

Energy consumption and Economic Development: A critical analysis on Indian electricity sector.

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Received: 08 January 2013

Reviewed & Received: 07 February 2013

Accepted: 07 February 2013

Abstract

Energy is an input in an integral part of economic development. An increase demand for energy is a natural consequence of expanding economic activity. The scale of its use is closely associated with its capabilities and the quality of life that its members experience.

Worldwide, great disparities are evident among nations in their level of energy use, prosperity, health, political power and demand upon the world's resources. In present the India's final energy demand grows faster than the development of its natural resources. To tackle the long run constraints of the present demand and supply trends, drastic changes in the management of the sector is required. India accounts for about 2.4percent of the world's total annual energy production and for about 3.3percent of the world's total annual energy consumption. The world wide general evident is that there is positive correlation between percapita income and percapita energy consumption. Now days, the percapita energy consumption is regarded as one of the important indices of economic development.

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Objective of the study:

1. To understand the importance of percapita energy consumption and energy intensity in India.
2. To know the present conditions of production sources of electrical energy in India.
3. To identify the existing problems in Indian electrical energy at the time of consumption and generation process.

Methodology:

For the study analysis secondary data is collected from published sources of statistical report of Indian energy department. For the collected data simple growth rate, percentage and compound annual growth are calculated to review the present situation of India's energy condition.

Table:1.1

Trends in Per-capita Energy consumption and Per-capita Energy intensity in India

Year	Energy Consumption In billion (KWH)	Mid year Population in '000 numbers	GDP (Rs.crore) (1999-2000 prices)	Percapita Energy Consumption (KWH)	Energy Intensity (KWH) per rupee
1970-71	663.99	551311	517148	1204.39	0.1284
1975-76	840.53	617248	596428	1361.74	0.1409
1980-81	1012.58	688320	695361	1471.09	0.1456
1985-86	1477.5	766135	894041	1928.51	0.1653
1990-91	1902.75	852297	1193650	2232.5	0.1594
1995-96	2436.77	939540	1529453	2593.58	0.1593
2000-01	3154.28	1034931	2030710	3047.81	0.1553
2005-06	3909.37	1117734	2844942	3497.59	0.1374
2006-07	4226.78	1134023	3120029	3727.24	0.1355
2007-08	4508.26	1147677	3402716	3928.16	0.1325
2008-09	4845.25	1161495	4154973	4171.56	0.1166
2009-10	5462.31	1175480	4464081	4646.87	0.1224
2010-11	5693.54	1182105	4877842	4816.44	0.1167
Growth rate of 2010-11 over 2009-10(%)*	4.23	0.56	9.27	3.65	-4.61
CAGR* 1970-71 to 2010-11(%)	5.38	1.88	5.63	3.44	-0.23

Source: Energy Statistics 2012

*Calculated value

The table (1.1) shows the precapita energy consumption and precapita energy intensity in India, for the period 1970-71 to 2010-11. The energy consumption is the primary indicator for economic development. In India, the level of energy consumption is increased from 663.99 billion Kwh in 1970-71 to 5693.54 billion Kwh in 2010-11. The compound annual growth rate of energy consumption in India from 1970-71 to 2010-11 is 5.38 percent. The population of Indian Economy is vibrantly increased from 55 crores to 118 crores from 1970-71 to 2010-11. The compound annual growth rate of population is calculated as 1.88 percent for the study area. The GDP of India is also increased from 51.71 crores to 487.8 crores from 1970-71 to 2010-11 with the calculated CAGR of 5.63 percent. The table also reveals that the precapita energy consumption in India is increased from 1204.39Kwh to 4816.44Kwh during the period of 1970-71 to 2010-11. The CAGR of precapita energy consumption was 3.44 percent.

The level of energy consumed for producing one unit of GDP was increased from 0.1284 per rupee to 0.1653 per rupee from 1970-71 to 1985-86, but it was reduced to 0.1167 per rupee in 2010-11. The CAGR of energy intensity during the study period was in -0.23 percent. The table clearly shows that the growth rate of energy consumption is more than the population growth rate which in turn emphasizes the need for demand side management on available energy sources. The negative value of energy intensity shows the level of utilization of existing natural resource in India was very high.

