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Regional Hydro-power Resources: Status of Development and Barriers

India

 **Nexant**

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Nexant SARI/Energy

List of Abbreviations

BBMB	Bhakra Beas Management Board
CCEF	Cabinet Committee on Economic Affairs
CEA	Central Electricity Authority
CERC	Central Electricity Regulatory Commission
CIR	Central India River System
CRG	Crisis Resolution Group
DPR	Detailed Project Report
DVC	Damodar Valley Corporation Ltd.
EFC	Expenditure & Finance Committee
EFR	East Flowing River System
EIA	Environment Impact Assessment
EMP	Environment Management Plant
FDI	Foreign Direct Investment
GOI	Government of India
H.P.	Himachal Pradesh
IPP	Independent Power Producer
J & K	Jammu & Kashmir
Kar	Karnataka
KEB	Karnataka Electricity Board
Ker	Kerala
KPCL	Karnataka Power Corporation Ltd.
MCM	Million Cubic Meters
MNES	Ministry of Non-Conventional Energy Resources
MOP	Ministry of Power
MOU	Memorandum of Understanding
M.P.	Madhya Pradesh
MU	Million Units
MW	Mega Watt
NEEPCO	North-East Electric Power Corporation Ltd.
NHPC	National Hydro-electric Power Corporation Ltd.
NJPC	Naptha Jhakri Power Corporation Ltd.
PFC	Power Finance Corporation Ltd.
PIB	Public Investment Board
PSS	Pumped Storage Schemes
R & R	Rehabilitation & Resettlement
Raj	Rajasthan
ROR	Run-of-River System
S & I	Survey & Investigation
SEB	State Electricity Board
TBD	To Be Determined
THDC	Tehri Hydro-power Development Corporation Ltd.
T.N.	Tamilnadu
U.P.	Uttar Pradesh
W.B.	West Bengal
WFR	West Flowing River System

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Executive Summary

This study aims to provide information about the status of development of hydro-power in India. The report presents an overview of the country's economic status, about its power sector and principal organizations involved in the planning of the sector. The report provides detailed information about India's hydro-power potential, its current status of utilization, possibility of enhancing hydro-power capacity of existing schemes by renovation and modernization, hydro-power schemes under construction, and the schemes planned for development over the next 10 year period and beyond, the role of hydro-power within the overall power sector, the present government policy for hydro-power development both in the government sector as well as in the private sector, the issues and barriers that are being faced in developing hydro-power schemes.

India is a vast country having borders with most of the SAARC member countries. It has a population of above one billion. It is also one of the fastest growing economies, with GDP growth rate of about **6%**.

India's per capita power consumption is rather low as compared to developed economies, being lower than 400 kWh per year. With the economy growing at **6%** the rate of growth of electricity demand will rise substantially over the next two decades. The rise of demand has consistently exceeded the installed capacity addition, thus there has been chronic shortage of both the peaking power as well as energy.

India's hydro-power potential has been assessed at about 150,000 MW installed capacity to provide about 600 billion units. Most of the hydro potential lies in the northeastern and northern region of the country in the Himalayan range of mountains. About **17%** of the hydro resources have been developed so far. Ideal thermal-hydro mix in the power system has been established at 60:40, but the present mix is about 75:25 which is creating operational problems in the power system including backing down of large thermal power units. Presently 229 hydro-power stations are operational with aggregate installed capacity of about 25,587 MW.

The Government of India (GOI) has adopted a national hydro-power policy to accelerate the development of hydro-power resources. Under this policy, GOI has undertaken a number of actions which include rationalization of the process of project clearances, providing committed funds for the ongoing schemes, creation of a new fund for survey & investigation of hydro schemes by levying a surcharge on the electricity sold, multistage clearance from the environment & forest angles to facilitate undertaking feasibility study and pre-construction activities at the proposed project site, rationalizing the formulation of tariff, promoting private sector participation in hydro-power development, special concession for mega power projects, creation of electricity regulatory authorities at central and state government levels, setting up Power Trading Corporation to facilitate sale of power across the country.

The GoI aims to develop the entire hydro-power potential of the country by the year 2025-26. During the 10-year period up to 2012, it is plans to add 32,844 MW hydro generating capacity to the existing 25587 MW, which means more than doubling the hydro-power capacity within the 10-year period. However there are many barriers and hurdles in achieving the above goal. The principal barriers are lack of financial resources, complicated and multi-

agency involvement in project clearances procedure, inadequate hydrological & geological investigations, inter-state disputes, limitation of managerial capabilities & contract management skills, lack of competent construction agencies, lack of adoption of the latest construction methodologies and technologies etc.

The demand growth in India can be expected to continuously outgrow the planned capacity addition if India is to come anywhere near the per capita electricity consumption of developed countries. Thus while concentrating on developing its own hydro-power resources, India should actively consider and further promote cooperation among the SAARC neighboring countries to develop their vast hydro resources and purchase the power so produced so that a healthy hydro thermal mix can be maintained amongst the SAARC region, which will optimize the resources utilizations for the entire region to benefit all the countries. This will also improve the power generation mix for the neighboring countries also thus creating a win-win situation for all participants of the region.

1.1 The Republic of India is second most populated country in the world with population of over one billion and is the world's largest democracy. India is a member of the SAARC and has borders with Pakistan, Nepal, Bhutan and Bangladesh. A map of India is shown at Map1. Situated between the Indian Ocean in the south and the Himalayan range of mountains in the North, the country has one of the lowest per capita income but is among the fastest growing economies in Asia. Since early 1990s India began to open up its economy to foreign investment and trade after several decades of pursuing protectionist "import substitution" trade policies and placing severe limitations on foreign investment,. By the mid-1990s, India's real GDP growth rate had reached a rate of **7.4%** (1995-96). Sanctions imposed as a result of the country's 1998 nuclear tests, among other factors, slowed India's real GDP growth to **4.6%** in 1997-1998, but it recovered to **6.4%** for 1999-2000 and **7.2%** for 2000-2001. Real GDP growth is projected at **5.0%** for 2001-2002, with the slowdown largely a result of reduced demand for Indian exports in connection with the global economic slowdown. The GDP growth in the current year (April 2002 – March 2003) is expected to be around **6%** as estimated by the Reserve Bank of India (RBI).

1.2 India is the world's sixth largest energy consumer, plans major energy infrastructure investments to keep up with increasing demand--particularly for electric power and possible imports of liquefied natural gas to support power projects. India also is the world's third-largest producer of coal, and relies on coal for more than half of its total energy needs. In spite of the huge size of the country and growing economy, the per capita electricity consumption remains at a low of 360 kWh.

1.3 India has a vast and expanded power sector commensurate with its geographical area and population. The country's power system is divided into five major regions namely, the Northern Region, Western Region, Southern Region, Eastern Region and North-east Region. The planning of power sector is region focused. While the Eastern and Northeastern regions have abundance of resources, the Northern and Western regions have larger power demands. The Central Electricity Authority (CEA) and the Ministry of Power (MOP) are the nodal agencies involved in the power sector planning and development. Under the Indian Constitution, electricity is included in the list of concurrent subjects and therefore its development can be undertaken by both the state sector as well as by the central sector. Therefore, power generation and transmission are planned, constructed and maintained both the by the Central Government agencies as well as by the respective State level organizations. The distribution of electricity remains largely with the state utilities except for some metro areas like Delhi, Mumbai, Calcutta and Ahmedabad where private parties have been operational. Private sector participation in power sector is presently small and is being encouraged by the central and the state governments. This is showing encouraging results although there are some multi-national projects, which, for various reasons, could not achieve the level of success expected.

1.4 India's power sector has been facing chronicle peaking and energy shortages. The total installed generating capacity as on 1.1.2002 was 103134 MW, predominantly coal based. The share of Hydro was **24.8%**, Coal **61%**, Gas about **10%**, Nuclear about **2.8%** and the rest was wind, diesel etc. Region-wise installed capacity as on 1.1.2002 is shown in Table 1.1 :

Table 1.1: India - Region-wise Installed Capacity (MW) as on 1.1.2002

S.No.	Region	Hydro	Thermal	Nuclear	Wind	Total
1	Northern	8453	18057	1320	14	27844
2	Western	4327	25731	760	429	31247
3	Southern	9640	14585	780	980	25985
4	Eastern	2453	13735	0	3	16191
5	Northeastern	696	1122	0	0	1818
6	Islands	5	44	0	0	49
Total		25574	73274	2860	1426	103134

1.5 Of the total installed capacity, about **60%** is owned by the state sector, **30%** by the central sector and the remaining **10%** by private sector. The country is experiencing energy deficit of about **7.5%** and peak deficit of about **13%**. Although in every successive five year plans, ambitious targets are laid for capacity addition, the actual achievements have been rather low.

1.6 During the tenth five year plan (2002-2007) total of 41110 MW installed capacity is targeted to be added to the system of which Hydro share is proposed to be 14393 MW. Table 1-2 shows the sector-wise planned addition to the capacity during this period.

Table 1-2: India - Target Capacity Addition 2002-07
(MW)

Sector	CENTRAL	STATE	PRIVATE	Total
Thermal	12790	6676	5951	25417
Hydro	8742	4481	1170	14393
Nuclear	1300	0	0	1300
Total	22832	11157	7121	41110

1.7 Besides above, about 3100 MW installed capacity is planned to be achieved through development of small hydro (less than 25 MW) and other non-conventional sources of energy including wind power, solar energy etc. For these projects, Ministry of Non-conventional Energy Sources (MNES) is responsible.

1.8 The projected power demand for over the next 10 years is shown in Table 1-3 below.

Table 1-3: India - Projected Power Demand

Region	Energy (MkWh)		Peak Demand (MW)	
	Mar-07	Mar-12	Mar-07	Mar-12
Northern	220820	308528	35540	49674
Western	224927	299075	35223	46825
Southern	194102	262718	31017	42061
Eastern	69467	90396	11990	15664
North-eastern	9501	14061	1875	2789
Islands	280	444	60	94
Total	719097	975222	115705	157107
Installed Capacity Required			165293	224439

1.9 From the above figures, it is observed that in spite of the ambitious capacity addition plans, the demand is expected to surpass the available peaking power and energy and power shortages are likely to continue over this period, up to the year 2012.

The Advisory meeting on Hydro-power Development and Rehabilitation of Hydro Plants in SARI region held in Sri Lanka has recommended a list of prioritized issues needing to be addressed in regional context. In order to address the issues raised in the workshop, particularly (i) Evaluation of unique economic and other benefits of a hydro-power project from a regional prospective and develop a pricing mechanism of hydro-power (ii) Develop a Regional Master Plan for exploitation of hydro-power resources and (iii) a Regional Least Cost Generation Plan a comprehensive and authentic documentation of Regional Hydro-power resources the present status of development, hydro-power development policies adopted and issues and barriers perceived by the partner countries in the hydro-power will be needed.

To provide a Comprehensive and Authentic Reference Document comprising of the hydro-power potentialities with the parameters of all the identified projects the present status of utilization of hydro-power resources, the future hydro-power development plan, policies currently followed for the hydro-power development and the problems and issues as perceived by the partner countries

The data presented in this report have been drawn, largely from published documents. However, extensive discussions were also held with the relevant organizations including the Central Electricity Authority (CEA), National Hydro-electric Power Corporation Ltd. (NHPC), Power Finance Corporation (PFC), private hydro-power developers, and others to supplement and update the available information. Table 4.1 provides a list of resources used in producing this report.

Table 4-1: India - References and Resources Database

S. No.	COUNTRY CODE AND REPORT REF.	TITLE	AUTHOR	AGENCY	YEAR	STATUS
1	2	3	4	5	6	7
1	3001	Policy on Hydro-power Development	Ministry of Power	GOI	1998	Published
2	3002	Power on Demand	CEA	GOI	1999	Published
3	3003	Blueprint for Power Sector Development	Ministry of Power	GOI	2001	Published
4	3004	Small Hydro-power Potential in India	CEA	GOI	1997	Published
5	3005	Renovation, Modernization, Upgrading and Life Extension of Hydro-power Stations	CEA	GOI	2000	Published
6	3006	Preliminary Ranking Study of Hydro-electric Schemes Vol I -VII	CEA	GOI	2001	Published
7	3007	Sixteenth Electrical Power Survey of India	CEA	GOI	2000	Published
8	3008	Mega Power Plant Policy	MOP	GOI	1999	Published
9	3009	Accelerated Power Development Program	MOP	GOI	2001	Published
10	3010	Policy for R & M of Existing Stations	MOP	GOI	1995	Published
11	3011	Annual Report 2001-02 Ministry of Power	MOP	GOI	2002	Published
12	3012	Policy for Setting up of Mega Power Projects in Private Sector	MOP	GOI	1995 and amendments	Published

S. No.	COUNTRY CODE AND REPORT REF.	TITLE	AUTHOR	AGENCY	YEAR	STATUS
1	2	3	4	5	6	7
13	3013	Techno-economic Clearance of CEA	MOP	GOI	1999	Published
14	3014	Century of Hydro-power in India	CBIP	GOI	1997	Published
15	3015	Mission 2012: Power for All: Capacity Addition Programme	MOP	GOI	2002	Published
16	3016	Annual Review of SEBs	Planning Commission	GOI	2001	Internal
17	3017	Report of the Committee Constituted by the Govt. of India	GOI	GOI	1998	Internal
18	3018	Vision Paper for Development of Hydro-electric Potential by 2025-26	CEA	GOI	2001	Internal
19	3019	Data Base CEA	CEA	GOI	2002	Internal
20	3020	Data Base NHPC	CEA	GOI	2002	Internal
21	3021	Post-construction Environmental Impact Assessment of Chamera HE Project Stage I (HP)	NHPC	NHPC	1996 - 97	Internal

Note : Country code for India is '3' followed by the reference title

5.1 India has huge potential of hydro-power contained within its river systems and topography. Physiographically India can be divided in three major divisions namely, Himalayas and associated young fold mountains, the ancient block of Peninsular India and the Indo-Gangetic plains lying between the two. The three regions are vastly different in geological history and in character of their terrain. Out of these three divisions, the Himalayan range comprising greater Himalayas, the lesser or middle Himalayas and the Shivalik range possess vast hydro potential. Greater Himalayas being inaccessible provide little opportunity to harness hydro potential but they do act as reservoirs of water for all the rivers of this region. This leaves the other two ranges viz. Lesser Himalayas and Shivalik as the potential source for development of hydro-power potential.

5.2 The country has been classified into six major river systems for the purpose of assessment of hydro-power potential. These are Indus, Brahmaputra, Ganga, Central Indian River System, East Flowing River System and West Flowing River System. Map 2 shows the various river system/basins of India.

5.3 The Indus Basin comprises six major rivers namely, Indus, Jhelum, Chenab, Sutlej, Ravi and Beas. The basin comprises the states of Jammu & Kashmir, Punjab and Himachal Pradesh. The total area intercepted by these six rivers is about 1.16 million square km. Out of which 0.17 million sq. km lies in the Indian Territory.

5.4 The Ganga Basin with about **25%** of the total geographic area of the country has a total drainage area of about 1.05 million sq. km. Of which about 0.87 million sq. km lies in India. The basin covers the areas in Uttaranchal, UP, Punjab, Haryana, Himachal Pradesh, Rajasthan, Madhya Pradesh, Chattisgarh, Bihar, Jharkhand, West Bengal, and Delhi. The basin comprises rivers like Upper Ganga, Upper Yamuna, Lower Yamuna, Chambal, Sarda-Gomti-Ghaghara, Sone, Betwa-Sind, Kosi-Gandak- Mahananda, Lower Ganga, Damodar.

5.5 The Great Brahmaputra Basin has a total drainage area of about 554 thousand sq. km of which approximately 265000 sq.km lies in India. It comprises the states of Arunachal Pradesh, Assam, Meghalaya, Manipur, Tripura, Nagaland, Sikkim, and a substantial part of West Bengal. The major rivers in this basin are Brahmaputra, Barak, Teesta, Subansiri, Kameng, Kalang, Dihang-Dibang, Lohit etc.

5.6 The Central India River System has a drainage area of about 760000 sq.km. and includes the states of Rajasthan and Gujarat. The major rivers in this basin are Narmada, Tapi, Subernrekha, Brahmani-Baitarni, Mahanadi, Sabarmati and Luni-Banas rivers.

5.7 The West Flowing River System (WFR) of Southern India covers the states of Kerala, Goa, parts of Tamilnadu, Karnataka, Gujarat and Konkan region of Maharashtra state. This basin comprises rivers like Minodhola-Damanganga, Vaitarna-Savitri, Vashishta-Tillari, Mandvi-Sharavathi, Varahi-Kuttiyadi, Baypore-Periyar and Pamba-Paraliyar.

5.7 The East Flowing River System of Southern India constitutes the largest river system of the country draining a total catchment area of about 900 thousand sq. km. And comprises major inter-state basins of Godavari, Krishna, Cauvery etc.

5.9 For assessing the country's hydro-power potential, studies were first carried out during the period 1953-59. These studies indicated that India's economically exploitable hydro-power potential was about 42100 MW at **65%** load factor corresponding to an annual energy generation of 221 billion units. A reassessment of the potential was carried out by the Central Electricity Authority (CEA) during 1978-87 period by using modern assessment techniques and additional hydrological information available. This reassessment resulted in establishing the potential at 84044 MW at **60%** load factor and 600 billion units, comprising of 845 hydro-electric schemes. This potential when fully developed would result in an installed capacity of over 150,000 MW on the basis of probable average load factor. The basin-wise estimated hydro potential and probable installable capacity are given in the Table 5.1.

Table 5-1 India: Basin-wise Hydro-power Potential

Region	Potential (at 60% Load Factor) (MW)	Probable Installable Capacity (MW)
Indus Basin	19988	33832
Ganga Basin	10715	20711
Central India Rivers	2740	4152
West Flowing Rivers	6149	9430
East Flowing Rivers	9532	14511
Brahmputra Basin	34920	66065
Total	84044	148701

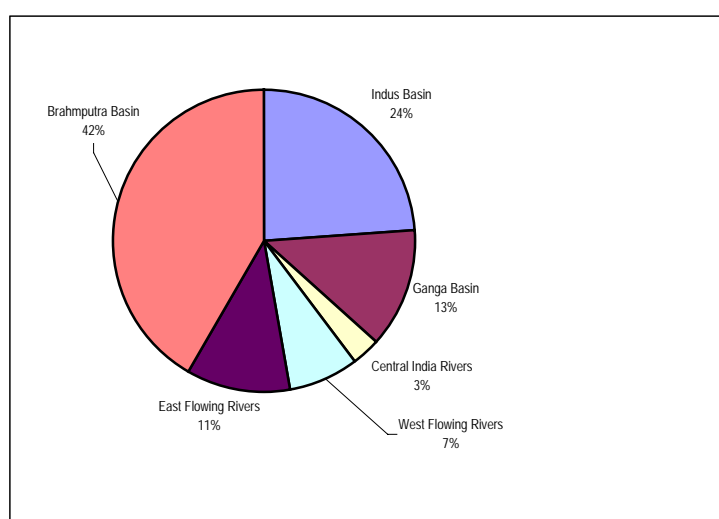


Fig 5-1 Percentage of Basin-wise Hydro Potential

5.10 Of the five regions of the power system, the northern and north-eastern regions have the highest hydro-power potential. Table 5.2 shows region-wise hydro-power potential of the country.

