

Hydropower Development in India

C.V.J. Varma and Tanushree Sharma



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Introduction

Hydropower is a renewable, economic and non-polluting source of energy. Hydropower stations can start quickly, stop quickly and offer load variations, all of which provide operational flexibility and improving the reliability of power systems in general. Hydro stations are the best choice for meeting the peak demand. The generation cost is not only inflation free but actually reduces with time. Hydropower projects have long useful life extending over 50 years, which helps conserve scarce fossil fuels. Hydropower also helps open avenues of development for remote and backward areas. Development of hydropower resources is important for energy security of the country.

As of 31st March, 2013 there were 634 Indian hydroelectric generating units installed in 182 hydro electric stations with an aggregate installed capacity of 39,491.40 MW in operation. Fifty-six sites for pumped storage schemes with an aggregate installed capacity of 94,000 MW have been identified for future development. The government expects to harness its full potential of hydropower by 2027, supporting that vision with a whopping investment of 5,000 billion Rupees.

Today, India faces a challenge of exploiting those available hydro resources but in a manner that does not compromise the ability of future generations to meet their power needs.

Hydropower Potential

Reassessment studies of India's hydroelectric power potential in various river basins of the country were carried out by Central Electricity Authority from 1978 to 1987. According to these studies, the total hydroelectric power potential in the country was assessed at 84,044 MW (at 60% load factor) from a total of 845 identified potential hydroelectric schemes. The hydro potential of 84,044 MW at 60% load factor when fully developed would result in an installed capacity of about 150,000 MW on the basis of probable average load factor. The total energy potential

is assessed at 600 billion units per year. As of 31.03.12, hydroelectric schemes having total installed capacity of 34,204.80 MW (23.54%) excluding pumped storage stations of capacity of 4785.60 MW had already been developed and the schemes under development account for capacity of 12,252 MW (8.43%).

Status of Hydro Electric Potential Development (as of 30.11.13)

(In terms of Installed capacity - Above 25 MW)