Table:1.2

Trends in Consumption of Conventional Energy in India (Peta Joules)

Year	Coal & Lignite	Crude Petroleum	Natural Gas	Electricity	Total
1970-71	1491	770	25	1574	3860
1975-76	1929	933	43	2169	5074
1980-81	2288	1082	59	2965	6394
1985-86	3051	1797	191	4432	9471
1990-91	3800	2168	492	6853	13313
1995-96	5059	2459	697	9973	18188
2000-01	5396	4331	1073	11398	22198
2005-06	6828	5448	1195	14828	28299
2006-07	7289	6136	1208	16407	31040
2007-08	8675	6536	1189	18028	34428
2008-09	9383	6732	1223	18992	36330
2009-10	10143	8071	1791	20448	40453
2010-11	10179	8632	1974	21879	42664
Growth rate* of 2010-11 over 2009-10 (%)	1.36	6.94	10.21	7	5.73
CAGR** 1970-71 to 2010-11(%)	4.8	6.07	11.25	6.63	6.04

Source: Energy Statistics 2012

* Calculated value, ** Compound Annual Growth rate

The table (1.2) shows trends in consumption of conventional energy like coal, crude petroleum, Natural gas and electricity in India. The table illustrates that the consumption of electricity for economic activities plays a major role than other sources of energy. For the period 1970-71, the consumption of coal and lignite was 1491Pj, crude petroleum of 770Pj, 1574Pj of electricity and only 25Pj of natural gas. But due tremendous increase in population and changes in economic development which increased the level of augmentation on energy consumption.

That is for the period 2010-11, the consumption on electricity was 21879Pj with the CAGR of 6.63percent. For the same period the consumption of coal and lignite was 10179Pj with CAGR of 4.8percent, crude petroleum of 8632Pj and with the 1974Pj of natural gas and the calculated CAGR of 11.25percent. The compound annual growth scenario on consumption of conventional energy in India for the period of 1970-71 to 2010-11 was 6.04percent. The table concludes that the level of consumption on conventional energy is much higher than other types of resources in India.

Table:1.3

Trends in Gross Generation of Electricity in Utilities and Non-utilities in India

(Giga Watt hour) = (106 x Kilo Watt hour)

Year	Utilities				Non-Utilities			Grand Total
	Thermal	Hydro	Nuclear	Total	Railways	Others	total	
1970-71	28,162	25,248	2,418	55,828	37	5,347	5,384	61,212
1975-76	43,303	33,302	2,626	79,231	38	6,657	6,695	85,926
1980-81	61,301	46,542	3,001	110,844	42	8,374	8,416	119,260
1985-86	114,347	51,021	4,982	170,350	43	12,997	13,040	183,390
1990-91	186,547	71,641	6,141	264,329	29	25,082	25,111	289,440
1995-96	299,316	72,579	7,982	379,877	24	38,142	38,166	418,043
2000-01	409,940	74,362	16,902	501,204	-	59,638	59,638	560,842
2005-06	505,001	101,494	17,324	623,819	-	73,640	73,640	697,459
2006-07	538,350	113,502	18,802	670,654	-	81,800	81,800	752,454
2007-08	585,282	120,387	16,957	722,626	-	90,477	90,477	813,103
2008-09	617,832	113,081	14,713	745,626	-	95,905	95,905	841,531
2009-10	670,965	106,680	18,636	796,281	-	109,693	109,693	905,974
2010-11	704,323	114,257	26,266	844,846	-	114,224	114,224	959,070
Growth rate of 2010-11 over 2009-10 (%)	4.97	7.1	40.94	6.1	-	4.13	4.13	5.86
CAGR* 1970-71 to 2010-11(%)	8.17	3.75	5.99	6.85	-	7.75	7.74	6.94

Source: Energy Statistics 2012

* Calculated value, ** Compound Annual Growth rate

The table (1.3) shows the trends in gross generation of electricity in utilities and non-utilities in India. In India thermal, hydro and nuclear are the major sources for producing energy. In 1970-71, the total production of electrical energy are 61212Gwh, with in this 55828Gwh are produced through thermal, hydro and nuclear and 5384Gwh are produced by non-utilities like railways and other sources. The amount of Gross generation of electrical energy was increased from 6122Gwh in 1970-71 to 959-070Gwh in 2010-11.