Table 5-2 India: Region-wise Hydro-power Potential (At 60% load Factor)(MW)

Region	Potential Assessed	Potential Developed as on 1.1.2002
Northern	30155	4623
Western	5679	1858
Southern	10763	5797
Eastern	5590	1369
North-eastern	31857	389
TOTAL	84044	14036

5.11 CEA's reassessment studies have also identified 56 sites for Pumped Storage Schemes (PSS) with total installation of about 93,920 MW. In addition to the medium and large hydro schemes included above, a sizable potential also exists for development of hydro-power on rivulets and canal drops. As per assessment made by the CEA in 1996, 1512 small hydro-electric schemes having aggregate installed capacity of above 6782 MW on canals/streams have been identified. Thus the total hydro-power capacity potential of India is considered to be 2,49,402 MW.

6.1 India's first hydro-power project was commissioned in the year 1897 at Darjeeling in West Bengal with installed capacity of 130 kW. At the time of independence in 1947, the hydro-power capacity was 508 MW against the total installed capacity of 1362 MW i.e. the hydro share was **37%**.

6.2 In the period that followed the independence, India's power development remained hydro-power oriented. By 1963, the share of hydro-power had increased to about **61%**. The period of about 25 years after independence saw commissioning of many large hydro-power projects across the country like Bhakra Nangal, BBMB, Rana Pratap Sagar, Rihand, Koyna, Sabaragiri, Kundah etc.

6.3 With the increasing tempo of development, demand for electricity has been growing tremendously. India multiplied its electricity generation by as many as 61 times from 1362 MW in 1947 to over 83000 MW in 1996. But the pressure of a developing economy necessitates a considerable increase in generation capacity with every year passing.

6.4 For meeting the rapidly growing demand for electricity and mitigating the power shortages, from the early seventies, greater stress was given to development of fast track fossil fuel fired power stations. This resulted in hydro-power projects getting a secondary priority and consequently, the hydro-power development suffered setbacks. In spite of having huge resources, the actual utilization of hydro-power has been declining over the years. Table 6.1 shows the performance of achievement of hydro-power resources against the set targets planned during the various plans for the period 1969 to 2002.

Table 6-1 India: Plan-wise Hydro Capacity Targets/Achievements

Period/Plan	Target (MW)	Achievement (MW)	% Achievement
1969-74, Fourth Plan	3518	1057	30
1974-79, Fifth Plan	4654	3812	82
1979-80, Annual Plan	548	549	100
1980-85, Sixth Plan	4768	2873	60
1985-90, Seventh Plan	5541	3828	69
1990-91, Annual Plan	1007	446	44
1991-92, Annual Plan	754	436	58
1992-97, Eight Plan	9282	2427	26
1997-2002, Ninth Plan	9820	4538	46
TOTAL	39138	19966	51

6.4 Details of hydro-power potential and its development are given in Table 6.2. The maximum exploitation has been in the west flowing rivers of the South India at about **60%** of the potential, while in the Brahmaputra Basin, which has the maximum potential, only **1.5%** potential has been harnessed.

Table 6-2 India - Basin-wise Hydro-power Developed (At 60% load Factor) (MW)

Region	Potential Assessed	Potential Developed as on 1.1.2002
Indus	19988	3195
Ganga	10715	1909
Central India	2740	647
West Flowing	6149	3687
East Flowing	9532	4061
Brahmputra	34920	537
TOTAL	84044	14036

6.6 Of the total 845 schemes identified by the CEA, 229 schemes have been commissioned and are operational as on 1.4.2002. The total capacity installed in these schemes is approx. 25,587 MW, which is only **17.2 %** of the total potential. A list of existing hydro-power projects is shown in Table 6.3. Hydro-power stations of less than 3 MW installed capacity are numerous and are not included in this list.

Table 6-3 India - Existing Hydro-electric Projects

1	Project Name	Owner	Year of installation	Output				Reservoir		Type 1- run of river 2-Run of river/Pondage 3-Peaking 4- Storage 5- Pump Storage	Possible Renovation, Modernization and Up-grading
				No. of unit	Unit Size	Total MW	Annual Energy MU(1)	Cap. MCM	Area(*) Km2		
1	2	3	4	5			6	7	8	9	10
1	NORTHERN REGION										
	CENTRAL SECTOR										
	(1) Bhakra(L)	BBMB	1960,61	5	108	540	4191	6860		4	2002-07
	(2) Bhakra(R)	BBMB	1966,68	5	132	660		6860		4	
	(3) Ganguwal	BBMB	1952,61	1 2	29.25 24	77.25	1269			1	2002-07
	(4)Kotla	BBMB	1956,61	1 2	29.25 24	77.25				1	2002-07
2	Dehar	BBMB	1977,83	6	165	990	3057	18.5		1	2007-12
3	Pong	BBMB	1978,83	6	60	360	1422	7120		4	2002-07
4	Baira Siul	NHPC	1980,81	3	60	180	606			1	
5	Salal-I	NHPC	1987	3	115	345	2930	280		1	
6	Salal-II	NHPC	1993,95	3	115	345					1

Table 6-3 India - Existing Hydro-electric Projects

	Project Name	Owner	Year of installation	Output				Reservoir		Type 1- run of river 2-Run of river/Pondage 3-Peaking 4- Storage 5- Pump Storage	Possible Renovation, Modernization and Up- grading
				No. of unit	Unit Size	Total MW	Annual Energy MU(1)	Cap. MCM	Area (*) Km2		
1	2	3	4	5			6	7	8	9	10
7	Tanakpur	NHPC	1992	3	40	120	412			1	
8	Chamera Stage I	NHPC	1994	3	180	540	1956			4	
9	Uri	NHPC	1996	4	120	480	2087	391		4	
								2316			
	STATE SECTOR										
1	W.Y.Canal,A,B,C	Haryana	1986,87,89				232			1	
2	Giri Bata	Himachal Pradesh	1978	2	30	60	192			1	
3	Bassi	Himachal Pradesh	1970-81	4	15	60	258			1	
4	Sanjay	Himachal Pradesh	1989	3	40	120	482			1	
5	Andhra	Himachal Pradesh	1987	3	5.65	16.95	60			1	
6	Binwa	Himachal Pradesh	1984	2	3	6	21			1	
7	Thirot	Himachal Pradesh	1994,95	3	1.5	4.5				1	
8	Baner	Himachal Pradesh	1996	3	4	12				1	
9	Gaj	Himachal Pradesh	1996	3	3.5	10.5				1	
10	Ghanvi	Himachal Pradesh	2000	2	11.25	22.5				1	
11	Lower Jhelum	Jammu & Kashmir	1978-79	3	35	105				1	2002-07
12	Upper Sindh	Jammu & Kashmir	1973-74	2	11	22				1	

Table 6-3 India - Existing Hydro-electric Projects

	Project Name	Owner	Year of installation	Output				Reservoir		Type 1- run of river 2-Run of river/Pondage 3-Peaking 4- Storage 5- Pump Storage	Possible Renovation, Modernization and Up-grading
				No. of unit	Unit Size	Total MW	Annual Energy MU(1)	Cap. MCM	Area (*) Km2		
1	2	3	4	5			6	7	8	9	10
13	Chenani	Jammu & Kashmir	1971-75	5	4.6	23	228			1	
14	Mohara	Jammu & Kashmir	1962	2	4.5	9				1	
15	Ghandharbal	Jammu & Kashmir	1955-63	2 2	3 4.5	15				1	2002-07
16	Stakna	Jammu & Kashmir	1986-87	2	2	4				1	
17	Kargil	Jammu & Kashmir	1995	3	1.25	3.75				1	
18	Upper Sindh St. II & Ext	Jammu & Kashmir	2000,01-02	2 1	35 35	105					
19	Chenani Stage III	Jammu & Kashmir	2000	3	2.5	7.5				1	
20	Sewa	Jammu & Kashmir	2001-02	3	3	9				1	
21	Shanan	Punjab	1932,82	4 1	15 40	110		472			1
22	U.B.D.C. St. I P.H - I	Punjab	1971	1	15	15	300			1	2002-07
23	U.B.D.C. St. I P.H - II	Punjab	1972	1	15	15				1	2002-07
24	U.B.D.C. St. I P.H - III	Punjab	1973	1	15	15				1	2002-07
25	U.B.D.C. St. II P.H - I	Punjab	1989	1	15	15				1	
26	U.B.D.C. St. II P.H - II	Punjab	1991	1	15	15				1	
27	U.B.D.C. St. II P.H - III	Punjab	1991	1	15	15				1	
28	Mukerian st. I	Punjab	1983	3	15	45				1	

Table 6-3 India - Existing Hydro-electric Projects

1	Project Name	Owner	Year of installation	Output				Reservoir		Type 1- run of river 2-Run of river/Pondage 3-Peaking 4- Storage 5- Pump Storage	Possible Renovation, Modernization and Up- grading
				No. of unit	Unit Size	Total MW	Annual Energy MU(1)	Cap. MCM	Area(*) Km2		
2	3	4	5	6	7	8	9	10			
29	Mukerian st. II	Punjab	1988-89	3	15	45	1171		1		
30	Mukerian st. III	Punjab	1989	3	19.5	58.5			1		
31	Mukerian st. IV	Punjab	1989	3	19.5	58.5			1		
32	A.P.Sahib St. I	Punjab	1985	2	33.5	67	539		1	2002-07	
33	A.P.Sahib St. II	Punjab	1985	2	33.5	67			1	2002-07	
34	Ranjit Sagar(Thein Dam)	Punjab	2000	4	150	600	1229		4		
35	R.P.Sagar	Rajasthan	1968-69	4	43	172	259	2900	4	2002-07	
36	J.Sagar	Rajasthan	1972-73	3	33	99	200	4934	4	2002-07	
37	Mahi Bajaj-I	Rajasthan	1986	2	55	110	69		1		
38	Mahi Bajaj-II	Rajasthan	1989	2	45	90			1		
39	Anoopgarh-I	Rajasthan	1987-88	3	1.5	4.5	14		1		
40	Anoopgarh-II	Rajasthan	1987-88	3	1.5	4.5			1		
41	R.M.C. Mangrol	Rajasthan	1994	3	2	6			1		
42	Suratgarh	Rajasthan	1992	2	2	4			1		
43	Rihand	Uttar Pradesh	1962-66	6	50	300	1041		4	2002-07	
44	Obra	Uttar Pradesh	1970-71	3	33	99	391		1	2002-07	
45	Matatilla	Uttar Pradesh	1965	3	10	30	135		1	2002-07	
46	Khara	Uttar Pradesh	1952	3	24	72	309		1		

Table 6-3 India - Existing Hydro-electric Projects

1	Project Name	Owner	Year of installation	Output				Reservoir		Type 1- run of river 2-Run of river/Pondage 3-Peaking 4- Storage 5- Pump Storage	Possible Renovation, Modernization and Up-grading
				No. of unit	Unit Size	Total MW	Annual Energy MU(1)	Cap. MCM	Area(*) Km2		
1	2	3	4	5			6	7	8	9	10
47	Dhakrani(Y. St. I)	Uttaranchal	1965-70	3	11.25	33.75	195			1	2002-07
48	Dhalipur(Y. St. II)	Uttaranchal	1965-70	3	17	51	193			1	2002-07
49	Kulhal (y.St. IV)	Uttaranchal	1975	3	10	30	124			1	2002-07
50	Chhibro (y St. II)	Uttaranchal	1975-76	4	60	240	740			1	2002-07
51	Khodri (Y. St.II)	Uttaranchal	1984	4	30	120	365			1	2002-07
52	Ramganga	Uttaranchal	1975-77	3	66	1194.8	274			4	2002-07
53	Chilla	Uttaranchal	1980-81	4	36	144	541			1	2002-07
54	Maneri Bhali St. I	Uttaranchal	1984	3	30	90	391			1	2002-07
55	Khatima	Uttaranchal	1955-56	3	13.8	41.4	171			1	2002-07
56	Pathari	Uttaranchal	1955	3	6.8	20.4				1	2002-07
57	Mohamadpur	Uttaranchal	1950	3	3.1	9.3	154			1	
58	Nirgajani	Uttaranchal	1937	2	2.5	5				1	
59	Sobla	Uttaranchal	1998,99	2	3	6	0			1	
	PRIVATE SECTOR		1992								
1	Malana	Himachal Pradesh./IPP	2001	2	43	86	234			1	

Table 6-3 India - Existing Hydro-electric Projects

1	Project Name	Owner	Year of installation	Output				Reservoir		Type 1- run of river 2-Run of river/Pondage 3-Peaking 4- Storage 5- Pump Storage	Possible Renovation, Modernization and Up- grading
				No. of unit	Unit Size	Total MW	Annual Energy MU(1)	Cap. MCM	Area(*) Km2		
2	3	4	5	6	7	8	9	10			
WESTERN REGION											
STATE SECTOR											
1	Ukai	Gujarat	1974-76	4	17	68	234	1690		4	
2	Kadana	Gujarat	1990-98	4	10	40	41	21		5	
3	Ukai LBC	Gujarat	1987-88	2	60	120	12			1	
4	Ghandi Sagar	Madhya Pradesh	1960-66	5	30	150	114	7618		4	2002-07
5	Bargi	Madhya Pradesh	1988	2	66	546.1	522			4	
6	Pench	Madhya Pradesh	1986-87	2	80	160	138			4	
7	Bansagar Tons	Madhya Pradesh	1990,92	3	105	315	1296			4	
8	Birsinghpur	Madhya Pradesh	1991	2	10	20	36			4	
9	Hasdeo Bango	Chhatisgarh	1994,95	3	40	120	392			4	
10	Rajghat	Madhya Pradesh	1999	3	15	45	105			4	

Table 6-3 India - Existing Hydro-electric Projects

1	Project Name	Owner	Year of installation	Output				Reservoir		Type 1- run of river 2-Run of river/Pondage 3-Peaking 4- Storage 5- Pump Storage	Possible Renovation, Modernization and Up-grading
				No. of unit	Unit Size	Total MW	Annual Energy MU(1)	Cap. MCM	Area(*) Km2		
2	3	4	5				6	7	8	9	10
11	Koyana I & II	Maharashtra	1962-67	4	65	560	2889	2797		4	
12	Koyana III	Maharashtra	1975-78	4	80	320		36.2		4	2007-12
13	Koyana IV	Maharashtra	1999-2000	4	250	1000		279		4	2007-12
14	Koyana DPH	Maharashtra	1980-81	2	20	40	85			1	2002-07
15	Vaitarna	Maharashtra	1976	1	60	60	128			1	2002-07
16	Eldari	Maharashtra	1968	3	7.5	22.5	28			1	2002-07
17	Bhatgarh	Maharashtra	1977	1	16	16	67			1	
18	Bhira Tail Race	Maharashtra	1987-88	2	40	80				1	
19	Tillari	Maharashtra	1986	1	60	60	89			1	
20	Paithon	Maharashtra	1984	1	12	12	8			5	
21	Bandhardhara - I	Maharashtra	1986	1	10	10	32	2147		1	
22	Pawana	Maharashtra	1988	1	10	178	7			1	
23	Khadakwasla - I	Maharashtra	1991	1	8	8	50			1	
24	Khadakwasla - II	Maharashtra	1991	1	8	8				1	
25	Bhatsa	Maharashtra	1991	1	15	15	58			1	
26	Vir	Maharashtra	1975	2	4.5	9	67			1	
27	Radhanagri	Maharashtra	1951	4	1.2	4.8	6			1	
28	Kanher	Maharashtra	1991	1	4	4				1	

Table 6-3 India - Existing Hydro-electric Projects

1	Project Name	Owner	Year of installation	Output				Reservoir		Type 1- run of river 2-Run of river/Pondage 3-Peaking 4- Storage 5- Pump Storage	Possible Renovation, Modernization and Up-grading
				No. of unit	Unit Size	Total MW	Annual Energy MU(1)	Cap. MCM	Area(*) Km2		
2	3	4	5				6	7	8	9	10
29	Ujjaini	Maharashtra	1993	1	12	12		1440		5	
30	Manikdoh	Maharashtra	1995	1	6	6	68			1	
31	Surya	Maharashtra	1996	1	6	6				1	
32	Bhandardhara II	Maharashtra	1996	1	34	34				1	
33	Dimwe	Maharashtra	1997	1	5	5				1	
34	Warna	Maharashtra	1997-98	2	8	16				1	
35	Dudhganaga	Maharashtra	1999-2000	2	12	24		18			4
	PRIVATE SECTOR										
1	Tawa	Maharashtra/IPP		2	6.75	13.5	17				
2	Bhira	TATA	1927(5),1950	6	22	132	1301	523		4	
3	Bhivpuri	TATA	1921-24	6	12	72				4	
4	Khopoli	TATA	1914-26	6	12	72				4	
5	Bhira PSS	TATA	1995	1	150	150				5	

Table 6-3 India - Existing Hydro-electric Projects

1	Project Name	Owner	Year of installation	Output				Reservoir		Type 1- run of river 2-Run of river/Pondage 3-Peaking 4- Storage 5- Pump Storage	Possible Renovation, Modernization and Up- grading
				No. of unit	Unit Size	Total MW	Annual Energy MU(1)	Cap. MCM	Area(*) Km2		
2	3	4	5				6	7	8	9	10
SOUTHERN REGION											
STATE SECTOR											
1	Machkund	Andhra Pradesh	1955-59	3 3	17 21.25	114.75	729			4	2002-07
2	Upper Sileru I	Andhra Pradesh	1967-68	2	60	120	449			4	2002-07
3	Upper Sileru st. II	Andhra Pradesh	1994-95	2	60	120				1	2002-07
4	Lower Sileru	Andhra Pradesh	1976-78	4	115	460	1058			4	2007-12
5	T.B.Dam	Andhra Pradesh	1957-64	4	9	36	165			4	2002-07
6	Hampi	Andhra Pradesh	1958-64	4	9	36				4	2002-07
7	N.J.Sagar	Andhra Pradesh	1978-85	1 X 110 + 7 x 100 7		810	1069	29		5	2002-07
8	Sri Sailum	Andhra Pradesh	1982-87	7	110	770	1943	7080		4	
9	N.J.Sagar R.B.C.	Andhra Pradesh	1983	2	30	60	61	5563		1	2007-12
10	N.J.Sagar R.B.C. ext	Andhra Pradesh	1990	1	30	30					1
11	N.J.Sagar LBC	Andhra Pradesh	1991,91	2	30	60	23			1	
12	Donkarayi	Andhra Pradesh	1983	1	25	25	83			1	2007-12
13	Pochampad	Andhra Pradesh	1987,88	3	9	27	104			1	

