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Study of Infrastructural Development of Energy Sector in Indian Economy

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ABSTRACT:
This paper attempts to study the pattern and structure of energy development in India. The developments of various sources of commercial energy have been studied under three headings, namely, hydro, thermal and nuclear energy. Attempts have been made to bring out the salient features of each of them and to give a brief account of recent developments in these fields. The growth of production, consumption and productive capacity is shown together with other basic information, and a description is also given of the main changes that have occurred in the organization and ownership of these forms of energy.
Key words: energy development, hydro, thermal and nuclear energy

INTRODUCTION:

Infrastructure investment is an important driving force to achieve rapid and sustained economic growth. The presence of sufficient infrastructure will require for the modernization and commercialization of agriculture and the achievement of income surpluses for capital accumulation. It can provide a basis for the expansion of local manufacturing industries, as well as enlarging markets for the outputs of these industries. Many studies have found a positive relationship between the level of economic development (measured by per capita income and other indicators), and quality of housing and access to basic amentias like electricity, safe drinking water, toilets (Human Development Report of India 2011). There is a precise link between infrastructure and development. Infrastructure investment directly affects the economic development. Therefore, that the only way to build up a country's productive potential and raise per capita income is to expand the capacity for producing goods, this need not refer simply to the provision of plant and machinery, but also to roads, railways, power lines, water pipes, schools, hospitals, houses and even "incentive" consumer goods such as consumer durables, all of which can contribute to increased productivity and higher living standards.

The prosperity of a country depends directly upon the development of agriculture and Industry. Agriculture production, however, requires power, credit, transport facilities, etc. Industrial production requires not only machinery and equipment but also skilled manpower, management, energy, credit facilities, marketing facilities, transportation services which include railways, roads, shipping, communication facilities, etc. All these facilities and services constitute collectively the infrastructure of an economy. Regions with inadequate infrastructure usually have lower per capita income, bigger proportion of the primary sector, and smaller population density. Regions with high infrastructure level usually have higher per capita income, a smaller proportion of the primary sector and bigger population density. In which regions having a good basic facilities like health, educational, transport, communication, water, sanitation, energy, housing, etc. it will attract more investments especially the small and marginal entrepreneur starts their production activities. Good transportation, low cost of electricity, availability of skilled lobar facilities always negative effects on the cost of production, positive effects on production as well as profit levels. Inadequate infrastructure and services become the burden for infrastructure suppliers, and led the low efficiency of output. World Development Report(1994) published by the World Bank under the title "Infrastructure for Development' rightly mentions that the adequacy of infrastructure helps determine one country's success and another's failure in diversifying production, expanding trade, coping with population growth, reducing poverty, or improving environmental conditions" Socioeconomic development can be facilitated and accelerated by the presence of social and economic infrastructure.

It has been universally recognized that an adequate supply of infrastructure services is an essential ingredient for productivity and growth. If these facilities and services are not available in that place development will be very difficult, it will lead negative effect on the production activities of the economy, which means lower levels of production capacity is always leads to the under utilization of the resources, scarcity of goods and services. People will spend more money for obtaining basic needs and facilities. It can be linked to a very scarce commodity that can only be secured at a very high price and costs. The pursuit of higher level of welfare for the citizens of countries in the era of globalization requires efficiency, productivity and growth in all spheres of economic activities. The East Asian region including China and India is projected to experience stronger growth in electricity consumption than any other region of the World. Total electricity consumption is projected to grow by more than 3 trillion-kilowatt hours between 1995 and 2015, a growth rate above 5 percent per year, with China alone accounting for more than half the growth. The projection of electricity demand growth is driven largely by economic expansion in the region, where GDP is expected to increase by 6 percent annually. Again, China is the leading source of the growth, with an expected annual GDP growth rate of about 7.3 percent. Coal remains the dominant fuel for the region's electricity generation. The relative shares for oil and nuclear power are expected to decline, while natural gas and renewable (principally hydropower) are projected to increase in importance. Both China and India are more heavily dependent on coal for electricity generation than are the other developing Asian nations.

Capacity Addition in the Energy Sector

The all-India installed capacity of electric energy generating stations under utilities was 412 058.42 MW (megawatt) as on 2013 consisting of 77968.53 MW of thermal, 99500.23 MW of hydro, 6780 MW of nuclear, and 3869.66 MW of wind energy which as increased to 89544.81 MW as on 2013 consisting of 94201.45 MW of thermal, 45135.23 MW of hydro, 3520 MW of nuclear, and 4688.13 MW of wind energy. A capacity addition of 315110 MW has been targeted for the Twelfth Five-year Plan.