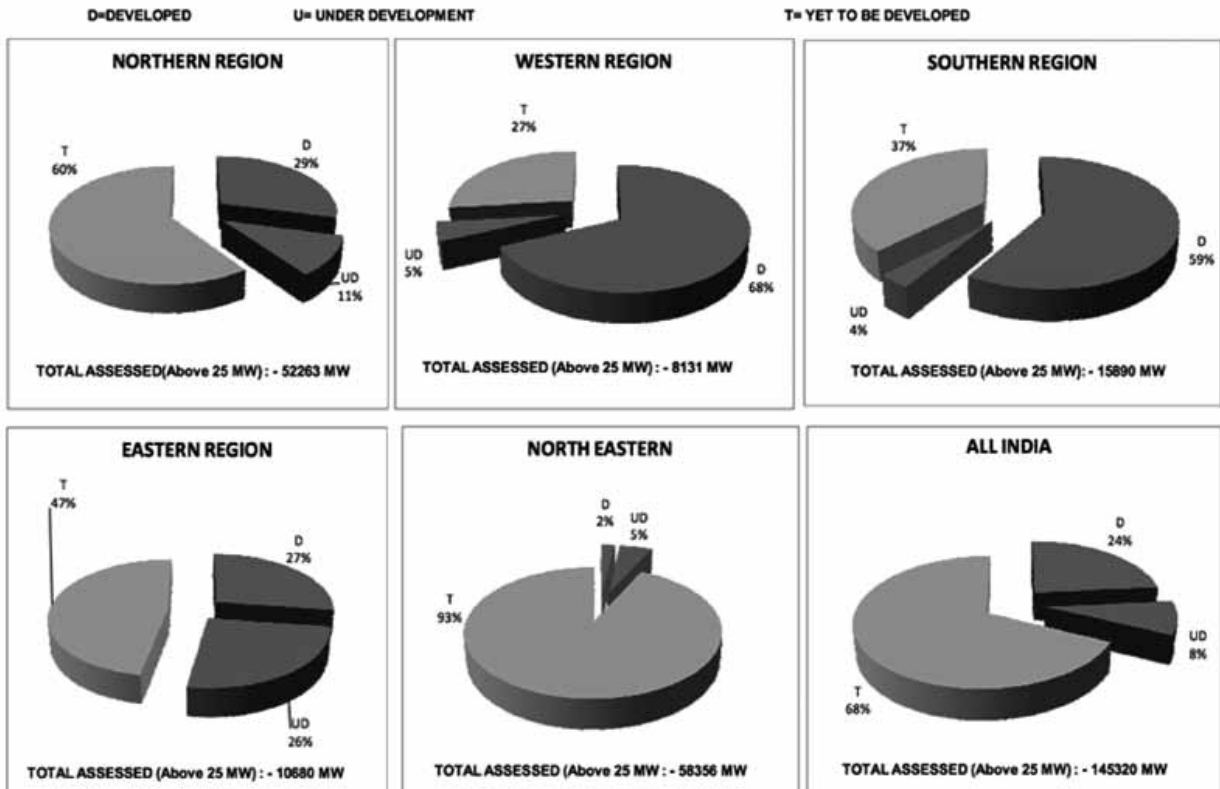
Region/ State	Identified Capacity as per reassessment study		Capacity Under Operation		Capacity Under Construction		Capacity Under Operation + Under Construction		Capacity yet to be taken up under construction	
	Total (MW)	Above 25 MW	(MW)	%	(MW)	(%)	(MW)	(%)	(MW)	%
NORTHERN										
Jammu & Kashmir	14146	13543	2609.0	19.26	1690.0	12.48	4299.0	31.74	9244.0	68.26
Himachal Pradesh	18820	18540	7594.0	40.96	3948.0	21.29	11542.0	62.25	6998.0	37.75
Punjab	971	971	1206.3	100	206.0	21.22	1412.3	100.00	0.0	0.00
Haryana	64	64	0.0	0	0.0	0.00	0.0	0.00	64.0	100.00
Rajasthan	496	483	411.0	85.09	0.0	0.00	411.0	85.09	72.0	14.91
Uttarakhand	18175	17998	3426.4	19.04	1196.0	6.65	4622.4	25.68	13375.7	74.32
Uttar Pradesh	723	664	501.6	75.54	0.0	0.00	501.6	75.54	162.4	24.46
Sub Total (NR)	53395	52263	15748.3	30.13	7040.0	13.47	22788.3	43.60	29474.8	56.40
WESTERN										
Madhya Pradesh	2243	1970	2395.0	100	400.0	20.30	2795.0	100.00	0.0	0.00
Chhattisgarh	2242	2202	120.0	5.45	0.0	0.00	120.0	5.45	2082.0	94.55
Gujarat	619	590	550.0	93.22	0.0	0.00	550.0	93.22	40.0	6.78
Maharashtra	3769	3314	2487.0	75.05	0.0	0.00	2487.0	75.05	827.0	24.95
Goa	55	55	0.0	0.00	0.0	0.00	0.0	0.00	55.0	100.00
Sub total (WR)	8928	8131	5552.0	68.28	400.0	4.92	5952.0	73.20	2179.0	26.80
SOUTHERN										
Andhra Pradesh	4424	4360	2177.8	49.95	410.0	9.40	2587.8	59.35	1772.3	40.65
Karnataka	6602	6459	3585.4	55.51	0.0	0.00	3585.4	55.51	2873.6	44.49
Kerala	3514	3378	1881.5	55.70	100.0	2.96	1981.5	58.66	1396.5	41.34
Tamilnadu	1918	1693	1782.2	100	0.0	0.00	1782.2	100.00	0.0	0.00
Sub Total (SR)	16458	15890	9426.9	59.33	510.0	3.21	9936.9	62.54	5953.2	37.46
EASTERN										
Jharkhand	753	582	170.0	29.21	0.0	0.00	170.0	29.21	412.0	70.79
Bihar	70	40	0.0		0.0	0.00	0.0		40.0	100.00
Orissa	2999	2981	2027.5	68.01	0.0	0.00	2027.5	68.01	953.5	31.99
West Bengal	2841	2829	272.2	9.62	160.0	5.66	432.2	15.28	2396.8	84.72
Sikkim	4286	4248	669.0	15.75	2322.0	54.66	2991.0	70.41	1257.0	29.59
Sub Total (ER)	10949	10680	3138.7	29.39	2482.0	23.24	5620.7	52.63	5059.3	47.37
NORTH EASTERN										
Meghalaya	2394	2298	282.0	12.27	40.0	1.74	322.0	14.01	1976.0	85.99
Tripura	15	0	0.0		0.0		0.0		0.0	
Manipur	1784	1761	105.0	5.96	0.0	0.00	105.0	5.96	1656.0	94.04
Assam	680	650	375.0	57.69	0.0	0.00	375.0	57.69	275.0	42.31
Nagaland	1574	1452	75.0	5.17	0.0	0.00	75.0	5.17	1377.0	94.83
Arunachal Pd	50328	50064	405.0	0.81	2710	5.41	3115.0	6.22	46949.0	93.78
Mizoram	2196	2131	0.0	0.00	60.0	2.82	60.0	2.82	2071.0	97.18
Sub Total (NER)	58971	58356	1242.0	2.13	2810	4.82	4052.0	6.94	54304.0	93.06
ALL INDIA	148701	145320	35107.8	24.16	13242	9.11	48349.8	33.27	96970.2	66.73