Table 6-3 India - Existing Hydro-electric Projects

	Project Name	Owner	Year of installation	Output				Reservoir		Type 1- run of river 2-Run of river/Pondage 3-Peaking 4- Storage 5- Pump Storage	Possible Renovation, Modernization and Up-grading	
				No. of unit	Unit Size	Total MW	Annual Energy MU(1)	Cap. MCM	Area(*) Km2			
1	2	3	4	5			6	7	8	9	10	
14	Nizam Sagar	Andhra Pradesh	1956	2	5	10	3			1		
15	Penna Ahobilam	Andhra Pradesh	1994	2	10	20	14			1		
16	Singur	Andhra Pradesh	1999-2000	2	7.5	15	4			1		
17	Sharavati	KPCL	1964-77	10	89.1	60	4216	4012		4	2002-07	
18	Lingnamakki	KPCL	1979-80	2	27.5	12	177	4416		4	2002-07	
19	Bhadra(L)	KPCL	1962-63	1 X 2 + 2 X 12		26	41			1	2002-07	
20	Bhadra(R)	KPCL	1963	1	7.2	7.2					1	2002-07
21	Bhadra(RBC)	KPCL	1998	1	6	6					1	2002-07
22	Kalinadi	KPCL	1979-84	6	135	810	2423	264		4	2002-07	
23	Supa DPH	KPCL	1985	2	50	100	397	4418		4		
24	Varahi	KPCL	1989,90	2	115	230	901	95		4	2002-07	
25	Ghatprabha	KPCL	1992	2	16	32	73			1		
26	Mani DPH	KPCL	1993	2	4.5	9	21			1		
27	Mallapur	KPCL	1993-94	2	4.5	9	8			1		
28	Kalinadi st II(Kadra)	KPCL	1997,99	3	50	150	292	93		4		
29	Kalinadi st II(Kodasil)	KPCL	1998,99	3	40	120	282	16		4		
30	SharaVathi T.R.	KPCL	2000-02	4	60	240	413			1		

Table 6-3 India - Existing Hydro-electric Projects

1	Project Name	Owner	Year of installation	Output			Annual Energy MU(1)	Reservoir		Type 1- run of river , 2-Run of river/Pondage, 3-Peaking , 4- Storage 5- Pump Storage	Possible Renovation, Modernization and Up-grading
				No. of unit	Unit Size	Total MW		Cap. MCM	Area(*) Km2		
2	3	4	5			6	7	8	9	10	
32	Jog	KEB	1947-52	4 x 12 + 4 x 18		120	117			4	
33	Shiva Samudram	KEB	1922,34	6 x 3 + 4 x 6		42	5			1	
34	ShimSapura	KEB	1938,40	2	8.6	17.2	43			1	
35	Munirabad	KEB	1962-65	3	9	27	66			1	2002-07
36	Idukki	Kerala	1976 & 1985-86	6	130	780	2753	1460		4	2007-12
37	Sabragiri	Kerala	1966-67	6	50	300	1405			4	2002-07
38	Kuttiadi	Kerala	1972	3	25	75	333			4	2002-07
39	Kuttyadi Ext.	Kerala	2001	1	50	50				1	
40	Sholoyar	Kerala	1966-68	3	18	54	227			4	2002-07
41	Sengulam	Kerala	1954,55	4	12	48	115			1	2002-07
42	Nariamamgalam	Kerala	1961-63	3	15	45	273			1	2002-07
43	Pallivasal	Kerala	1940-51	3 x 5 + 3 x 7.5		37.5	118			1	2002-07
44	Poringal Kuttu	Kerala	1957-60	4	8	32	191			1	2002-07
45	Panniar	Kerala	1963-64	2	15	30	123			4	2002-07
46	Idamalayar	Kerala	1987	2	37.5	75	332			4	2002-07
47	Kallada	Kerala	1993-94	2	7.5	15	67			4	
48	Lower Periyar	Kerala	1996-97	3	60	180	562			1	
49	Poringal Kuthu	Kerala	1999	1	16	16	29			1	

Table 6-3 India - Existing Hydro-electric Projects

1	Project Name	Owner	Year of installation	Output				Reservoir		Type 1- run of river 2-Run of river/Pondage 3-Peaking 4- Storage 5- Pump Storage	Possible Renovation, Modernization and Up-grading
				No. of unit	Unit Size	Total MW	Annual Energy MU(1)	Cap. MCM	Area(*) Km2		
2	3	4	5				6	7	8	9	10
50	Kakkad	Kerala	1999	2	25	50	184			1	
51	Kundah I	Tamil Nadu	1960-64	3	20	60	1343	153		4	2002-07
52	Kundah-II	Tamil Nadu	1960-64	5	35	175		1.56		4	2002-07
53	Kundah-III	Tamil Nadu	1965-68	3	60	180		1.02		4	2002-07
54	Kundah-IV	Tamil Nadu	1966-78	2	50	100		35		4	2002-07
55	Kundah-V	Tamil Nadu	1964 & 88	2	20	40		85		4	2007-12
56	Mettur Dam	Tamil Nadu	1937-46	4	10	40	418	2652		4	Uprated
57	Mettur Tunnel	Tamil Nadu	1965-66	4	50	200		11		4	2007-12
58	Periyar	Tamil Nadu	1958-65	4	35	140	98			4	2002-07
59	Kodayar I	Tamil Nadu	1970	1	60	60	216			4	2007-12
60	Kodayar II	Tamil Nadu	1971	1	40	40				4	2002-07
61	Sholayar I	Tamil Nadu	1971	2	35	70	260			4	2002-07
62	Sholayar II	Tamil Nadu	1971	1	25	25				4	2002-07
63	Pykara	Tamil Nadu	1932,54	$3 \times 6.65 + 2 \times 14 + 2 \times 11$		69.95	383			4	
64	Aliyar	Tamil Nadu	1970	1	60	60	122			4	2007-12
65	Sarkar Pathy	Tamil Nadu	1966	1	30	30	260			1	2007-12
66	Papanasam	Tamil Nadu	1944-51	4	28	112	151	155.8		1	

Table 6-3 India - Existing Hydro-electric Projects

1	Project Name	Owner	Year of installation	Output				Reservoir		Type 1- run of river 2-Run of river/Pondage 3-Peaking 4- Storage 5- Pump Storage	Possible Renovation, Modernization and Up-grading
				No. of unit	Unit Size	Total MW	Annual Energy MU(1)	Cap. MCM	Area(*) Km2		
2	3	4	5				6	7	8	9	10
66	Moyar	Tamil Nadu	1952-53	3	36	108	164			1	2002-07
67	Suruliyar	Tamil Nadu	1978	1	35	35	87			4	
68	Servalar	Tamil Nadu	1986	1	20	20	24			4	
69	Lower Mattur Power house I	Tamil Nadu	1988	2	15	30	459			1	
70	Lower Mattur Power house II	Tamil Nadu	1988	2	15	30				1	
71	Lower Mattur Power house III	Tamil Nadu	1987-88	2	15	30				1	
72	Lower Mattur Power house IV	Tamil Nadu	1988-89	2	15	30				1	
73	Kadamparai	Tamil Nadu	1987-88	4	100	400	163			5	
74	Vaigai Dam	Tamil Nadu	1990	2	3	6	64	21		4	
75	Lower Bhawani	Tamil Nadu	1990	2	4	8				1	
76	Sathanur Dam	Tamil Nadu	1999	1	7.5	7.5				4	
77	Parson's Vally	Tamil Nadu	2000	1	30	30	34			4	
78	Kalpong	A&N Islands	2001-02	3	1.75	5.25	12.5			1	
	PRIVATE SECTOR										
1	Guntur	A.P./IPP		3	1.25	3.75	11				
2	Shivpur	Karnataka/IPP	1992	2	9	18	105			1	
3	Maniyar	Kerala/IPP	1994	3	4	12	39			1	

Table 6-3 India - Existing Hydro-electric Projects

1	Project Name	Owner	Year of installation	Output				Reservoir		Type 1- run of river 2-Run of river/Pondage 3-Peaking 4- Storage 5- Pump Storage	Possible Renovation, Modernization and Up-grading
				No. of unit	Unit Size	Total MW	Annual Energy MU(1)	Cap. MCM	Area(*) Km2		
	2	3	4	5			6	7	8	9	10
	EASTERN REGION										
	CENTRAL SECTOR										
1	Rangit-III	NHPC	1999	3	20	60	348			1	
2	Maithon	DVC	1957-58	3	20	60	140			4	2002-07
3	Panchet & Extn.	DVC	1958 & 90	2	40	80	137	229		5	
4	Tilaya	DVC	1953	2	2	4	10			4	
	STATE SECTOR										
1	Kosi	Bihar	1970-78	4	5	20	8			1	
2	Subenrekha - I	Jharkhand	1977	1	65	65	101			4	2002-07
3	Subenrekha - II	Jharkhand	1980	1	65	65				4	2002-07
4	Sone Western Canal	Bihar	1993	4	1.65	6.6	25			1	
5	Eastern Gandak	Bihar	1994-97	3	5	15	25			1	
6	Sone Eastern	Bihar	1996	2	1.65	3.3				1	
7	Hirakud I	Orissa	1956-63,90	5	37.5 24	235.5	967			4	2002-07
8	Hirakud II	Orissa	1962-62	3	24	72				1	2002-07
9	Balimela	Orissa	1973-77	6	60	360	1065			4	2002-07

Table 6-3 India - Existing Hydro-electric Projects

1	Project Name	Owner	Year of installation	Output				Reservoir		Type 1- run of river 2-Run of river/Pondage 3-Peaking 4- Storage 5- Pump Storage	Possible Renovation, Modernization and Up-grading	
				No. of unit	Unit Size	Total MW	Annual Energy MU(1)	Cap. MCM	Area(*) Km2			
2	3	4	5				6	7	8	9	10	
10	Rengali	Orissa	1985-92	5	50	250	793			4		
11	Upper Kolab	Orissa	1988-93	4	80	320	668			4		
12	Upper Indravati	Orissa	1999,2000-01	4	150	600	2963	1486		4		
13	Lower Lagyap	Sikkim	1979	2	6	12					1	
14	Upper Rognichu	Sikkim	1993-94	4	2	8					1	
15	Moyangchu	Sikkim	1993	2	2	4					1	
16	Jaldhaka I	West Bengal	1967,92	3	9	27	138			1	2002-07	
17	Jaldhaka II	West Bengal	1983	2	4	8					1	2002-07
18	Massanjore	West Bengal	1956	2	2	4	7			1		
19	Rammam II	West Bengal	1995-96	4	12.5	20	236			1		
20	Teesta Falls	West Bengal	1997-2000	3	7.5	67.5	169			1		
				3	7.5							
				3	7.7							
NORTH EASTERN REGION												
CENTRAL SECTOR												
1	Loktak	NHPC	1983	3	35	105	563			4	2002-07	
2	Khandong	NEEPCO	1984	2	25	50	181			4	2007-12	

Table 6-3 India - Existing Hydro-electric Projects

1	Project Name	Owner	Year of installation	Output				Reservoir		Type 1- run of river 2-Run of river/Pondage 3-Peaking 4- Storage 5- Pump Storage	Possible Renovation, Modernization and Up-grading
				No. of unit	Unit Size	Total MW	Annual Energy MU(1)	Cap. MCM	Area(*) Km2		
2	3	4	5				6	7	8	9	10
3	Kopili	NEEPCO	1988	2	50	100	549			4	
4	Kopili Ext	NEEPCO	1996-97	2	50	100				4	
5	Doyang	NEEPCO	2000-01	3	25	75	141			4	
6	Rangandi	NEEPCO	2001-02	3	135	405	22	523		4	
STATE SECTOR											
1	Tago	Arunachal	1991	3	1.5	4.5	19			1	
2	Nuranang	Arunachal	1997	3	2	6				1	
3	Kyrdemkulai	Meghalaya	1979	2	30	60	159			1	2002-07
4	Umiam st. I	Meghalaya	1965	4	9	36	118			4	2002-07
5	Umiam st. II	Meghalaya	1970	2	9	18	50			4	2002-07
6	Umtru	Meghalaya	1957	4	2.8	11.2	76			1	
7	Umiam-Umtru st. IV	Meghalaya	1992	2	30	60	210			4	
8	Likim RO	Nagaland	2001-02	2	8	16	4			1	
9	Gumti	Tripura	1976-84	3	5	15	68			4	
TOTAL ALL INDIA											
							25587				

6.7 Region-wise hydro-power potential and developed is shown in Table 6.4

Table 6-4 Region-wise Hydro-power Potential (At 60% Load Factor) (MW)

Region	Potential Assessed	Potential Developed as on 1.1.2002
Northern	30155	4623
Western	5679	1858
Southern	10763	5797
Eastern	5590	1369
Northeastern	31857	389
TOTAL	84044	14036

6.8 Various studies have concluded that for optimal operations, India's power system should ideally have a hydro-thermal mix of 40:60. For reasons stated above, the hydro-thermal mix of the country's power system became tilted in favor of the thermal generation. From a healthy **40%** share in 1970 the hydro-power share has reduced to less than **25%** by the end of the year 2001. Because of the imbalance in the hydro-thermal mix, many thermal power stations especially in the Eastern and Western regions are required to back-down during off-peak hours.

7.1 As many as 35 hydro-power projects are currently under various stages of construction in India. The Northern region leads the country with 18 projects followed by western region with 6 projects, Southern region & North Eastern region with four projects each and Eastern region with three projects. 17 of these projects are in the state sector, 13 in the central sector and the remaining 5 projects are in the private sector. The total capacity under construction is 13620 MW of which 11034 MW is likely to be commissioned between 2002 and 2007 and the remaining 2586 MW is likely to be commissioned between 2007 to 2012. Table 7.1 provides the details of region-wise and sector-wise capacity under construction.

Table 7-1 India - Hydro Project Under Construction (Region-Wise)

Region/ Sector	Nos. of Projects	Capacity (MW)	Benefits (MW)	
			2002-2007	2007-2012
1. Northern Region				
Central Sector	7	4670	3870	800
State Sector	7	1604	1114	490
Private Sector	4	1630	700	930
Total Northern Region	18	7904	5624	2220
2. Western Region				
Central Sector	1	1000	1000	
State Sector	4	1845	1755	90
Private Sector	1	400	400	-
Total Western Region	6	3245	3155	90
3. Southern Region				
Central Sector	-	-	-	-
State Sector	4	750	600	150
Private Sector	-	-	-	-
Total Southern Region	4	750	600	150
4. Eastern Region				
Central Sector	2	1410	1410	-
State Sector	1	36	-	36
Private Sector	-	-	-	-
Total Eastern Region	3	1446	1410	36
5. North Eastern Region				
Central Sector	3	175	85	90
State Sector	1	100	100	-
Private Sector	-	-	-	-
Total North Eastern Region	4	275	185	90
6. All India				
Central Sector	13	7255	6365	890
State Sector	17	4335	3569	766
Private Sector	5	2030	1100	930
Total All India	35	13,620	11,034	2,586

Table 7-2 provides the detailed list of hydro-power projects currently under construction.

Table 7-2 India - Projects Currently Under Construction

1	Project Name	Owner	Expected year of commissioning	Output				Reservoir		Type 1- run of river 2- Run of river/Pondage 3- Peaking 4- Storage 5- Pump Storage
				No. of unit	Unit Size	Total MW	Annual Energy MU	Cap. MCM	Area Km ²	
2	3	4	5	6	7	8	9			
	<u>NORTHERN REGION</u>									
	<u>CENTRAL SECTOR</u>									
1	Tehri-I	THDC	2003	4	250	1000	3568	3540	4	
2	Kotshwar	THDC	2006	4	100	400	1234	88.9	1	
3	Dulahasti	NHPC	2004	3	130	390	1928	10.7	4	
4	Chamera-II	NHPC	2005	3	100	300	1500		1	
5	Dhauliganga st. I	NHPC	2005	4	70	280	1134		1	
6	Nathpa Jhakadi	NJPC	2004	6	250	1500	6700		1	
7	Kol Dam	NTPC	2012	4	200	800	2803		4	
	<u>STATE SECTOR</u>									
1	Largi	Himachal Pradesh	2004	3	42	126	574		1	
2	Shahapur Kandi	Punjab	2007	4	41					
3	Maneri Bhali-II	Uttaranchal	2007	1	8	168	486		1	
4	Lakher Vyasi	Uttaranchal	2008	3	100					
				2	60	420	994.0	634	4	

Table 7-2 India - Projects Currently Under Construction

1	Project Name	Owner	Expected year of commissioning	Output				Reservoir		Type 1- run of river 2-Run of river/Pondage 3-Peaking 4- Storage 5- Pump Storage
				No. of unit	Unit Size	Total MW	Annual Energy MU	Cap. MCM	Area Km ²	
2	3	4	5	6	7	8	9			
5	Baglihar	J & K	2007	3	150	450	2680		1	
6	Uhl	H.P.	2012	2	35	70	294		1	
7	Kashang-I	H.P.	2007	2	33	66	173			
	<u>PRIVATE SECTOR</u>									
1	Baspa II	H.P./IPP	2004	3	100	300	1209		1	
2	Sawalkot	J & K / IPP	2012	6	100	600	3679		1	
3	Vishnu Prayag	Uttaranchal/IPP	2007	4	100	400	2067		1	
4	Shrinagar	Uttaranchal/IPP	2008	6	55	330	1301			
	Total Northern Region					7904				
	<u>WESTERN REGION</u>									
	<u>CENTRAL SECTOR</u>									
1	Indirasagar	JV/NHPC	2006	8	125	1000	1980		4	
	<u>STATE SECTOR</u>									
1	Sardar Sarovar	Gujarat & M.P.	2006	6	200	1450	3811		4	
2	Bansagar Tons PH II III & IV	M.P.	2007	1	15	55	164			

Table 7-2 India - Projects Currently Under Construction

1	Project Name	Owner	Expected year of commissioning	Output				Reservoir		Type 1- run of river 2-Run of river/Pondage 3-Peaking 4- Storage 5- Pump Storage
				No. of unit	Unit Size	Total MW	Annual Energy MU	Cap. MCM	Area Km ²	
2	3	4	5	6	7	8	9			
3	Ghatghar PSS	Maharashtra	2005	2	125	250	187	6.05	5	
4	Bhivpuri PSS	Maharashtra	2008	1	90	90	32	364	5	
	<u>PRIVATE SECTOR</u>									
1	Maheshwar	M.P./IPP	2007	10	40	400	701		4	
	TOTAL WESTERN REGION					3245				
	<u>SOUTHERN REGION</u>									
	<u>CENTRAL SECTOR</u>									
	STATE SECTOR									
1	Pykara Ultimate	Tamil Nadu	2004	3	50	150	92	53.63	4	
2	Srisaillam LBPH	Andhra Pradesh	2006	3	150	450	158	7080	4	
3	Sarapadi	Karnataka	2012	3	30	90	276		4	
4	Balimela	Andhra Pradesh	2012	2	30	60	163			
	TOTAL SOUTHERN REGION					750				

Table 7-2 India - Projects Currently Under Construction

1	Project Name	Owner	Expected year of commissioning	Output				Reservoir		Type 1- run of river 2-Run of river/Pondage 3-Peaking 4- Storage 5- Pump Storage	
				No. of unit	Unit Size	Total MW	Annual Energy MU	Cap. MCM	Area Km ²		
1	2	3	4	5				6	7	8	9
	<u>EASTERN REGION</u>										
	<u>CENTRAL SECTOR</u>										
1	Puralia PSS	JV/NHPC & W.B.	2007	4	225	900	1857				5
2	Teesta V	NHPC	2007	3	170	510	2579				5
	<u>STATE SECTOR</u>										
1	Rammam -I	W.B.	2008	3	12	36	164				1
	TOTAL EASTERN REGION					1446					
	<u>NORTH EASTERN</u>										
	<u>CENTRAL SECTOR</u>										
1	Kopili st. II	NEEPCO	2007	1	25	25	50				1
2	Tuirial	NEEPCO	2007	2	30	60	162.5				1
3	Lokatak DS	NHPC	2008	3	30	90	421				1
	<u>STATE SECTOR</u>										
1	Karbi Langpi (LBP)	Assam	2004	2	50	100	213				1
	TOTAL NORTH EASTERN REGION					275					
	TOTAL ALL INDIA					13,620					

8.1 Renovation, Modernization, and upgrading of existing projects present the best option to get additional generating capacity at much lower costs and faster pace than setting up new projects. Since India has a large number of projects, which are quite old, there exists a good potential for obtaining additional capacity by renovation etc. of such plants.

