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HYDRO POWER SCENARIO IN INDIA

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ABSTRACT

Though Indian civilisation emerged in the Indus valley in 3300 BCE with urban ideas, India's first introduction to electricity was on 15th January 1897, in Calcutta under British Rule. After independence a stress was given to generate more hydropower for a period of about 20 years. But due to various reasons the stress on hydro power gradually reduced and thermal power got more focused. The present Hydro thermal ratio in India is 23:77. In spite of having a hydropower potential of 250000 MW (including storage pump schemes) till date India has harnessed only 20 % of the potential. Presently India ranks 5th in generation of Hydro power in the world. In 2003 after reforming the policies in National Electricity Plan, Indian government was trying to boost hydropower by identifying and distributing 162 projects of hydro capacity of 47,930 MW mostly to Private developers. Despite government efforts, issues like environmental clearances, less geotechnical investigations, R&R problems, land acquisition issues, interstate disputes, finance initiative have influenced the development of hydro power generation, with a slippage of 9,500 MW in the 11th Plan and the optimistic target of the 12th Plan. After that a realistic plan has been taken in 12th and 13th Plan. In the recent Pasis Climet Agreement India has taken a target of 40 per cent non-fossil-based power capacity by 2030. To achieve this augmentation of hydropower and with solar and wind power in inevitable. Solar and wind are intermittent sources of power and to ensure an efficient and stable grid we need sources to respond to the fluctuations. Hydro with its inherent capabilities to quickly ramp up or swiftly shut off the generation is a critical . India will take a target to double is hydro power resources by next decade

History of Electricity Generation in India

Though Indian civilisation emerged in the Indus valley in 3300 BCE with urban ideas, India's first introduction to electricity was on 15th January 1897, in Calcutta under British Rule. Up until then, Indian civilisation had been dependent mainly on fuel woods and seed oil. During the British rule, the Calcutta Electric Supply Corporation (CESC) Limited pioneered the generation of electricity in India. They brought about the electrification of Kolkata city in 1899, seventeen years after New York (1882), thirteen years after Tokyo (1886), and eleven years after London (1888). However, to date, some 300 million people of India still do not have access to electricity.

Starting from the pre-independence period, the Indian power sector has been regulated for almost a century. The first Electricity Act was introduced in 1910 to govern the Indian power sector. Following independence, in 1948 the Electricity (Supply) Act was introduced but did not achieve the desired results. As the power sector's performance started to deteriorate it became essential to restructure the power sector. Several regulatory changes have been made since 1991, which have transformed the performance of varies industries.

The most important of all the policies announced by the government was the enactment of the Electricity Act in 2003. This marked a new beginning of reforms in the Electricity Sector in India, with enactment of the Electricity Act replacing the legal framework for the sector hitherto governed by the Electric Supply Act of 1948 and the ERC Act of 1998. Indeed, there have been a number of regulatory changes since the enactment of the Electricity Act in 2003, which have opened up the power generation sector and have set it on a high growth trajectory.

Following the provisions of the Electricity Act 2003, the Central Government published the National Electricity Policy on 6th February 2005. Since then, the Government of India has undertaken several legislative measures, and carried out extensive policy reforms, with a view to accelerating the growth of the power sector and encouraging greater private participation. Some of these measures have included the National Tariff Policy, the National Electricity Plan, Competitive Bidding Guidelines, and Ultra Mega Power Projects. Now 100% of Foreign Direct Investment (FDI) is allowed in generation, transmission and distribution segments. Incentives are given to the sector through the waiver of duties on capital equipment under the Mega Power Policy. Present power generation capacity of India is 223343.6 MW. And the deficit in demand is over recorded more than 9000MW in April,2013.