Note:

(Source: Central Electricity Authority, India)

- Does not include pumped storage schemes
- In some states the total of the capacity developed and balance capacity is different from the potential assessed. This is due to underassessment of the potential initially.
- In addition to above 9 PSS (4,785.6 MW) are under operation and 2 PSS (1,080 MW) are under construction

(REGIONWISE STATUS OF HYDRO ELECTRIC CAPACITY AS ON 31.03.2012)



Generation Performance

Generation from hydroelectric power stations (above 25 MW Installed Capacity) in the country during 2012-13 was 11,3720.29MU against the target of 12,2045 MU which was 6.82% below the target.

Region-wise generation performance of hydro electric stations during 2012-13 is indicated in the following:

Generation Performance – Regionwise (2011-12)

S. No.	Region	Installed Capacity as on 31.03.12 (MW)	Generation During 2011-12		
			Target (MU)	Actual (MU)	Shortfall(-)/ Surplus (+) Over Target (%)
1	Northern	15178.25	53474	64293.77	20.23
2	Western	7392.00	14645	19247.59	31.43
3	Southern	11372.45	30493	33637.93	10.31
4	Eastern	3847.70	9306	9551.99	2.64
5	North-eastern	1200.00	4132	3778.24	(-)8.56
Total(All India)		38990.40	112050	130509.52	16.47

Generation during 2011-12 exceeded the targets in northern, western, southern and eastern regions, whereas it was below expectations in the northeastern region of the country.

Hydroelectric generation during 2011-12 was 130,509.52 MU against a target of 112,050 MU viz surplus in generation by 18,459.52 MU (16.47%). Actual generation of 130,509.52 MU was also more than previous year’s generation by 14.22% (114,257.36 MU). Hydroelectric generation exceeded targets in

northern, western, southern and eastern regions by 20.23%, 31.43%, 10.31% and 2.64% respectively. In the northeastern region, hydroelectric generation fell 8.56% below expectations.

Hydro Capacity added during 12th Plan (2012-17)					
Sl. No.	Name of Project/ L.C. (No.xMW)	State	Unit No.	Capacity (MW)	Date of Commng.
Commissioned During 2012-13					
Central Sector					
1	Chamera-III, NHPC 3x77	H.P.	3	77	07.06.2012
			2	77	12.06.2012
			1	77	28.06.2012
2	Chutak, NHPC 4x11	J&K	2	11	08.11.2012
			3	11	11.11.2012
			1	11	22.11.2012
			4	11	28.01.2013
3	Teesta Low Dam-III, NHPC 4x33	W.B.	2	33	20.01.2013
			1	33	30.01.2013
			3	33	24.02.2013
Sub-total: Central Sector				374	
State Sector					
4	Bhawani Kattlai Barrage-III 2x15	T.N.	1	15	08.12.2012
5	Myntdu Unit-3 1x42	Meghalyn.	3	42	07.03.2013
Sub-total: State Sector				57	
Private Sector					
6	Budhil, LANCO 2x35	H.P.	2	35	26.05.2012
			1	35	30.05.2012
Sub-total: Private Sector				70	
Total: (2012-13)				501	

Source: Central Electricity Authority, India

Relations with Neighboring Countries

India has very cordial relations with its neighboring countries, especially Bhutan. In the year 2012-13, Indian imported 5,586 million units of electricity from its northeastern neighbor. Subsequently, the Bhutanese government has now expressed an interest to buy power from India and they have approached PTC India to negotiate terms and conditions for that exchange.

India's cooperation with Bhutan demonstrates the genial and mutually beneficial association that is possible in the hydropower sector, and the energy sector more generally.