8.2 The Government of India set up a National Committee in 1987 to formulate a strategy on Renovation & Modernization of Hydro-electric Power Plants. Based upon the recommendations of this committee and subsequent reviews, 55 hydro schemes were identified for possible renovation with an aggregate capacity of 9653 MW to accrue a benefit of 2531 MW/7181 MU. This was known as Phase I of the RM&U program. The work included uprating of generating units (19 schemes), restoration of generating units to rated capacity (8 schemes), prevention of capacity loss of generating units which had outlived their useful life (14 schemes) and renovation of generating units to improve their reliability and availability (14 schemes). Of these 55 projects, work of 25 has been completed with expected benefit of 1313.48 MW/3262.74 MU. Work on 21 schemes is ongoing. Work on 4 schemes is yet to commence and the remaining 5 schemes were dropped after review.

8.3 Following up the declaration of National Hydro-power Development Policy in 1998, the Government of India set up a Standing Committee to identify new RM&U Hydro schemes. A total of 83 proposals were received and of these, 74 schemes were identified for undertaking the renovation. Work on 13 of these schemes has been undertaken.

8.4 Based on recommendations of the National Committee & the Standing Committee, a total of 80 schemes have been identified as possible RM&U candidates for implementation over the next 10-year period. The list of these projects is contained in Table 8.1.

Table 8-1 India - Renovation, Modernization, Upgrading & Life Extension of Existing Projects								
S. No.	Project Name	Owner	Existing Capacity (MW)	New Estimated capacity (MW)	Benefit of Annual Energy (MU)	Possible Type of Renovation, Mod., Upgrading & Life Extension		
						Civil	Elect/Mech	Comments
1	Machkund	Andhra Pradesh	114.75	114.75	675		Governor/runner, wicket gates etc.	Prevention of capacity loss
2	Subernrakha	Bihar	130	130	11.3		Renovation of Cooling Water System, stator air coolers, excitation system etc	Renovation
3	Lower Jhelum	J&K	105	105	0		New turbine runner, guide vanes, stator and rotor winding insulation, etc	Renovation
4	Sumbhal Sindh	J & K	33.9	33.9	0		Replacement of Stator winding insulation, reconditioning of governor, renovation of Turbine	Renovation
5	Neriamanglam	Kerala	45	54	330.75		Replacement of Stator winding insulation, reconditioning of governor, renovation of Turbine	Upgrading and prevention of capacity loss
6	Poriangalkuthu	Kerala	32	32	171		Replacement of Stator winding insulation, reconditioning of governor, renovation of Turbine	Prevention of capacity loss

Table 8-1 India - Renovation, Modernization, Upgrading & Life Extension of Existing Projects								
S. No.	Project Name	Owner	Existing Capacity (MW)	New Estimated capacity (MW)	Benefit of Annual Energy (MU)	Possible Type of Renovation, Mod., Upgrading & Life Extension		
						Civil	Elect/Mech	Comments
7	Sabarigiri	Kerala	300	360		0	Replacement of stator winding insulation, augmenting transformer capacity, replacement of brake jet valve, static excitation system, electronic governor etc	Prevention of capacity loss and uprating. Financial tie -up awaited
8	Kyredemkulai	Meghalaya	60	66		0	Modified runner design	Uprating
9	Umiam St I & II	Meghalaya	54	54		0	Governor and turbine control system, stator coils, AVR, etc	Prevention of capacity loss
10	Hirakud - I Unit 3 & 4	Orissa	48	64		231.04	New runner, stator winding insulation, electronic governor, static excitation	Uprating and prevention of capacity loss
11	Hirakud - I Unit 5 & 6	Orissa	75	96		422.9	New runner, stator winding insulation, electronic governor, static excitation, main transformer with busduct etc	Uprating and prevention of capacity loss
12	Jaldhaka St I	West Bengal	36	36		0	Modernization of governors, provision of draft tube gates, replacement of MOCB and associated electrical equipment	Renovation

Table 8-1 India - Renovation, Modernization, Upgrading & Life Extension of Existing Projects								
S. No.	Project Name	Owner	Existing Capacity (MW)	New Estimated capacity (MW)	Benefit of Annual Energy (MU)	Possible Type of Renovation, Mod., Upgrading & Life Extension		
						Civil	Elect/Mech	Comments
19	Salal Ph II	NHPC	690	690	0		Modernization of control, protection and instrumentation of Stage I & II and purchase of under water parts etc for stage II	R & M
20	Nagjhari (Kalanadi)	Karnataka	405	450	0		Upgrading of units from 135 to 150 MW	Upgrading
21	Sharavathi	Karnataka	891	891	0		Provision of SCADA and other elect/mech equipment	Modernization
22	Lingnamakki	Karnataka	55	55	0		Replacement of excitation system, governor and associated equipment	Modernization
23	Bhadra	Karnataka	39.2	63.2	75.3		Replacement of excitation system, governor and associated equipment and extension of river bed	Upgrading and modernization, Life extension and renovation
24	Varahi	Karnataka	230	230			SCADA with auto sequencer	Modernisation
25	Munirabad	Karnataka	28.3	28.3			Replacement of stator insulation, excitation system, governor and associated equipment	Prevention of loss of capacity
26	Gandhi Sagar	M.P.	115	125	423		Upgrading of turbine runner	Upgrading and Life extension

Table 8-1 India - Renovation, Modernization, Upgrading & Life Extension of Existing Projects

S. No.	Project Name	Owner	Existing Capacity (MW)	New Estimated capacity (MW)	Benefit of Annual Energy (MU)	Possible Type of Renovation, Mod., Upgrading & Life Extension		
						Civil	Elect/Mech	Comments
27	Koyna Dam	Maharashtra	36	58	0		Upgrading	Upgrading
28	Vaitarna	Maharashtra	60	60	0		Replacement of stator insulation, excitation system, governor and associated equipment	Renovation
29	Balimela	Orissa	360	396	1180		Electrical and mech. equipment renovation	Upgrading and prevention of capacity loss
30	Rana Pratap Sagar	Rajasthan	172	172	459		Electrical and mech. equipment renovation	Prevention of loss of capacity
31	Jawahar Sagar	Rajasthan	99	99	298		Electrical and mech. equipment renovation	Prevention of loss of capacity
32	Anand Pur Sahib	Punjab	134	160	112		Upgrading of units	Upgrading
33	Rihand	Uttar Pradesh	300	360	860		Replacement of stator insulation, excitation system, governor and associated equipment	Upgrading and prevention of capacity loss

Table 8-1 India - Renovation, Modernization, Upgrading & Life Extension of Existing Projects								
S. No.	Project Name	Owner	Existing Capacity (MW)	New Estimated capacity (MW)	Benefit of Annual Energy (MU)	Possible Type of Renovation, Mod., Upgrading & Life Extension		
						Civil	Elect/Mech.	Comments
34	Obra	Uttar Pradesh	99	99	283		Renovation of shaft seals, and governors, amplidyne sets, stator winding insulation etc.	Prevention of capacity loss
35	Chibro	Uttar Pradesh	240	240	20		Renovation of breakers, lubrication system, top and bottom labyrinth etc	Renovation
36	Dhakrani	Uttar Pradesh	33.75	33.75	160		Rewinding Stator, elect. Equipment etc.	Prevention of capacity loss
37	Dhalipur	Uttar Pradesh	51	51	20		Rewinding Stator, elect. Equipment etc.	Prevention of capacity loss
38	Chilla	Uttar Pradesh	144	144	60		Renovation of units including repair and modification of runners, modification of lubricating system etc	Renovation and Modernization
39	Ramganga	Uttar Pradesh	198	198	0		Rewinding Stator, elect. Equipment etc.	Restoration to original capacity
40	Tiloth	Uttar Pradesh	90	90	30		Renovation of units including repair and modification of runners and related equipment	Renovation

Table 8-1 India - Renovation, Modernization, Upgrading & Life Extension of Existing Projects

S. No.	Project Name	Owner	Existing Capacity (MW)	New Estimated capacity (MW)	Benefit of Annual Energy (MU)	Possible Type of Renovation, Mod., Upgrading & Life Extension		
						Civil	Elect/Mech.	Comments
41	Pathri	Uttar Pradesh	20.4	20.4	40		Replacement of electrical equipment and renovation of units	Renovation and Life extension
42	Khodri	Uttar Pradesh	120	120	10		Renovation of excitation system etc	Renovation and Modernization
43	Khatima	Uttar Pradesh	41.4	41.4	198		Rewinding Stator, elect. Equipment etc.	Prevention of capacity loss
44	Kulhal	Uttar Pradesh	30	30	10		Rewinding Stator, elect. Equipment etc.	Renovation and Modernization
45	Matatila	Uttar Pradesh	30.6	40.8	124		Replacement of runners, excitation system field coils with class F insulation etc	Upgrading and prevention of loss
46	Sholayar I	Tamil Nadu	70	84	188		Upgrading of units	Upgrading and prevention of loss of capacity
47	Sholayar II	Tamil Nadu	25	27.5	66		Upgrading of units	Upgrading and prevention of loss of capacity
48	Periyar	Tamil Nadu	140	168	409		Upgrading of units	Upgrading and life extension
49	Khodayar II	Tamil Nadu	40	46	66		Upgrading of units	Upgrading and life extension

Table 8-1 India - Renovation, Modernization, Upgrading & Life Extension of Existing Projects

S. No.	Project Name	Owner	Existing Capacity (MW)	New Estimated capacity (MW)	Benefit of Annual Energy (MU)	Possible Type of Renovation, Mod., Upgrading & Life Extension		
						Civil	Elect/Mech	Comments
50	Moyar	Tamil Nadu	36	36	115		Life Extension	R&M and prevention of capacity loss
51	Kundah St I	Tamil Nadu	60	60	115		Life Extension	Prevention of capacity loss
52	Kundah St II	Tamil Nadu	175	175	437		Life Extension	Prevention of capacity loss
53	Kundah St III	Tamil Nadu	180	180	300		Life Extension of Unit 1 & 2 and renovation of unit 3	Prevention of capacity loss
54	Kundah St IV	Tamil Nadu	100	100	250		Life extension of unit 1 and renovation of unit 2	Prevention of capacity loss
55	Jaldhaka St II	W.B.	8	8	27		Life Extension of Unit 1 & 2	Prevention of capacity loss
56	Ganderbal	J&K	15	15	93.616		Replacement of turbine blades, governors and augmentation of water conductor system	Prevention of capacity loss
57	Sholayar	Kerala	54	54	233		Stator of Units 1 & 2 and repair of unit 3	Life extension
58	Kuttiady	Kerala	75	75	248		Life extension of units	Prevention of capacity loss

Table 8-1 India - Renovation, Modernization, Upgrading & Life Extension of Existing Projects

S. No.	Project Name	Owner	Existing Capacity (MW)	New Estimated capacity (MW)	Benefit of Annual Energy (MU)	Possible Type of Renovation, Mod., Upgrading & Life Extension		
						Civil	Elect/Mech	Comments
59	Panniar	Kerala	30	30	148		Repalcement of inlet valves, excitation system etc	Prevention of capacity loss
60	Pallivasal	Kerala	37.5	37.5	284		Repalcement of turbines, generators, excitation system governors etc	Prevention of capacity loss
61	Sengulam	Kerala	48	48	184		Repalcement of turbines, generators, excitation system governors etc	Prevention of capacity loss
62	Idamalayar	Kerala	75	75	0		Replacement of exciter and governor	Modernization
63	Ganguwal U 1	BBMB	29.25	32	270		Life extension	Prevention of loss of capacity and uprating
64	Kotla U 1	BBMB	29.25	32	270		Life extension	Prevention of loss of capacity and uprating
65	Pong	BBMB	180	216	0		Change of poles, reducing air gaps	Uprating
66	Bhakra LB	BBMB	990	1140	1765		Replacement of runners, guide vanes & bushes, stator core & windings, excitation system etc	Prevention of loss of capacity and uprating

Table 8-1 India - Renovation, Modernization, Upgrading & Life Extension of Existing Projects								
S. No.	Project Name	Owner	Existing Capacity (MW)	New Estimated capacity (MW)	Benefit of Annual Energy (MU)	Possible Type of Renovation, Mod., Upgrading & Life Extension		
						Civil	Elect/Mech	Comments
67	Khandong	NEEPCO	50	50	0		Renovation of units for reliable operation	R & M
68	Lower Sileru	Andhra Pradesh	460	460	1070		Life extension	Prevention of capacity loss
69	Nagarjun Sagar RB	Andhra Pradesh	60	60	0		R & M of units	R&M and prevention of capacity loss
70	Dobkarayi	Andhra Pradesh	25	25	0		R & M of units	R&M and prevention of capacity loss
71	Subernrakha	Bihar	130	130	149		Life extension	Prevention of capacity loss
72	Dehar U 3 & 4	BBMB	165	165	518		Life extension	Prevention of capacity loss
73	Koyna III	Maharashtra	320	320	520		Life extension	Prevention of capacity loss
74	Idduki St I	Kerala	390	390	1196		Life extension	Prevention of capacity loss
75	UBDC I	Punjab	45	45	160		Life extension	Prevention of capacity loss
76	Aliyar	Tamil Nadu	60	60	175		Life extension	Prevention of capacity loss
77	Kundah St V	Tamil Nadu	40	40	175		Life extension	Prevention of capacity loss

Table 8-1 India - Renovation, Modernization, Upgrading & Life Extension of Existing Projects								
S. No.	Project Name	Owner	Existing Capacity (MW)	New Estimated capacity (MW)	Benefit of Annual Energy (MU)	Possible Type of Renovation, Mod., Upgrading & Life Extension		
						Civil	Elect/Mech	Comments
78	Mettur Tunnel	Tamil Nadu	200	200	451		Life extension	Prevention of capacity loss
79	Kodayar PH I	Tamil Nadu	60	60	100		Life extension	Prevention of capacity loss
80	Sarkarpathy	Tamil Nadu	30	30	162		Life extension	Prevention of capacity loss
		TOTAL	5431.15	5683.35	10816.616			

9.1 Realizing that the hydro-power presents the cheapest, clean, and renewable energy resource, the Government of India (GOI) has set a target of fully utilizing the entire hydro potential in the country by the year 2025-26. In order that this is achieved, the Government has already undertaken a number of steps to accelerate the development of hydro-power projects including simplification of clearance route, allocation of additional funds and promoting private sector participation in the development of the hydro-power resources.

9.2 During the period April 2002 to March 2007, it is proposed to add 14393 MW hydro-power installed capacity. This includes commissioning of 25 ongoing projects and 16 new projects, construction of which is yet to commence. Of the total planned capacity addition of 14,393 MW, 11034 MW will be obtained by commissioning the 25 projects currently under construction and the balance 3359 MW is to be obtained from 16 new projects whose construction is yet to commence.

9.3 During the following five years i.e. April 2007 to March 2012, another 18451 MW installed capacity is planned to be added by 43 projects. 2586 MW of this capacity is likely to be accrued from the 10 projects that are currently under construction while the remaining 15,865 MW will be achieved by undertaking the construction and commissioning of 33 new projects for which construction is yet to commence. Thus at the end of 10-year period, about 32844 MW hydro-power will be added to the existing 25587 MW. These figures exclude the contribution of small hydro-power projects (25 MW and below), which are likely to add another 2000 MW in the same period. An abstract of new projects to be undertaken in the next 10 years (2002-2012) is given in Table 9.1 and the details of the identified projects is given in Table 9.2.

9.4 In order to expedite the projects beyond 2012, the GOI, through the Central Electricity Authority (CEA), has carried out basin-wise preliminary ranking studies. The study covered 399 sites and ranked them in categories A, B and C in descending order of priority. Of the 399 sites, 98 have been classified as of category A, 247 in category B and 54 sites in category C. The potential of sites in category A is 15650 MW, schemes under category B is 69850 MW and those in category C is 21420 MW. The study has also brought out that a majority of the schemes are run of the river schemes.

9.5 Some of the schemes under the above study have been already identified for implementation up to the period 2012. There are other schemes which were originally planned to construct by 2012 have now been shifted to the period beyond the year 2012. The detailed basin wise lists of the projects to be undertaken beyond the year 2012 are given in Table 9.3 to Table 9.8.