Requirement of Power in India

India‘s economic growth is second in the World after China. India's incremental energy demand for the next decade is projected to be among the highest in the world, increased by sustained economic growth, a rise in income levels, an improvement in lifestyle and increased availability of goods and services, this increasing energy demand also translates into higher demand for electricity. The annual rate of growth of power supply needs to be over 10% in order to support a growth rate of the gross domestic product (GDP) of around 7% per annum. This requires the rapid development of the country's power sector, taking into account, inter alia, the considerations of long-term sustainability, environmental aspects and social concerns.
The 17th electric power survey of India report carried out by CEA claims

- Over the period 2010–11, 35% of electrical power was required by India's industry, domestic household use accounted for 28%, agriculture 21%, commercial 9%, public lighting and other miscellaneous applications accounted for the rest.
- The electrical energy demand for 2016–17 is expected to be at least 1392 Tera Watt Hours, with a peak electric demand of 218 GW.
- The electrical energy demand for 2021–22 is expected to be at least 1915 Tera Watt Hours, with a peak electric demand of 298 GW.

Percentage of present power share of in India from different sources in presented in Figure 1.

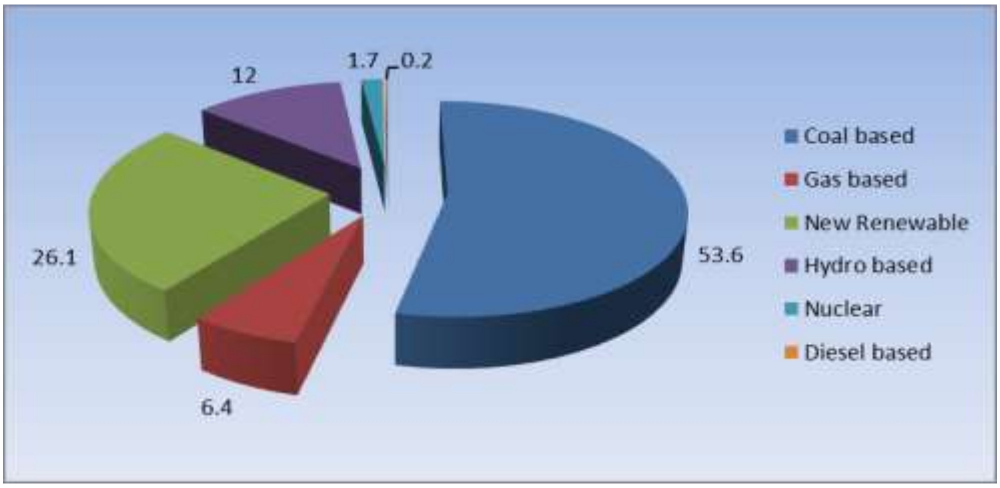


Figure 1: Percentage share of Power in India from Different sources

In the 11^{th} Master Plan (2008-2012) the capacity addition target was fixed as 78,000 MW to meet the demand fully by 2012 out of which Hydro power is 15627 MW. Finally at the end of 11^{th} Plan the total achieved target was 52,063 MW out of which Hydropower is 6,111MW.

India is committed to have 40 per cent of its installed capacity from non-fossil fuel sources by 2030, and is pursuing a renewable target of 175 GW by 2022 and 450 GW by 2030. Therefore, hydropower is highly relevant for grid integration of renewable energy and for balancing infirmities.

Hydro Power Scenario in India Compared to the World

Presently, the total hydropower capacity in operation in India is 807GW excluding pump storage, and annual hydropower generation production currently stands at more than 3,030 TWh per year. Hydropower projects under construction in 106 countries worldwide represent a capacity of about 50GW. Hydropower provides at least 50% of electricity production in 66 countries and at least 90% in 24 countries. But in India only 12% of electricity is generated from hydropower.

Production from hydropower has increased in all parts of the world, except Australia. Currently Asia has the greatest amount of hydro development where Hydro capacity under construction has increased by about 27%. The leading countries in hydro production are China, Brazil, US, Canada and India. The ten largest producers of hydroelectric power in the world are listed in Table 1.0.

