	12/06	DPR to be prepared	C
Myntdu St I	STO	Megh	MeSEB	84	84	2008-09	Ready	20.09.1999	26.9.2001	19.6.2001	9.6.2003	Mar 04	Dam work awarded. E/M package under award	A
New Umtru	ROR	Megh	MeSEB	40	40	2009-10	Ready	Done			12/05	3/06	Work award to be done	B
Umium Umtru St V	ROR	Megh	MeSEB	36	36	2010-11	12/05	3/06			6/06	9/06	DPR to be prepared	C
Ganol	ROR	Megh	MeSEB	25	25	2010-11	4/06	7/06			9/06	12/06	DPR to be prepared	C
Tuivai	ROR	Manipur	PDD	51	51	2010-11	12/05	3/06			6/06	9/06	DPR to be prepared	C
Bairabi	STO	Mizoram	PDD	80	80	2010-11	Ready	09.11.2000	Feb 2003	Oct 2002	12/05	3/06	Funds constraints to be solved	C
Tuirail	STO	Mizoram	NEEPCO	60	60	2008-09	Ready	June 1997	16.10.96	16.3.00 (lind st)	Jul 1998.	Feb 2002	Work held up/law and order problem	C
Upper Borpain	ROR	Assam	ASEB	60	60	2010-11	12/05	3/06			6/06	9/06	DPR to be prepared	C
				<b>Total</b>	<b>4956</b>									C

Source: Central Electricity Authority.

\* (Category A – Realistic, 100% confidence; Category B – Optimistic, 80% confidence; Category C – Critical, 30% confidence)

- Government of Arunachal Pradesh has withdrawn consent for 4 schemes with a total capacity of 6,300 MW;
- In the case of the 3,000 MW Demwe project the issue relating to the type of scheme (storage of run-of-river or ROR) is to be resolved,
- The National Thermal Power Corporation (NTPC) is not willing to take up DPR preparation in case of Hutong (3,000 MW) and Kalai (2,600 MW) projects unless given for implementation; these projects are also proposed to be converted from storage to ROR.
- Difficulties in getting clearances from the Ministry of Environment and Forests (MOEF) are indicated in the Oju I and II projects (1,700 MW).

Thus projects totaling a capacity of 13,606 MW seem to have high level of uncertainty.

## Issues in Hydropower Development

Some of the specific problems experienced in the NER in developing hydropower include

- **Land-related costs:** The recent norms of adoption of the net present value for assessing the cost of forest diversion is likely to add a huge burden to cost of storage projects.<sup>27</sup>
- **Law and order problems:** Problems of insurgency has been a matter of concern in a number of projects in recent years. This has been causing delays in completion of projects. In addition this is also necessitating high expenditure on security arrangements from concept till commissioning of the project and operation thereafter. These in turn could adversely impact viability of the project.
- **Low demand in home states:** Demand for power in states like Arunachal Pradesh and Meghalaya, where the above-mentioned low tariff projects are located, are not high enough to utilize the entire power. Hence the developers would have to identify buyers in other states. In fact the demand in the entire region is low compared to the available potential.
- **Transmission issues:** Bulk of power generated in the NER has to be exported to Northern Region. Since there are severe right-of-way constraints in this corridor, power evacuation system is being planned in an integrated manner keeping in view the staged development of the projects. As a result, transmission charges are likely to be high. In case slippages of projects, as had happened in the past, there could be operational problems, besides an increase in transmission charges.

<sup>27</sup> The Ministry of Power had mooted a proposal to off-load the costs of security and other indirect costs from the project cost in order to bring down the tariffs and make the projects viable; but this has not found favor with the Planning Commission, Ministry of Finance and Ministry of Home Affairs.

Table 9.2: List of Low Tariff Schemes in NER under 50,000 MW Hydroelectric Initiative