Table 9-1 India - New Hydro-electric Projects Planned Up to 2012 (Region-Wise)

Region/ Sector	Nos. of Projects	Capacity (MW)	Benefits (MW)	
			2002-2007	2007-2012
1. Northern Region				
Central Sector	12	6422	1520	4902
State Sector	3	129	-	129
Private Sector	4	1722	70	1652
Total Region	19	8273	1590	6683
2. Western Region				
Central Sector	3	575	557	18
State Sector	1	40	40	-
Private Sector	-	-	-	-
Total Region	4	615	597	18
3. Southern Region				
Central Sector	1	50	-	50
State Sector	7	761	558	203
Private Sector	1	810	-	810
Total Region	9	1621	558	1063
4. Eastern Region				
Central Sector	3	425	300	125
State Sector	1	150	150	-
Private Sector	-	-	-	-
Total Eastern Region	4	575	450	125
5. North Eastern Region				
Central Sector	11	7975	-	7975
State Sector	2	164	164	-
Private Sector	-	-	-	-
Total Region	13	8139	164	7975
6. Total All India				
Central Sector	30	15,447	2377	13070
State Sector	14	1244	912	332
Private Sector	5	2532	70	2462
Total Region	49	19,223	3359	15864

Table 9-2 India-New Projects Planned Up to 2012

1	Project Name	Level of study	Owner	Expected year of commissioning	Output				Reservoir		Type 1- run of river 2-Run of river/Pondage 3-Peaking 4- Storage 5- PuM.P. Storage
					No. of unit	Unit Size	Total MW	Annual Energy MU(1)	Cap. MCM	Area(*) Km2	
2	3	4	5	6	7	8	9	10			
	<u>NORTH EASTERN</u>										
	<u>CENTRAL SECTOR</u>										
1	Tehri PSP	CEA Cleared	THDC	2007	4	250	1000	5256			
2	Sewa - II	CEA Cleared	NHPC	2007	3	40	120	630.72			
3	Parbati - II	CEA Cleared	NHPC	2012	4	200	800	4204.8			
4	Parbati - III	New Scheme	NHPC	2012			520	2733.1			
5	Uri -II	New Scheme	NHPC	2012			280	1471.7			
6	Pakal Dul	New Scheme	NHPC	2012			1000	5256			
7	Bursur	New Scheme	NHPC	2012			1020	5361.1			

Table 9-2 India - New Projects Planned Up to 2012

1	Project Name	Level of study	Owner	Expected year of commissioning	Output				Reservoir		Type 1- run of river 2-Run of river/Pondage 3-Peaking 4- Storage 5- PuM.P. Storage
					No. of unit	Unit Size	Total MW	Annual Energy MU(1)	Cap. MCM	Area(*) Km2	
2	3	4	5	6				7	8	9	10
8	Chamesa - III	New Scheme	NHPC	2012			231	1214.1			
9	RaM.P.ur	New Scheme	NJPC	2007	4	100	400	2102.4			
10	Parbati - I	New Scheme	NHPC	2012			750	3942			
11	Gauriganga	New Scheme	NHPC	2012			70	367.92			
12	Chamera - III	New Scheme	NHPC	2012			231	1214.1			
	<u>STATE SECTOR</u>										
1	Pamai	CEA Cleared	H.P.	2012	3	12.5	37.5	240			
2	SYL Canal	CEA Cleared	Punjab	2008			50	202			
3	Tuini Palasu	CEA Cleared	Uttaranchal	2012			42	238			

Table 9-2 India - New Projects Planned Up to 2012

1	Project Name	Level of study	Owner	Expected year of commissioning	Output				Reservoir		Type 1- run of river 2-Run of river/Pondage 3-Peaking 4- Storage 5- PuM.P. Storage
					No. of unit	Unit Size	Total MW	Annual Energy MU(1)	Cap. MCM	Area(*) Km2	
2	3	4	5	6	7	8	9	10			
	<u>PRIVATE SECTOR</u>										
1	Allain Dhungam	CEA Cleared	H.P.	2012			192	1009.2			
2	Dhanwari Sunda	New Scheme	H.P./IPP	2012			70	288			
3	Palamaneri	New Scheme	Uttaranchal/IPP	2012			460	2417.8			
4	K.Wangtoo	New Scheme	H.P./IPP	2012	4	250	1000	5256			

Table 9-2 India - New Projects Planned Up to 2012

1	Project Name	Level of study	Owner	Expected year of commissioning	Output				Reservoir		Type 1- run of river 2-Run of river/Pondage 3-Peaking 4- Storage 5- PuM.P. Storage
					No. of unit	Unit Size	Total MW	Annual Energy MU(1)	Cap. MCM	Area(*) Km2	
2	3	4	5	6				7	8	9	10
	<u>WESTERN REGION</u>										
	<u>CENTRAL SECTOR</u>										
1	Omkareshwar	CEA Cleared	JV/NHPC	2007			520	2733.1			
4	Bav – I	CEA Cleared	NHPC	2012			18	94.608			
3	Bav – II	CEA Cleared	NHPC	2007			37	194.47			
	<u>STATE SECTOR</u>										
1	Marikheda	CEA Cleared	M.P.	2007	2	20	40	70			ROR
	<u>SOUTHERN REGION</u>										
	<u>CENTRAL SECTOR</u>										
1	Nagarjun Sagar Tail	CEA Cleared	NHPC	2012	2	25	50	157			ROR

Table 9-2 India - New Projects Planned Upto 2012

1	Project Name	Level of study	Owner	Expected year of commissioning	Output				Reservoir		Type 1- run of river 2-Run of river/Pondage 3-Peaking 4- Storage 5- PuM.P. Storage
					No. of unit	Unit Size	Total MW	Annual Energy MU(1)	Cap. MCM	Area(*) Km2	
2	3	4	5	6	7	8	9	10			
	<u>STATE</u> <u>SECTOR</u>										
1	Priyadarshini Jurala	CEA Cleared	Andhra Pradesh	2007	2	39	78	304.97		ROR	
2	Adirapalli	CEA Cleared	Kerala	2012	2	80	160	840.96		ROR	
3	Kuttiyadi Aug	CEA Cleared	Kerala	2007			100	213		ROR	
4	Paralayar	New Scheme	Tamil Nadu	2012			25	131.4		ROR	
5	Bhavani Barrage I/II/III	New Scheme	Tamil Nadu	2007			90	340		ROR	
6	Jalaput	CEA Cleared	Andhra Pradesh	2012			18	94.608		ROR	
7	AlMati Dam	New Scheme	Karnataka	2007			290	1524.2		ROR	

Table 9-2 India - New Projects Planned Upto 2012

1	Project Name	Level of study	Owner	Expected year of commissioning	Output				Reservoir		Type 1- run of river 2-Run of river/Pondage 3-Peaking 4- Storage 5- PuM.P. Storage
					No. of unit	Unit Size	Total MW	Annual Energy MU(I)	Cap. MCM	Area(*) Km2	
2	3	4	5	6	7	8	9	10			
	<u>PRIVATE SECTOR</u>										
1	Upper Krishna	New Scheme	KAR/IPP	2012			810	1603.8			ROR
	<u>EASTERN REGION</u>										
	<u>CENTRAL SECTOR</u>										
1	Farraka Barage	CEA Cleared	NHPC	2012	5	25	125	467.95			ROR
2	Teesta Low Dam III	CEA Cleared	NHPC	2007			132	598.68			ROR
3	Teesta Low Dam IV	CEA Cleared	NHPC	2007			168	900.32			ROR

Table 9-2 India - New Projects Planned Upto 2012

1	Project Name	Level of study	Owner	Expected year of commissioning	Output				Reservoir		Type 1- run of river 2-Run of river/Pondage 3-Peaking 4- Storage 5- PuM.P. Storage
					No. of unit	Unit Size	Total MW	Annual Energy MU(1)	Cap. MCM	Area(*) Km2	
2	3	4	5	6	7	8	9	10			
<u>STATE SECTOR</u>											
1	Balimela II	CEA Cleared	Orissa	2007	2	75	150	434			ROR
<u>NORTH EASTERN REGION</u>											
<u>CENTRAL SECTOR</u>											
1	Tuivai	CEA Cleared	NEEPCO	2012	3	70	210	51			ROR
2	Kameng	CEA Cleared	NEEPCO	2012	4	150	600	3153			ROR
3	Dhaleshwari	CEA Cleared	NEEPCO	2012	3	40	120	630.72			ROR
4	Siang Lower	New Scheme	NHPC	2012			1700	9000			ROR
5	Siang Middle	New Scheme	NHPC	2012			700	1900			ROR

Table 9-2 India - New Projects Planned Upto 2012

1	Project Name	Level of study	Owner	Expected year of commissioning	Output				Reservoir		Type 1- run of river 2-Run of river/Pondage 3-Peaking 4- Storage 5- PuM.P. Storage
					No. of unit	Unit Size	Total MW	Annual Energy MU(1)	Cap. MCM	Area(*) Km2	
2	3	4	5	6	7	8	9	10			
6	Subansiri Middle	New Scheme	NHPC	2012			2000	6000			ROR
7	Subansiri Lower	New Scheme	NHPC	2012			2000	7551.2			ROR
8	Koludyne	New Scheme	NEEPCO	2012			90	473.04			ROR
9	Lower Kopili	New Scheme	NEEPCO	2012	3	50	150	749			ROR
10	Ranganain – II	New Scheme	NEEPCO	2012	3	60	180	729			ROR
11	Sissari	New Scheme	NEEPCO	2012			225	1182.6			ROR
	STATE SECTOR										
1	Bairabi Dam	CEA Cleared	Mizoram	2007	2	40	80	213.55			ROR
2	Mintdu(Liska)	CEA Cleared	Meghalaya	2007	2	42	84	147			ROR
	TOTAL ALL INDIA						19219.3				

Table 9-3 India - New Projects Planned Beyond 2012 (Brahmaputra Basin)

1	Project Name	Level of study	Owner	Expected year of commissioning	Output				Reservoir		Type	IM.P.act(**)	Benefit(***)
					No. of unit	Unit Size	Total MW	Annual Energy MU(1)	Cap. MCM	Area(*) Km2			
2	3	4	5	6	7	8	9	10					
1	Teesta Low Dam st. I	New Scheme	NHPC			40	116			ROR	TBD	TBD	
2	Teesta Low Dam st. II	New Scheme	NHPC			60	174			ROR	TBD	TBD	
3	Teesta St - III	New Scheme	NHPC			1200	3905			ROR	TBD	TBD	
4	Deekrong	New Scheme	NEEPCO			100	289			ROR	TBD	TBD	
5	PapuM.P.	New Scheme	NEEPCO			100	289			ROR	TBD	TBD	
6	Teesta - VI	DPR	NHPC			360	1640			ROR	TBD	TBD	
7	Teesta - IV	DPR	NHPC			495	1783			ROR	TBD	TBD	
8	Lachung	DPR	Sikkim			30	137			ROR	TBD	TBD	
9	GoM.P.a	DPR	Sikkim			46	307			ROR	TBD	TBD	
10	Talem	DPR	Sikkim			65	262			ROR	TBD	TBD	
11	Kalep	DPR	Sikkim			41	165			ROR	TBD	TBD	
12	UmiaM.P.hang	DPR	Meghalaya			28	141			ROR	TBD	TBD	
13	Panan	DPR	Sikkim			230	1031			ROR	TBD	TBD	

Table 9-3 India - New Projects Planned Beyond 2012 (Brahmaputra Basin)

Project Name	Level of study	Owner	Expected year of commissioning	Output				Reservoir		Type	IM.P.act(**)	Benefit(***)
				No. of unit	Unit Size	Total MW	Annual Energy MU(1)	Cap. MCM	Area(*) Km2			
2	3	4	5	6	7	8	9	10				
Namium	DPR	Sikkim			175	781			ROR	TBD	TBD	
Dikchu	DPR	Sikkim			90	397			ROR	TBD	TBD	
Rammam - III	DPR	West Bengal			100	376			ROR	TBD	TBD	
Teesta - II	S & I	NH.P.C			450	2109			ROR	TBD	TBD	
Bhareli Lift Dam - II	New Scheme	Arunachal			330	1683			ROR	TBD	TBD	
Hegio	New Scheme	Arunachal			250	1062			ROR	TBD	TBD	
Bhareli Lift Dam - I	New Scheme	Arunachal			240	1226			ROR	TBD	TBD	
Irang	S & I	Manipur			60	219.4			Storage	TBD	TBD	
Emini	New Scheme	Arunachal			285	1160			ROR	TBD	TBD	
Amulin	New Scheme	Arunachal			235	996			ROR	TBD	TBD	
Agolin	New Scheme	Arunachal			235	960			ROR	TBD	TBD	
Kapak Layak	New Scheme	Arunachal			195	753			ROR	TBD	TBD	
Sushen	New Scheme	Meghalaya			150	514			ROR	TBD	TBD	
Rigong	New Scheme	Arunachal			130	599			ROR	TBD	TBD	
Badao	New Scheme	Arunachal			120	489			ROR	TBD	TBD	
Pakke	New Scheme	Arunachal			120	447			ROR	TBD	TBD	
Kuring Dam - II	New Scheme	Arunachal			115	427			ROR	TBD	TBD	
Seba	New Scheme	Arunachal			105	401			ROR	TBD	TBD	

Table 9-3 India - New Projects Planned Beyond 2012 (Brahmaputra Basin)

1	Project Name	Level of study	Owner	Expected year of commissioning	Output				Reservoir		Type	IM.P.act(**)	Benefit(***)
					No. of unit	Unit Size	Total MW	Annual Energy MU(I)	Cap. MCM	Area(*) Km2			
2	3	4	5	6	7	8	9	10					
32	Yepin	New Scheme	Arunachal			95	530			ROR	TBD	TBD	
33	Laruri	New Scheme	Nagaland			80	344			ROR	TBD	TBD	
34	Milli	New Scheme	Arunachal			75	343			ROR	TBD	TBD	
35	Chela	New Scheme	Arunachal			75	369			ROR	TBD	TBD	
36	Par	New Scheme	Arunachal			65	327			ROR	TBD	TBD	
37	Penging	New Scheme	Arunachal			60	315			ROR	TBD	TBD	
38	Tago - I	New Scheme	Arunachal			55	242			ROR	TBD	TBD	
39	Para	New Scheme	Arunachal			55	208			ROR	TBD	TBD	
40	Khongnem Chakha-III	New Scheme	Manipur			48	257			ROR	TBD	TBD	
41	Sepla	New Scheme	Arunachal			46	180			ROR	TBD	TBD	
42	Lachung	New Scheme	Arunachal			41	161			ROR	TBD	TBD	
43	Sape	New Scheme	Arunachal			38	190			ROR	TBD	TBD	
44	Langey	New Scheme	Assam			37	142			ROR	TBD	TBD	
45	Raigam	New Scheme	Arunachal			32	166			ROR	TBD	TBD	
46	Neypin	New Scheme	Arunachal			32	160			ROR	TBD	TBD	
47	Gimliang	New Scheme	Arunachal			31	162			ROR	TBD	TBD	
48	Sakhar - II	New Scheme	Nagaland			31	109			ROR	TBD	TBD	
49	Rebby	New Scheme	Arunachal			30	117			ROR	TBD	TBD	
50	Laniye - II	New Scheme	Manipur			27	99			ROR	TBD	TBD	

Table 9-3 India - New Projects Planned Beyond 2012 (Brahmaputra Basin)

Project Name	Level of study	Owner	Expected year of commissioning	Output				Reservoir		Type	IM.P.act(**)	Benefit(***)
				No. of unit	Unit Size	Total MW	Annual Energy MU(1)	Cap. MCM	Area(*) Km2			
2	3	4	5	6	7	8	9	10				
Chanda	New Scheme	Arunachal			110	415			ROR	TBD	TBD	
Tarang Warang	New Scheme	Arunachal			65	242			ROR	TBD	TBD	
Upper Borpani	S & I	Assam			60	213			Storage	TBD	TBD	
Hiya	New Scheme	Arunachal			41	204			ROR	TBD	TBD	
Tidding - I	New Scheme	Arunachal			31	153			ROR	TBD	TBD	
Kimi	New Scheme	Arunachal			535	2751			ROR	TBD	TBD	
Umjant	New Scheme	Meghalaya			85	267			ROR	TBD	TBD	
Tato - II	New Scheme	Arunachal			360	1794			ROR	TBD	TBD	
Umduna	New Scheme	Meghalaya			95	321			ROR	TBD	TBD	
Phanchung	New Scheme	Arunachal			90	346			ROR	TBD	TBD	
Dardu	New Scheme	Arunachal			60	303			ROR	TBD	TBD	
Yoksam	New Scheme	Sikkim			44	190			ROR	TBD	TBD	
Hutong	New Scheme	Arunachal			950	4622			ROR	TBD	TBD	
Chomi	New Scheme	Arunachal			80	398			ROR	TBD	TBD	
Oju - II	New Scheme	Arunachal			2580	109231			ROR	TBD	TBD	
Attinli	New Scheme	Arunachal			175	745			ROR	TBD	TBD	
Kynshi - II	New Scheme	Meghalaya			175	856			ROR	TBD	TBD	
Manhu	New Scheme	Meghalaya			90	336			ROR	TBD	TBD	
Umiam Umtru - V	New Scheme	Meghalaya			27	175			Storage	TBD	TBD	

Table 9-3 India - New Projects Planned Beyond 2012 (Brahmaputra Basin)

1	Project Name	Level of study	Owner	Expected year of commissioning	Output				Reservoir		Type	IM.P.act(**)	Benefit(***)
					No. of unit	Unit Size	Total MW	Annual Energy MU(1)	Cap. MCM	Area(*) Km2			
2	3	4	5	6	7	8	9	10					
70	Naba	New Scheme	Arunachal			1290	6038			ROR	TBD	TBD	
71	Lingza	New Scheme	Sikkim			160	716			ROR	TBD	TBD	
72	Rukel	New Scheme	Sikkim			90	406			ROR	TBD	TBD	
73	Emra - II	New Scheme	Sikkim			870	2515			ROR	TBD	TBD	
74	Umain Umtru - VI	New Scheme	Meghalaya			145	500			Storage	TBD	TBD	
75	Irang	S & I	Manipur			75	219.4			Storage	TBD	TBD	
76	Mana	New Scheme	Sikkim			37	167			ROR	TBD	TBD	
77	Nunglibam	New Scheme	Manipur			85	299			ROR	TBD	TBD	
78	Noa-Dinching	S & I	Arunachal			75	N.A.			Storage	TBD	TBD	
79	Tammu	New Scheme	Arunachal			55	307			ROR	TBD	TBD	
80	Ringpi	New Scheme	Sikkim			160	716			ROR	TBD	TBD	
81	Etalin	New Scheme	Arunachal			3045	12040			ROR	TBD	TBD	
82	Kalai	New Scheme	Arunachal			2550	12251			ROR	TBD	TBD	
83	Naying	New Scheme	Arunachal			495	2483			ROR	TBD	TBD	
84	Teesta St - I	New Scheme	Sikkim			320	N.A.			ROR	TBD	TBD	
85	Oju - I	New Scheme	Sikkim			1925	5565			ROR	TBD	TBD	
86	Niare	New Scheme	Sikkim			1405	4062			ROR	TBD	TBD	
87	Bichom - II	New Scheme	Sikkim			205	593			ROR	TBD	TBD	
88	Rang Yong	New Scheme	Sikkim			175	785			ROR	TBD	TBD	

Table 9-3 India - New Projects Planned Beyond 2012 (Brahmaputra Basin)