Table 1.0: Largest producers of hydropower producers of world

Sl No	Country	Installed capacity (GW)
1	China	370.2
2	Brazil	109.3
3	United States	102.0
4	Canada	82.0
5	India	50.5
6	Japan	49.9
7	Russia	49.9
8	Norway	33.0
9	Turkey	31.0
10	France	25.5

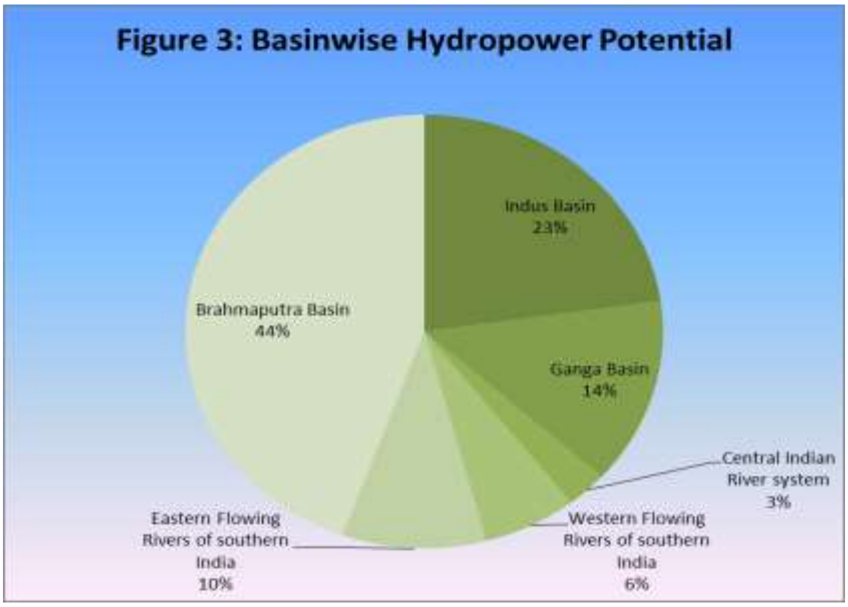
River-based India has an immense amount of hydro-electric potential, estimated to be about 150,000 MW. Globally it ranks 5th in terms of exploitable hydro-potential. According to an assessment made by the Central Electric Authority (CEA), India has an economically exploitable hydro-power potential of 148,700 MW of installed capacity which is equivalent to 84,000 MW with 60% load factor. The different river basins in India are shown in Figure 2**.** The basin wise assessed potential is presented in Table 2.0 with the percentage of Basin potential shown in Figure 3.

Figure 2: River Basins in India

Table 2.0: Basin wise hydro power potential in India

Basin/Rivers Probable	Identified Projects (numbers)	Probable Installed Capacity (MW)
Indus Basin	(190)	33,832
Ganga Basin	(126)	20,711
Central Indian River system	(53)	4,152
Western Flowing Rivers of southern India	(94)	9,430
Eastern Flowing Rivers of southern India	(140)	14,511
Brahmaputra Basin	(226)	66,065
Total:	**(854)**	**1,48,701**

Source: NHPC Ltd



In addition, in India, 56 pumped storage projects have been identified with an estimated installed capacity of 94,000MW. Added to this, the, hydro-potential from small, mini & micro schemes has been estimated to be 6,782MW from 1,512 sites. Thus, in total, India has a hydro-potential of about 250,000 MW.
To date, only 20% of India's Hydropower potential has been harnessed. As of 2021, the total installed hydro capacity of India is 50500 MW.

The Development of Hydropower in India

Sidrapong Hydel Power Station, located at an altitude of 3,600 ft (1,100 m) in the foot-hills of the Arya Tea Estate, 12 km from Darjeeling, was the oldest hydropower station in India (Figure 4). This power station, with a 2× 65 kW capacity, was commissioned on 10th November 1897 by C. C. Stevens, the then Acting Lieutenant Governor of Bengal.

Figure 4: Sidrapong Hydel Power Station

India's first major hydroelectric power installation started generating electricity in 1902 from Sivasamudram, an island located in the upper course of the Cauvery River in South India. The power station initially transmitted three megawatts of electricity 90 miles to the Kolar Gold Field mines operated by a consortium of British companies.

India's first privately owned hydro power project, theTata-Khopoli project, was commissioned in 1915 in Maharashtra. It had a hydropower capacity of 32 MW.

The Pykara Ultimate, with a capacity of 150 MW, was established between 1920 and 1930 in the southern state of Tamil Nadu. The power station is situated at a height of 1039 m, making it the highest in Asia. The power station was declared a heritage project in 1997, the reservoir being one of the most exotic tourist places in the region with boat house restaurant. The longest head race tunnel in India is the 1,500 MW capacity Naphtha Jhakri Project in Himachal Pradesh, with a length of 27 km and a diameter of 10.15m . The largest diameter tunnel has been excavated as part of the 700 MW Shrishailam project in Andhra Pradesh – it has a diameter of 15 m .