The CAGR of electrical energy are calculated as 6.94 percent for the period 1970-71 to 2010-11. Of the table, In India hydro electricity plays an important role on producing electricity than thermal and nuclear sources. The production of hydro is 25248Gwh in 1970-71, for the same period 28162Gwh of thermal and 2418Gwh nuclear energy are produced. But it was raised to 114257Gwh of hydro, 704.323Gwh thermal and only 26266Gwh of nuclear energy were produced in India. The table clearly shows that in India present generating capacity is trust worthy but which is not enough to coup-up the future need. The government of India should give important attention on generating electrical energy.

Table:1.4

Total Installed Generating Capacity of Electricity (Utilities) in India

Source: Energy Statistics 2012

* Calculated value

The table (1.4) illustrates the state and central government contributes on energy production in India through hydro, thermal, nuclear and other renewable sources. Of the table installed generating capacity of electricity among the state is grater than that of central government. In India, the production of hydro and thermal energy sources of energy in the hands of state government and the production of nuclear and renewable sources in the control of central government. It can be visualized that the annual growth rate of state government is more than that of central government. The growth rate of installed generating energy capacity was 11.39 percent in state and it was only 5.92 percent in centre. The overall installed generating capacity of India is 9.62 percent during 2009-10 to 2010-11. The central government should take necessary step to encourage the

Sources	Total States		Total Central		Total All India	
	31.03.10	31.03.11	31.03.10	31.03.11	31.03.10	31.03.11
Hydro	28.3	28.68	8.56	8.89	36.86	37.57
Thermal	62.86	72.08	37.94	40.75	100.81	112.82
Nuclear	0	0	4.56	4.78	4.56	4.78
New & Renewable	15.52	18.45	0	0	15.52	18.45
Total	106.68	119.21	51.06	54.42	157.75	173.62
Growth Rate in % (2009-10 to 2010-11)*	11.39		5.92		9.62	

state government on producing electricity by liberalizing the fiscal sources.

Table:1.5

Consumption of Electricity (from utilities) by Sectors in India

(Giga Watt hour) = (106 x Kilo Watt hour)

Year	Industry	Agriculture	Domestic	Commercial	traction	Others	Total
1970-71	29579	4470	3840	2573	1364	1898	43724
1975-76	37568	8721	5821	3507	1855	2774	60246
1980-81	48069	14489	9246	4682	2266	3615	82367
1985-86	66980	23422	17258	7290	3182	4967	123099
1990-91	84209	50321	31982	11181	4112	8552	190357
1995-96	104693	85732	51733	16996	6223	11652	277029
2000-01	107622	84729	75629	22545	8213	17862	316600
2005-06	151557	90292	100090	35965	9944	24039	411887
2006-07	171293	99023	111002	40220	10800	23411	455749
2007-08	189424	104182	120918	46685	11108	29660	501977
2008-09	209474	109610	131720	54189	11425	37577	553995
2009-10	236752	120209	146080	60600	12408	36595	612644
2010-11	272589	131967	169326	67289	14003	39218	694392
Growth rate of 2010-11 over 2009-10 (%)	15.14	9.78	15.91	11.04	12.85	7.17	13.34
CAGR 1970-71 to 2010-11(%)	5.57	8.61	9.67	8.29	5.84	7.67	6.98

Source: Energy Statistics 2012

* Calculated value, ** Compound Annual Growth rate

The table 1.5 shows the consumption of electricity by various sectors in India during the period 1970-71 to 2010-11. In India, industry, agriculture and domestic are the major consumers of produced electrical energy in India. The commercial, traction and other miscellaneous activities are also plays a significant role on absorbing the produced electricity. The table shows that, the level of consumption on electricity is increased from 29579Gwh to 272589Gwh during 1970-71 to 2010-11. The CAGR of industrial sector was calculated as 5.57percent, which is comparatively less than agriculture and domestic activities. The agriculture sector shows that 131967Gwh in 2010-11 from 4470Gwh in 1970-71 with the CAGR of 8.61 percent. And it was 9.67percent for domestic purpose with the amount of 3840Gwh in 1970-71 to 169326Gwh in 2010-11.