1	Project Name	Level of study	Owner	Expected year of commissioning	Output		Reservoir		Type	IM.P.act(**)	Benefit(***)
					No. of unit	Unit Size	Total MW	Annual Energy MU(1)			
2	3	4	5	6	7	8	9	10			
89	Serum	New Scheme	Sikkim			50	229		ROR	TBD	TBD
90	Pasar	New Scheme	Arunachal			32	111		Storage	TBD	TBD
91	Emra - I	New Scheme	Arunachal			275	1080		ROR	TBD	TBD
92	Minnying	New Scheme	Arunachal			195	671		ROR	TBD	TBD
93	Elango	New Scheme	Arunachal			180	679		ROR	TBD	TBD
94	Duimukh Storage	New Scheme	Arunachal			170	766		Storage	TBD	TBD
95	Mirak	New Scheme	Arunachal			160	753		ROR	TBD	TBD
96	Tato - I	New Scheme	Arunachal			80	384		ROR	TBD	TBD
97	Najong	New Scheme	Arunachal			65	309		ROR	TBD	TBD
98	paik	New Scheme	Arunachal			50	250		ROR	TBD	TBD
99	Satuk	New Scheme	Arunachal			447	214		ROR	TBD	TBD
100	Gameng	New Scheme	Arunachal			37	186		ROR	TBD	TBD
101	Zungki	New Scheme	Nagaland			48	170		Storage	TBD	TBD
102	Laniye - I	New Scheme	Manipur			34	118		Storage	TBD	TBD
103	Papu	New Scheme	Arunachal			160	788		Storage	TBD	TBD
104	Jaru	New Scheme	Arunachal			60	302		Storage	TBD	TBD
105	Amring	S & I	Assam			33	139		Storage	TBD	TBD
106	Pichang	New Scheme	Arunachal			31	123		Storage	TBD	TBD
107	Mawpat	New Scheme	Meghalaya			55	183		ROR	TBD	TBD

Table 9-3 India - New Projects Planned Beyond 2012 (Brahmaputra Basin)

1	Project Name	Level of study	Owner	Expected year of commissioning	Output				Reservoir		Type	IM.P.act(**)	Benefit(***)
					No. of unit	Unit Size	Total MW	Annual Energy MU(1)	Cap. MCM	Area(*) Km2			
2	3	4	5	6	7	8	9	10					
108	Rangmaw	New Scheme	Meghalaya			42	169			ROR	TBD	TBD	
109	Mathithing	New Scheme	Arunachal			40	190			ROR	TBD	TBD	
110	Khuitam	New Scheme	Arunachal			29	146			ROR	TBD	TBD	
111	Talong	New Scheme	Arunachal			150	653			Storage	TBD	TBD	
112	Utung	New Scheme	Arunachal			110	519			ROR	TBD	TBD	
113	Dibbin	New Scheme	Arunachal			95	453			ROR	TBD	TBD	
114	Jarong	New Scheme	Arunachal			85	464			ROR	TBD	TBD	
115	Novgnam	New Scheme	Meghalaya			36	129			ROR	TBD	TBD	
116	Khuzami	New Scheme	Nagaland			32	113			Storage	TBD	TBD	
117	Nongmawlar	New Scheme	Meghalaya			29	122			ROR	TBD	TBD	
118	But	New Scheme	Arunachal			26	132			ROR	TBD	TBD	
119	Hirang	New Scheme	Arunachal			180	902			ROR	TBD	TBD	
120	Tuivawl	S & I	Mizoram			48	168			Storage	TBD	TBD	
121	Malinye	New Scheme	Arunachal			335	1324			ROR	TBD	TBD	
122	Heo	New Scheme	Arunachal			90	450			ROR	TBD	TBD	
123	Yangman Storage	New Scheme	Nagaland			60	561			Storage	TBD	TBD	
124	Chhota Pathing	New Scheme	Sikkim			55	244			ROR	TBD	TBD	
125	Nonglyngkien	New Scheme	Meghalaya			47	206			ROR	TBD	TBD	
126	Mawsyrbat	New Scheme	Meghalaya			45	187			ROR	TBD	TBD	

Table 9-3 India - New Projects Planned Beyond 2012 (Brahmaputra Basin)

1	Project Name	Level of study	Owner	Expected year of commissioning	Output		Reservoir		Type	IM.P.act(**)	Benefit(***)
					No. of unit	Unit Size	Total MW	Annual Energy MU(1)			
2	3	4	5	6	7	8	9	10			
127	Nongkolait	New Scheme	Meghalaya			180	671		ROR	TBD	TBD
128	Tonga	New Scheme	Arunachal			275	1043		Storage	TBD	TBD
129	Jedang	New Scheme	Sikkim			185	741		ROR	TBD	TBD
130	Mihumdam	New Scheme	Arunachal			145	570		ROR	TBD	TBD
131	yangnyu Storage	New Scheme	Nagaland			135	561		Storage	TBD	TBD
132	Rurrur	New Scheme	Nagaland			36	126		Storage	TBD	TBD
133	Dibang	S & I	Arunachal			1000	N.A.		Storage	TBD	TBD
134	Khognem Chokha – II	New Scheme	Manipur			90	379		Storage	TBD	TBD
135	Jamuna Dam PH	New Scheme	Assam			28	129		ROR	TBD	TBD
136	Deh	New Scheme	Mizoram			26	90		Storage	TBD	TBD
137	Diyung Dam PH	New Scheme	Assam			47	211		Storage	TBD	TBD
138	Rongni Storage	New Scheme	Sikkim			95	486		Storage	TBD	TBD
139	Siang Upper	S & I	Arunachal			11000	29000		Storage	TBD	TBD
140	Bichom Storage	New Scheme	Arunachal			190	948		Storage	TBD	TBD
141	Upper Subam Siri	New Scheme	Arunachal			2500	7750		Storage	TBD	TBD
142	Kurung Dam – I	New Scheme	Arunachal			200	749		Storage	TBD	TBD
143	Someshwari Dam	S & I	Meghalaya			130	619		Storage	TBD	TBD
144	Amagam Storage	New Scheme	Meghalaya			35	143		ROR	TBD	TBD
145	Mawblei Storage	New Scheme	Meghalaya			100	273		Storage	TBD	TBD

Table 9-3 India - New Projects Planned Beyond 2012 (Brahmaputra Basin)

	Project Name	Level of study	Owner	Expected year of commissioning	Output				Reservoir		Type	IM.P.act(**)	Benefit(***)
					No. of unit	Unit Size	Total MW	Annual Energy MU(1)	Cap. MCM	Area(*) Km2			
1	2	3	4	5				6	7	8	9	10	
146	Dikhu Lift Dam	S & I	Nagaland				120	465			Storage	TBD	TBD
147	Dilli Storage	New Scheme	Assam				33	114			Storage	TBD	TBD
148	Kaldam Storage	New Scheme	Mizoram				545	2139			Storage	TBD	TBD
149	Pabarom Storage	New Scheme	Manipur				232	813			Storage	TBD	TBD
150	Sinjal	New Scheme	Manipur				39	135			Storage	TBD	TBD
151	Demwe	S & I	Arunachal				3000	N.A.			Storage	TBD	TBD
152	Jhanji Storage	New Scheme	Nagaland				75	257			Storage	TBD	TBD
153	Kyanshi I Storage	New Scheme	Meghalaya				295	1165			Storage	TBD	TBD
154	Tipang	New Scheme	Arunachal				80	429			Storage	TBD	TBD
155	Umngot Star	New Scheme	Meghalaya				265	129			ROR	TBD	TBD
156	Tizu	New Scheme	Nagaland				365	1277			Storage	TBD	TBD
157	Teesta High Dam	New Scheme	Sikkim				2505	8777			Storage	TBD	TBD
158	Tipaimukh	New Scheme	Manipur				1500	3888			Storage	TBD	TBD
159	Mawthaba	New Scheme	Meghalaya				70	333			Storage	TBD	TBD
160	Dikhu Dam	New Scheme	Nagaland				470	1634			Storage	TBD	TBD
161	Umngi Storage	New Scheme	Meghalaya				35	176			Storage	TBD	TBD
162	Lungiang Storage	New Scheme	Mizoram				690	2245			Storage	TBD	TBD
163	Bainu Storage	New Scheme	Mizoram				635	2211			Storage	TBD	TBD
	TOTAL						56995						

Table 9-4 India - New Projects Planned Beyond 2012 (Ganga Basin)

	Project Name	Level of Study	Owner	Expected Year of Commissioning	OUTPUT		RESERVOIR		Type
					Cap MW	Annual Energy MU	Cap MCM	Area Km2	
	1	2	3	4	5	6	7	8	9
1	Benakuli	New Scheme	Uttaranchal		40	160			ROR
2	Orchha	New Scheme	U.P.		39	163			ROR
3	Dhurwara	New Scheme	M.P.		28	111			ROR
4	Tapovan Chunar	S & I	Uttaranchal		485	1943			ROR
5	Lata Tapovan	S & I	Uttaranchal		320	1276			ROR
6	Tiuni	DPR	Uttaranchal		42	238			ROR
7	Bowala Nand Prayag	DPR	Uttaranchal		132	781			ROR
8	Vishnugarh PipalKoti	DPR	Uttaranchal		360	1586			ROR
9	Bhela Tipri	New Scheme	Uttaranchal		100	518			ROR
10	Bhainro Ghati	S & I	Uttaranchal		60	331			ROR
11	Naitwar Mori	New Scheme	Uttaranchal		70	257			ROR
12	Karri	New Scheme	Chatisgarh		70	236			ROR
13	Kharauli	New Scheme	Chatisgarh		46	163			ROR
14	Balasan	New Scheme	WB		33	124			ROR
15	Sankari Kunari	New Scheme	Uttaranchal		33	164			ROR
16	Pishnaitwar	New Scheme	Uttaranchal		30	148			ROR
17	Ugmir	New Scheme	Uttaranchal		28	137			ROR
18	Diulong-Sumangaon	New Scheme	Uttaranchal		26	114			ROR
19	Pangula Sanail	New Scheme	H.P.		26	135			ROR
20	Chorhat	New Scheme	M.P.		55	176	500		Storage
21	Badrinath	New	Uttaranchal		260	1041			ROR

Table 9-4 India - New Projects Planned Beyond 2012 (Ganga Basin)

	Project Name	Level of Study	Owner	Expected Year of Commissioning	OUTPUT		RESERVOIR		Type
					Cap MW	Annual Energy MU	Cap MCM	Area Km2	
	1	2	3	4	5	6	7	8	9
22	Nand Prayag Langasu	New Scheme	Uttaranchal		180	717			ROR
23	Khartoli Lumit Talli	S & I	Uttaranchal		105	512			ROR
24	Khadwan	DPR	Jharkhand		450	755	1600		Storage
25	Harsil Dam	New Scheme	Uttaranchal		350	1285			ROR
26	Nelang	New Scheme	Uttaranchal		190	757			ROR
27	Jadh Ganga	New Scheme	Uttaranchal		110	440			ROR
28	Taluka Saul	New Scheme	Uttaranchal		39	192			ROR
29	Karmali	New Scheme	Uttaranchal		190	758			ROR
30	Jamolna Ghansyali	New Scheme	Uttaranchal		44	192			ROR
31	Gangotri	New Scheme	Uttaranchal		70	339			ROR
32	Tokh Garupa	New Scheme	Uttaranchal		26	134			ROR
33	Kalika Dantu	New Scheme	Uttaranchal		140	682			ROR
34	Dhargaon Jandarwali	New Scheme	Uttaranchal		29	151			ROR
35	Banoli Nalgam	New Scheme	Uttaranchal		55	203			ROR
36	Nakot Patiasu	New Scheme	Uttaranchal		43	226			ROR
37	Kuwa Ford	New Scheme	Uttaranchal		42	222			ROR
38	Tamak Lata	New Scheme	Uttaranchal		200	918			ROR
39	Devi Bagar Khartoli	S & I	Uttaranchal		40	206			ROR
40	Mandakini	S & I	Uttaranchal		36	206			ROR
41	Kotli Bhel		Uttaranchal		1000	5411	2635		Storage
42	Pasal	New Scheme	Chatisgarh		55	184	100		Storage

Table 9-4 India - New Projects Planned Beyond 2012 (Ganga Basin)

	Project Name	Level of Study	Owner	Expected Year of Commissioning	OUTPUT		RESERVOIR		Type
					Cap MW	Annual Energy MU	Cap MCM	Area Km ²	
	1	2	3	4	5	6	7	8	9
43	Mapang Bogudyar	S & I	Uttaranchal		185	717			ROR
44	Khet Tawaghat	New Scheme	Uttaranchal		225	995			ROR
45	Sela Urthing	New Scheme	Uttaranchal		165	728			ROR
46	Duniadhin	New Scheme	Chatisgarh		80	276	390		Storage
47	Malkhat Dam	New Scheme	Uttaranchal		37	131	75		Storage
48	Girthi Ganga	New Scheme	Uttaranchal		34	155			ROR
49	Lohari Nag Tharang	DPR	Uttaranchal		520	1939			ROR
50	Sirkari Bhroi Rus Bagar	New Scheme	Uttaranchal		145	571			ROR
51	Sobala Jhimrigaon	New Scheme	Uttaranchal		145	633			ROR
52	Niti Ghansali	New Scheme	Uttaranchal		32	146			ROR
53	Urthing Sobala	New Scheme	Uttaranchal		340	1496			ROR
54	Sirkari Bhyai Bagudiar	New Scheme	Uttaranchal		240	940			ROR
55	Chhangerchal	New Scheme	Uttaranchal		145	642			ROR
56	Rishi Ganga-II	New Scheme	Uttaranchal		65	287			ROR
57	BaM.P.a Kurkuti	New Scheme	Uttaranchal		60	263			ROR
58	KhelKuran Neti	New Scheme	Uttaranchal		49	199			ROR
59	Nayar Dam	New Scheme	Uttaranchal		34	119			ROR
60	Pala Bhila Tipri	DPR	Uttaranchal		400	1576			ROR
61	Bokang Bailing	New Scheme	Uttaranchal		145	666			ROR

Table 9-4 India - New Projects Planned Beyond 2012 (Ganga Basin)

	Project Name	Level of Study	Owner	Expected Year of Commissioning	OUTPUT		RESERVOIR		Type
					Cap MW	Annual Energy MU	Cap MCM	Area Km2	
	1	2	3	4	5	6	7	8	9
62	RamGanga Dam	New Scheme	Uttaranchal		75	258	530		Storage
63	Deodi	New Scheme	Uttaranchal		65	257			ROR
64	Joka	New Scheme	Chatisgarh		28	96	160		Storage
65	Rishi Ganga-I	New Scheme	Uttaranchal		115	453			ROR
66	Jalem Tamak	New Scheme	Uttaranchal		150	685			ROR
67	Maleri Jhelum	New Scheme	Uttaranchal		90	409			ROR
68	Devasari Dam	New Scheme	Uttaranchal		78	271	85		Storage
69	Khasiya Bara	New Scheme	Uttaranchal		280	1092			ROR
70	Utyasu Dam	S & I	Uttaranchal		1140	3983	3200		Storage
71	Garba Tawaghat	New Scheme	Uttaranchal		195	828			ROR
72	Gohana Tal	New Scheme	Uttaranchal		95	389	60		Storage
73	Tawaghat Dharchula	New Scheme	Uttaranchal		310	1499			ROR
74	Garija Dam	New Scheme	Uttaranchal		295	1018	780		Storage
75	Kishau Dam	DPR	Uttaranchal		600	1327	1824		Storage
			TOTAL		12239				

Table 9-5 India - New Projects Planned Beyond 2012 (West Flowing River System)

S No	Project Name 1	Level of Study 2	Owner 3	Expected Year of Commissioning 4	OUTPUT		RESERVOIR		Type 9
					Cap MW 5	Annual MU 6	Cap MCM 7	Area Km2 8	
1	Machchattu	New Scheme	Karnataka		35	168			ROR
2	Pandiarpunnapuzha-II	DPR	Kerala		70	262			ROR
3	Natravati	New Scheme	Karnataka		60	263	838		Storage
4	Kumardhari	New Scheme	Karnataka		49	172	799		Storage
5	Kuriarkutty	DPR	Kerala		84	240	117		Storage
6	Barapole-II	New Scheme	Kerala		85	361			ROR
7	Kalinadi-III (Mardi)	New Scheme	Karnataka		175	61	470		Storage
8	Krishnapur	New Scheme	Karnataka		210	764			ROR
9	Bennehole	S & I	Karnataka		55	182	106		Storage
10	Gangavali-II	New Scheme	Karnataka		105	359	1130		Storage
11	Porinjakuthu (R.B)	New Scheme	Kerala		65	217	340		Storage
12	Manali	New Scheme	Kerala		36	183	66		Storage
13	Parinjankutty	New Scheme	Kerala		120	488	71		Storage
14	Aghnashini	New Scheme	Karnataka		370	1297	998		Storage
15	Lower Sabrigiri	New Scheme	Kerala		55	180	399		Storage
16	Kudal	New Scheme	Kerala		47	207	85		Storage
17	Nirar	New Scheme	Tamil Nadu		26	98			ROR
18	Twin-Kallar M.P.P	New Scheme	Kerala		65	229	242		Storage
19	Paraliyar	New Scheme	Tamil Nadu		39	135			ROR
20	Cholathipuzha	DPR	Kerala		80	329	86		Storage
21	Silent Valley	New Scheme	Kerala		130	448	248		Storage
22	Pandiarpunnapuzha-I	DPR	Tamil Nadu		100	262	159		Storage
23	Chalipuzha	S & I	Kerala		50	256	50		Storage
24	Sonal	New Scheme	Goa		55	193	378		Storage
25	Barapole St-I	New Scheme	Karnataka		335	361	681		Storage
TOTAL					2501				

Table 9-6 India - New Projects Planned Beyond 2012 (East Flowing River System)

	Project Name	Level of Study	Owner	Expected Year of Commissioning	OUTPUT		RESERVOIR		Type
					Cap MW	Annual Energy MU	Cap MCM	Area Km2	
	1	2	3	4	5	6	7	8	9
1	Dummagudem	New Scheme	Andhra Pradesh		360	1308			ROR
2	Kutru-I	DPR	Chattisgarh		150	358	226		Storage
3	Konta	New Scheme			65	327			ROR
4	Kumbhi-II	New Scheme	Maharashtra		27	595			ROR
5	Pulichintala	DPR	Andhra Pradesh		60	630	893		Storage
6	Singareddi	New Scheme	Andhra Pradesh		250	886			ROR
7	Kunghara	New Scheme	Maharashtra		115	514			ROR
8	Ghargaon	New Scheme	Maharashtra		105	393			ROR
9	Samda	New Scheme	Maharashtra		95	340			ROR
10	Pondugala	New Scheme	Andhra Pradesh		95	323	504		Storage
11	Bhavani-Kattalai	DPR	Tamil Nadu		90	429			ROR
12	Kasari-I	New Scheme	Maharashtra		215	739	995		Storage
13	Patharpunj	New Scheme	Maharashtra		29	102	67		Storage
14	Chitrakut	New Scheme	Chattisgarh		38	192	365		Storage
15	Kadvi	New Scheme	Maharashtra		215	746	267		Storage
16	Caveri PH-I	S & I	Karnataka		235	1034			ROR
17	Kumbhi-I	New Scheme	Maharashtra		170	980	780		Storage
18	Bhopal-Patnam	DPR	Chattisgarh		1000	2501	8475		Storage
19	Pathri	New Scheme	Maharashtra		40	1310	585		Storage
20	Kutru-II	DPR	Chattisgarh		150	538	1454		Storage
21	Arkavathi	New Scheme	Karnataka		42	215			ROR
22	Caveri PH-IV	New Scheme	Karnataka		36	183			ROR

