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Indian power system: Issues and Opportunities

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ABSTRACT- Power generation is the harbinger of economic growth and industrial development of any country. India has a large verity of renewable and non-renewable energy resources still it suffers lack of generation, Transmission and distribution of electricity due to its poor policies and week planning strategy. This paper discusses Issues, challenges and opportunities particular to India and suggests strategies which contribute to plan the electricity network in order to meet the growing electricity demand for the development of country.

Keywords-Power Sector, Energy Audit, Restructuring, Deregulation, Distributed Generation.

I. INTRODUCTION

Economic growth the world over is driven by energy, whether in the form of finite resources such as coal, oil and gas or in renewable forms such as hydroelectric, wind, solar and biomass, or its converted form, electricity. This energy generation and consumption powers the nation's industries, vehicles, homes and offices. It also has significant impact on the quality of the country's air, water, land and forest resources. For future growth to be both rapid and sustainable, it needs to be as resource-efficient and environmentally benign as possible.

II. INDIAN POWER SECTOR AT A GLANCE

The Indian power sector has made remarkable progress since Independence. The total installed capacity has gone up from 1,362 MW in 1947 to more than 2, 00,000 MW in 2012 and the transmission network has increased from the isolated system concentrated around urban and industrial areas to country wide National Grid. However, the demand of electricity has always been overstepping the supply. The importance of electricity as a prime mover of growth is very well acknowledged and in order to boost the development of power system the Indian government has participated in a big way through creation of various corporations viz State Electricity Boards (SEB), National Thermal Power Corporation (NTPC), National Hydro-Electric Power Corporation (NHPC) and Power Grid Corporation Limited (PGCL) etc. However, even after this the country is facing power shortage in terms of energy as well as peak demand to the tune of 10.9% and 13.8% respectively. Here are some facts about the scenario of power sector in India:

- 17 percent of world's population.
- Population growth rate of 1.58 percent annually.
- GDP growth rate of 6 – 9 percent.
- 6th (IEA Report) largest energy producer of the world.
- Ranks 5th in energy consumption.
- Energy consumption per capita among the lowest in the world (900 kWh/year approx.). [1]

A. Generation

India's electricity generation has been increasing continuously to meet the needs of the rapidly growing economic activity of the country. Total installed capacity of electricity generation at the end of December, 2011 is given in Table.

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TABLE I.
INSTALLED CAPACITY OF ELECTRICITY GENERATION
SECTOR WISE AS ON 29/02/2012

1.Total Installed Capacity:

SECTOR	MW	%
State Sector	84,101.27	44.12
Central Sector	58,082.63	30.47
Private Sector	48,408.65	25.39
Total	**1,90,592.55**	

Source-ministry of power

TABLE II

Fuel	MW	%age
Total Thermal	124730.98	65.44
Coal	105,437.38	55.32
Gas	18,093.85	9.49
Oil	1,199.75	.63
Hydro(Renewable)	38,848.40	20.38
Nuclear	4,780.00	2.51
RES(MNRE)**	22,233.17	11.66
Total	**1,90,592.55**	**100**

Source-Central Electricity Authority

B. Transmission

The current installed transmission capacity is only 13 percent of the total installed generation capacity. With focus on increasing generation capacity over the next 5-10 years, the corresponding investments in the transmission sector is also expected. The Ministry of Power plans to establish an integrated National Power Grid in the country by 2012 with close to 200,000 MW generation capacities and 37,700 MW of inter-regional power transfer capacity. Considering that the current inter-regional power transfer capacity of 20,750 MW, this is indeed an ambitious objective for the country. [2]

Table-III
Existing Transmission Lines (in ckm)

Transmission lines (cKm)	Existing by 10th (ckm) plan	Additions 11th plan	Total by March 2012	Estimated addition in 12th plan
765 KV	2184	5428	7615	25000 TO 30,000
HVDC 500KV	5872	1606	7478	
HVDC 800/600 KV	0	3600	3600	5000
400 KV	75722	49278	125000	50,000
200 KV	114629	35371	150000	40,000
TOTAL	198965	95283	293852	155,000 to 180,000

C. Distribution

India's distribution network starts at the 33-kV India's distribution network starts at the 33-kV substation and ends at the customer's doorstep. Each state has its own distribution network, and the old vertically integrated SEBs have been unbundled into smaller distribution companies in many states. India's distribution system included more than 6.76 million cubic km of lines and over 482,000 MVA of distribution transformer capacity as of March 2012. This is assumed to be growing at an annual average rate of around 3% and 7.5%, respectively [2]. The estimated electricity

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customer base of 160 million is growing at an annual rate of about 4.5%. The average per-capita consumption of 778 kWh in 2010-11 is expected to surpass 1,000 kWh by 2012-13.