After independence, there was a drive to develop hydro power in India, as green energy. This peaked in 1960 to 1970. After 1970, the development of hydropower declined compared to the total power being generated from other sources. The development of hydro power in different plans is shown in Table 3.0.

Table 3.0: Development of Hydropower in different Plans

Plan	End of Year	Installed (MW) total Capacity	Capacity (MW) Hydro	Hydro As % of Total
--	1947	1361.76	508.13	37.31
1st	1955- 56	2886.14	1061.44	36.78
2nd	1960- 61	4653.05	1916.66	41.19
3rd	1965- 66	9027.02	4123.74	45.68
4th	1973- 74	16663.56	6965.30	41.80
5th	1978- 79	26680.06	10833.07	40.60
6th	1984- 85	42584.72	14460.02	33.96
7th	1989- 90	63636.34	18307.63	28.77
8th	1996- 97	85319.31	21644.80	25.46
9th	2001- 02	103410.04	26261.23	25.40
10th	2006- 07	132329.21	34653.77	26.19
11th	2011-12	199877.03	38990.40	22.10
12th	2016-17	288414.03	49887.0	17.29
13th (planned)	2021-22	436951.03	61887	18.05

Source:NEP 2013 and NEP 2018

Considering the status of various hydro projects, a hydro capacity addition of about 6,823 MW is likely during the years 2017-22. Additionally, hydro projects totalling to 12,000 MW have been considered for likely benefit during the years 2022- 27.The graph in Figure 5 shows the capacity of hydropower generation compared to other sources of power generation.

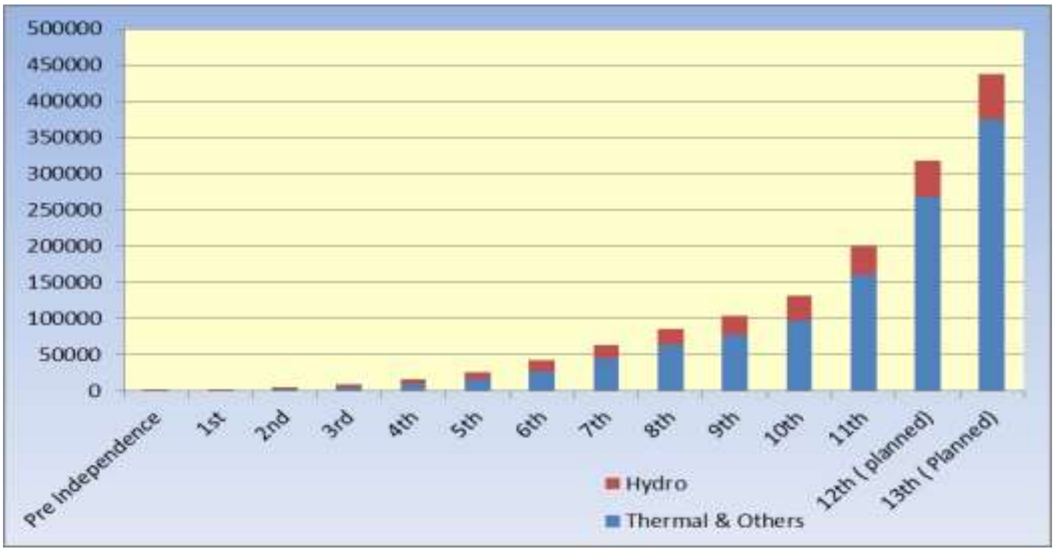


Figure 5: Power generation in India in different Plans

India imports power from neighbouring Bhutan and Nepal. It has a export potential in Bangladesh, Nepal, Pakistan. The planed import and export figure of Hydropower is presented in Table 4.0.