The National Electricity Policy (NEP) stipulates energy for all by 2012 and annual per capita consumption of electricity to raise to 1000 units from the present level of 931 units. To fulfill the objectives of the NEP, a capacity addition of 128,577 MW has been proposed for the 11th plan. This capacity addition is expected to provide a growth of 9.5 % to the energy sector. The break up of the capacity addition target is given as under:

Table-1

Capacity Addition Target

(in MW)

Type/sector	**Central**	**State**	**Private**	**Total**
Thermal	9685	26800	3380	39865 (50.7%)
Hydro	3605	24347	0	27952 (35.5%)
Nuclear	3263	7497	0	10760 (13.8%)
Total	**16553 (21%)**	**58644 (74.6%)**	**3380 (4.4%)**	**78577 (100%)**

Source: Annual Report 2012-13, Ministry of power, Government of India.

(A) PATTERN OF POWER INDUSTRY

Pattern of Energy Industry Development

Energy is the most convenient and versatile form of energy and plays a crucial role in the economic development of a country. The history of energy development in India dates back to 1887 when first a hydro station was established at Darjeeling. In the early years, most of the energy supply facilities were privately and local bodies owned the catered to the needs of big towns and cities. The first thermal energy station in India was established in Calcutta in 1899 with a total installed capacity of 1000 KW. During the first two decades of the twentieth century steam power stations at Kanpur, Madras and Calcutta of 2,170 KW, 9000 and 15000 KW were commissioned. In 1902, hydro-electric plants of 4,500 KW at Sivasamudram in Karnataka, in 1907, 3000 KW at Mahara in Jammu and Kashmir, in 1911, 500 KW at Simla in Himachal Pradesh, in 1914, 1550 KW at Gokak Falls and in 1915, 40,000 KW at Greater Bombay were installed. Between 1921 and 1940 total installed capacity

increased by about 10 times, from about 0.13 million kilowatts to 1.3 million KW. The industrial boom following World War I, realization of the use of electricity in industries and the interest shown by some of the provincial Government were responsible for this increase. By the end of 1940 that total installed capacity was 0.6 million comprising steam 0.5 million hydro and 0.1 million diesel. The growth of electricity development between 1941 and 1951 was hardly substantial. Steam generating capacity rose by 60 per cent and slow growth were the stresses and strains of the Second World War and the abnormal post was conditions that followed. The available plants were used up to the maximum capacity and were subject to heavy wear and tear and frequent break-downs. Deterioration of coal supply and shortage of fuel oil also worsened the situation. Thus, at the end of the war, the energy supply industry was in a very precarious position.

(B) GROWTH & DEVELOPMENT OF POWERS DURING THE FIVE YEAR PLAN

The Growth in Capacity, Production and Consumption of Hydro, Thermal and Nuclear Energy during the plans

During the first plans, construction of a number of major river valley projects like Bhakra-Nangal, Damodar Valley, Hirakund and Chambal Valley was taken up. These projects resulted in the stepping up food production and energy generation. Emphasis in Second Plan was on development of basic and heavy industries and related need to step-up energy generation.

During the Third Plan, emphasis was an extending energy supply to rural areas. The significant development in this phase was the emergence of inter-state grid system. The country was divided into five regions, regions electricity boards were established in each region to promote integrated operation of constituent energy system. In the mid-sixties the country experienced increasing number/degree of the planners to re-orient the emphasis on rural electrification. Thus the three Annual Plans, that followed the Third Plan aimed at consolidating the programmes initiated during the Third Plan. During Fourth Plan envisaged the need for central participation in expansion of electricity generation programmes in strategic locations to supplement the activities in the State sector and revival of imbalance and to enable equitable distribution. Progress in energy generation programmes during the end of the Fourth Plan was substantial. Emphasis in Fifth Plan was on speeding up the construction and commissioning and the construction work on others was speeded up. A number of power stations were commissioned and construction work on others was speeded up. Consequent upon these efforts, the total installed generating capacity in the country reached to about 8 million KW at end of Fifth Plan. The installed capacity at the beginning of the current sixth plan period was 26 million K.W. During the Tenth plan period, IREDA sanctioned capacity of 1261.71 MW and 2.84 lakh metric tons coal replacement (MTCR/annum). The financial achievements in terms of loan sanction and disbursement were of the order of Rs. 3851.63 crore and Rs. 2027.03 crore respectively. During the Eleventh plan, capacity addition target of 41,110 MW comprising 14,393 MW hydro, 25,417 MW thermal and 1,300 MW nuclear was fixed for the 11th Plan. The sector wise, type wise summary of this capacity addition target is given in Table below.