III. INDIAN POWER SECTOR ISSUES

According to planning commission report, in 11th Five-Year Plan (2007-2012), Indian government aims to add over 78,500 MW of new capacity to achieve the ambitious mission of 'Power for All by 2012'. To meet its large and growing power needs, there are many shortcomings [3].

A. *Limited fuel*

In the Indian Power sector, primarily electricity production is from thermal power stations. The main fuel used is coal. Coal fuels about 55% of India's power generation, and if current projections are accurate, that proportion will grow substantially in the next 20 years. Additional power generation is likely to require incremental amount of coal transportation by Indian Railways within the country and increasing unloading at ports in India for imported coal.

B. *Equipment Shortage*

Equipment shortages have been a significant reason for India missing its capacity addition targets for the 11th five year plan. While the shortage has been primarily in the core components of Boilers, Turbines and Generators, there has been lack of adequate supply of Balance of Plant (BOP) equipment as well. These include coal-handling, ash handling plants, etc. Apart from these, there is shortage of construction equipment as well.

C. *Land Acquisition and Environment Clearance*

Land Acquisition poses an increasingly significant challenge in the Indian Power sector. Power plants and utilities face major constraints and delays regarding the availability of land and obtaining the requisite environment and other clearances for the projects. The new Bill relating to land acquisition has continued to face political opposition. While it provides for acquisition by project development agencies to the extent of 70 percent of the land required for a project, with the balance to be obtained by the Government. In addition, it has been reported that in some cases, even after land owners were asked to sell and handover their land in 'Public Interest', the project was not completed for several years due to other delays, a fact that eroded the credibility of both the industry and the government. Consequently there is a significant mismatch of expectations from the Project Affected Persons (PAP).

D. *Transmission & Distribution Losses*

High distribution-line losses are among the most vexing problems in the Indian power sector. India's aggregate technical and commercial losses average about 32% of electricity which is very high as compared to those developed countries (6-11%). This is a matter of concern as well as potential for saving, which may reduce the demand supply gap. A reduction in Transmission & Distribution losses by 1% would result in a saving in capacity by about 800 MW.

E. *Aging Power Plants and Transmission network*

Since most of the power plants and transmission lines have been installed immediately after the independence; they have become old and inefficient. This is the main reason for low growth and transmission rate in electricity generation and transmission during the recent years. Old and inefficient plants and lines need to be replaced or renovated and modernized to achieve the electricity production and demand target.

F. *Sharp increase in demand*

Although India has large installed capacity but still there is large demand and supply difference. The following table describes the forecasted demand scenario.

Table-IV
Demand and supply forecasts for power in India (GW)

	2001/02	**2006/07**	**2011/12**
Peak load	95.76	130.94	176.65
Installed Capacity	126.04	181.1	242
Peaking Capacity	89.92	129.82	146.67

Source: EIA

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G. *Interstate Disputes*

India is a federal democracy, and because rivers cross state boundaries, constructing efficient and equitable mechanisms for allocating river flows has long been an important legal and constitutional issue. Due to this there is not availability of water all the times to operate hydro plants. Inter-state disputes also restrict the excess power exchange between the states.

H. *Delay in construction of projects*

The commissioning of new power projects have been delayed for too long. The main reason behind this is the lack of financing and long route of money flow from the departments. They left most of the utilities to rot away even as they were lacing their own pocket. Hence the recent power sector has remained without any improvement.

I. *Erratic monsoons*

India is a big country with different geographical conditions. The monsoon in India is very erratic so that the hydro plants can't be operating during whole year. Many times, the depletion of the reservoirs caused a shortage in generation from the hydro plants.

J. *Less inclination to renewable*

India is abundantly gifted with variety of renewable energy (RE) sources, not all States are endowed with same level of renewable energy sources. While some States have very high renewable energy potential, some States have very little renewable energy potential. But still the renewable resources are not explored, having only approx. 10% of total energy generation.

IV. FUTURE OUTLOOK FOR CHANGING INDIAN POWER SECTOR

There is to be changed in condition of Indian Transmission, Generation and Distribution by adapting new, innovative strategies.

A. Renovation and Modernization of Generation Sector

For improvement of performance of existing old power plants a massive renovation and modernization program need to be launched. Increase the efficiency of coal-based power plants**.** The fuel conversion efficiency of the existing population of thermal power stations is on average around 30 per cent. Super-critical boilers can provide an efficiency of 38-40 per cent. No new thermal power plant should be allowed without a certified fuel conversion efficiency of at least 38 per cent.

B. Development of National Grid

In order to increase the transmission capability of power the important role plays by national grid development. It is envisaged to add new inter-regional capacities of 20700 MW at 220 kV and above during the Eleventh Plan period. This would increase the total inter-regional transmission capacity of national power grid at 220 kV and above from 14100 MW (by the end of the Tenth Plan) to 37750 MW by 2011–12.