Table 4.0: Hydro Imports and Exports till 2026-27(All figures in MW)

	Bangladesh	Nepal	Pakistan	Bhutan	Total
Export	1,500	400	500		2,400
Import		10,000		14,000	24,000
Net Imports					21,600

The major Hydropower projects in the different states in India are presented in Table 5.0

Table 5.0: Major Hydropower Stations in India

Station	State	Operator	Generator units	Capacity (MW)
Baira Suil	Himachal Pradesh	NHPC	3 X 60	180
Bansagar Dam	Madhya Pradesh			425
Bargi Dam	Madhya Pradesh			105
Baspa-II	Himachal Pradesh	JHPL	3 X 100	300
Bhakra Dam	Punjab	BBMB	5 X 108, 5 X 157	1,325
Chamera-I	Himachal Pradesh	NHPC	3 X 180	540
Chamera-II	Himachal Pradesh	NHPC	3 X 100	300
Dehar (Pandoh)	Himachal Pradesh	BBMB	6 X 165	990
Dhauliganga-I	Uttarakhand	NHPC	4 X 70	280
Dulhasti	Jammu & Kashmir	NHPC	3 X 130	390
Ghatghar Pumped Storage Scheme	Maharashtra	MahaGenco	125 X 2	250
Idukki	Kerala	KSEB	6 X 130	780
Indira Sagar	Madhya Pradesh	NHPC	8 X 125	1,000

Kalinadi	Karnataka	KPCL	2X50, 1x135, 5X150, 3X50, 3X40	1,240
Koyna	Maharashtra	MahaGenco	4X70, 4X80, 2X20, 4X80, 4X250	1,960
Linganamakki Dam	Karnataka			55
Loktak	Manipur	NHPC	3 X 35	105
Madikheda Dam	Madhya Pradesh			60
Mettur Dam	Tamil Nadu	TNEB	50 x 4	240
Mulshi Dam	Maharashtra		6 X 25	150
Nagarjunasagar	Andhra Pradesh	APGenco	1 X 110, 7 X 100.8, 5 X 30	965
Nathpa Jhakri	Himachal Pradesh	SJVNL	6 X 250	1,500
Omkareshwar	Madhya Pradesh	NHPC	8 X 65	520
Pong	Himachal Pradesh	BBMB	6 x 66	396
Rangeet	Sikkim	NHPC	3 X 20	60
Salal	Jammu & Kashmir	NHPC	6 X 115	690
Sardar Sarovar	Gujarat	SSNNL	6X200, 5X140	1,450
Sharavathi	Karnataka	KPCL	10 X 103.5, 2X27.5, 4X60	1,469
Srisailam Dam	Andhra Pradesh	APGenco	6 × 150, 7 × 110	1,670
Tanakpur	Uttarakhand	NHPC	3 X 40	120
Teesta-V	Sikkim	NHPC	3 X 170	510
Tehri Dam	Uttarakhand	THDC India Ltd.	4*250, 4*100, 4*250	2400
Uri Hydroelectric Dam	Jammu & Kashmir	NHPC	4 X 120	480

Few major hydropower projects of India:

Bhakra Nahgal Project

The Bhakra-Nangal multipurpose dams (Figure 6) were among the earliest river valley development schemes undertaken by India after independence, though the project had been conceived long before India became a free nation. Preliminary works commenced in 1946 and construction of the dam started in 1948. However, the project was delayed only to be restarted soon after Independence. In October 1963, the Bhakra–Nangal Project was completed and was dedicated to the nation.

The dam, at 741 ft (226 m), is one of the highest gravity dams in the world (compared to USA's largest Hoover Dam at 743 ft). Over recent years, the area has become a tourist spot because of its vast size and uniqueness. The dam provides irrigation to 10 million acres (40,000 km²) of fields in Punjab, Himachal Pradesh, Haryana, and Rajasthan. Bhakra and Nangal dams house hydroelectric power generators, situated on both sides of each of the dams. Each power plant comprises of five turbines. Two power houses, with a total capacity of 1325 MW, flank the dam on either side of the river. The left power house contains five 108 MW Francis turbines while the right contains five 157 MW. The power generated by Bhakra Power houses is distributed among partner states of Punjab, Haryana, Rajasthan, Gujarat and Himachal Pradesh and also supplies common pool consumers like National Fertilizers Ltd. and Chandigarh.