Year	Gross Electricity Generated form utilities	Consumption in Power station Auxiliaries	Net Electricity Generated from Utilities	Purcahes from Non-Utilities and + Imported from other countries	Net Electricity Available for Supply	Sold to Ultimate Consumers & other Countries	Loss in Transmission	Loss in Transmision (in %)
1970-71	55828	2863	52965	66	53031	43724	9307	17.55
1975-76	79231	4556	74675	121	74796	60246	14550	19.45
1980-81	110844	7230	103614	120	103734	82367	21367	20.6

1985-86	170350	13157	157193	107	157300	123106	34194	21.71
1990-91	264329	19604	244725	2216	246941	190420	56521	22.89
1995-96	379877	27220	352657	3784	356441	277078	79363	22.27
2000-01	501204	34932	466272	5596	471868	316795	155073	32.86
2005-06	623819	41970	581849	10354	592203	412096	180107	30.41
2006-07	670654	43577	627077	11931	639008	455964	183044	28.65
2007-08	722626	45531	677095	12685	689780	502267	187513	27.18
2008-09	746626	47573	699053	13487	712540	527564	184976	25.96
2009-10	796281	49706	746576	15359	761935	610457	151478	19.88
2010-11	844846	52380	792466	16989	809455	663392	146063	18.04
Growth rate of 2010-11 over 2009-10 (%)*	6.1	5.38	6.15	10.62	6.24	8.67	-3.57	-9.24
CAGR** 1970-71 to 2010-11(%)	6.85	7.35	6.82	14.5	6.87	6.86	6.95	0.07

The commercial, traction and other are represented with CAGR of 8.29percent, 5.84percent and 7.67percent respectively. The CAGR on consumption of energy from 1970-71 to 2010-11 in India was 6.98percent. The table clearly shows that the existing production of electrical energy is still inadequate with respect to consumption of electrical energy.

Table:1.6

Electricity Generated (from Utilities), Distributed, Sold and Lost in India
(Giga Watt hour) = (106 x Kilo Watt hour)

Source: Energy Statistics 2012

* Calculated value, ** Compound Annual Growth rate

The table (1.6) shows the electrical energy distributed, sold and lost in India. For the period 1970-71, the gross electricity generated from utilities is 55828Gwh from that 2863Gwh was consumed by the power sector for the same period. The net electrical energy availability was 53031Gwh with the purchase from non-utilities and import from other countries. With the total electrical energy only 43724Gwh was supplied to consumers and remaining 9307Gwh is loosed at the time of electricity transmission. More over the percentage of line loss was calculated as 17.55. The line loss problem seems to be a major issue in Indian energy industries. The percentage of line loss is continuously increased up to 32.86 percent in 2000-01.

During this period the total availability of electrical energy was 471868Gwh with in this 316795Gwh was able to transmit to the ultimate consumers and 155073Gwh was loss in transmission. Due to policy implication in electricity sector the transmission loss was reduced to 18.04 percent in 2010-11. Of this the net electricity availability was 809455Gwh and 146063Gwh as loss in transmission. The CAGR of net electricity supply in India was 6.87 percent but the line loss was calculated as 6.95 percent the over all percentage of line loss was recorded as 0.07.

Summary and findings of the study:

The growth rate of energy consumption is more than the population growth rate which in turn emphasizes the need for demand side management on available energy sources. The negative value of energy intensity shows the level of utilization of existing natural resource in India was very high. The level of consumption on conventional energy is much higher than other types of resources in India. The present generating capacity is

trust worthy but which is not enough to coup-up the future need. The central government should take necessary step to encourage the state government on producing electricity by liberalizing the fiscal sources. The existing production of electrical energy is still inadequate with respect to consumption of electrical energy in India.

Suggestions:

1. Provide for private sector participation in distribution.
2. To minimize the time and cost over-runs in on-going projects by providing adequate outlay.
3. To understand rigorous renovation and modernization programs on existing capacity.
4. Clear cut policies on purchasing and wheeling from captive and co-generation to increasing capacity.
5. To formulate a long range plan to bring down the line losses
6. To concentrate on demand side management.

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