India-Bangladesh cooperation also has entered a new phase, with the two countries jointly breaking ground for a 1,320-MW coal-fired power plant and inaugurating the construction of a transmission line that will export 500 MW from India to Bangladesh.

Conclusion

India needs to recognise that the only way energy security can be achieved in the most eco-friendly manner is to develop its water resources for hydropower and other uses such as navigation. In the process of this development, compromises will be inevitable. The power sector is very visible and affects every human being and nearly every activity. Suddenly, the power sector in India is once again at cross roads and needs a pragmatic approach.

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CVJ Varma is a graduate in Engineering. He has more than 30 years of experience in the field of hydropower development in India. He was involved in the construction of the Tungabhadra dam and

hydroelectric plant. Subsequently, he was involved in the design of hydro projects, such as Lower Sileru, Srisailem and others. He joined with Prof. Ven T. Chow, Prof. Gabor Karadi and Prof. Masony in the formation of International Water Resources Association and held office of Secretary General. In 1997, he became First Governor of the World Water Council's Board of Governors. From 2000 to 2003, Mr. Varma served as President of the International Commission on Large Dams (the first Indian, and Asian, to have held this post). From 2004 to 2006, he was President of the Association of the Electricity Supply Industry of East Asia and the Western Pacific (AESIEAP), and is the only Indian to have been elected to this post. He hosted the CEPSI 2006 in Mumbai, attended by more than 1000 delegates from 23 countries, and additionally 350 delegates from India. This included more than 300 CEOs. Currently he is President of Council of Power Utilities, Hon. President International Commission On Large Dams (Paris) and Hon. Member, CIGRE (Paris).

Corresponding address: cvjvarma@gmail.com

Ms. Tanushree Sharma, has experiences of addressing several international level conferences in India and abroad. She is currently working with the Council of Power Utilities, India as its Secretary. She is responsible for interacting with various public and private utilities, Ministries of the country and international associations with an aim of establishing understanding and co-operation between them. She is also the Associate Editor of the Quarterly Journal-India Power, which has entered its 25th year of successful publication.

CALENDAR OF EVENTS - WATER RESOURCES

3 – 7 March, 2014- Nexus 2014: Water, Climate, Food and Energy Conference, Location: University of North Carolina at Chapel Hill, USA, URL: <http://nexusconference.web.unc.edu>

7 - 11 April 2014- The United States Society on Dams 2014 Annual Meeting and Conference; Location: San Francisco, California, USA, Contact: United States Society on Dams, Email: stephens@ussdams.org; URL: www.ussdams.org/2014conf

April 01 - 02, 2014, Seepage Through Earthen Dams Technical Seminar (sponsored by the Association of State Dam Safety Officials), Location- Denver, Colo. USA,

31 August– 5 September, 2014 - World Water Week; Location: Stockholm, Sweden URL: <http://www.worldwaterweek.org/>

21 – 26 September, 2014- The 2014 IWA World Water Congress & Exhibition, Location: Lisbon, Portugal; URL: <http://www.iwa2014lisbon.org/>

23 - 27 June 2014, UNESCO-IHE Short Course: Design of Hydropower Schemes Organisers: Miroslav Marenc, Email: m.marenc@unesco-ihe.org, URL: www.unesco-ihe.org

Sept. 27- 1 Oct. 2014, WeFtec 2014, the Water Quality Event, Location - NewOrleans, USA,

CALENDAR OF EVENTS - ENERGY

12- 15 June 2014, ACSEE2014 - The Fourth Asian Conference on Sustainability, Energy and the Environment, Location - Osaka, Japan, contact: Enquiries: acsee@iafor.org, Web address: <http://acsee.iafor.org>, sponsored by: IAFOR - The International Academic Forum

27 July– 1 August, 2014 - Grand Renewable Energy 2014 International Conference Location: Tokyo Big Sight, Koto, Tokyo, Japan, URL: <http://www.renewableenergy.jp/2014/english/>

[renewableenergy.jp/2014/english/](http://www.renewableenergy.jp/2014/english/)

7 – 9 April, 2014 - WWEC2014 - 13th World Wind Energy Conference; Location: Shanghai, URL: www.wwec2014.net

03 Sep - 05 Sep, Renewable Energy India Expo, Greater Noida, India Organisers: UBM India Email: rajneesh.khattar@ubm.com, URL: www.renewableenergyindiaexpo.com