Nathpa Jhakri HE Project

Figure 6: Bhakra Dam

The 1,500 MW Nathpa Jhakri Hydroelectric Project (Figure 7) is a run-of-the river type development for harnessing the hydroelectric potential and is the largest project on the River Satluj. Construction of the project started in 1993 and it was completed in 2004.The project generates 6,786 million units of electrical energy in a 90% dependable year with 7,447 million units in a mean year of 486 cumecs to be diverted by construction of a 61.5 M high concrete gravity dam. There are 4 intakes and 4 underground desilting chambers, a head race tunnel which is 10.15m in diameter and 27.3 kms long, which terminates in a surge shaft, 21m in diameter and 225m deep. Three pressure shafts, each 4.9m in diameter, emanating from the surge shaft, will feed six generating units which have a capacity of 250 MW each, in an underground power house, utilizing a head of 425m.

Figure 7: Nathpa Jhakri Dam

Tehri Dam Project

The Tehri Dam is the highest dam in India, the second highest in Asia and the eighth highest in world (Figure 8). It is a multi-purpose rock and earth-fill embankment dam on the Bhagirathi River near Tehri in Uttarakhand. The dam has created a reservoir for irrigation, the supply of municipal water and the generation of 1,000 MW of hydroelectricity. Phase 1 was completed in 2006; the dam's 1,000MW pumped-storage scheme is currently under construction.

Figure 8: Tehri Dam

In 1988 the Tehri Hydro Development Corporation was formed to manage the construction of the dam with 75% of the funding being provided by the federal government, and the remaining 25% being provided by the state. Uttar Pradesh would finance the entire irrigation portion of the project. In 1990, the project was reviewed and the design changed to its current multi-purpose. Construction of the Tehri Dam was completed in 2006. Currently, the second part of the project, the Koteshwar Dam, is completed in 2012 while the pumped storage power planned is scheduled to be commissioned in February 2016.

The dam is a 260.5 metres (855 ft) high rock and earth-fill embankment dam. It is 575 metres (1,886 ft) long and has a crest width of 20 metres (66 ft), and a base width of 1,128 metres (3,701 ft). The dam creates a reservoir of 2.6 cubic kilometres (2,100,000 acre·ft) with a surface area of 52 square kilometres (20 sq mile). The installed hydro capacity of the dam is 1,000 MW along with an additional 1,000 MW of pumped storage hydroelectricity.

The Tehri Dam and the Tehri Pumped Storage Hydroelectric Power Plant are part of the Tehri Hydropower Complex which also includes the 400 MW Koteshwar Dam downstream. The complex will afford irrigation to an area of 270,000 hectares (670,000 acres), irrigation stabilization to an area of 600,000 hectares (1,500,000 acres), and will supply 270 million imperial gallons (1.2×10^6 m^3) of drinking water per day to the industrialized areas of Delhi, Uttar Pradesh and Uttarakhand.

The Tehri Dam has been the object of protests for submergence by social activists and local people in the region. In addition to the human rights concerns, the project has raised concerns about the environmental consequences of locating a large dam in the fragile ecosystem of the Himalayan foothills. There are also concerns regarding the dam's geological stability. The Tehri dam is located in the Central Himalayan Seismic Gap, a major geologic fault zone. This region was the site of a 6.8 magnitude earthquake in October 1991, with an epicenter 500 kilometers (310 miles) from the location of the dam. Dam proponents claim that the complex is designed to withstand an earthquake of 8.4 magnitude, but some seismologists say that earthquakes with a magnitude of 8.5 or more could occur in this region. Were such a catastrophe to occur, the potentially resulting dam-break would submerge numerous towns downstream, whose populations total almost half a million.

Dibang Valley Project

Arunachal Pradesh in north-eastern part of India is considered as power house of India. Arunachal Pradesh has a hydro power potential of over 57000 MW out of which 98% is still untapped. Earlier state had allotted 168 projects to Private Power Developers and PSUs aggregating to nearly 46,000 MW. However, due to failure to take off the projects by some of the power developers, the Government has terminated many such projects.