Table 9-6 India - New Projects Planned Beyond 2012 (East Flowing River System)

S No	Project Name	Level of Study	Owner	Expected Year of Commissioning	OUTPUT		RESERVOIR		Type
					Cap MW	Annual Energy MU	Cap MCM	Area Km2	
	1	2	3	4	5	6	7	8	9
23	Jal Durg	New Scheme	Karnataka		270	1095			ROR
24	Narayanpur	New Scheme	Karnataka		70	269	1066		Storage
25	Sahasra Kund-I	New Scheme	Maharashtra		29	101	968		Storage
26	Hirna Kashi-II	New Scheme	Maharashtra		405	1414	1472		Storage
27	Caveri PH-II	New Scheme	Karnataka		165	796			ROR
28	Nugar -II	S & I	Chattisgarh		270	934	4463		Storage
29	Nugar-I	S & I	Chattisgarh		160	548	1615		Storage
30	Kotri	S & I	Chattisgarh		70	250	2334		Storage
31	Pola-Varam	DPR	Andhra Pradesh		720	2047	5511		Storage
32	Pranhita	New Scheme	Maharashtra		310	1328	3115		Storage
33	Lower Kolab	New Scheme	Orissa		375	1300	2577		Storage
34	Caveri PH-III	New Scheme	Karnataka		90	453			ROR
35	Manatha Vadi	DPR	Kerala		240	817	608		Storage
36	Wainganga	New Scheme	Maharashtra		150	517	7015		Storage
37	InchaM.P.alli	DPR	Andhra Pradesh		975	3206	4286		Storage
38	Lower Moyar	New Scheme	Tamil Nadu		33	126	56.6		Storage
39	Krishna RajSagar	New Scheme	Karnataka		55	184	1369		Storage
	TOTAL				7969				

Table 9-7 India - New Projects Planned Beyond 2012 (Central Indian River System)

	Project Name	Level of Study	Owner	Expected Year of Commissioning	OUTPUT		RESERVOIR		Type
					Cap MW	Annual Energy MU	Cap MCM	Area Km2	
	1	2	3	4	5	6	7	8	9
1	Upper Sankh-II	DPR	Jharkhand			242000	867		Storage
2	Basania	New Scheme	M.P.			238000			ROR
3	Serengda	New Scheme	Jharkhand			156000			ROR
4	Bhimkund	DPR	Orissa			102000	1350		Storage
5	Hirakud St-III	DPR	Orissa			451000			ROR
6	Jahanpur	New Scheme	M.P.			275000	1527		Storage
7	Lodani	New Scheme	Orissa			162000	1091		Storage
8	Subernarekha M.P.P	New Scheme	Jharkhand			103000	1117		Storage
9	Baljori	New Scheme	Orissa			1558000	1180		Storage
10	Naraj	New Scheme	Orissa			754000	6226		Storage
11	Tikkarpara	New Scheme	Orissa			883000	3256		Storage
12	Bumher	New Scheme	M.P.			96000	1067		Storage
13	Lower Sankh	New Scheme	Jharkhand			186000	1252		Storage
	TOTAL				1894				

Table 9-8 India - New Projects Planned Beyond 2012 (Indus Basin)

1	Project Name	Level of study	Owner	Expected year of commissioning	Output				Reservoir		Type
					No. of unit	Unit Size	Total MW	Annual Energy MU	Cap. MCM	Area Km2	
2	3	4	5	6	7	8	9	10			
1	Renuka	CEA Cleared	H.P.			40			ROR		
2	Kishan Ganga	CEA Cleared	J & K			330	1025		Storage		
3	Budhil	CEA Cleared	H.P.			70	286		ROR		
4	Kugati	CEA Cleared	H.P.			45			ROR		
5	Bharmor	New Scheme	H.P.			45			ROR		
6	Harsar	New Scheme	H.P.			60			ROR		
7	Ans – II	New Scheme	H.P.			30			ROR		
8	Lower Kalavi	New Scheme	H.P.			50			ROR		
9	New Ganderbal	New Scheme	H.P.			45			ROR		
10	Shitkari Kalan	New Scheme	H.P.			84			ROR		
11	Kashang – I	New Scheme	H.P.			66			ROR		
12	Ranakhad	New Scheme	H.P.			29	153		ROR		
13	Shongtong Karcham	S & I	H.P.			780	3355		ROR		
14	Jangi Thopan	New Scheme	H.P.			410	273		ROR		
15	Gharopa	New Scheme	H.P.			85	343		ROR		
16	Luhri	New Scheme	H.P.			425	1963		ROR		

Table 9.8: India - New Projects Planned Beyond 2012 (Indus Basin)

1	Project Name	Level of study	Owner	Expected year of commissioning	Output				Reservoir		Type
					No. of unit	Unit Size	Total MW	Annual Energy MU	Cap. MCM	Area Km ²	
2	3	4	5	6	7	8	9	10			
17	Thopan Powari	S & I	H.P.			650	437			ROR	
18	Sainj IV	New Scheme	H.P.			27	139			ROR	
19	RaM.P.ur Nainj	S & I	H.P.			420	1901			ROR	
20	Macchetri	New Scheme	H.P.			60	312			ROR	
21	Tirthan - III	New Scheme	H.P.			26	149			ROR	
22	Chulan	New Scheme	H.P.			55	966			ROR	
23	Khab II	S & I	H.P.			425	282			ROR	
24	Wangum	New Scheme	J & K			60	224			ROR	
25	Leh	New Scheme	J & K			29	173			ROR	
26	Tidong II	New Scheme	H.P.			90	386			ROR	
27	Parkhachik	New Scheme	J & K			60	245			ROR	
28	Hatian	New Scheme	J & K			215	1095			ROR	
29	Chenari	New Scheme	J & K			475	2430			ROR	
30	Thibda	New Scheme	H.P.			55				ROR	
31	Ratle	New Scheme	J & K			515				ROR	
32	Naunut	S & I	J & K			1120	5073			ROR	

Table 9.8: India - New Projects Planned Beyond 2012 (Indus Basin)

1	Project Name	Level of study	Owner	Expected year of commissioning	Output				Reservoir		Type
					No. of unit	Unit Size	Total MW	Annual Energy MU	Cap. MCM	Area Km ²	
1	2	3	4	5	6	7	8	9	10		
33	Karkit	New Scheme	J & K			190	464			ROR	
34	Kanyunche	New Scheme	J & K			105	520			ROR	
35	Gandhala	New Scheme	H.P.			90	373			ROR	
36	Dunadi	New Scheme	J & K			60	231			ROR	
37	Chhota Dara	New Scheme	H.P.			50	199			ROR	
38	Chechesma	New Scheme	J & K			47	192			ROR	
39	Khabru	New Scheme	J & K			30	115			ROR	
40	Thambas	New Scheme	J & K			29	192			ROR	
41	Dandal	New Scheme	J & K			26	89			ROR	
42	Khoksar	New Scheme	H.P.			80	325			ROR	
43	Kwar	New Scheme	J & K			440	2116			ROR	
44	Bardang	New Scheme	H.P.			145	667			ROR	
45	Chhatru	New Scheme	H.P.			140	554			ROR	
46	Kiari	New Scheme	J & K			28	158			ROR	
47	Kiru	New Scheme	J & K			295	1316			ROR	
48	Khalsi	New Scheme	J & K			170	689			ROR	

Table 9.8: India - New Projects Planned Beyond 2012 (Indus Basin)

1	Project Name	Level of study	Owner	Expected year of commissioning	Output				Reservoir		Type
					No. of unit	Unit Size	Total MW	Annual Energy MU	Cap. MCM	Area Km2	
2	3	4	5	6	7	8	9	10			
49	Seli	New Scheme	H.P.			150	765			ROR	
50	Takwaching	New Scheme	J & K			75	375			ROR	
51	Sach Khas	New Scheme	H.P.			70	284			ROR	
52	Kyurik	New Scheme	H.P.			41	204			ROR	
53	Udaipur	New Scheme	H.P.			41				ROR	
54	Shamnot	New Scheme	J & K			200	1092			ROR	
55	Nurla	New Scheme	J & K			65	325			ROR	
56	Dumkhar	New Scheme	J & K			130	656			ROR	
57	Tidong I	New Scheme	H.P.			90	314			Storage	
58	Tipri	S & I	J & K			36	139			ROR	
59	Gangbal	New Scheme	J & K			55	180			Storage	
60	Taiti - I	New Scheme	H.P.			50	176			Storage	
61	Kesar	New Scheme	J & K			42	237			ROR	
62	Nimu	S & I	J & K			180	742			Storage	
63	Bichlari	New Scheme	J & K			75	288			ROR	
64	Kiwa	S & I	J & K			37	143			ROR	
65	Naga	New Scheme	J & K			21				ROR	

Table 9.8: India - New Projects Planned Beyond 2012 (Indus Basin)

1	Project Name	Level of study	Owner	Expected year of commissioning	Output				Reservoir		Type
					No. of unit	Unit Size	Total MW	Annual Energy MU	Cap. MCM	Area Km ²	
1	2	3	4	5	6	7	8	9	10		
66	Jhalma	New Scheme	J & K			275	1181			ROR	
67	Gunderman	New Scheme	J & K			120	737			ROR	
68	Chalunka	New Scheme	J & K			45	93			ROR	
69	Shuas	New Scheme	J & K			525	2440			ROR	
70	Actinhang	New Scheme	J & K			140	707			ROR	
71	Raoli	New Scheme	H.P.			715	3651			ROR	
72	Batalik	New Scheme	J & K			235	1165			ROR	
73	Sho	New Scheme	J & K			215	1033			ROR	
74	Tillarchu	New Scheme	J & K			39	209			ROR	
75	Barinaum	New Scheme	J & K			435	2103			ROR	
76	Tahamus	New Scheme	J & K			120	66			ROR	
77	Paidar	New Scheme	J & K			46	245			ROR	
78	Railing	New Scheme	H.P.			155	654			Storage	
79	Parfila	New Scheme	J & K			45	238			ROR	
80	Khab - I	S & I	H.P.			1640	1092			ROR	
81	Kuther	New Scheme	H.P.			260				ROR	
82	U.B.D.C. - III	New Scheme	Punjab			75				ROR	
83	Baggi	New Scheme	Punjab			40				ROR	
		TOTAL				15284					

10.1 Under the Indian Constitution, the power to legislate over water rests with the states. However, the center has been given the responsibility of “Regulation and Development of interstate rivers and river valleys to the extent to which such a regulation and development under the control of Union is declared by the Parliament by law to be expedient in the public interest” under provisions of the Constitution. Thus the Constitution has assigned a primary role to the states in development of water. Theoretically thus, the union or the central government has hardly any power in the matter of water development. In practice, however the center has been playing an important role in the matter. No water resource scheme can be included in the in the plan by a state without the clearance of the Planning Commission. The execution of the schemes is also very closely monitored by the central government agencies. States on their part have willingly transferred development of some of the schemes to the central government and these are implemented by the central public sector organizations or joint ventures. The center has evolved a power sharing formula for all central projects under which the home state is given benefit of free/additional power from the project situated in that state.

10.2 Realizing the benefits that the hydro-power presents over all other resources and to improve the deteriorating hydro share in the country’s power system, the Government of India has decided to give a boost to the development of hydro-power. It aims to harness all the hydro-power potential available in the country by the year 2026. Consequently, the Government declared a Policy on Hydro-power Development in August 1998. Under the policy, the Government of India set the following objectives for accelerating the pace of hydro-power development:

- Ensuring targeted capacity during the Ninth Plan (1997-2002) of 9815 MW hydro-power out of the total capacity addition planned of 40245 MW.
- Accelerating the exploitation of vast hydro potential by way of undertaking implementation of all hydro schemes cleared by CEA and take steps to update and obtain clearances for pending DPRs. Towards this end, resolving inter-state disputes and undertaking vigorous survey and investigations for new green field projects sites were also identified as priorities.
- According higher priority to development of small and mini hydel projects in the hilly regions and on the canals. Strengthening the role of public sector undertakings (PSUs) and the state electricity boards (SEBs) for taking up new hydel projects; and
- Increasing the private sector investment in this sector. While it was recognized that the PSUs and the SEBs would play a greater role in the development of new schemes in the near term, the funds constraints would limit the development of hydro resources through these agencies. Thus the participation of private sector was considered essential and inevitable if the pace of development was to increase. As such the hydro-power policy aimed to create the atmosphere, incentives and relief to the IPPs and joint ventures to stimulate and maintain a trend in this direction.

10.3 As follow-up of the policy declaration, the GOI has taken the following actions to achieve the objective of accelerating hydro-power development:

- The ongoing central sector hydro-electric projects provided with full budgetary support;
- In principle, creation of a power development fund by levying a Power Development Cess on the sale of electricity. This fund would be used to finance the expenditure on survey and investigation, pre-construction and enabling works of prospective hydro projects. The Central Electricity Regulatory Authority (CERC) has allowed levy of **5%** development surcharge to supplement resources for hydro-electric projects by National Hydro-electric Power Corporation Ltd.
- Stress on Basin-wise development of hydro potential for maximizing benefits and prioritizing execution of projects.
- CEA, in consultation with the states, Central Water Commission, Department of Space, Geological Survey of India, Ministry of Environment & Forests has undertaken a basin-wise ranking study of all the balance hydro sites with a view to identify those hydro projects which could be taken up first so that hydro-power development is taken up in an appropriate sequence. The objective of the study is to optimally utilize the potential of feasible hydro projects of feasible hydro projects in the country over the next few decades. The study covered 399 sites and ranked them in categories A, B and C in descending order of priority. Of the 399 sites, 98 have been classified as of category A, 247 in category B and 54 sites in category C. The potential of sites in category A is 15650 MW, schemes under category B 69850 MW and those in category C 21420 MW.
- Simplification of the process of clearances of the projects by introducing three stage clearance, raising the limit for requirement of techno-economic clearance by CEA and simplification of getting environment and forest clearance by introducing multi-stage clearances by the Ministry of Environment and Forests;
- Setting up of Power Trading Corporation to facilitate inter-region transaction of power by various promoters including the joint ventures and IPPs.
- More involvement of state governments towards land acquisition, resettlement and relocation and catchments area development. The developer now has only to contribute funds for these activities and the cost are to be passed through tariff.
- Impetus to private participation through IPPs and Joint Ventures;
- **100%** Foreign Direct Investment (FDI) permitted on automatic approval route without any upper ceiling;
- Setting up Crisis Resolution Group (CRG) for resolving ‘last mile’ problems.

10.4 A three-stage clearance system has been evolved for hydro-power projects. With the introduction of three stage clearances for the hydro-power projects, the cycle of approval has become much more friendly and faster and enables taking up of survey, investigation and pre-construction activities in stages so as to expeditiously implement the project. A flow chart of the clearance procedure for the projects in the Government sector is given in Figure 10.1

10.5 The three stages of clearance of a hydro-power projects works as under:

Stage I: Survey and preparation of pre-feasibility report;

- Stage II: Detailed investigation, preparation of DPR and pre-construction activity including land acquisition;
- Stage III: Execution of the project after investment decision through PIB/CCEA

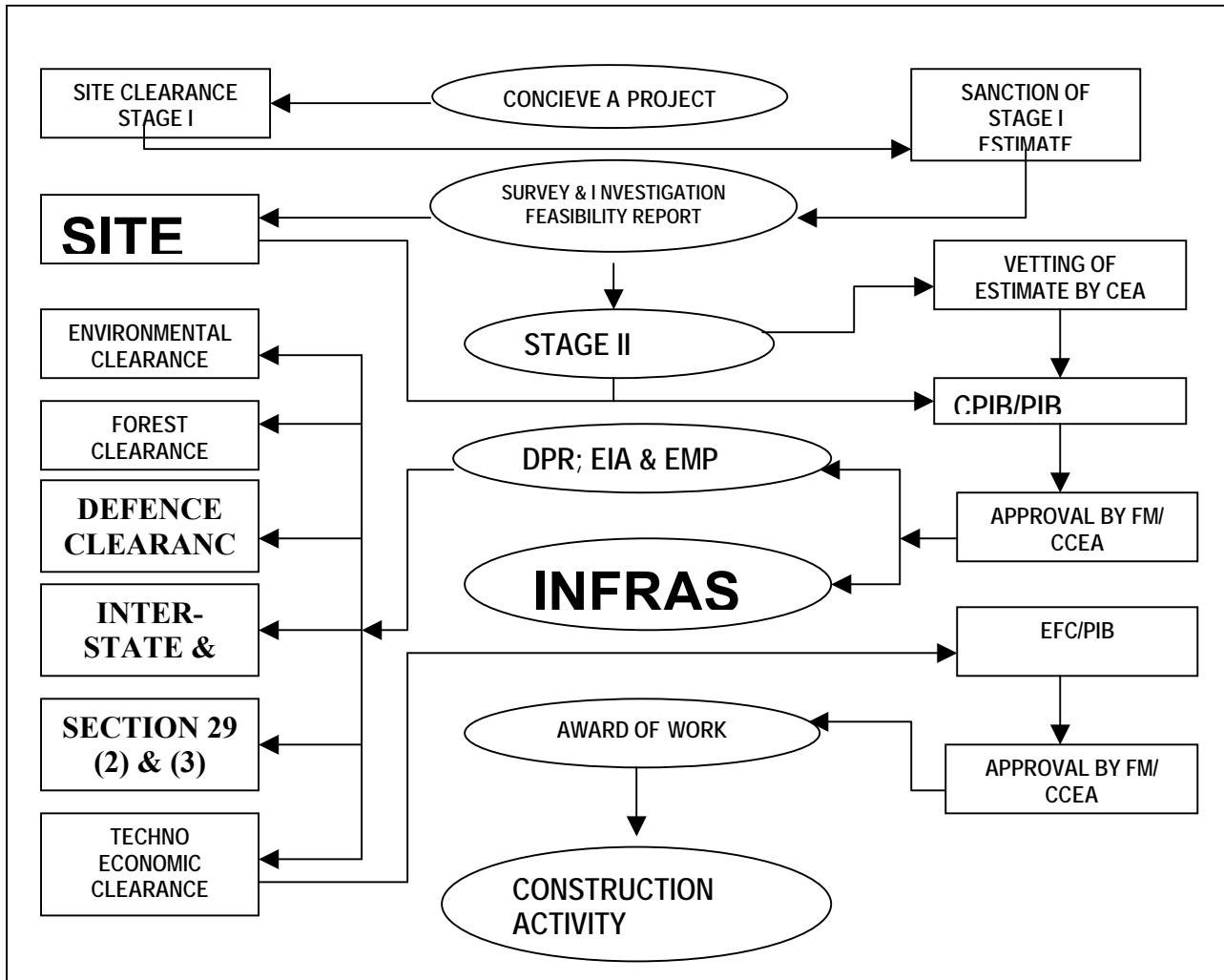


Fig 10.1: India - Flow Chart OF Clearances: Government Projects

10.6 In terms of the guidelines of the three stage clearance and delegation of powers approved in consultation with the Ministry of Finance and Ministry of Environment & Forests, the Ministry of Power has been authorized to sanction expenditure of Rs. 100 million on survey, investigation and preparation of feasibility report for new hydro-power projects. Expenditure up to Rs 500 million can be incurred on the preparation of DPR, pre-construction activities and land acquisition subject to approval by a committee of PIB based on the site clearance from Ministry of Environment & Forests and after the commercial viability of the project has been established. Proposals involving expenditure above Rs. 500 million would require approval of the PIB/CCEA.