Table 2

11th plan capacity addition target-sector wise

Sector	Hydro	Thermal	Nuclear	Total (%)
Central	8,742	12,790	1,300	22,832 (55.5%)
State	4,481	6,676	0	11,157 (27.2%)
Private	1,170	5,951	0	7,121 (17.3%)
Total	14,393	25,417	1,300	41,110 (100%)

Source: Annual Report 2011-12, Ministry of power, Government of India.

A moderate target was set for state and private sectors keeping in view the preparedness of various state power utilities and IPPs.

Actual Capacity Addition

A capacity addition of 17,995 MW has been achieved during 12th Plan. The total installed capacity as on 31/12/2013 was 1,27,753 MW comprising 33,642 MW hydro, 84,020 MW thermal including gas & diesel, 3,900 MW nuclear energy plants and 6,191 MW from renewable energy sources including wind.

Power supply position in 11th plan

The year-wise actual power supply position during 2007-08, 2008-09, 2009-10, 2010-11 and 2011-12 of 11th plan is given in Table below.

Table-3
Actual power supply position (All India Basis)

Year	Peak			Energy		
	Requir-ement (MW)	Avilabil-ity (MW)	Shortage MW(%)	Requir-ement (MW)	Avilabil-ity (MW)	Shortage MW(%)
2007-08	81492	71547	9945 (12.2%)	545983	497690	48093 (8.8%)
2008-09	84574	75066	9508 (11.2%)	559264	559264	39866 (7.1%)
2009-10	87906	77652	10254 (11.7%)	591373	548115	43258 (7.3%)
2010-11	93255	81792	11463 (12.3%)	631757	578819	52938 (8.4%)
2011-12	100466	86425	14041 (14.0%)	510223	465149	45074 (8.8%)

Growth in Generation during 11th Plan

The Compounded Annual Growth Rate (CAGR) of generation during the 10th Plan period is expected to be about 5.1%. However, higher growth could have been achieved if adequate gas would have been available for the existing and new gas based plants commissioned during 10th plan.

Growth in Generation during 11th Plan

Electricity is in the concurrent list in the constitution. The National Electricity Policy (NEP), 2008 recognizes electricity as a "basic human need" and targets a rise in per capita availability from 631 units to 1,000 units per annum by the end of 2012. To fulfill the objectives of the NEP, a capacity addition of 78,577 MW has been proposed for the eleventh five-year plan. The power sector is expected to grow at 9.5 percent per annum

Table-4
Eleventh plan power capacity addition targets (MW & per cent)

Sector	Hydro	Thermal	Nuclear	Total (MW)	Share (%)
Central	9.685	26,800	3,380	39,865	50.7
State	3,605	24,347	0	27,952	35.5
Private	3,263	7,497	0	10,760	13.8
Total	16,553	58,644	3,380	78,577	
Share (%)	**21.1**	**74.6**	**4.4**	**100**	

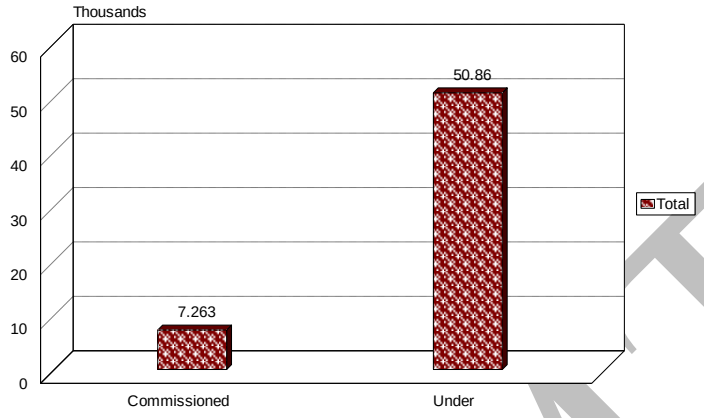
Source: Economic survey 2011-12, Govt. of India

A number of projects envisaged for the Eleventh Five-Year Plan have made steady progress, with most of these in a position to be commissioned well within the Plan period. The status of placement of orders for the main plant (thermal projects) and main civil works (for hydro projects) is given in Table.

Table-5
Status of eleventh five year plan capacity addition (MW)

Status	Central	State	Private	Total
Commissioned	2,230	4,783	250	7,263
Under	27,945	14,337	8,578	50,860
Construction				

Source: Economic survey 2011-12, Govt. of India



As per the Integrated Energy Policy (IEP), issued by the Planning Commission, GDP growth rates of 8%-9% have been projected during the 11th Plan. Assuming a higher growth rate of 9% and assuming the higher elasticity projected by the IEP of around 1.0, electrical energy generation would be required to grow at 9% p.a. during the 11th plan period. Also generation has to be collectively met by utilities, captive plants and Non-conventional energy sources. No reliable plans about captive power capacity expansion are available but based on indications available from the manufacturers for addition in captive capacity and present utilization of available capacity, the generation from captive plants is expected to increase from 78 BU to 131 BU per annum. Since the load factor of nonconventional energy sources is very low (about 20% on an average), even though the capacity projected by MNRE from these sources is about 23,500 MW by the end of 11th Plan, the expected generation would be only around 41 BU. The generation from these renewable however has not been taken into account for planning purposes.