Figure 9: Dibang Valley

Dibang Multipurpose Project is a hydropower cum flood moderation scheme proposed on Dibang River in Lower Dibang Valley District. The Dam site is located about 1.5 km upstream of the confluence of Ashu Pani and Dibang rivers and about 43 km from Roing, District Headquarter. The project would moderate flood in the areas downstream of the Dibang Dam during the entire monsoon period to the extent of 3000 cumecs. If constructed, it will be India's largest dam and the world's tallest concrete gravity dam, standing 278 metres tall. The Dibang Dam is expected to provide up to 2880 MW of hydroelectric power and will also assist with flood control in the Arunachal Pradesh and Assam in Brahmaputra valley. the foundation stone for the dam was laid on 31 January 2008. In 2013, the Ministry of Environment and Forests rejected the project's application but NHPC Limited resubmitted it in 2014. In 2019 NHPC received the go ahead on the project after environmental clearances but due to various other issues there is not much progress.

Efforts by the Government of India to Boost Hydro Power

For grid stability, the ideal hydro-thermal mix ratio for the situation in India is 40:60. In order to achieve the correct hydro-thermal mix to meet the grid requirements and peak power shortage, in August 1998, and then again in Nov 2008, the Government of India announced a Policy on 'Hydro Power Development'. Project Affected People were made long term beneficiary stakeholders in the hydro projects by way of 1% of free power, with a matching 1% support from State government for local area development thereby ensuring a regular stream of benefits for the population. An initiative to install 50,000 MW large hydro projects in the country was announced by the government. By 1998 small hydro power projects had established themselves as a techno economically viable option for generating power, with some preferential treatments. Encouraged by growing private sector involvement in the hydropower industry, and the potential of Small Hydro Projects (ie less than 25 MW), projects to meet the power requirements of remote and isolated areas, where grid extension is relatively expensive, small scale hydro was identified as an area which could reinforce the overall hydropower development of the country. Consequently, in December 1999, the subject of hydro up to 25 MW was transferred from the Ministry of Power (MOP) to the Ministry of Nuclear and Renewable Energy MNRE .

The process of reform is on-going and the Government of India has been pursuing this path vigorously, for the past decade. Hydro Power is a feasible and renewable source of clean energy which is used to supplement the base load provided by thermal power plants and the storage for wind energy through pumping. To provide the project developer in the Hydro Sector with a reasonable and rapid return on their investment, merchant sale of up to a maximum of 40% of the saleable energy has been allowed. The Central Electricity Authority (CEA) has issued various hydroelectric related reports and guide lines are available through the internet.

Some of the following documents, published by the CEA, detail what is best practice in Hydroelectric Generation.

Preliminary ranking study of hydroelectric schemes
Guidelines for accord of concurrence of HE Schemes
Guidelines for formulation of DPRs for HE schemes
Draft model contract document for hydro projects
Project monitoring status reports
Project clearance status reports
Status of 50,000 MW Hydroelectric Initiative reports.

Preliminary Reports for 162 projects, representing a total hydro capacity of 47,930 MW have been prepared. Optimistically, in 2008 the addition of 30,920 MW by hydropower was planned for the 12th plan, with a total of 109 projects comprising of 28 projects for the central sector, 35 projects for the state sector and 46 projects for the private sector.

Despite government efforts, the following issues have influenced the development of hydro power generation, with a slippage of 9,500 MW in the 11th Plan and the optimistic target of the 12th Plan.

- Difficult/ inaccessible locations
- Land Acquisition problems
- Resettlement & Rehabilitation issues
- Law & Order situations
- Geological surprises
- Inter- state disputes
- Issues concerning the apportionment of project cost among the various beneficiaries
- Cumbersome process for environment/ forest/ wildlife clearances
- Excessive burden on account- Net Present Value

Finally, a realistic projection of hydro projects, with an aggregate capacity of about 22,000 MW, has been identified, which is likely to yield benefits during 12th / 13th Plan**.** Considering the status of various projects under construction and uncertainties relating to geological surprises, natural calamities like floods, R&R and environmental issues expected to be experienced during the execution of the hydro projects, it is proposed that a hydro capacity addition of about 10,897 MW is likely to be achieved during the 12th Plan. A similarly realistic target of 12,000 MW has been fixed for the 13th plan between 2017 and 2022.