Sl No.	Name of Scheme	State	Agency (MW)	IC	TYPE Tariff	First Year (Rs/KWh)	DPR	Status
1	Etalin	Ar.P	NTPC	4000	ROR	2.17	-	MOU signed
2	Attunli	Ar.P	NTPC	500	ROR	2.35	-	MOU signed
3	Naba	Ar.P	NHPC	1000	ROR	2.14	-	Consent withdrawn by state government
4	Niare	Ar.P	NHPC	800	ROR	2.02	-	Consent withdrawn by state government.
5	Demwe	Ar.P	NEEPCO	3000	STO	1.97	3/08	Consent for DPR preparation only MOU yet be signed/ storage scheme/state govt. wants ROR
6	Kameng Dam	Ar.P	NEEPCO	600	STO	2.29	3/07	For implementation
7	Talong	Ar.P	NEEPCO	300	STO	2.24	3/06	Consent for DPR preparation only included in 11th Plan
8	Bhareli – II	Ar.P	NEEPCO	600	ROR	1.67	3/07	Consent for DPR preparation only
9	Bhareli – I	Ar.P	NEEPCO	1120	ROR	1.65	3/07	Consent for DPR preparation only
10	Kapak leyak	Ar.P	NEEPCO	160	ROR	1.74	3/06	Consent for DPR preparation only 11th Plan
11	Badao	Ar.P	NEEPCO	120	ROR	2.32	3/06	Consent for DPR preparation only 11th Plan
12	Dibbin	Ar.P	NEEPCO	100	ROR	2.23	3/06	Consent for DPR preparation only 11th Plan
13	Oju – II	Ar.P	NEEPCO	1000	ROR	1.46	-	For implementation/MOEF problem
14	Oju – I	Ar.P	NEEPCO	700	ROR	2.08	-	For implementation/MOEF problem
15	Hutong	Ar.P	NTPC	3000	STO	1.28	-	Scheme proposed to be converted to two ROR schemes/NTPC given consent for preparation of DPR for one ROR scheme. NTPC not willing to take up project unless given for implementation
16	Kalai	Ar.P	NTPC	2600	STO	1.01	-	Scheme proposed to be converted to two ROR schemes/NTPC given consent for preparation of DPR for one ROR scheme. NTPC not willing to take up project unless given for implementation
17	Naying	Ar.P	IPP	1000	ROR	1.18	3/07	For implementation
18	Tato – II	Ar.P	IPP	700	ROR	1.48	3/07	For implementation
19	Hirong	Ar.P	IPP	500	ROR	1.62	3/07	For implementation
20	Umduna	Megh.	CWC	57	ROR	1.68	3/08	For preparation of DPR only/Fund constraints
21	Selim	Megh.	CWC	170	STO	2.02	3/08	For preparation of DPR only/Fund constraints
22	Mawhu	Megh.	NEEPCO	120	ROR	1.40	1/07	For implementation
23	Nongkolait	Megh.	MeSEB	120	ROR	1.97	3/07	For implementation
24	Nongnaw	Megh.	MeSEB	50	ROR	2.44	3/07	For implementation
25	Rangmaw	Megh.	MeSEB	65	ROR	2.32	3/07	For implementation

Source: Central Electricity Authority.



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## Private Sector Participation

In the NER, Arunachal Pradesh is taking a keen interest in private sector participation in hydropower development. According to a recent newspaper report,<sup>28</sup> the State has allotted five projects in Siang valley, with a total installed capacity of 4,800 MW to three leading private companies as follows:

- Reliance Energy, two projects with a total capacity of 1,700 MW;
- Jaypee Associates, two projects with a total capacity of 2,100 MW; and
- DS Construction Ltd, one project with a capacity of 1,000 MW.

These projects are expected to be commissioned in 7–8 years. The State has preferred private developers over CPSUs because they have agreed to (a) give 12–19% free power as royalty as against the prevailing Government of India norm of 12%, (b) develop the projects on a lease basis for 40 years as against ownership basis, and (c) provide more benefits like reservation of jobs for locals even in managerial and technical posts and development of infrastructure like schools around the project areas.

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28 5 Hydropower projects to come up in Arunachal, *The Assam Tribune*, 2 March 2006.

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23. Website of National Hydroelectric Power Corporation (NHPC) ([www.nhpc.co.in](http://www.nhpc.co.in)).
24. Website of Ministry of Power ([www.powermin.nic.in](http://www.powermin.nic.in)).
25. Website of Central Electricity Authority ([www.cea.nic.in](http://www.cea.nic.in)).



## About the Asian Development Bank

ADB aims to improve the welfare of the people in the Asia and Pacific region, particularly the nearly 1.9 billion who live on less than \$2 a day. Despite many success stories, the region remains home to two thirds of the world's poor. ADB is a multilateral development finance institution owned by 67 members, 48 from the region and 19 from other parts of the globe. ADB's vision is a region free of poverty. Its mission is to help its developing member countries reduce poverty and improve their quality of life.

ADB's main instruments for helping its developing member countries are policy dialogue, loans, equity investments, guarantees, grants, and technical assistance. ADB's annual lending volume is typically about \$6 billion, with technical assistance usually totaling about \$180 million a year.

ADB's headquarters is in Manila. It has 26 offices around the world and more than 2,000 employees from over 50 countries.