Coal and gas input for the power sector:

The power sector is a major consumer of coal using about 78 percent of the country's coal production. Coal-fired thermal units accounts for around 62.2 per cent of total power generation in the country. Thus, coal continues to be the mainstay for the power sector.

The total consumption of coal by the power sector in 2011-12 was 302.5 million tonne (MT). Of this, about 9.7 MT was imported in 2011-12. About 7.3 MT of coal has been imported in 2007-08 (up to December 31, 2007). Apart from bridging the demand – supply gap, blending of imported high quality coal with high ash domestic coal helps thermal power stations to adhere to the environmental stipulations of using coal with less than 34 percent ash content.

Financial Performance of Power Utilities

Improving financial viability of power utilities is one of the key deliverables of power sector reforms. The total commercial losses excluding subsidy of the State power sector has been estimated at Rs. 28,824.9 crore in 2011-12. The rate of return of the State power sector which was (-) 24.01 per cent in 2011-12 (P) is estimated to have improved to (-) 18 percent in 2007-08 (RE). Nevertheless, the gross subsidy remained substantially higher at Rs. 43,132.6 crore with the subvention estimated at Rs. 14,159.6 crore in 2007-08.

Table-6
Details of Financial Performance of Power Utilities
(Rs. crore)

		2007-08	2008-09	2009-10	2010-11	2011-12
A	Gross Subsidy on sale of electricity of	43,132.60	46,087.40	37,021.40	35,539.60	40,054.00
	(i) Agriculture	29,299.40	30,194.20	35,221.32	23,833.40	26,605.70
	(ii) Domestic	13,307.90	14,499.20	17,212.31	10,432.50	13,171.80
	(iii) Inter-State Sales	525.40	1,394.00	1,352.22	1,273.00	276.50
B	Less subvention from State Govt.	14,159.60	13,358.80	12,212.18	13,414.70	13,752.50
C	**Net Subsidy**	**28,973.10**	**32,728.60**	**29,426.60**	**22,125.00**	**26,301.50**
D	Surplus Generated by sale to other sector	8,704.00	9,638.90	8,421.21	8,232.70	5,275.60
E	Uncovered Subsidy	20,269.10	23,089.70	25,123.21	13,892.30	21,025.90
F	(i) Commercial Losses (excluding subsidy)	25,701.40	26,461.80	25,231.21	22,733.80	28,824.90
F	(ii) Commercial Losses(Including subsidy)	11,541.80	13,103.00	14,152.21	9,319.10	15,072.40
G	**Rate of Return (ROR%)a**	**-18.0**	**-14.3**	**-16.3**	**-19.7**	**-24.0**
H	Revenue Mobilization - From introducing					
	50 Paise/ Unit from Agriculture/irrigation	1,768.80	1,308.60	1,408.60	1,541.10	1,631.90

Source: Economic survey 2011-12, Govt. of India

CONCLUSION

Energy is crucial variable to determine the rate of growth and development as well as crooning and poverty have a link with power sector. More important is the fact that plans after plan energy development was accorded relatively greater importance, which is reflected in the fact that investment on energy increased. Proposed outlay for the eleventh plan of Rs. 10460 crore (at constant price) includes GBS of Rs. 3537 crore. The main challenge before the energy sector for fuelling the proposed growth in the Twelfth Plan is to enhance energy supply in cost-effective ways. The persistent shortages of electricity both for peak power and energy indicate the magnitude of the problem. Average peak shortages are estimated to be 12% in 2012–13 which is an underestimate as scheduled load shedding is not included in it. The very high load factor of 76.8% for the system indicates that the system is operating under strain or has limited reserve. At the same time, for want of natural gas, some gas-based power plants are kept idle. Nuclear plants are also operated at lower load factors for want of adequate uranium. Power shortages are an indication of insufficient generating capacity and inadequate transmission and distribution (T&D) networks. To a great extent this is the outcome of poor financial health of the State Electricity Utilities having high levels of Aggregate Technical and Commercial (AT&C) losses.

The pace of energy development in India has, however, not been in accordance with demand for energy. The persistence of chronic shortages of energy in India is attributed to a number of causes which have been examined in the paper dealing with the energy crisis and its impact on Indian economy.

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