In India, a hydro power project generally takes around 10 years to be executed from the planning stage to the commissioning stage. Insufficient study and investigation during the planning stages, having to halt the project midway due to various administrative bottlenecks (such as clearances and R & R issues) in the development stages, together with the problem of insufficient finance due to the long gestation period and long loan repayment period, are the main reasons for the time and cost overrun of many projects. To develop the untapped capacity of almost 100,000 MW in hydropower, the government must increase its efforts in resolving the issues surrounding land acquisitions, resettlement & rehabilitation, environmental clearances and financial support and they need to attract private investors by demonstrating improved efficiency. The tender document should be clear comprehensive and both the financial backing and the ability and experience of the developer should be examined thoroughly before the project is allocated. All this must be performed in a transparent manner. There should be proper coordination between the various ministries and departments involved in co-ordinating the hydro projects so plans can be approved speedily. This is essential if the implementation period for projects is to be reduced to a minimum.

The present Hydro thermal ratio in India is 23:77. In both the 12th Plan and the 13th Plan the planned hydro thermal ratio is 20:80. To allow a hydro thermal ration in India of 40:60 the following issues have to be considered together with the lessons learned to date:

- Identification of the potential hydro power projects is complete. Priority has now to be given for clearing the bottleneck in order to allow the scheduled completion of the allocated projects. In addition, there needs to be a timely allocation of new projects.
- There are genuine difficulties for hydro developers to participate in tariff based competitive procurement inquiries due to: a) Cost uncertainty emanating from high geological risks in the Himalayan region; b) Energy uncertainty due to variations in water flow
- It is logical for States with hydropower potential to obtain both reasonable compensation and a fair opportunity price for their hydropower project sites from the prospective developers. This should include

at least 12% free power, a certain amount of equity participation and help with socio-economic development as determined by the State. CPSUs should deposit, in advance, funds equivalent to the monetary value of 2 % power out of the 12% free power of the host State on an annual basis, until the first year of the commercial operation of the project. Any stipulation by the State Government requiring the developers to part with free power over and above the 12% may also be justified, but in such cases, the producers are likely to transfer the burden of the increase to the customers. Similarly any lump sum, upfront, one-time compensation from the IPPs/CPSUs is likely to result in a higher eventual tariff for customers.

- A transparent system should be developed for allocating the hydro sites to IPPs and PPPs. . The guidelines should provide the required flexibility in order to meet the special conditions of individual States.
- There is a need to review the existing tariff policy applicable to both the IPPs and PPPs for hydropower projects. The CEA and Ministry of Environment & Forests (MoEF) may need to examine and give clearance to hydro project proposals on a priority basis
- The State Government should have the power to allocate projects up to 250 MW in agreement with the mega definition of hydropower project.
- The host State should be allowed to sell its share of power from a project at a market/negotiated price, without any restrictions.
- The Central Government should provide substantial assistance to a State to allow it to develop a transport and communication infrastructure to a level which enables the development of the hydropower sites to occur more easily and speedily.
- The Policy on Resettlement and Rehabilitation (R&R) should be clearly outlined by the State. The cost of R&R would need to be suitably inbuilt into the project cost. The Governments should also outline the nature of the assistance that can be provided by them.
- The hydropower project should be planned so that it meets the maximum peaking power capability.
- The Central Government should provide viability gap funding to keep the transmission cost of the remote hydropower project reasonable, thereby ensuring the landed cost of electricity is affordable.
- Advanced action should be taken to plan for the evacuation of 55,000 MW through the chicken-neck area, keeping national security and energy security in view. Financial assistance may be considered for POWERGRID for this purpose.
- A national transmission tariff should be developed as visualized in the National Electricity Policy and Tariff Policy, so that the cost of power evacuation from remotely located hydropower projects is socialised. The National Transmission Tariff should be structured in such a manner that, for example, it is economically viable for generating stations in remote states of the country to supply power to the Distribution companies located in other parts of the country.

In the recent Pasis Clemet Agreement India has taken a target of 40 per cent non-fossil-based power capacity by 2030. To achieve this augmentation of hydropower and with solar and wind power in inevitable. Solar and wind are intermittent sources of power and to ensure an efficient and stable grid we need sources to respond to the fluctuations. Hydro with its inherent capabilities to quickly ramp up or swiftly shut off the generation is a critical . India will take a target to double is hydro power resources by next decade.

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