C. Strengthened role of Renewable in the sector

To boost investment in renewable energy, it is essential to introduce clear, stable and long-term support policies. A number of policy measures at national level, which could be applied concurrently, would significantly improve the framework for renewable energy in India. However, they must be carefully designed to ensure that they operate in harmony with existing state level mechanisms and do not lessen their effectiveness.

D. Implementation of modern techniques for electric power conservation (DSM)

DSM is the planning, implementation and monitoring of utility activities designed to influence customer use of electricity in ways that will produce the desired changes in the load, shape of the utility. An integrated approach to DSM and successful implementation of DSM schemes results in capital expenditure, maintenance, operating costs, fuel savings, improved system efficiencies and reduced system losses and improved plants life.

E. Introducing Cogeneration Systems

India have a large number of sources for the electricity generation and the energy from all available resources should be converted to electricity for better operation, utilization in order to meet growing electricity demand. The Central and State Grid networks are being contemplated for efficient and uninterrupted supply of energy, but such complex networks have large number of problems [5]. To solve such problems, the Cogeneration, be implemented which is

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gaining popularity now days. The Total Energy System consists of generator for producing electricity and the waste heat from prime mover fuel is utilized for air-conditioning etc. Introduction of cogeneration will reduce transmission and distribution cost.

F. Institution of energy audit

There should be a board that should be involved in the auditing of electric power at intervals of time to ensure that the future of electricity industry will not jeopardize the growth of national economy.

G. Adoption of innovative business models

Emerging opportunities in the sector along with increasing presence of the private sector would also drive adoption of newer business/operating models. On one hand, large players may move towards integrated presence in the value chain; at the same time many new entrants are expected to establish niche presence in the market. Power tolling, direct supply to bulk customers, peak demand based capacities etc. could emerge in a big way in the future.

V. CONCLUSIONS

In this paper the Indian Power Scenario is discussed. India's growing economy has forced the country to increase installed power capacity to 200 GW this year. Despite this growth in supply, the country is still facing major challenges in providing electricity access to all the households and also improving reliability and quality of power supply. Its power systems are struggling to overcome power shortages and poor power quality. The major constraint in achieving the target is shortage of capital resources. Shortages are exacerbated by inefficiencies in power generation, distribution and end-use systems.

There is an immediate need for change in planning strategies from the traditional approach of increasing generation to meet in disciplined consumption to need, resource and conservation based approach for economic and environmental benefits. Considering the scale of the target, multipronged strategies are envisaged. Some of these are partial solution for power shortages, yet these are important measures in context of resource crunch since these would enable reducing the requirement for new generating capacity. These include removing obsolescence, optimum utilization of existing assets, reducing transmission and distribution losses, demand side management through greater conservation of electrical energy, policy changes in pricing mechanism, shift and emphasis on renewable energy sources for power generation, total energy systems, new energy storage systems like Superconducting Magnetic Storage Systems as spinning reserve to meet peak demand and energy efficiency promotions in accordance with national and socio-economic and environmental priorities. Steps which may help large scale integration of renewable power with conventional power generation are also enumerated.

REFERENCES

[1] Dr. Tarlochan Kaur, 'The Indian Power Sector – A Sustainable Way Forward', IPEC2010, pp. 666-669

[2] National Electricity Plan, 2011. (Vol.1&2), Central Electricity Authority, Govt. of India, 2012.

[3] Neerja Mathur, 'Power Development in India', Water and Energy International, CBIP, Vol. 66, No. 1, pp. 11-25, January-March 2009.

[4] Report on Seventeenth Electric Power Survey Of India, Central Electricity Authority, Govt. of India, March, 2007.

[5] Saifur Rahman and Arnulfo de Castro, " Environmental Impacts of Electricity Generation: A Global Perspective," IEEE Trans. On Energy Conversion, Vol.10, Issue .2, pp 307-314, June 1995.

[6] R. G. Yadav, Anjan Roy, S. A. Kharparde, and P. Pentayya, "India's fast-growing power sector-from regional development to the growth of a national grid", *IEEE Power and Energy Magazine*, July-August 2005.

[7] Philip D. Baumann,, "Energy Conservation and Environmental Benefits that may be realized from Super Conducting Magnetic Energy Storage," IEEE Trans. On Energy Conversion, vol.7, No.2, pp. 253-259, June 1992.

[8] A. Srivastava, M. Shahidehpour, "Restructuring choices for the Indian power sector", IEEE Power Engineering Review, Vol. 22, Issue 11, , pp. 25 – 29, Nov. 2002.

[9] www.mnes.nic.in

[10] www.eia.nic.in

[11] www.cia.nic.in

[12] J.T. Cain, "Power System Restructuring [Asian and Australian Power Policy]", IEEE Power Engineering Review, Vol. 16, Issue 2, pp. 9, Feb. 1996.

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