10.7 The Ministry of Environment & Forests has also simplified the procedure for according site clearance in two stages. In stage I, preliminary site clearance is accorded to proceed with survey and investigation and preparation of pre-feasibility report. The final site clearance (Stage II) is accorded based on the data made available from survey and investigation carried out and the findings of the pre-feasibility stage. The final forest and environment clearance is accorded on the basis of Environment/Forest Impact Assessment Study (EIA) and Environment Management Plan.

10.8 The GOI has also formulated an extensive policy for encouraging hydro-power projects in private and joint venture sector. Small hydro-power projects up to 25 MW can be set up in private sector without central government's involvement. However, if the estimated cost of the project exceeds Rs 2500 million and/or there are inter-state issues involved, then techno-economic clearance of the project is to be obtained from CEA. The nodal ministry for development of small hydro-power schemes is the Ministry of Non-conventional Energy Sources (MNES) which also provides some form of subsidy for development of power projects in remote and hilly areas

10.9 For setting up a small hydro-power project, the concerned state government identifies the potential sites and carries out preliminary geological/hydrological investigations. The schemes that are offered to the private sector players are published and are awarded to them either through the route of Memorandum of Understanding (MOU) or through competitive bidding.

10.10 For setting up Mega Power Projects (1000 MW and above) in private as well as public sector, import of capital equipment is allowed free of customs duty. In addition, income tax holiday period of 10 years is allowed within the first 15 years period of the project.

10.11 Mega Power Projects are offered to private developers only after all the clearances/land have been obtained to facilitate taking up construction work immediately after the project is granted to the most competitive bidder.

A flow chart of clearances required for private power producers is shown in Fig.10.2

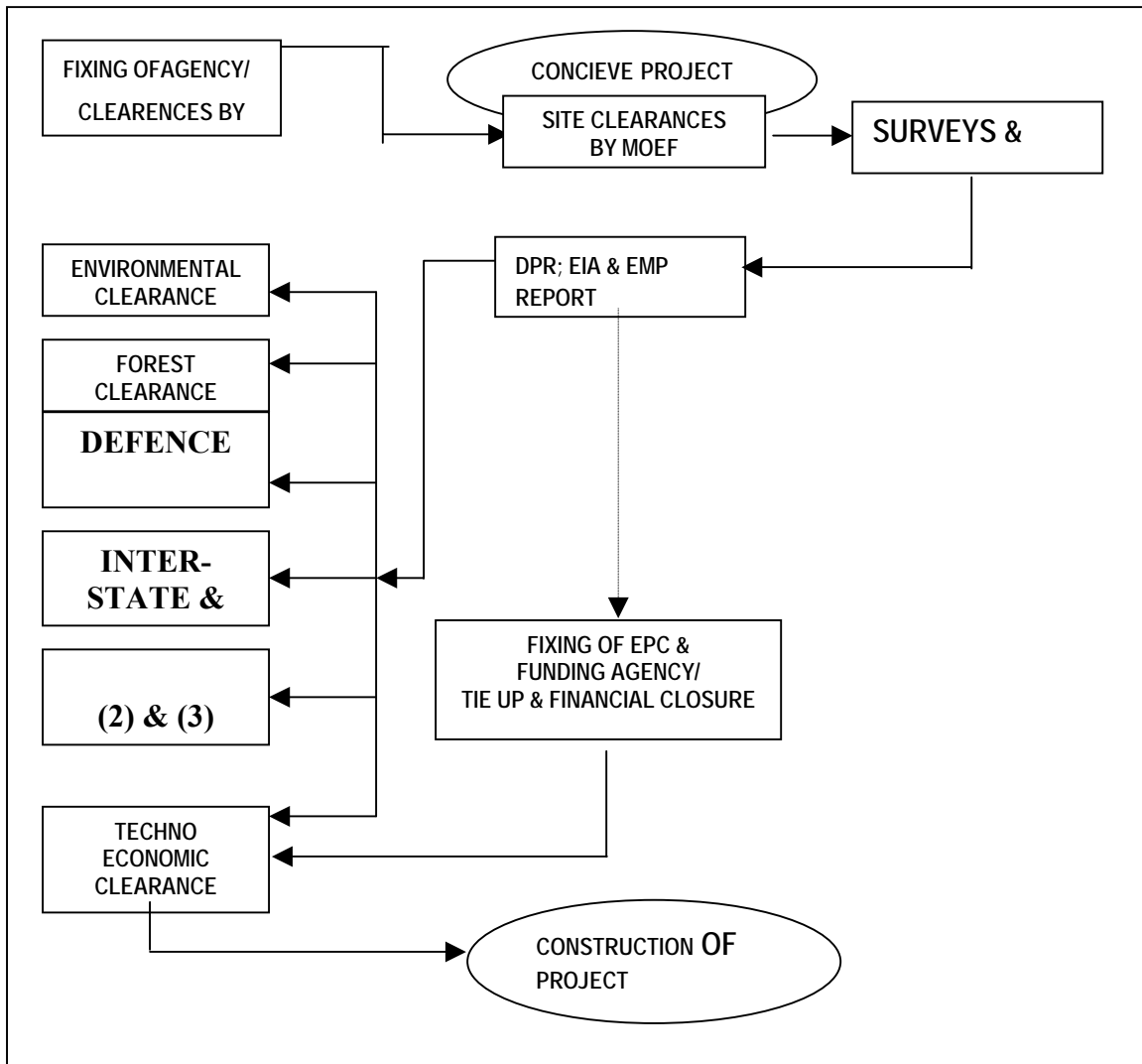


Fig 10.2: India- Flow Chart of Clearances for IPP

11.1 The progress of development of hydro-power resources in India has slowed down over the past few years and this has been well accepted by all the concerned. There are a number of reasons for the slow development of hydro-power resources. Some of the important reasons are due to the government policies and practices while the others are financial resource crunch, tardy implementation, lack of concerted effort for investigation of geology and hydrology, inadequate project management skills, environmental concerns, R&R problems and so on. The barriers and issues delaying the hydro-power development due to govt. policies and procedures or the legal/constitutional provisions and the reasons for poor implementation of hydro-power schemes after approval are described in the paragraphs that follow.

11.2 In accordance with the provisions of the Indian Constitution, the responsibility of development of water resources lies with the state governments while the development of electricity is in concurrent list i.e. both the central and the state governments can undertake power sector development works. Since hydro-power projects involve water resources, the state governments are primarily responsible for their development. The state governments on the other hand have limited resources in respect of funds, technology, work culture etc are also more prone to political considerations and priorities. Even if the central government wishes to develop hydro-power schemes in a state, its consent has to be obtained.

11.3 There have been instances where the state government handed over the development of hydro-power project to the central government and subsequently withdrew its consent while the central government agencies had undertaken preliminary works and investigations etc. Such projects thereafter suffer from lack of resources and priority and languish.

11.4 Agriculture plays a major role in Indian states' economy. The hydro-power projects are often developed as a part of multi-purpose schemes rather than only power generation schemes. These schemes are more prone to delays due to their larger sizes, multidisciplinary activities, political considerations and interferences etc.

11.5 It has generally been presumed that the hydro-power projects have long gestation period and may even take anywhere from 8 to 12 years to be completed. To some extent that is true also. The hydro-power projects by their very nature are prone to natural calamities during the construction period like floods, land slides etc and due to poor, difficult and accident prone approach roads and communication infrastructure, may even become cut off from the rest of the world. Due to the longer gestation period and uncertainty, the Government stress was diverted to development of fast track fossil fuel fired power projects. The Government's concerns were quite valid under the prevailing circumstances as the steeply growing power demand had resulted in power shortages all over the country and was adversely affecting the growth of economy. Thus the projects which were considered less susceptible to natural calamities and could be constructed and commissioned on fast track got the Government priority. Such fast track projects got major share of funds allocated to the power sector. The initial results were encouraging as thermal projects were commissioned within 4/5 years and started feeding the consumers. This set in motion a chain reaction against development of hydro-power projects in the country.

11.6 Rivers in Indus Basin flow from India into Pakistan. Some rivers in Ganga Basin also flow from Nepal/Bhutan into India. Development of hydro-power resources on these rivers

involve the settlement of the issues of riparian rights and reaching agreements between the countries. This is a long and sensitive process and might take many years of prolonged negotiations between the countries before the construction of the project can be taken up.

11.7 Similarly, within the country many rivers flow from one state to another. For developing any hydro facility on these rivers inter-state issues crop up and may take many years to settle and enable construction. Many projects are held up on such account.

11.8 The process of obtaining clearances to start construction of hydro-power project has been very involved and time consuming. A number of organizations are to be contacted and clearances obtained. Although the government has lately tried to simplify the clearance procedure but still the process remains time consuming, tedious and discouraging. That applies both to the projects in the government sector as well as the private sector. Many projects have faced delays in obtaining clearances from the various agencies involved. No time limits are generally specified for processing the applications for clearances and wherever the time schedule are specified, these are hardly complied with.

11.9 Implementation of many hydro-power projects has been delayed for want of clearance from the Ministry of Environment and Forests. Some of the schemes had to be dropped altogether e.g. Silent Valley (240 MW) was not allowed to be taken up. Although the procedure has lately been broken up in stages, still the absence of clear cut policy/guidelines issued by the MOEF the clearance of hydro-power schemes from environment and forests angles gets unduly delayed. Another hurdle in speedy implementation is the treatment of the catchments area at the project cost.

11.10 Delays in land acquisition has been a major factor in the delays of the hydro projects. In some projects the land acquisition could not be completed even after 5-10 years of the approval of the project. Cases like Koel-Karo (710 MW) in Bihar, Ranjit Sagar (Thein Dam –600 MW) in Punjab are the examples where land acquisition has delayed the projects for years

11.11 Rehabilitation and Resettlement (R&R) problems have been another area where lack of proper guidelines and interference by the government agencies, NGOs, politicians and pressure groups the progress of hydro-power projects has been adversely affected.

11.12 Paucity of funds has been one of the major constraints in hydro-power development. The hydro-power projects by nature are capital intensive. The states where the bulk of hydro-power potential exists have neither the resources to develop major hydro-power projects nor the demand to justify the large scale hydro development. Several sanctioned projects are facing the problem of non-availability of funds as well as cash flow problems after initial mobilization of works, resulting in delay in commencement of work. Such projects have to retain heavy establishments without adequate work adding to the project costs. Some of the projects being funded by the international funding agencies are languishing due to cash flow problems as the loan disbursement have either been suspended or terminated. Many projects are languishing due to non-availability of funds with the executing agencies even after several years of investment decision. Such suspensions and delays entail heavy expenditure on the part of executing agency maintaining their infrastructure at project site, contractual claims and results in highly increased cost and loss of revenue that could have accrued if the project were to be commissioned within the scheduled time.

11.13 Himalayan mountains are relatively younger and the geological conditions are difficult and unpredictable. Thorough geological and hydrological investigations are therefore essential before construction is taken up. Many projects have been facing delays running in many years due to geological surprises during constructions.

11.14 One of the major problems being faced in execution of hydro-power projects is the non-availability of competent and resourceful civil contractors in the country. Presently, not more than half-a-dozen resourceful contractors are available who are being called upon for execution of about 40 projects of 100 MW and above capacity. Due to limitations of manpower, machinery, technology and resources, the performance of even the better contractors has been less than satisfactory. The situation is going to become worse in the wake of ambitious hydro capacity addition program of the government. Along with the unsatisfactory performance of the contractors, the contract management by the executing agencies too is responsible for delays. The contract packages are many times not clearly defined, the terms and conditions arbitrarily set and approach to contractors' problems and claims is not equitable and conducive to the progress of the progress. Many projects suffer on account of poor contract management.

11.15 Poor financial health of state electricity boards has been a detrimental factor for private sector participation in the hydro-power development in the country. Unless the promoter is assured of getting payments in time, no promoter would like to invest huge capital required to put up hydro-power stations. During the last few years the central government has taken many steps to reform the power sector in order to make the electricity boards financially healthy. The reforms have started showing some positive results but the full impact can be expected in few years.

11.16 Local law and order problems, strong unions and labor troubles have also been causing projects in some states to suffer. The labor laws which are very old and now out lived their utility become hindrance in the smooth implementation of projects.

12.1 Hydro-power provides a clean, perennial, low cost and natural energy resource. It has been accepted that in India's power system the hydro-power share should ideally be around **40%** so that the fossil fuel fired power stations could be operated efficiently. However, over the past few decades, its development has been relegated to lower priorities resulting in hydro-power share of below **25%** only and this is creating operational problems for the power system.

12.2 The Government of India (GOI) has decided to accelerate development of hydro-power and has adopted a policy envisaging macro-level changes in the legal framework to promote development of hydro-power resources both in the government sector as well as in the private sector. It has also undertaken a national program to renovate and modernize the old hydro-power stations to upgrade and revive their life as this provides the cheapest and the fastest way to augment the available capacity without affecting the environment.

12.3 India has vast hydro-power resources in the country, bulk of which is contained within the North and North-east regions, in the Himalayan range of mountains. As per latest studies carried out by the Central Electricity Authority, India's hydro-power resources can result in approximately 150,000 MW installed capacity generating annually about 600 billion units. These figures do not include the potential provided by the small hydro-power sites and the pump storage schemes.

12.4 Currently 229 hydro-power stations are operational having aggregate installed capacity of 25,587 MW. 35 projects are under construction to add 13,620 MW installed capacity by the year 2012. Renovation and modernization of 80 schemes has been planned during the next 10-year span to facilitate generation of additional 10 billion units.

12.5 Towards the objective of developing the entire hydro-power resources by the year 2026, and to improve the hydro-thermal mix in the power system, it has been planned to install additional 32,844 MW installed capacity by the year 2012 by completing the projects under construction and initiating construction of new projects. Besides the large and medium sized projects, another 2,000 MW installed capacity is to be added through smaller hydro-power projects (less than 25 MW capacity). Thus within the next 10 years, the GOI intends to more than double the hydro-power capacity. In fact the GOI intends to develop the entire hydro-power resources of the country by the year 2026.

12.6 Thus the country has set for itself a very ambitious hydro-power development plan and all out efforts would be required if these targets are to be achieved. The performance of capacity addition in the previous years give little encouragement and confidence of achieving this ambitious plan. On its part, the GOI has provided the policy and legal framework to facilitate accelerated development and private sector participation. However still a lot requires to be done in removing the still existing bottlenecks and barriers at the ground level.

12.7 The above plans will require huge investment that is not possible to be available from the government resources alone keeping in view the present economic situation and ways and means of the government. Private sector involvement has to be encouraged further by giving it priority and providing a real positive ground situation to facilitate such investment. One of the biggest barriers in private sector investment is the process of project clearances which

needs to be addressed and simplified further. It would be prudent to provide a single window system of obtaining clearances so that the potential does not have to enter into years of frustrating interaction with various governmental offices to get the permission to set up hydro-power plants in the country.

12.8 The environment and forest clearance procedure and practices have to be made more transparent, logical and systematic. There is a need to clearly identify the norms that the power producer has to follow and make these norms widely known. Also, there should be a time limit fixed to decide on any application for MOEF clearance.

12.9 To improve the pace of construction of projects some fundamental changes are required to be made in the project management style. The practice of changing the project leader/key team members half way through the project construction period is proving a big barrier, they should be made fully responsible and delegated full authority to undertake the project till completion within the initial time frame.

12.10 Efforts will have to be made to develop a number of competent civil engineering contractors to undertake the mammoth work that entails use of latest construction technologies and resources. Here again the work culture and contract management practices need to be reviewed to infuse positive encouragement, equity and fairness in selection of contractors and a mechanism to resolve the contractual disputes and claims. A system of incorporating Dispute Review Board in large contracts have been found useful in many countries to resolve contractual claims before the parties enter into arbitration and/or legal cases which delay the project progress.

12.11 It may be prudent to concentrate on a few large size mega projects rather than many medium size projects so that the limited financial, managerial, construction resources are not diluted and the nation is ensured of the benefit of large capacity addition in the near term. Such large projects, carried out under the best available talents and resources could also become the catalysts and training ground for newer generation of managers, professional and contractors which could be successfully deployed on the medium sized long term projects. Concentrating on such few large size projects would also ease the burden of arranging financial resources, obtaining clearances etc. for many small and medium sized projects.

12.12 The power sector reforms have to be accelerated and implemented with more vigor and thrust so that the financial health of the electricity boards improve. They should be able to recover the cost of electricity supplied to their consumers and thereby become capable of paying for the power purchased through national and private power projects.

12.13 Even if the ambitious plans for capacity addition are undertaken in all seriousness and the proposed capacity added, the demand growth is expected to outstrip the capacity addition. India has a low per capita electricity consumption of about 360 kWh per year and if it has to attain the levels of development comparable to any of the developed countries in the next 15/20 year period, its electricity consumption would grow much faster than projected so far. Thus it will be difficult, if not impossible to maintain a hydro-thermal mix of 40:60 even if the entire hydro potential is developed. Thus India has to look towards developing and sharing the vast hydro-power potential of its neighboring countries Bhutan and Nepal. If the hydro-power resources of these countries are developed in an integrated manner with India's power system, that will not only provide additional cheap and clean energy to India but will

also provide ideal power mix and security to these countries. This will be a situation highly desirable for the entire region and beneficial to all the countries in the region.

Location Map



India's River Basin System

